

Arqiva submission to National Infrastructure Committee's Call for Evidence on 5G

About Arqiva

Arqiva is a communications infrastructure and media services company operating at the heart of the mobile and broadcast communications industry. Arqiva provides infrastructure for television, radio, mobile and other wireless communication in the UK.

Arqiva operates shared radio site assets throughout the UK, including masts from under 30 to over 300 metres tall. We have worked with the mobile industry over two decades to deliver mobile services to consumers with a significant presence in suburban and rural areas. Our portfolio includes over 8,600 active, and more than 16,500 marketable sites, including radio and television broadcast sites, BT telephone exchange rooftops and use of National Grid pylons.

Arqiva enables the Airwave emergency services network in remote areas through c1,000 of our sites. We are working with DCMS to build new shared sites for villages in 'not-spots' as part of the Mobile Infrastructure Programme (MIP). We also own and operate 50 In-Building Systems to extend the MNOs' coverage and capacity into challenging environments such as Canary Wharf and the ExCel Centre. We are one of the UK's largest public WiFi providers, enabling us to offer unique propositions for venue WiFi and small cell networks, for example at Heathrow airport or in Central London.

Arqiva is building a national Internet of Things ("IoT") network, starting with 10 of the UK's largest cities. Our smart metering service, connecting 10 million homes using long-range radio technology, will be one of the UK's largest machine-to-machine deployments.

Arqiva is a founder member and shareholder of Freeview. We broadcast all eight Freeview multiplexes, are the licensed operator of four of them as well as owning Connect TV - the first company to launch a live IP streaming channel on Freeview. Arqiva is the licensed operator of both national commercial DAB digital radio multiplexes.

Arqiva is a major player in the UK's satellite industry, operating over 80 antennas to geostationary satellites, and providing Telemetry, Tracking and Command support services to some of the leading satellite operators. We are a major provider of permanent satellite services to both Freesat and Sky customers. Arqiva also provides global satellite based services to the broadcast, communications, security, oil & gas and exploration sectors.

Our major customers include EE, H3G/Three, Telefónica/O2, Vodafone, BBC, ITV, Channel 4, Five, Sky, Global Radio, Airwave, Heathrow and Whitbread/Premier Inn.

Arqiva is owned by a consortium of long-term investors and has its headquarters in Hampshire, with major UK offices in London, Buckinghamshire and Yorkshire.

Overview

The much anticipated emergence of new wireless services in the coming years will very likely require creative policy approaches to ensure that those services are allowed to flourish. There is still a lack of clarity as to *precisely* what 5G will be. However it is becoming increasingly clear that the ambition that drives 5G is to deliver outcomes to consumers that will greatly enhance quality of life and experience. This will likely include the delivery of high speed data services to customers – even in otherwise hard to reach areas – as well as new and innovative machine to machine applications.

To enable 5G to deliver on such an ambition, two initial challenges must be met. First, the required spectrum must be identified. Second, the necessary infrastructure must be put in place. These are significant challenges and we are, therefore, grateful for the opportunity to contribute to the National Infrastructure Commission's consultation on 5G. Arqiva is the UK's largest independent provider of mobile network assets. As such we offer a specific insight into the critical role that this sector will play in the provision of infrastructure that will underpin future 5G mobile services.

Independent Infrastructure Providers deliver benefits for all parts of the 5G ecosystem:

- Consumers benefit as they get better coverage and the lower cost of roll out can be passed through to their phone bills;
- Operators benefit from reduced costs and faster roll out of their networks;
- The local community benefits as fewer masts are required so there is less visual impact, and mobile coverage adds to the attractiveness of an area for residents and business; and
- The environment benefits as there are lower energy and construction costs from fewer masts

This submission sets out how 5G infrastructure could be rolled out in a way that minimises costs for operators, thereby enabling services to end users to be provided more cost effectively.

In particular, we focus on two areas in which 5G roll-out could be promoted in a timely and cost effective fashion, namely:

- The role that independent provision of mobile infrastructure can play in minimising costs and disruption in rolling out future 5G networks; and
- How improvements to the planning regime can further facilitate improved roll-out of mobile infrastructure.

Independent mobile infrastructure provision will play a critical role in delivering 5G

While it is not yet clear what 5G will be *precisely*, it is clear that there will clearly be a need for more mobile infrastructure. There will need to be more masts in rural areas to extend the benefits of mobile to all, and there will also need to be additional infrastructure to improve coverage on transport routes such as road, rail and on the underground.

Network operators will rely on access to wireless infrastructure assets to provide future 5G services. While much policy focus is typically given to the requirements of Mobile Network Operators (MNOs), this infrastructure is also crucial to delivering other services such as fixed-wireless broadband, radio and TV broadcast, emergency services and, Internet of Things and machine-to-machine communications.

Increasingly, MNOs have sought to access infrastructure jointly in sharing arrangements. They have done this in the UK by setting up joint ventures (EE and H3G setting up MBNL and Vodafone and Telefónica/O2 setting up CTIL and Beacon) as well as making extensive use of Independent Infrastructure Providers (IIPs), whose business model is based on allowing their assets to be used as widely as possible.

In the UK, the MNOs own and operate the majority of passive mobile assets. However the IIPs constitute a small but significant part of this market. There are difficulties in determining what the precise market share is, but a reasonable Arqiva assessment suggests that in the region of 30-40% of passive assets are provided by IIPs. This contrasts with the United States, where EY has estimated that 84% of market share is accounted for by independent providers.

The contribution that IIPs bring to the mobile ecosystem is, therefore, significant and it will continue to be important as 5G develops. It ensures that greater numbers of consumers enjoy the social and economic benefits of mobile communications. In that respect, we note that many IIP sites are based in rural areas, delivering those benefits to consumers who may otherwise not receive them.

The importance of IIPs is illustrated by H3G's entry into the UK MNO market as the fifth operator in 2003. Due to Arqiva's commercial incentive to share masts, we were a key partner in a fast and cost effective rollout so H3G could rapidly launch its own 3G network.

Wireless infrastructure sharing has grown over the past few years

In a consolidating, competitive and cost-conscious mobile environment, infrastructure sharing has become an increasingly attractive option for a number of reasons, including:

- It facilitates faster roll-out of services as it reduces the potential for delays associated with acquisition, design and build of suitable sites;

- Costs to industry can be significantly reduced if more efficient use is made of existing infrastructure. Moreover, increasing utilisation rates of each tower ensures that the unit costs for network operators can be reduced;
- Co-locating equipment allows for the use of joint backhaul to the core network, further reducing cost to MNOs; and
- Using existing infrastructure can promote greater coverage for more operators sharing masts.

For the additional coverage and capacity required for 5G ensuring that the mobile ecosystem can utilise these benefits will be even more critical.

Additionally, the Electronic Communications Code (Conditions and Restrictions) Regulations 2003 also places an obligation on Code Operators to maximise the use of existing infrastructure. This is, in part, to avoid a proliferation of structures which could cause a negative impact on the environment and/or local communities.

Independent infrastructure provision would be a cost-effective solution to deploying 5G services

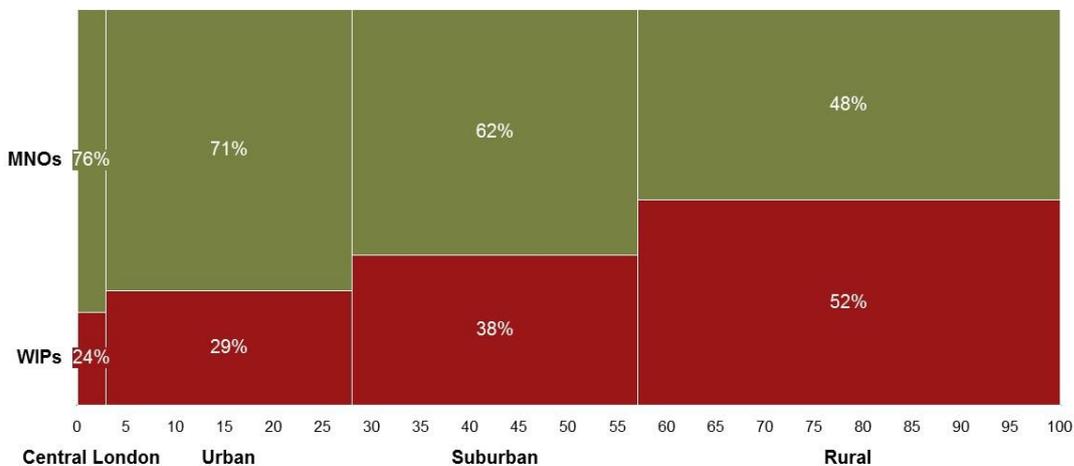
Independent infrastructure providers have a commercial incentive to make their assets available to all wireless network operators – thus facilitating the emergence of 5G services. For example, the average number of sharers on each MNOs' mast compared with that of the IIPs shows that the latter achieve significantly higher utilisation rates through providing access to multiple operators.

As well as competition from within the IIP sector, IIPs face competition from self-providing network passive asset holders such as CTIL and MBNL. This acts as a competitive constraint on their ability to arbitrarily raise prices to MNOs.

As a result of these factors, the otherwise significant fixed costs involved in constructing and maintaining passive infrastructure assets are reduced as more efficient use is made of them. Increasing utilisation rates of infrastructure ensures that the unit costs for MNOs can be lower. This makes it cost effective to improve service coverage, including rolling out 5G to areas where it may be unprofitable for them to invest in additional own assets.

This is illustrated by the diagram below:

Figure 1: Breakdown of sites by player type and location



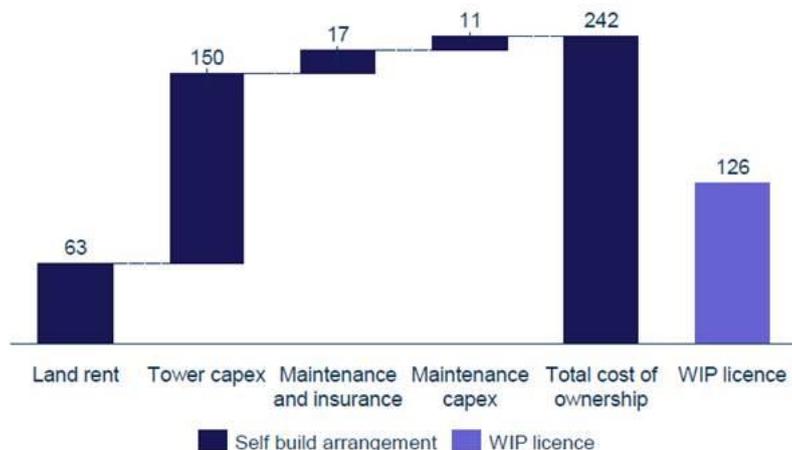
Source: AT Kearney

This diagram shows that despite IIPs accounting for just c.34% of the total UK macro sites, they provide more than half of sites based in rural areas. This is consistent with the benefits we would expect to see from maximising sharing opportunities, particularly where costs of site deployment would otherwise be expected to be high.

The higher rate of co-location achieved by IIPs reduces the need to build more masts, speeds up deployment and reduces MNO lifecycle costs. IIPs are also able to reduce operating costs and lower the cost of capital. This is as a result of the ownership and operation of masts being our core business.

The difference in costs for an IIP operating masts compared to a self-provider was shown by Analysys Mason in the extract below:

Figure 5.6: Total cost of ownership: comparison of self-build tower vs WIP licence model (GBP thousand per site in NPV terms) [Source: Industry submissions]



Source: Financial Impact of Electronic Communications Code Changes, Analysys Mason, May 2016

This report, published in May 2016, was commissioned by the Department for Culture Media and Sport (DCMS) to inform its policy approach to reforming the Electronic Communications Code. That report was accompanied by DCMS implicitly supporting the future development of the independent infrastructure sector:

“we do not want to disrupt market incentives for investment in passive infrastructure by establishing a legal framework to allow compulsory access and thereby subject the market to further regulation”¹

Cost effective infrastructure solutions can help underpin roll out of 5G networks

Significant cost savings could be derived depending on from supply side decisions that are made when rolling out networks. The extent of those savings would largely rely on the precise evolution and make-up of the 5G network that was being rolled out at the time. It would also depend on the mobile technology being adopted to meet the UK’s coverage ambitions. For example, there may be merit in exploring the potential of fixed wireless access solutions for those homes in challenging areas that struggle to receive sufficiently fast speeds indoors.

Finally, we note that the ongoing reform of the Electronic Communications Code and the other policy changes in areas such as planning will improve the prospects for more cost effective mobile broadband provision for all mobile infrastructure providers, thus making a mobile contribution to 5G roll-out an increasingly viable alternative to fixed.

¹ A New Electronic Communications Code, DCMS, May 2016

Changes are required to allow small cell deployment at scale

Small cells already play an important role in the continued deployment of 4G networks and the increasing data capacity that is vital to mobile connectivity. In order to deliver 5G services to mobile users there will be a need to deploy small cells on a scale not previously seen in the UK. Hundreds of thousands of small cells are expected to be rolled out in London alone and over a million will be required across the country.

Small cell deployment in significant numbers will require the use of buildings or other structures, such as lamp posts and other suitable street furniture. As it stands there are challenges to businesses in getting the planning permission that they need in order to roll out small cells. Government has acknowledged this and recently announced a number of changes in the Written Ministerial Statement (HCWS631) (WMS). While the changes are welcome they do not allow industry to roll out 5G in the volumes that are required. For the government to deliver its objective to be a world leader in 5G, at a minimum, the following further changes are required:

- The current limitation only allows the installation of two “small cell antennas” on a building or other structure. This is too restrictive. It does not allow for instances where a third backhaul antenna or other apparatus is required. This could be overcome **by allowing the installation of “small cell systems”, and including “small cell antennas” within its definition** e.g. a “small cell system” means the installation of small cell antennas and any associated apparatus.
- Small cell antennas often face the highway as most suitable buildings are within 20 metres of a highway. The current limitation prevents this and brings about the requirement for full planning permission. The WMS indicates that this limitation will be removed on residential and commercial premises. However this leaves out Council owned properties, such as libraries, schools and depots, which are not commercial premises. In view of this, **the 20 metre highway limitation should be removed entirely.**
- Under current conditions, the prior approval procedures apply to small cell antennas proposed on buildings or other structures (which include lamp posts) within designated areas, e.g. conservation areas. Given the extent of conservation areas, this is a very significant obstacle. **The requirement for prior approval should therefore be removed for small cell systems entirely.**
- It has become increasingly apparent that to allow scalability from 4G to 5G, operators are likely to require cabinets in protected areas. Under current conditions these require prior approval. This problem arose for the cabinets required for fixed line broadband and the Government addressed this by removing the cabinets from this requirement. **The requirement for prior approval for small radio equipment housing in protected areas should also be removed.**

Responses to questions

1. What uses have been envisaged for 5G?

The evolution of 5G will be principally driven by use cases as opposed to technology innovation. There are a number of potential use cases which may emerge. However, we expect that the most significant will be:

- Increased video demand including at higher definitions;
- Connected devices at scale;
- Intelligent transport including autonomous transport;
- e-health; and
- Newer aspirational use cases such as augmented reality and the tactile internet.

We expect Internet of Things (IoT) to develop to the extent that billions of devices will be connected and they will be delivered over 5G and other technologies. This will require lower bandwidth than in most other use cases, However, some of the services will need to be always on and will require super low latency to make extreme real time communications viable. Examples of this are lifeline services centered on healthcare in the home, bringing changes to how and where people are treated.

In our view, there is starting to be that some of services delivered over 5G will require:

1. Densification of the network;
2. High capacity to devices;
3. Very low latency; and
4. Low power consumption.

However, different use case have different requirement so things such as real-time immersive gaming will require the very low latency, and high capacity, but that will sit alongside IoT uses such as the monitoring whether bins are full or empty that will require lower capacity and low power consumption but can live with higher latency.

In terms of broadband delivery, we expect that a combination of technical innovation and public intervention (in particular, the introduction of a universal service obligation) will move the UK towards an environment where all consumers will be able to enjoy 50 Mbit/s+ download speed.

2. Of those use cases identified, which appear most credible from a UK perspective, and over what timeframe?

All of the use cases referred to in our response to question 1 are plausible within the UK. The timing of when they become available will be largely driven by the speed of network deployments. Networks will likely start to rollout at scale from 2019-2020 with all the use cases becoming viable thereafter.

What is becoming clear is that 5G is a global initiative and the UK has to either lead, or adopt, global standards. Equipment manufacturers will not make equipment solely for a UK market at prices that UK consumers will be willing to pay.

3. What is the potential scale of benefits?

While the scale of the benefits is likely to be significant we have not carried out any analysis to quantify that to date.

4. Are there planning or wider legal issues which have the potential to hold back the deployment of 5G networks?

Whatever the system or process, the town planning environment is generally worsened by additional numbers of operators as this creates pressure for more development and pressure on scarce local authority resources. Important stakeholders such as local communities often fail to understand why infrastructure has to be replicated so multiplying its potential impact.

There are therefore good town planning arguments to return to a similar model that existed for 1G, i.e. two wholesale network operators, who provided network time and access to a large number of virtual retailers. This would also be a more direct and efficient way of finding the network synergies that the MNOs are seeking to achieve through network sharing and reflect better their desire to focus on providing services to their wholesale and retail customers rather than the detail of running a network. It also overcomes the difficulties that would be faced by any new entrant who would be confronted with the significant cost of deploying a credible network in order to be able to attract customers.

Such an approach could also help simplify the town planning framework in the UK – in fact there are four different town planning systems in operation in the UK and another three covering the Channel Islands and the Isle of Man. The permitted development rights (PDRs) that apply to Electronic Communications Code Operators are all different. Taking the four UK systems, the PDRs are all based upon the same objective, i.e. to encourage and facilitate the growth and development of modern communications, whilst minimising the potential impact on the natural environment and the built heritage. The systems that grew out of the UK-wide legislation in force before town planning was devolved are now very different. That in itself poses difficulties for Code Operators, but these are made worse in England and Wales where there are issues such as the prior approval process effectively removing the benefits of PDRs.

In England, the amendments to the Code Operator PDRs since their introduction have resulted a number of anomalies. The changes announced in the Written Ministerial Statement on 17 March 2016 (WMS) will lead to further anomalies. For example, a third small backhaul antenna required on a building elevation to support two small cell antennas will still need planning permission, but the same operator will be allowed to install pole mounted antennas on the roof of the same building that can be in excess of 6 metres high at the point of installation. That same operator may have a 15 metre high mast in the adjoining countryside, which even if in a protected area will be given a PDR to extend by 5 metres, another form of development that will have a considerably greater visual impact than a third small antenna on the face of a building.

The prior approval process may have some relevance to the detailed siting and appearance of new masts but, by contrast, its application to mast extensions adds bureaucracy without clear benefits – the mast is already established and its appearance will be dictated by the structure being extended.

This creates challenges with deploying next generation 5G networks, but there are some straightforward policy amendments that could be made to address those challenges.

The key issue is to ensure that the PDRs are properly configured to allow the installation of new apparatus with appropriate, but not excessive controls. When introduced some of the changes in the WMS should help achieve this, although the detail of these changes are yet to be seen. However, the WMS does not go far enough in relation to small cell antennas, we have made representations to DCMS about this already and include that as an annex to the document. While this is important for 4G roll out already it is particularly relevant to the hundreds of thousands of small cells that will be deployed for 5G.

In the longer term the government should consider rewriting the PDRs with the aim of producing a simplified and logical set of PDRs free of prior approval. As it stands the prior approval requirement provide a degree of certainty on timing but are otherwise little different from the requirement for full planning permission.

The Government should also harmonise the PDRs with the overlapping requirements of the Electronic Communications Code (Conditions and Restrictions) Regulations 2003 (Regulations). If brought into harmony the PDRs and Regulations could provide a system of checks and balances that would be more logical and simpler to use (for industry and planning authorities) and one which would better meet the Government's objectives. We would be pleased to work with industry and Government to develop a more effective framework.

5. Are there issues around working across industry sectors which may hold back the deployment of 5G networks?

As noted above, there will need to be dark fibre in order to support ever increasing backhaul demands. This will require enhanced co-operation between industry players and, in the absence of progress, may require a degree of regulatory intervention.

More broadly, we note the concerns raised by Ofcom in its Digital Communications Review on the requirement to improve backhaul provision in the context of BT's role in the market. We support any measures that will lead to such an improvement, given the benefits which would likely accrue to a future 5G roll out.

6. What do the services and uses for 5G suggest about the infrastructure requirement?

The infrastructure requirement will likely involve an evolution of the existing radio access network. These will contain a full Evolved Packet Core on the macro side with requirements for new antennas to support those higher frequencies being proposed for discussion at the World Radiocommunication Conference in 2019. It will also likely require new ground based equipment.

This will require the introduction of more assets. For illustrative purposes, we set out below the likely antenna changes which will be required as the existing radio access network evolves to meet the changing demands which will underpin the growth of 5G services:

Scenario	Antenna Impact	Breach Arqiva Config 6+2	Feeder Impacts	Ground Based Equipment Impact	%-sites Impacted	Deployment Start
700 MHz	Multiband (may require swap)	Yes due to size	Existing	Existing	80%	2019
2.3 GHz	Multiband (may require swap)	Yes due to size	Existing	Existing	60%	2017
2.6 GHz	Multiband (may require swap)	Yes due to size	Existing	Existing	40%	2017
3.4 GHz	New Antennas	Yes	Unknown	Existing	Unknown	2018
2100 MHz reform	Multiband (may require swap)	Yes due to size	Existing	Existing	100%	2018
5 G (30 GHz >)	New	Yes	New	New	100%	2020

7. What level of UK coverage will be optimum and what does this mean for the challenge of delivering higher speeds and lower latency? Are there particular issues faced by urban, suburban and rural areas?

In a 5G world where there will be a need for network that are suitable for services ranging from IoT, to driverless cars to high definition video, coverage needs to be looked at afresh. In the past, coverage obligations have focussed on targets for population or geography but for 5G a new approach is required. Government should particularly look at:

- **Transport routes:** Coverage on roads will be critical for driverless cars while coverage on trains and on the underground is critical for maximising productivity and growth. Coverage obligations for transport routes such as road and rails including the London Underground and tube systems elsewhere in the UK.
- **Rural areas:** There is already a digital divide between those who have services in rural and urban areas. While a USO will help to address this, those who live and work in rural areas should fully benefit from 5G. Therefore the government should consider obligations to deal with coverage in rural areas – this could be linked to the coverage work that is already being done for the Emergency Services Network.
- **Transient populations:** The need for coverage is not just related to areas with high population so the government should consider whether it should target areas with low permanent populations but high transient populations such as business districts or tourist areas where there can be high demand, or safety of life implications.

The existing geographical coverage obligations will be the starting position for future 5G coverage. It is likely that 4G will underpin future networks as 5G networks will be rolled out differently to 4G if it is solely left to commercial incentives. The 90% target UK geographical coverage obligation is technology neutral and is more likely to be achieved by 4G than 5G without specific obligations. Without intervention on 5G, for services such as IoT applications there may be a low capacity, high latency network that rolled out to near universal coverage using low frequency bands. At the same time very high capacity networks will only be rolled out in select urban areas. If the government wishes to deliver the full economic growth and consumer benefits of 5G it will need to consider interventions, in particular through coverage obligations that are more sophisticated than have been used to date.

In addition to this, in urban areas the availability of fibre will be key to the roll out of 5G network. Similarly in rural / suburban the ability to build backhaul networks, whether fibre or wireless, will define the network

8. Are there any 'no regrets' and 'low regrets' infrastructure investments that can be made to support 5G deployment?

We do not offer a view on this question at this time.

9. In what ways could collaboration between infrastructure sectors speed up and improve deployment, and how might it be incentivized?

There is already a significant amount of collaboration between infrastructure sectors. For example Arqiva has an agreement to put mobile infrastructure on electricity pylons and there are similar deals with water towers. Any intervention, or incentives, should not disrupt the arrangements that already exist in the market.

However there are a number of areas where intervention may be beneficial:

- Firstly in making it easier to access BT's ducts to make it easier to roll out the fibre backhaul that is required;
- Secondly to allow access to the railway land, masts and fibre in order to allow improved coverage on trains; and/or
- Thirdly to look at integration of mobile infrastructure when looking at major developments such as new garden cities, new roads or projects like HS2.

10. Are there any relevant international examples in the deployment of telecoms infrastructure that the UK can learn from?

We suggest that most relevant comparisons would be Japan and South Korea. Both countries are leaders in small cell deployment and have deployed at scale. It is important to reflect that the success of these roll-outs was driven, in part, by relaxed planning regimes and ready availability of dark fibre.

11. Who should bear the deployment costs of 5G?

Who pays for 5G deployment depends on which part of the value chain is being looked at, although ultimately it will be the consumer that pays either through the mobile packages that they buy from mobile operators or through taxes and government intervention.

More specifically the majority of the cost of rolling out the infrastructure to support 5G will be paid for by the mobile industry. It is in the commercial interests of the operators to deliver 5G services to customers. However if the government wants to deliver full coverage, that may require targeted intervention(s).

12. What is 5G deployment likely to cost the UK?

We do not offer a view on this question at this time.

13. Are there international examples to draw on?

There are several models of coverage obligations that have been used in spectrum auctions around the world (e.g. in Germany) that may help the UK to deliver the coverage that is needed.

14 Is the existing UK telecommunications model able to facilitate the efficient roll out of 5G infrastructure and technologies?

Delivering 5G will be a significant practical challenge. The expectation is that over a million small cells will be required to roll out 5G and there will also need to build new macro sites and upgrade equipment at existing sites. This will require infrastructure deployment on a scale not seen before in the UK or anywhere else in the world. In order to deliver this there will need to be a significant change in the delivery model for rolling out 5G. This will require changes in a number of areas:

- **Skills:** Developing the skills and the people to roll out the infrastructure at scale;
- **Supply chain:** Ensuring that the equipment and other parts of the supply chain are scaled up and prepared for the delivery challenge; and
- **Planning:** The programme management required to deliver 5G will need to be world class to deliver the network required. Mobile operators will need to ensure that their network, rollout, and other planning is developed in collaboration (with the rest of the industry to ensure that it is realistic. Ensuring that the plan is well communicated and agreed by all parties is prerequisite for success.

Given that the rest of the world will be looking to roll out 5G in a similar timescale this will put further pressure on the model and it will require the UK to start its planning as soon as possible.

15. Is spectrum policy and its management well placed to support future 5G technologies?

With the UK leaving the European Union, it will be even more critical for Ofcom to engage with spectrum policy and developments around the world to ensure that the UK can realise the benefits of harmonisation.

Annex – Changes required allowing small cell deployment at scale

Arqiva has specific experience of Permitted Development Rights (PDRs) in relation to small cells. In particular we have many concessionary agreements with local authorities to manage installations by the Mobile Network Operators (MNOs) on Council owned buildings and street furniture, such as suitable lamp posts, CCTV poles and street signs. The lamp posts are the best and most prolific usable structures, and they extend across entire local authority areas.

For an MNO seeking to deploy a small cell network, access to Council property is therefore a potentially quick and easy means of rapid and comprehensive coverage. This avoids having to reach agreement with large numbers of individual building owners, which would be time consuming and fraught with issues.

The use of lamp posts is also a good environmental solution. Lamp posts are familiar features in townscapes. They have always had an important secondary role in terms of supporting street signage, bins, CCTV apparatus etc. These secondary items, which are usually installed by the Council, are permitted without limitation or condition under their separate PDRs. The introduction of small cell systems is a continuation of the way in which lamp posts are already used as shown in the two examples below.



Another benefit of lamp posts is that they are self-regulating in two respects. First, they are owned by the Highway Authority, which is usually the Council and so the same body as the

Planning Authority. The concessionary agreements from Councils therefore include a range of controls, such as the use of certain structures and matters such as colouration. These remove the need for overlapping town planning controls on siting and appearance.

Second, lamp posts can only support a limited amount of apparatus as they are not generally sturdy structures. Therefore, any relaxations in the PDRs could not result in an excess of apparatus, even in the absence of other controls.

In our response to the Call for Evidence in August 2015, we highlighted some key concerns about the effectiveness of the changes to the PDRs for small cells that were introduced in 2013 and suggested changes necessary to overcome these. Since that time, we have also had a customer cancel a proposed deployment of 100 small cells on lamp posts in a London Borough because the onerous town planning requirements rendered the proposal unviable. This is an ongoing problem.

Insofar as the WMS addresses some of the issues it is welcome. However, in the light of current experience, it is vital that the existing obstacles be removed if small cells are to be deployed in the numbers required. This is explained further below.

The Permitted Development Rights and Changes Required

In setting out what is needed it is relevant that lamp posts are treated in the legislation as a building or other structure and not as a radio mast. We therefore focus on the key constraints with the existing PDRs on buildings or other structures, the effect of the changes announced in the WMS, and the further changes that are required.

Issue 1: The current limitation only allows the installation of two “small cell antennas” on a building or other structure.

- This limit is predicated on the basis that only two antennas will be required, whereas in some cases, for example where a radio link is required for backhaul, this is not sufficient. Breaching this limitation triggers the need for full planning permission.
- Where other apparatus such as small units for radio equipment is required, as shown in the photographs, we have experienced some local authorities interpreting the rights as excluding such apparatus.

Solution: The WMS does not address this issue and it could be overcome by allowing the installation of “small cell systems”, and including “small cell antennas” within its definition e.g. a “small cell system” means the installation of small cell antennas and any associated apparatus.

Issue 2: Small cell antennas often face the highway as most suitable buildings are within 20 metres of a highway. There is a current limitation which prevents that and brings about the requirement for full planning permission.

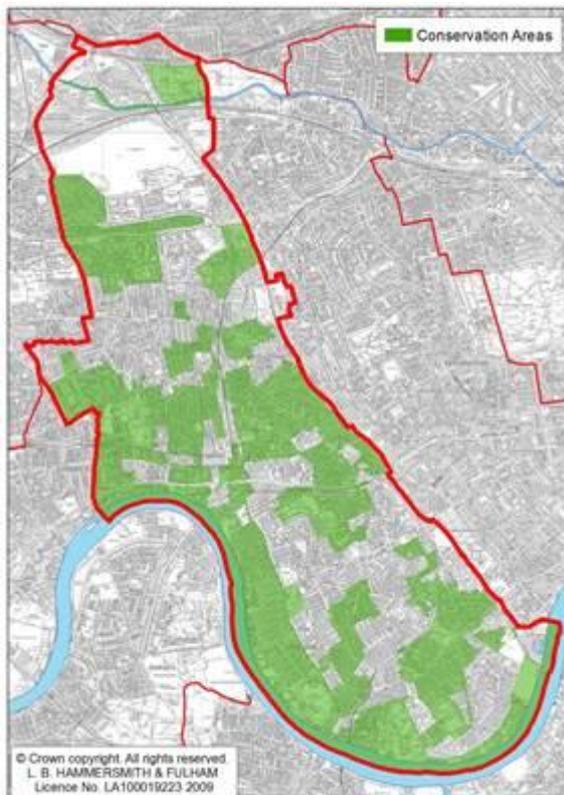
- The WMS indicates that this limitation will be removed on residential and commercial premises but does not remove it from all premises.

- The limitation does not in our view apply to lamp posts, because they do not have elevations, but the legislation should remove the scope for an alternative interpretation that might suggest this limit would apply to lamp posts. It suggests also that Council owned properties, such as libraries, schools and depots, which are not commercial premises might still be subject to this limitation.

Solution: The limitation should be removed entirely.

Issue 3: Under the current PDRs, the prior approval procedures apply to small cell antennas proposed on buildings or other structures (which include lamp posts) within designated areas, e.g. conservation areas.

- To appreciate the significance of this condition, an example of the extent of Conservation Area designations is included below for Hammersmith and Fulham.



- This pattern of extensive designations repeats itself across Central London and many other urban areas.
- In practice there is no difference between an application for full planning permission and one for prior approval – only a degree of certainty on timing. This requirement is therefore a significant burden in terms of timing and cost, as each lamp post has potentially to be the subject of an application, with the need to produce drawings, a location plan, an ICNIRP certificate and other supporting material, including the payment of a statutory fee.

- As indicated above, such an application is also unnecessary for lamp posts where a satisfactory degree of alternative control exists.
- The WMS indicates that the requirement for prior approval will be removed for small cell antennas on residential premises. This relaxation will be extremely limited in its effect. Taking Central London as an example, there are very few residential buildings in the core commercial and tourist areas.

Solution: The requirement for prior approval should be removed for all small cell systems.

Issue 4: The requirement for prior approval for radio equipment housing, within 2.5 cubic metres in protected areas

- Since making our original submissions, it has become apparent that the MNOs have a preference for small equipment cabinets over small units that might be attached to a building or lamp post. This is because the cabinets will offer greater flexibility and scope for upgrading to 5G, which will operate alongside 4G when first introduced.
- As there is a requirement for small equipment cabinets to be subject to prior approval this introduces the same obstacle on rapid and viable deployment. This is the same issue that was identified for the cabinets required for fixed line broadband. Government addressed this by removing them from the prior approval procedure by virtue of Condition A.2 (5)

Solution: The requirement for prior approval for small radio equipment housing in protected areas should be removed.

Building the Future:

The economic and fiscal impacts of making homes energy efficient



Document type: Report
Client: Energy Bill Revolution, E3G
Client contact: Ed Matthew
Other details: ed.matthew@e3g.org

Title: Building the Future: Economic and fiscal impacts of making homes energy efficient
Date: October 2014

Authors: Pratima Washan, Jon Stenning, Max Goodman

QA: Duncan Price, Phil Summerton

Author contact details

Email: pratima.washan@vercoglobal.com
Telephone: +44 (0)20 3598 9770

This report was kindly sponsored by the Energy Bill Revolution, Kingfisher plc, Mineral Wool Insulation Manufacturers Association, Sustainable Energy Association, UK Green Building Council, and Willmott Dixon.

Contents

Executive Summary	4
1. Introduction.....	11
2. Investing in domestic energy efficiency.....	12
2.1 Energy efficiency investment scenario	12
2.2 Investment required to upgrade homes to EPC C standard	13
2.3 Approach to technical modelling and key constraints.....	20
3. Modelling the macroeconomic impact of energy efficiency investment	21
3.1 Summary of findings.....	21
3.2 Approach to economic modelling.....	21
3.3 Macroeconomic benefits of investing in domestic energy efficiency	22
3.4 Government balance sheet.....	24
4. Energy Efficiency – An infrastructure priority	26
4.1 Summary	26
4.2 Approach to assessing Value for Money.....	26
4.3 Value for Money	28
4.4 Improved energy independence and economic resilience.....	29
4.5 Avoided cost of environmental externalities	30
4.6 Avoided health costs.....	31
4.7 Benefits to local economy	32
5. Conclusions.....	36
6. Appendices.....	37
6.1 Appendix 1 – Data sources.....	37
6.2 Appendix 2 – MDM-E3 Model Description	38
6.3 Appendix 3 – Technical modelling methodology	39
6.4 Appendix 4 – Programme investments by year.....	43

Executive Summary

High energy bills are causing considerable financial hardship in the UK, with millions of people living in fuel poverty. One of the biggest causes of the fuel poverty crisis is the poor condition of the UK housing stock, which is one of the least energy efficient in Western Europe.

Improving the energy efficiency of UK homes is an effective way to bring down energy bills, and offers a long term solution to fuel poverty. In addition, it is important to drive carbon emissions reductions, with buildings responsible for almost 37% of all UK carbon emissions.¹

At the same time, the building insulation market contracted by 22% in 2013,² as the installation of cavity wall insulation fell by 46%, the installation of loft insulation fell by more than 87%, and the installation of solid wall insulation fell by 30%, compared with the number of measures installed under the Carbon Emissions Reduction Target (CERT) in 2012.³ The Energy Bill Revolution is calling for a radical new approach to home energy efficiency. They are calling for all low income homes to be given measures, by 2025, to bring them up to Band C on an Energy Performance Certificate (EPC),⁴ and for all other households to be offered 0% interest loans to improve them to an equivalent EPC standard by 2035; delivered as part of a major infrastructure investment programme.

This report has undertaken detailed modelling to assess the economic, fiscal, and environmental impacts of this programme. It concludes that the economic case for making the energy efficiency of the UK housing stock a national infrastructure priority is strong.

In addition to making all low income households highly energy efficient, and reducing the level of fuel poverty, the modelling has established that this energy efficiency programme would deliver:

- **£3.20 returned through increased GDP per £1 invested by government**
- **0.6% relative GDP improvement** by 2030, increasing annual GDP in that year by £13.9bn
- **£1.27 in tax revenues per £1 of government investment**, through increased economic activity, such that the scheme has paid for itself by 2024, and generates net revenue for government thereafter
- **2.27 : 1 cost benefit ratio** (Value for Money), which would classify this as a “High” Value for Money infrastructure programme
- **Increased employment by up to 108,000 net jobs per annum over the period 2020-2030**, mostly in the service and construction sectors. These jobs would be spread across every region and constituency of the UK.

¹ Committee on Climate Change, *Meeting Carbon Budgets – 2014 Progress Report to Parliament*, July 2014

² Mintel, *Policy changes are putting a chill into the thermal insulation market*, October 2014

<http://www.mintel.com/blog/mintel-market-news/policy-changes-are-putting-a-chill-into-the-thermal-insulation-market>

³ Association for the Conservation of Energy, *Energy Bill Revolution: ECO and the Green Deal*, 2014

<http://www.energybillrevolution.org/wp-content/uploads/2014/07/ACE-and-EBR-fact-file-2014-06-ECO-and-the-Green-Deal.pdf>

⁴ Energy Performance Certificates (EPCs) are a measure of the level of energy efficiency of a home. The ratings span from A to G. A-rated homes would have relatively low energy bills, whereas G-rated homes would have high energy bills, and be expensive to heat. An EPC band of C represents a reasonably good level of energy efficiency. The average EPC rating in England and Wales is currently D. Increasing the energy efficiency rating (or EPC) delivers a warmer, healthier, and more comfortable home for the resident, whilst reducing the energy bills.

- **£8.61 billion per annum in total energy bill savings** across housing stock, after comfort take (including energy price inflation)
- **Net benefit of £4.95 billion per annum** from the total energy bill savings across the housing stock (after able-to-pay energy efficiency loans have been repaid)
- **23.6MtCO₂ reductions per annum by 2030**, after accounting for direct, indirect, and economy-wide rebound effects. This is roughly equivalent to cutting the CO₂ emissions of the UK transport fleet by one third.
- **Improved health and reduced healthcare expenditure**, due to warmer and more comfortable homes, and improved air quality. For every £1 spent on reducing fuel poverty, a return of 42 pence is expected in National Health Service (NHS) savings.^{5 6}
- **A more resilient economy**, less at risk of shock changes in gas prices, as the economy becomes less reliant on fossil fuels. Investment in energy efficiency in the domestic sector will result in a 26% reduction in imports of natural gas in 2030, worth £2.7bn in that year.

Background

The Government's energy efficiency strategy acknowledges that improving energy efficiency is fundamental to decarbonising the UK economy, combating fuel poverty, maintaining secure energy supplies, reducing domestic energy bills, reducing the need for new electricity generation capacity, and increasing the productivity of businesses. However, successive governments have failed to put in place policies or investment which could realise this opportunity. Within this context, this research seeks to quantify the macro-economic benefits of investing in energy efficiency in the UK building stock, based on the programme objectives of the Energy Bill Revolution campaign. The Energy Bill Revolution is a major alliance campaign to end fuel poverty which is supported by 200 major UK stakeholders.

This study assesses three main areas:

- Quantifying the scale of investment required to upgrade all UK homes to EPC band C by 2035, with all low income homes treated by 2025, and associated energy bill and CO₂ savings from installed energy efficiency measures;
- Modelling tax implications and macro-economic benefits from investment in energy efficiency
- Developing the quantitative and qualitative evidence to support investment in energy efficiency as an infrastructure priority

As such, this analysis represents a comprehensive assessment of the impacts of a substantive programme of investment, considering the (inter-related) impact on macroeconomic indicators and the Value for Money indicators used for infrastructure project assessment in standard cost-benefit analyses.

⁵ C. Liddell, *Estimating the impacts of Northern Ireland's warm homes scheme 2000-2008*, University of Ulster, 2008, <http://eprints.ulster.ac.uk/26173/1/FPcostbenefitsonweb.pdf>

⁶ Chief Medical Officer, *2009 Annual Report*, 2009. http://www.sthc.co.uk/Documents/CMO_Report_2009.pdf

Domestic energy efficiency retrofit: Investment and bill savings

The domestic energy efficiency retrofit programme presented in this research shows the investment required, and beneficial impacts of improving the energy performance of the whole UK housing stock to EPC band C by 2035. The improvements are financed via grants to low income homes, and 10-year interest free loans to able-to-pay homes. The programme is proposed to be rolled out using a street-by-street delivery model,⁷ starting with areas with a high proportion of low income households, to ensure the effective targeting of low income homes, and to exploit economies of scale.

Discussions with key industry experts and stakeholders have concluded that the level of activity and ramp-up rates presented are realistic, and the industry can scale up to deliver this level of activity. Additional regulatory drivers and financial incentives, such as mandatory energy performance standards, council tax and stamp duty rebates, may need to be considered to drive uptake of energy efficiency retrofits in able-to-pay homes.

The energy bill savings from the energy efficiency programme are shown in Table 0-1.

Table 0-1: Energy bill savings associated with the energy efficiency investment programme

Average energy bill savings for low income homes	£408 per annum £245 per annum after accounting for comfort take ⁸
Average energy bill savings for able-to-pay homes (after energy efficiency loan repayments)	£416 before loan repayment Net benefit of £203 per annum (after able-to-pay energy efficiency loan repaid) ⁹
Total energy bill savings across the housing stock, after comfort take (includes energy price inflation)	£8.61 billion per annum Net benefit of £4.95 billion per annum (after able-to-pay energy efficiency loans repaid)

The investment in the retrofit programme, both by the Government and the private sector, is shown by parliamentary term in Table 0-2.¹⁰ The Government investment consists of grants for low income homes, covering the installation of measures and cost of carrying out the energy assessments. For able-to-pay homes, the Government investment pays for the interest rate subsidy from 8% to 0%, over a 10-year loan term, plus the cost of energy assessments.¹¹

⁷ R Platt, J Aldridge, P Washan, and D Price; *Help to Heat: A solution to the affordability crisis in energy*; IPPR Nov 2013.

⁸ Homes with fuel poor residents often tend to be under-heated due to the high costs associated with heating. This means that modelling of energy demand and energy savings can be over-estimates, as they do not account for the behaviour and energy use patterns of the residents. It can be that, after energy efficiency measures have been installed, the residents increase the warmth of their homes (due to the reduced costs of achieving the warmer temperature), rather than achieving the predicted energy bill savings associated with energy efficiency. This is known as 'comfort take' – and assumed to account for a 40% reduction in the predicted energy bill savings for the purpose of this research.

⁹ This figure represents energy bill savings averaged over a 20-year lifetime for a package of measures. The loan repayment would be twice as large for the first 10 years after retrofit, reducing to £0 thereafter, once the loan has been repaid.

¹⁰ The investment in the retrofit programme is shown by year in Appendix 4 – Programme investments by year.

¹¹ The interest rate subsidy is calculated as the cost to government of guaranteeing the energy efficiency loans (taking the effective loan interest rate from 8% to 5%) plus the cost of direct subsidies (taking the effective interest rate from 5% to 0%) over a 10-year period.

For the first parliamentary term, the total investment required for the low income scheme is £8.1bn, and the Government contribution for the able-to-pay scheme is £4.9bn. As an indication of scale, this compares to over £100bn of committed public investment in infrastructure projects over the next parliamentary term (2015-2020), which includes £24 billion for road building, with £16 billion set aside for new roads. The Government has also committed to the building of High Speed 2 (HS2) which is budgeted at £42.6bn for the construction of the rail link, and an additional £7.5 billion for rolling stock.¹²

Table 0-2: Programme investment made by the Government and by the private sector, for each parliamentary term

Parliamentary Term	Investment in low income scheme (undiscounted) (£bn)	Government contribution to able-to-pay scheme (undiscounted sum of interest payments) (£bn)	Private sector investment in able-to-pay scheme (undiscounted) (£bn)	Government investment in all schemes (undiscounted) (£bn)	Total investment (undiscounted) (£bn)
15/20	£8.1 ¹³	£4.9	£13.1	£13.0	£26.1
20/25	£18.1	£8.4	£22.3	£26.4	£48.7
25/30	£0.0	£9.9	£26.6	£9.9	£36.5
30/35	£0.0	£4.2	£11.2	£4.2	£15.3
Total	£26.1	£27.4	£73.2	£53.5	£126.7

Value for money and tax implications of investing in domestic energy efficiency

The economic scenario analysis was undertaken using Cambridge Econometrics' MDM-E3 model of the UK economy and energy system.

The energy efficiency scenario differs from the baseline in investment expenditure and fuel use, as a result of efficiency measures. Investment in dwellings leads to a positive economic impact on industries supplying the construction sector with energy efficiency products. Changes in expenditure on energy affect consumption outlays and thus revenues of consumer-facing industries and their supply chains. The primary impacts that are modelled in this study are:

- Change in investment including expenditure of measures financed through funding provided for low income homes as well as loans for able-to-pay homes.
- Higher energy efficiency of homes leads to lower energy demand and therefore lower energy bills. The reduction in demand for gas in heating (and for gas used in the power sector which is then consumed by homes for heating) would substantially reduce imports of natural gas.
- Lower energy bills (after accounting for comfort take – which leads to a range of health benefits, as discussed in Section 4.5) lead to higher expenditure on other goods and services. In the case of able-to-pay homes, this is at first largely offset by loan repayments in the first 10 years following treatment.

¹² HM Treasury, *Investing in Britain's future*, June 2013,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209279/PU1524_IUK_new_template.pdf

¹³ This excludes £2bn Energy Companies Obligation (ECO) funding, expected to be invested by the utilities for 15/16 and 16/17, to meet ECO targets. Assuming similar level of ECO investment per annum to 2020, the additional investment required in the first parliamentary term is £3.1bn.

The Value for Money assessment is summarised in Table 0-3 (the calculations supporting each item are discussed in Section 4.2).

Table 0-3: Summary of modelling results

Total discounted benefit of energy efficiency investment programme, of which:	£91,186m
<i>Discounted net benefit to consumer spending</i>	£60,651m
<i>Discounted benefit of net government balances</i>	£9,960m
<i>Discounted benefit of net increase in company profits</i>	£15,111m
<i>Discounted benefit of net increase in savings</i>	£337m
<i>Discounted benefit of reduced emissions</i>	£5,127m
Total discounted investment in energy efficiency programme by government	£40,214m
Cost Benefit Ratio (CBR) (total benefit / total investment)	2.27

The Cost Benefit Ratio (Value for Money) indicator of the programme is estimated to be 2.27:1, which classifies the infrastructure programme as “High” Value for Money. The value of health benefits of improved efficiency from the comfort, warmth, and improved air quality in homes, is uncertain to quantify in monetary terms, and has therefore not been included in the formal Cost Benefit Ratio. However, there is evidence that significant health benefits will arise which would add to the central estimate of 2.27.

In terms of GDP, the programme would generate a return of £3.20 per £1 invested in energy efficiency measures by government. For value added, the return is £3.00 per £1 invested. In relative terms, as a result of the energy efficiency investments, GDP will be 0.6% higher in 2030.

The programme results in a net increase in annual employment of up to 108,000 over the period 2020-2030, with most jobs created in the services and the construction sectors.

Investment in energy efficiency in the domestic sector will result in a 26% reduction in imports of natural gas in 2030, worth £2.7bn in that year. As the economy becomes more fossil fuel efficient, the more resilient it becomes to shock changes in gas prices. A 50% gas price spike in 2030, leads to a 0.2% GDP decrease in the baseline scenario, but only a 0.15% decline in the Energy Efficiency scenario. For consumers directly, the gas price spike leads to an increase in energy bills of £220 per home (in 2030) in the baseline. As a result of the efficiency measures, this is reduced by £60 to £160 per home.

Both the direct impact (construction jobs at the installation sites) and many of the indirect impacts (extra employment generated by the spending of additional wages in the economy) stimulate employment and economic activity in close proximity to the sites where the energy efficiency measures are introduced. Given that the modelling demonstrates a net positive impact on output and jobs in the UK, the impacts are therefore fairly evenly distributed across the country (whether looking

at a regional, local, or constituency level): the increase in employment in 2030 ranges between 0.14-0.22% in each of the twelve nations and regions of the UK (against a UK average of 0.19%).

The funding investment and incentivising of take-up of energy efficiency measures by governments is self-financing. The increased economic growth leads to higher tax intake, cumulatively £51.1bn by 2030, or £1.27 per £1 invested throughout the whole period (in discounted terms). In Parliamentary Terms, the Government would be slightly worse off in the period 2015-20, but the investments would yield dividends to governments in the 2020-25 period and considerable payback in the 2025-30 period.

Table 0-4: Government balances (undiscounted)

Parliamentary Term	Government investment in all schemes (undiscounted) (£bn)	Additional government tax revenue (undiscounted) (£bn)	Net impact on government balance sheet (undiscounted) (£bn)
15/20	£13.0	£11.0	£-1.9
20/25	£26.4	£30.4	£4.0
25/30	£9.9	£28.7	£18.8
30/35	£4.2	not modelled	not modelled
Total	£53.5	>£70.2	>£16.7

Table 0-5: Government balances (discounted)

Parliamentary Term	Government investment in all schemes (discounted) (£bn)	Additional government tax revenue (discounted) (£bn)	Net impact on government balance sheet (discounted) (£bn)
15/20	£11.4	£9.7	£-1.8
20/25	£20.1	£23.0	£2.9
25/30	£6.4	£18.4	£12.0
30/35	£2.3	not modelled	not modelled
Total	£40.2	>£51.1	>£10.9

The wider co-benefits

The energy efficiency programme will contribute towards economy-wide emissions reductions of 23.6MtCO₂ per annum by 2030, after accounting for direct, indirect, and economy-wide rebound effects. The Committee on Climate Change has predicted the policy gap in emissions reduction targets from the building (residential and non-residential) sector, required to meet the fourth carbon budget in 2025, to be 17MtCO₂.¹⁴ This gap is based on an analysis of the potential across different sectors in the economy and positive action in the buildings sector has been acknowledged as an essential component of meeting our medium to long term carbon targets. The programme modelled in this research delivers 16MtCO₂ pa by 2025, which is a similar scale to the predicted gap.

¹⁴ Committee on Climate Change, *Meeting Carbon Budgets – 2014 Progress Report to Parliament*, July 2014 (Figure 3) http://www.theccc.org.uk/wp-content/uploads/2014/07/CCC-Progress-Report-2014_web_2.pdf

Improved air quality, and warmer, more comfortable homes will improve health and allow for reduced healthcare expenditure. According to recent evidence, for every £1 spent on reducing fuel poverty, a return of 42 pence can be seen in NHS savings.^{15 16}

The programme would result in a more resilient economy, less at risk of shock changes in gas prices, and less reliant on fossil fuels, as described above.

Investing in energy efficiency – a “high” infrastructure priority

To conclude, the targeted programme of upgrading the energy performance of the housing stock, as proposed by the Energy Bill Revolution, would generate a three-fold return in GDP for every pound invested by government, deliver a high Value for Money infrastructure programme, provide warmer homes with lower healthcare expenditure, provide a long term solution to mitigate fuel poverty, create local jobs, reduce gas imports by a quarter, while creating a resilient economy in the medium to long term, and delivering substantial environmental benefits. These benefits can be realised through a programme that will effectively be a net revenue generator for the Government, by 2024.

¹⁵ C. Liddell, *Estimating the impacts of Northern Ireland's warm homes scheme 2000-2008*, University of Ulster, 2008, <http://eprints.ulster.ac.uk/26173/1/FPcostbenefitsonweb.pdf>

¹⁶ Chief Medical Officer, *2009 Annual Report*, 2009. http://www.sthc.co.uk/Documents/CMO_Report_2009.pdf

1. Introduction

The Government's energy efficiency strategy acknowledges that improving energy efficiency is fundamental to decarbonising the UK, maintaining secure energy supplies, reducing domestic energy bills, and increasing the productivity of businesses.¹⁷ The strategy also acknowledges the benefits of energy efficiency in mitigating the health detriments associated with cold homes, purporting energy efficiency as one of the most cost-effective ways of making a sustained reduction in domestic heating costs, and removing homes from fuel poverty.

However, successive governments have failed to put in place policies which can meet the scale of opportunity. The building insulation market contracted by 22% in 2013,¹⁸ as the installation of cavity wall insulation fell by 46%, the installation of loft insulation fell by more than 87%, and the installation of solid wall insulation fell by 30%, compared with the number of measures installed under the Carbon Emissions Reduction Target (CERT) in 2012.¹⁹

The Energy Bill Revolution alliance of 200 national organisations has been advocating for energy efficiency to be made a national infrastructure investment priority with a programme to make every low income home highly energy efficient.

Within this context, this research seeks to quantify the macro-economic costs and benefits of investing in energy efficiency in UK building stock, and to analyse the impact of making energy efficiency an infrastructure priority. The analysis is carried out based on a programme to upgrade all of UK's housing stock to an EPC C standard²⁰ by 2035, through a combination of grants and low interest loans, with all low income homes treated by 2025.

The study assesses three main aspects:

1. Quantifying the scale of investment required to upgrade all UK homes to EPC band C by 2035, and associated energy bill and CO₂ savings from installed energy efficiency measures;
2. Modelling tax implications and macro-economic benefits from investment in energy efficiency
3. Developing the quantitative and qualitative evidence to assess investment in energy efficiency as an infrastructure priority

As such, this analysis represents a comprehensive assessment of the impacts of a substantive programme of investment, considering the (inter-related) impact on macroeconomic indicators and the Value for Money indicators used for infrastructure project assessment in standard cost-benefit analysis. All monetary values in the report are expressed in 2013 real terms, unless otherwise stated.

¹⁷ Department of Energy and Climate Change, *The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK*, November 2012

¹⁸ Intel, *Policy changes are putting a chill into the thermal insulation market*, October 2014

<http://www.intel.com/blog/mintel-market-news/policy-changes-are-putting-a-chill-into-the-thermal-insulation-market>

¹⁹ Association for the Conservation of Energy, *Energy Bill Revolution: ECO and the Green Deal*, 2014

<http://www.energybillrevolution.org/wp-content/uploads/2014/07/ACE-and-EBR-fact-file-2014-06-ECO-and-the-Green-Deal.pdf>

²⁰ Energy Performance Certificates (EPCs) gives a home an energy efficiency rating from A (most efficient) to G (least efficient)

2. Investing in domestic energy efficiency

2.1 Energy efficiency investment scenario

The energy efficiency investment scenario that underpins the macro-economic modelling was developed in discussions with the Energy Bill Revolution (EBR), and was informed by a consortium of organisations supporting the campaign. The scenario sets out target dates, minimum energy performance standards, and proposed financing routes, for delivering a programme of works in both low income and able-to-pay homes. It was developed taking into account the scale of ambition required to deliver meaningful reductions in domestic bills and meet medium term carbon reduction targets, as well as the capacity of the retrofitting industry to deliver the expected level of activity.

The scenario builds on the proposals outlined in the recent paper by Citizen's Advice *'Raising standards, cutting bills'*,²¹ and the Institute for Public Policy Research (IPPR) report *'Help to Heat'*.²² It consists of a programme to upgrade all UK housing to EPC band C, financed via energy efficiency grants for low income homes, and a 0% interest rate loan for able-to-pay homes, both capped at £10k. The £10k cap is indicative, and has been set on the basis of ensuring most homes treated can get up to EPC band C. In practise, the cap could be varied depending on the type of housing stock in each local authority area. Previous research has analysed the cost of improving fuel poor and low income homes to various EPC standards. EPC C was chosen as a relatively cost-effective standard for the UK housing stock, while delivering meaningful energy bill savings for residents. Improving all low income homes to EPC C standard is also an effective way to tackle fuel poverty as these households are most vulnerable to energy prices rises. It is worth highlighting that the average EPC rating in England and Wales is currently D and the average rating for a fuel poor home is EPC band E.²³

A local authority led, street-by-street approach to delivery is intended to ensure effective targeting and drive consumer demand for energy efficiency by engaging households within certain areas, initially low income areas. Trusted local intermediaries market the scheme, provide information and advice and make sure every household receives a free energy efficiency assessment, similar to the current Green Deal assessment. The area-based nature of the scheme would encourage social awareness on the benefits of energy efficiency, as well as reduce costs due to economies of scale. Local bodies would receive funds from national government to oversee the delivery of area-based programmes and make sure programmes are tailored to meet local circumstances, in a similar way to the Green Deal Communities scheme.

²¹ W Baker, *Raising standards, cutting bills: Healthy homes: a costed proposal to end fuel poverty through higher standards and fairer funding*, Citizens Advice Bureau, June 2014

²² R Platt, J Aldridge, P Washan, D Price, *Help to heat: A solution to the affordability crisis in energy*, Nov 2013

²³ Department of Energy and Climate Change, *Annual Fuel Poverty Statistics Report*, 2014

Key dates and targets are as outlined below.

Proposed UK domestic energy efficiency investment scenario

- All low income homes to be retrofitted to EPC C standard by 2025 through energy efficiency grants capped at £10k²⁴
- All able-to-pay homes to be retrofitted to EPC C standard by 2035 financed through 10 year interest free loans capped at £10k
- 500,000 low income houses retrofitted per year by 2018,²⁵ with 2 million treated to EPC C standard by 2020.
- One million deep retrofits supported per year by 2020 in able-to-pay homes

The programme ramp-up rates (numbers of homes retrofitted each year) is shown in Figure 2-2. Although the proposed programme sounds ambitious, discussions by Energy Bill Revolution with industry experts and stakeholders have indicated that the level of activity and ramp-up rates presented are realistic, and the industry can scale up to deliver this level of activity. Additional regulatory drivers and incentives, such as mandatory energy performance standards, council tax rebates, and stamp duty incentives, may need to be considered to drive uptake of energy efficiency retrofits in able-to-pay homes.

This is not an entirely new approach. There is a precedent in Europe of delivering energy efficiency activity at scale in the domestic sector through a combination of low interest loans and other financial incentives. For instance, in response to the KfW loan and grant programmes for energy efficient new buildings and refurbishments in Germany, the industry was able to ramp up the installation rate of energy efficiency measures from 280,000 homes in 2008 (€6.3bn of loans), to 617,000 homes in 2009 (€8.9bn of loans – of which 65% was allocated for the energy efficiency programme).

2.2 Investment required to upgrade homes to EPC C standard

For the purpose of the macro-economic analysis, the first step was to analyse the investment required to upgrade homes to EPC C standard, and an associated package of energy efficient measures. The energy efficiency measures in the package represent a cost-effective route to achieving the target SAP score,²⁶ based on a marginal abatement cost (MAC) curve; the most cost-effective measures are prioritised to be installed earlier in a package, before the less cost-effective measures are considered. The upfront investment for the measures, and the split between government investment and private sector investment from the home, are summarised below (all expressed as investment per home).

²⁴ This proposed target is the result of analysis undertaken by the Energy Bill Revolution campaign. For previous work, see the Citizens Advice report, *Help to Heat Mark 2: Cutting energy bills now*, 2014. The campaign includes key industry stakeholders, including from major construction sector organisations, and large social housing landlords.

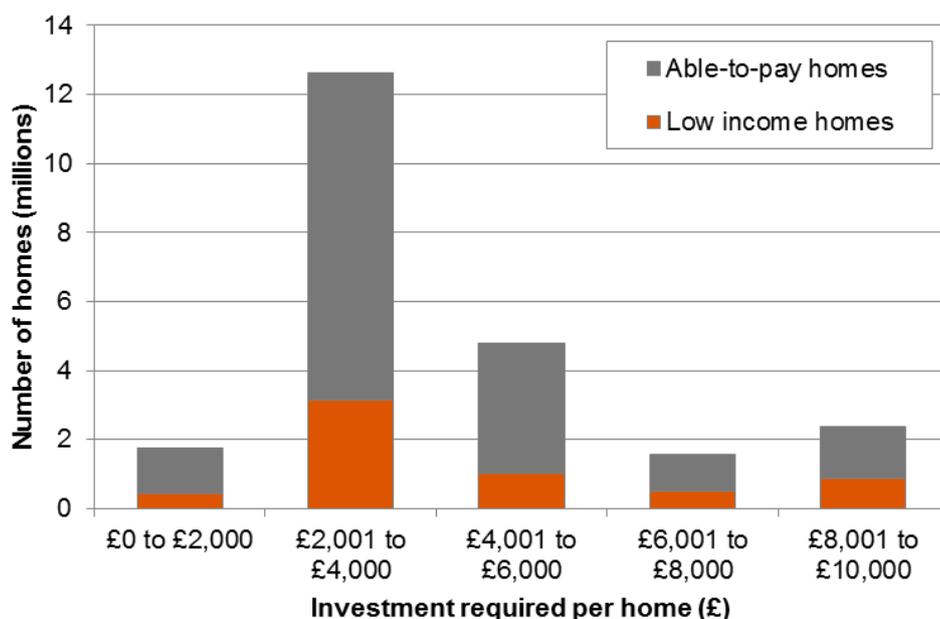
²⁵ UCL Energy Institute, *The KfW experience in the reduction of energy use in and CO₂ emissions from buildings: operation, impacts and lessons for the UK*, 2011

²⁶ The Standard Assessment Procedure (SAP) is the methodology used by the Government to assess and compare the energy and environmental performance of dwellings. Its purpose is to provide accurate and reliable assessments of dwelling energy performances that are needed to underpin energy and environmental policy initiatives.

- Low income homes:
 - Investment required to upgrade homes to EPC C: £4,376 (£4,256 for measures, plus £120 energy assessment fee)
 - Government investment: The full £4,376 is modelled to be subsidised by a government grant
- Able-to-pay homes:
 - Investment required to upgrade homes to EPC C: £4,385 (£4,265 for measures, plus £120 energy assessment fee)
 - Government investment support: £1,595 (£1,475 for interest rate subsidies²⁷ plus £120 energy assessment fee) is modelled to be covered by the Government.
 - Investment by the home / private sector: £4,265, modelled to be covered by the homeowner in instalments over 10-years – i.e. the principal loan value of the retrofit works

Figure 2-1 shows the spread of investment within the housing stock for low income homes.

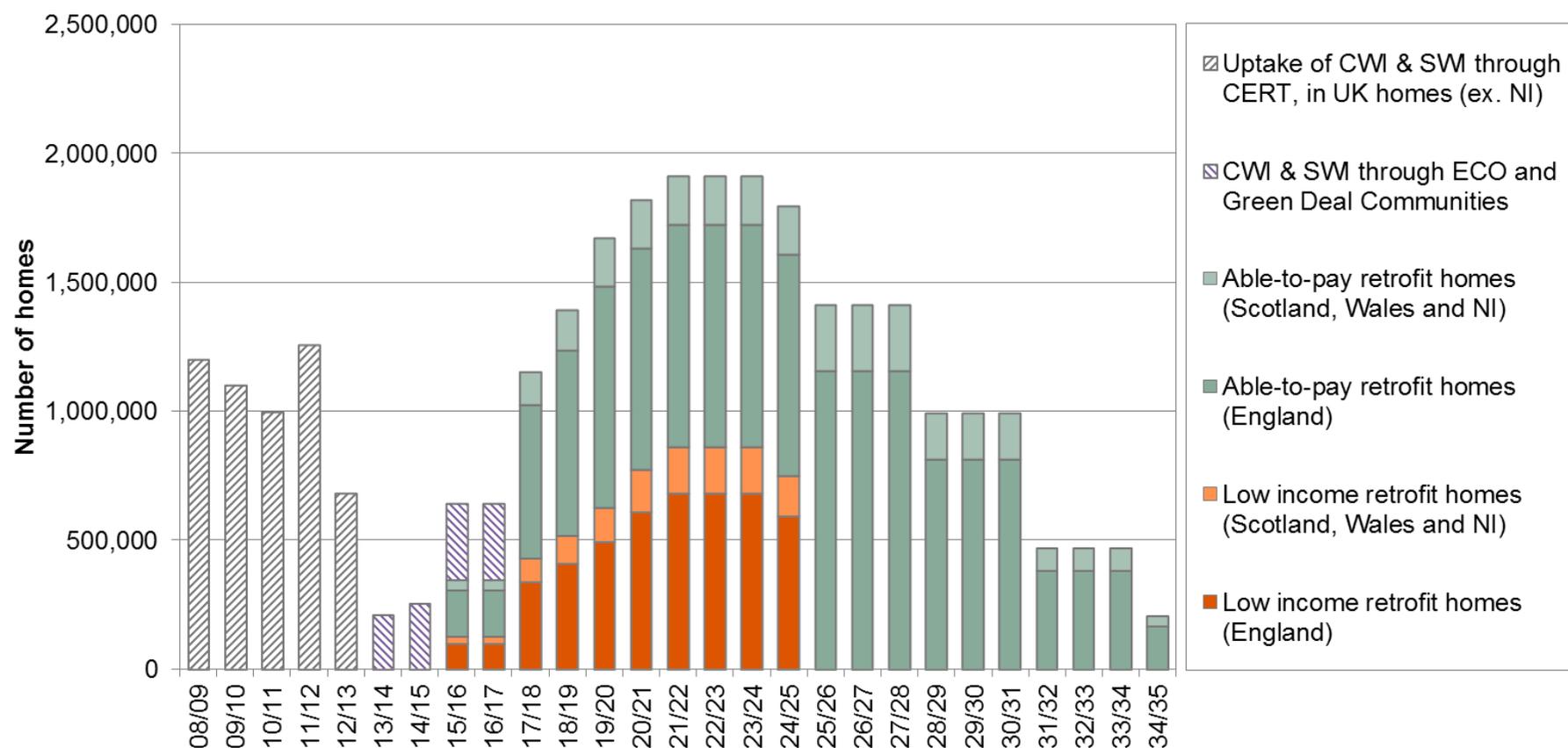
Figure 2-1: Spread of investment within the housing stock



The methodology for calculating the investment requirement is summarised in Section 2.3 and detailed further in Section 6.3. Example packages of measures are shown in Appendix 3 – Technical modelling methodology.

²⁷ For the able-to-pay homes, the current scenario assumes that the Government does not act as the loan provider. Instead, the Government is using a combination of guarantees and direct public subsidies to reduce the interest rate to 0%. This is done by the Government guaranteeing the debt of the Green Deal Finance Company (reducing the interest rate to the consumer from 8% to 5%), and then directly subsidising the remaining loan interest over a 10-year period (i.e. taking the effective interest rate from 5% to 0%). The total government investment is shown as the undiscounted value of both the guarantee and the direct subsidy and assumed to be incurred in the year the measures are installed. In effect, if the direct subsidy is spread out over the 10-year period, the NPV of the Government investment will be smaller.

Figure 2-2: Programme ramp-up rates, in terms of the number of homes retrofitted²⁸

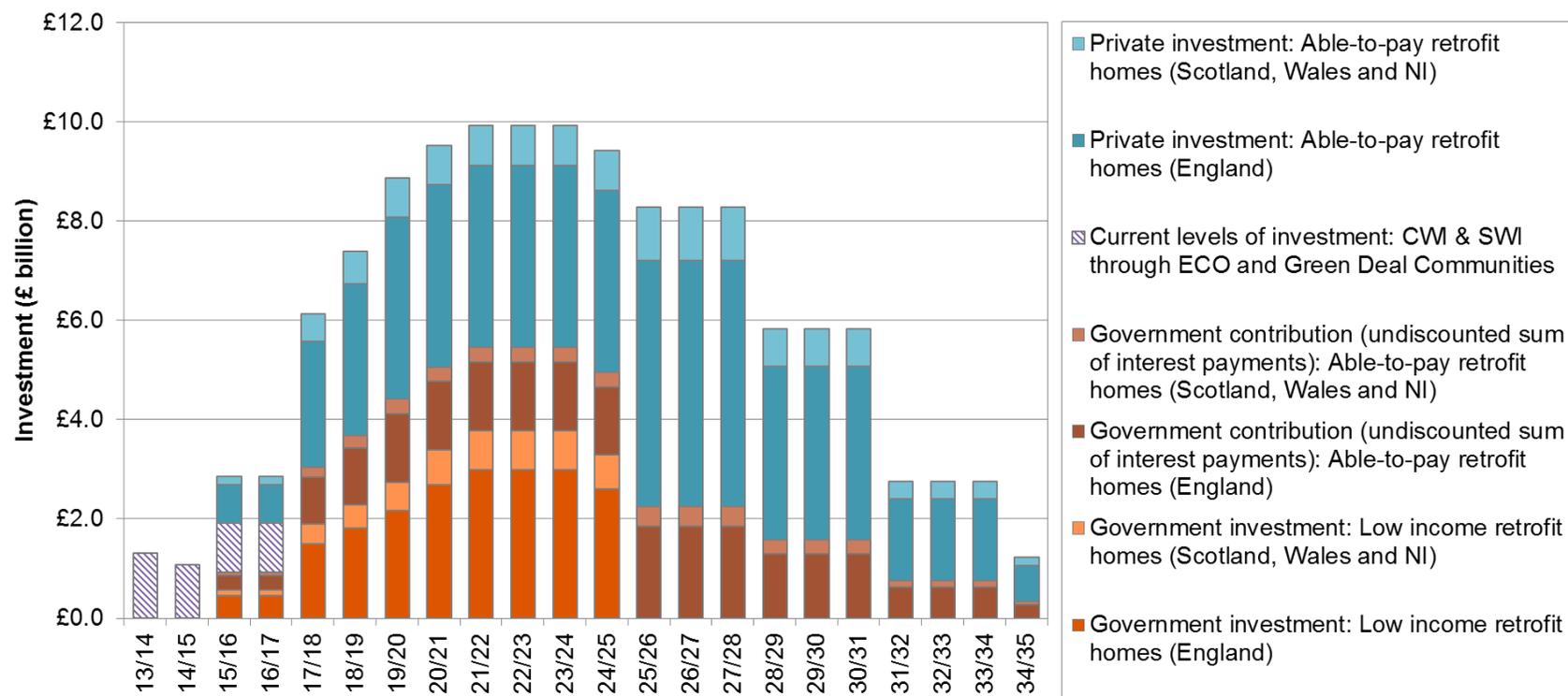


²⁸ The uptake of cavity wall insulation (CWI) and solid wall insulation (SWI) through the Carbon Emissions Reduction Target (CERT) scheme, in UK homes (excluding Northern Ireland (NI)) is taken from two data sources. For the period 2008/09, it is taken from Energy Saving Trust, *CERT Summary Report (Q16) by Local Authority, 2012*, <http://www.energysavingtrust.org.uk/Publications2/Housing-professionals/HEED-PDFs/HEED-publications-for-UK/CERT-reports-Q16/CERT-Summary-Report-Q16-by-Local-Authority> For the period 2012/13 it is taken from DECC, *Statistical release: Experimental statistics, Estimates of Home Insulation Levels in Great Britain: July 2013*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/240190/statistical_release_estimates_home_insulation_levels_gb_july_13.pdf

2.2.1 Total investment in upgrading all UK homes

The investment in the retrofit programme each year, by both the Government and the private sector (i.e. investment made by Green Deal Providers or households themselves in energy efficiency improvements), is shown in Figure 2-3 (and shown in table format, in Appendix 4 – Programme investments by year). For the whole UK housing stock, the total government investment in the low income scheme is £26.1bn, and in the able-to-pay scheme is £27.4bn. In the first two years of the programme, the investment made by the Government, and the private sector investment, are each of a similar scale to the current ECO funding.

Figure 2-3: Programme investment by the Government and the private sector²⁹



²⁹ For the able-to-pay homes, the graph shows the £1,595 investment from the Government, in the year that the retrofit works are done. The investment from the private sector in able-to-pay homes is also shown in the year that the retrofit works are done. As a result, the graph shows the up-front investment in retrofit activity, rather than the value of the loan repayments spread over 10 years.

The investment in the retrofit programme, by both the Government and the private sector, is shown by parliamentary term in Table 2-1. For the first parliamentary term, the total investment in the low income scheme is £8.1bn, and the Government contribution to the able-to-pay scheme is £4.9bn.

Table 2-1: Programme investment requirements from government and private sector, by parliamentary term

Parliamentary Term	investment in low income scheme (undiscounted) (£bn)	Government contribution to able-to-pay scheme (undiscounted sum of interest payments) (£bn)	Private sector investment in able-to-pay scheme (undiscounted) (£bn)	Government investment in all schemes (undiscounted) (£bn)	Total investment (undiscounted) (£bn)
15/20	£8.1 ³⁰	£4.9	£13.1	£13.0	£26.1
20/25	£18.1	£8.4	£22.3	£26.4	£48.7
25/30	£0.0	£9.9	£26.6	£9.9	£36.5
30/35	£0.0	£4.2	£11.2	£4.2	£15.3
Total	£26.1	£27.4	£73.2	£53.5	£126.7

2.2.2 Domestic energy bill savings

The energy bill savings generated from the energy efficiency retrofit packages are shown in Table 2-2. As the measures are proposed to be financed using grants for low income homes and interest free loans for the able-to-pay homes, the net energy bill savings are calculated differently for the two groups. Also, the re-bounce effect (also termed as comfort take³¹) is likely to impact the net benefit to fuel poor homes. This phenomenon is explained below:

- For the low income homes, the savings include in-use factors³² and a 'comfort take' factor of 40%³³
- For the able-to-pay homes, the savings include in-use factors and are net of the energy efficiency loan repayments. During the 10 years duration of the loan, some homes may be paying more in loan repayments, than they receive in energy bill savings, as the analysis was done without applying the 'Golden Rule' (savings in each year being greater than the loan repayment for that year). However, after year 10, the homes will receive 100% of the savings.

³⁰ This excludes £2bn Energy Companies Obligation (ECO) funding, expected to be invested by the utilities for years 15/16 and 16/17, to meet ECO targets. Assuming similar level of ECO investment per annum to 2020, the additional investment required in the first parliamentary term is £3.1bn.

³¹ Once energy efficiency measures are installed, the expected energy savings may not be realised as fuel poor homes can now afford to heat their homes adequately. The proportion of energy savings from energy efficiency measures that are not realised due to homes now heating homes for longer or to a higher temperature is referred to as 'comfort take'. There is a range of important health benefits associated with comfort take, as discussed in Section 4.5.

³² In-use factors have the effect of reducing the predicted energy savings from energy efficiency measures, by a specified percentage per measure. The percentage reduction is based on the application of evidence and research and expert recommendation, as adopted by the Department of Energy and Climate Change for the Green Deal and Energy Companies Obligation.

³³ Programmes such as CESP (that focus on low income areas and are likely to impact a higher number of homes in fuel poverty) allow for a 40% comfort take when predicting CO₂ savings. A similar 'comfort take' factor has been used for the purpose of this analysis and applied to all low income homes as a conservative assumption.

The energy bill savings include energy price inflation over time, in line with DECC's central energy forecast scenario.³⁴

Table 2-2: Energy bill savings associated with the energy efficiency investment programme

Average energy bill savings for low income homes	£408 per annum £245 per annum after accounting for comfort take
Average energy bill savings for able-to-pay homes (after energy efficiency loan repayments)	£416 before loan repayment Net benefit of £203 per annum (after able-to-pay energy efficiency loan repaid) ³⁵
Total energy bill savings across the housing stock, after comfort take (includes energy price inflation)	£8.61 billion per annum Net benefit of £4.95 billion per annum (after able-to-pay energy efficiency loans repaid)

2.2.3 CO₂ savings

The CO₂ savings generated from the energy efficiency retrofit packages are shown in Table 2-3. The CO₂ savings take account of grid decarbonisation over time, in line with the Interdepartmental Analysts' Group Guidance for Policy Appraisal.³⁶ The yearly profile of carbon savings is shown in Table 4-2.

The Committee on Climate Change has published analysis of the abatement needed to meet the fourth carbon budget in 2025. The predicted 'policy gap'³⁷ is 10MtCO₂ for residential buildings, and 7MtCO₂ for non-residential buildings, as shown in Figure 2-4. The programme modelled in this research delivers 16MtCO₂ pa by 2025 (as shown in Table 4-2). This is a similar scale to the predicted gap in emissions reduction from the building sector (both domestic and non-domestic).³⁸

The CO₂ savings associated with the energy efficiency programme are shown in Figure 2-3. To put the total CO₂ savings across the housing stock into context, the carbon savings are equivalent to the net annual carbon emissions reductions from 3,840 large (3MW) offshore wind turbines, or 13,380 intermediate (850kW) on-shore wind turbines. Alternatively, the annual CO₂ savings would be equivalent to the annual carbon emissions reductions from removing 10.4m cars (36% of the cars in Great Britain) from the road.³⁹

³⁴ Department of Energy and Climate Change, *Updated energy and emissions projections 2013*, September 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/239937/uep_2013.pdf

³⁵ This figure represents energy bill savings averaged over a 20-year lifetime for a package of measures. The loan repayment would be twice as large for the first 10 years after retrofit, reducing to £0 thereafter, once the loan has been repaid.

³⁶ Department of Energy and Climate Change, Inter-departmental Analysts' Group (IAG) Guidance for Policy Appraisal, 2011

³⁷ The term 'policy gap' is used by the Committee on Climate Change to express the difference between the emissions projections under current policies, and the emissions projected by the cost-effective path that would meet the fourth carbon budget, i.e. the 'gap' in emissions reductions resulting from insufficient policy framework.

³⁸ Committee on Climate Change, *Meeting Carbon Budgets – 2014 Progress Report to Parliament*, July 2014 (Figure 3) http://www.theccc.org.uk/wp-content/uploads/2014/07/CCC-Progress-Report-2014_web_2.pdf

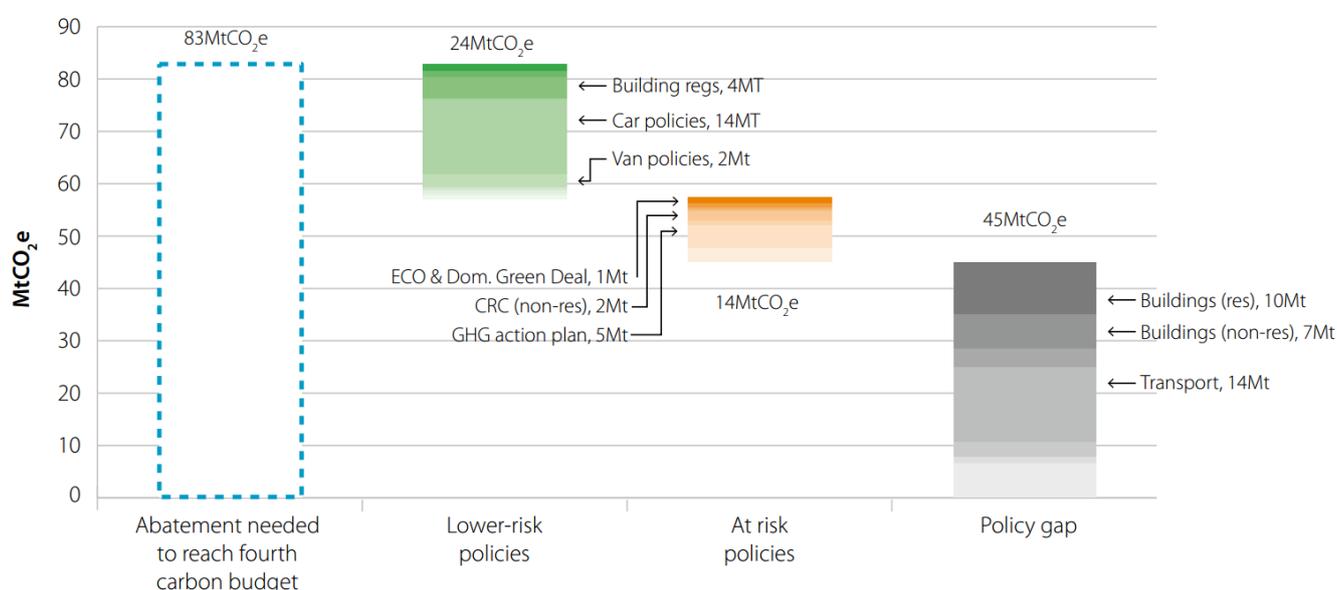
³⁹ Calculation based on average CO₂ emissions per km driven, average annual car mileage, and total number licensed cars on the road, taken from the following sources:

To provide a comparison with the average CO₂ savings for individual homes, as shown in Table 2-3, the carbon emissions from one passenger's one-way flight from London to New York, would be approximately 626 kgCO₂.⁴⁰

Table 2-3: Carbon savings associated with the energy efficiency investment programme

Total (net) CO₂ savings across economy	23.6 million tonnes CO₂ per annum
Average CO₂ savings for low income homes	1,092 kgCO₂ per annum (655 kgCO ₂ per annum including comfort take)
Average CO₂ savings for able-to-pay homes	1,079 kgCO₂ per annum

Figure 2-4: Getting from the DECC pre-2009 policy baseline to the fourth carbon budget in 2025⁴¹



Department for Environment & Rural Affairs, 2013 Government GHG Conversion Factors for Company Reporting, July 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224437/pb13988-emission-factor-methodology-130719.pdf

Department for Transport, National Travel Survey: 2012, September 2013,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/243957/nts2012-01.pdf

Department for Transport, Vehicle Licensing Statistics, Great Britain: Quarter 2 2012, September 2012,

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/9290/vls-q2-2012.pdf

⁴⁰ Calculation based upon 5,540 km distance, and 113 gCO₂/km for a long distance flight [H. Auvinen, Average passenger aircraft emissions and energy consumption per passenger kilometre in Finland 2008, LIPASTO, <http://lipasto.vtt.fi/yksikkopaastot/henkiloliikenne/ilmailiikenne/ilmae.htm> Accessed 23 September 2014]

⁴¹ Committee on Climate Change, Meeting Carbon Budgets – 2014 Progress Report to Parliament, July 2014 (Figure 3)

http://www.theccc.org.uk/wp-content/uploads/2014/07/CCC-Progress-Report-2014_web_2.pdf

2.3 Approach to technical modelling and key constraints

The analysis has been carried out using 2012 English Housing Survey (EHS) data to assess the investment required to improve all homes to an EPC C standard. Each home in the EHS dataset is assigned an 'energy archetype', based on its baseline energy consumption and key physical characteristics. Energy efficiency improvement measures are modelled incrementally to determine the most suitable package of measures for each archetype. The energy efficiency measures in the package represent a cost-effective route to achieving the target SAP score, based on a marginal abatement cost (MAC) curve; the most cost-effective measures are prioritised to be installed earlier in a package, before the less cost-effective measures are considered. The modelling methodology is explained in detail in Appendix 3 – Technical modelling methodology.

As the analysis is based on English Housing Survey data, it does not provide a detailed picture of the investment requirement to improve homes in the devolved nations. Investment in improving homes in devolved nations has been extrapolated based on average investment in improvement for homes in England.

The £10,000 cap⁴² on both grants and interest-free loans is intended to avoid a large amount of money potentially being spent on improving a relatively small number of extremely 'hard-to-treat' homes. As a result of this, some homes are not retrofitted to EPC C standard.⁴³ 15% of low income homes, and 16% of able-to-pay homes, do not achieve EPC band C, due to the limit of investment support per home. This is often due to the home having a particularly poor energy efficiency rating before the retrofit, or in need of solid wall insulation; hence requiring a high level of investment to achieve the minimum performance standard. However, despite the cap, these properties would still see a significant improvement in their energy performance.

⁴² The £10k cap is indicative, and has been set on basis of ensuring most homes treated can get up to EPC band C. The cap could be varied in practice, depending on type of housing stock in local areas, and could vary by local authority.

⁴³ Energy efficiency measures are modelled to be added to the package of measures, until either: the home is modelled to have achieved EPC C, or the package of measures reaches its maximum investment value, before going over the £10k cap.

3. Modelling the macroeconomic impact of energy efficiency investment

3.1 Summary of findings

- In terms of GDP (Gross Domestic Product), Cambridge Econometrics modelling estimates a return of £3.20 per £1 invested in energy efficiency measures by government. In relative terms, as a result of the energy efficiency investments, GDP will be 0.6% higher in 2030 (£13.9bn).
- The investment in funding and incentivising take-up of energy efficiency measures by governments is self-financing. The increased economic growth leads to higher tax intake, cumulatively £51.1bn by 2030 or £1.27 per £1 invested throughout the whole period (in discounted terms).
- Cambridge Econometrics estimate a net increase in annual employment of up to 108,000 over the period 2020-2030, with most jobs created in the services and the construction sectors.

3.2 Approach to economic modelling

A scenario analysis was undertaken using the MDM-E3 model of the UK economy and energy system. A baseline scenario was set to compare the alternative investment policy scenario against. The baseline scenario was constructed using the latest data from the Office of National Statistics (ONS) from 2012. For the years over 2013-2018, the latest economic projections for all components of final expenditure, income, employment, wages, and inflation, were obtained from the recent economic growth forecast from the Office of Budgetary Responsibility (OBR)⁴⁴. These OBR growth rates were applied to the latest historical data to obtain a series of consistent projection to 2018. For later years where no official projections were available, Cambridge Econometrics' updated economics forecast was used to extend the projections to 2030. Energy demand projections and end-user domestic prices for gas and electricity were derived from the most-up-to-date central projections from DECC over 2013-2030 (updated in September 2013).⁴⁵

The energy efficiency scenario differs from the baseline in investment expenditure and domestic fuel use as a result of efficiency measures. Investment in dwellings leads to a positive economic impact on industries dependent on the construction sector. Changes in expenditure on energy affect consumption outlays and thus revenues of consumer-facing industries and their supply chains.

Change in overall output also affects government tax intake through several avenues. Impact on consumer expenditure affects consumption tax intake (primarily VAT). Changes in industry revenues are reflected in wages and profits, these in turn affect government revenue through taxation of labour (income tax and national insurance contribution) and profits (corporate tax).

The various measures modelled have different time horizons, which results in different impacts arising from the timing of investments and energy savings:

- Energy efficiency measures affect the construction sector (and supply chain) primarily at the time the measure is implemented

⁴⁴ OBR's latest economic projections released in November 2013 were used

⁴⁵ <https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2013>

- Resulting benefits to consumers, in the form of lower energy bills and improved health persist over the lifetime of the measures⁴⁶
- Capital repayments by able-to-pay homes are evenly spread over a ten-year period after the investment is made.

In order to assess the macroeconomic impacts on the UK economy, the modelling must explain all the relevant flows of income and expenditure in the economy. The main channels (as explained by MDM-E3) are:

- Change in investment includes expenditure of measures financed through funding provided for low income homes as well as loans for able-to-pay homes
- Higher energy efficiency of homes leads to lower energy demand and therefore lower energy bills. The reduction in demand for gas in heating (and for gas used in the power sector which is then consumed by homes for heating) would substantially reduce imports of natural gas.
- Lower energy bills (after accounting for comfort take) lead to higher expenditure on other goods and services. In the case of able-to-pay homes, this is at first largely offset by loan repayments in the first 10 years following retrofit

In total, there is £127.5bn of investment in energy efficiency measures over a 20-year period. This constitutes £73.2bn from able-to-pay homes (supported by £27.4bn of loan support schemes from the Government) with the rest being direct government funding to low income homes (£26.9bn). This investment thus does not directly affect the spending of low income homes; it does however affect expenditure in able-to-pay homes throughout the period of repayment. By paying for the interest and guarantees, the Government makes the loans 27% cheaper on average for able-to-pay homes.

3.3 Macroeconomic benefits of investing in domestic energy efficiency

The combination of the construction stimulus and lower energy bills outweigh the repayment costs, leading to an increase in GDP of 0.6% in 2030 (13.9bn). The reduced expenditure on gas and electricity is displaced by repayment of the capital investment in the energy efficiency measures and, where net savings arise, spending on other goods and services in the economy.

In the short-to-medium term, there is therefore a positive stimulus in the construction sector (and supply chain) to manufacture and install the various energy efficiency measures (at the expense of the gas and electricity sectors, and supply chains). This yields positive macroeconomic benefits, since gas is heavily imported, whereas the demand generated by the energy efficiency programme yields output and jobs in the construction sector and supply chain (which is predominantly UK based).

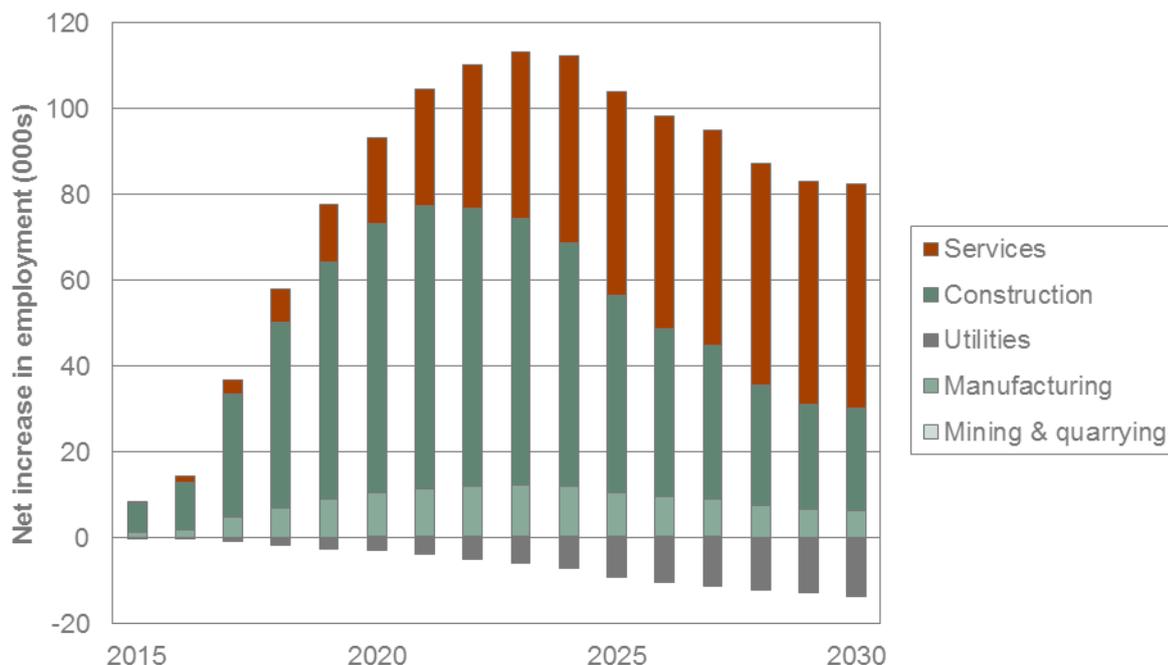
In the longer term, as the energy savings accumulate, there is a considerable net saving to homes (after paying for the efficiency measures) allowing homes to spend much more on other goods and services in the economy. Although a proportion of these goods and services are supplied by imports, a considerable proportion is supplied by UK based businesses. Towards the end of the period modelled the increased sector output and employment is predominantly in the service sectors of the

⁴⁶ The weighted average lifetime of a package of measures comes to 20 years. Some measures have a short lifetime (for example, 10 years for draught proofing), and some measures have a long lifetime (for example, 42 years for cavity wall insulation). Measure lifetimes taken from the Department of Energy and Climate Change guidance document, *Energy Companies Obligation (ECO): Measures Table, 2014*

<https://www.ofgem.gov.uk/ofgem-publications/83100/copyofecomeasurestable-mar2014url.pdf>

economy (see Figure 3-1). Note that the jobs generated in the construction sector mirror the investment profile in Figure 2-3, while the increasing jobs in services reflects the increasing net savings from the energy efficiency measures over time that can be spent on other sectors of the economy. At the peak, employment increases by 108,000 in 2023 and as the investment stimulus is reduced there is a long term net increase in employment of around 70,000 jobs by 2030.

Figure 3-1 Employment impact, by sector



Overall, the positive economic impact leads to an increase in net employment of around 70,000 new jobs by 2030, most of them in services and some in the construction sector and manufacturing supply chains. There are reductions in employment in utilities. In the report *'Jobs, Growth and Warmer Homes'*, Cambridge Econometrics modelling estimated an additional 127,000 jobs would be generated by the energy efficiency programme by 2027. In the report *'Jobs, Growth and Warmer Homes'*, the energy efficiency measures were fully funded by government. In the Energy Efficiency scenario in this report, able-to-pay households fund the energy efficiency measures (where they are able to do so) and are only incentivised (not fully-funded) by government. As a result of the self-financing of measures by able-to-pay households the net gains are smaller because the investment in energy efficiency measures is at the expense of consumer spending on other goods and services. The corollary of able-to-pay households investing directly (with support), is that in this analysis the Government finances are improved and the measures are fully funded (for both governments and homes).

3.4 Government balance sheet

The positive impact on the economy generates enough additional (net) tax revenue to more than pay for the measures. In discounted terms, there is an additional £51.1bn in tax revenues by 2030 (compared to the Government cost of the programme of £40.2bn [2015-34] in discounted cash flow terms), bringing in around £1.27 for every £1 spent, such that the programme would be cost effective for the Government.⁴⁷

As with any infrastructure programme, this programme requires upfront investment with the economy-wide gains from efficiency generating additional tax revenue over the lifetime of the investments. In undiscounted terms, the infrastructure programme would worsen the government balances by around £1.9bn in the next parliamentary term. However, in the subsequent parliamentary term of 2020-25 the additional revenues would outweigh the investment (and investment support) by government and improve the government balances in net terms by around £4bn. Over the 2025-2030 parliamentary term, the net improvement to the government balance sheet (in real terms) would be £18bn (see Table 3-1 and Table 3-2).

Table 3-1: Government balances (undiscounted)

Parliamentary Term	Investment in all schemes (undiscounted) (£bn)	Additional government tax revenue (undiscounted) (£bn)	Net impact on government balance sheet (undiscounted) (£bn)
15/20	£13.0	£11.0	£-1.9
20/25	£26.4	£30.4	£4.0
25/30	£9.9	£28.7	£18.8
30/35	£4.2	not modelled	not modelled
Total	£53.5	>£70.2	>£16.7

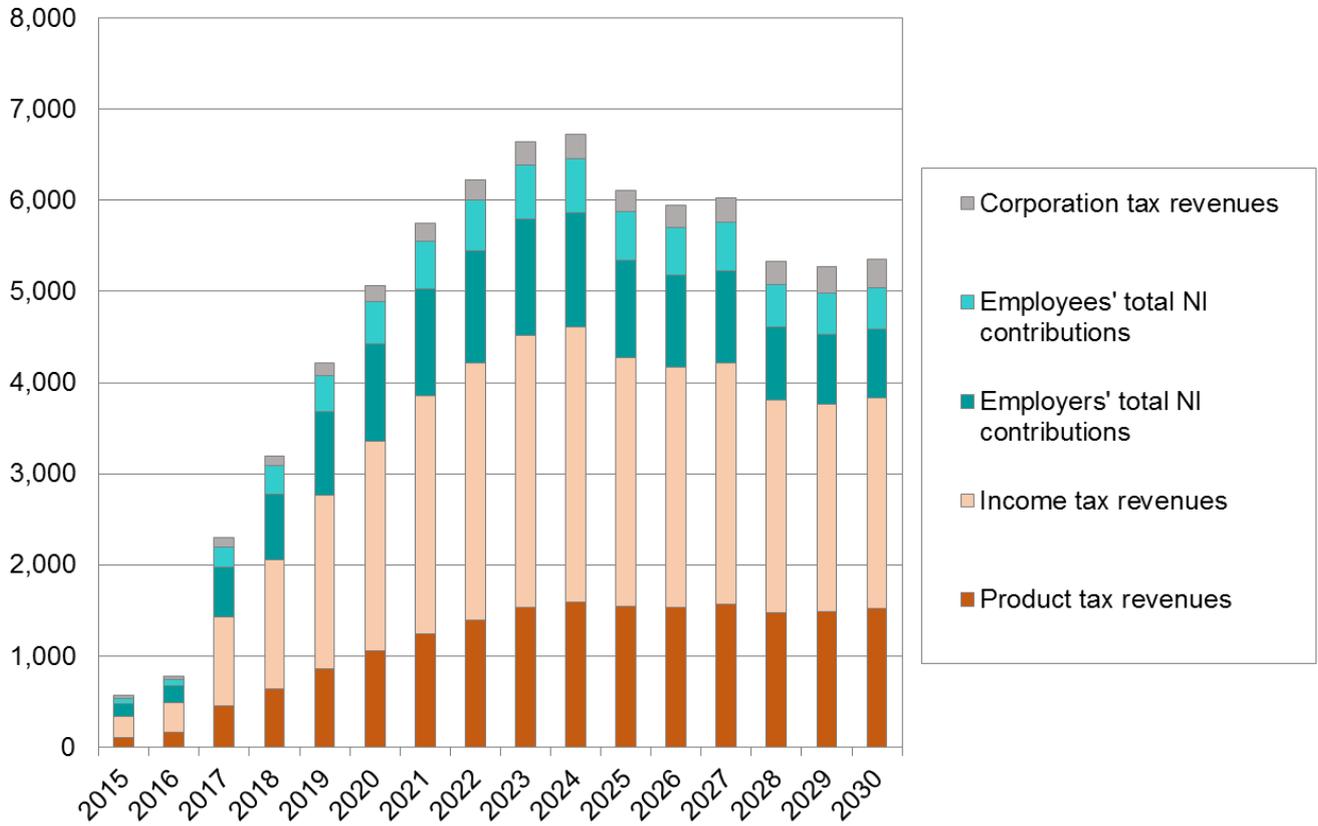
Table 3-2: Government balances (discounted)

Parliamentary Term	Government investment in all schemes (discounted) (£bn)	Additional government tax revenue (discounted) (£bn)	Net impact on government balance sheet (discounted) (£bn)
15/20	£11.4	£9.7	£-1.8
20/25	£20.1	£23.0	£2.9
25/30	£6.4	£18.4	£12.0
30/35	£2.3	not modelled	not modelled
Total	£40.2	>£51.1	>£10.9

⁴⁷ Both the revenue and expenditure numbers are discounted using the social discount rate of 3.5%.

By 2030, around 43% of the additional tax revenue is from income tax, 28% from taxes on products (e.g. VAT) and 23% from social security contributions and 6% from corporation tax (see Figure 3-2).

Figure 3-2: Net change in government tax revenue (£m)



4. Energy Efficiency – An infrastructure priority

4.1 Summary

There is a strong rationale for treating energy efficiency in UK housing stock as an infrastructure priority:

- 1) Cambridge Econometrics modelling estimates the Cost Benefit Ratio (Value for Money) indicator of the programme to be 2.27:1, which classifies the infrastructure programme as “High” Value for Money.
- 2) Improved air quality, warmer and more comfortable homes will improve health and allow for reduced healthcare expenditure, which would add further to the Value for Money indicator.
- 3) An energy efficiency programme will contribute towards economy wide emissions reductions of 23.6MtCO₂ pa by 2030, after accounting for direct, indirect, and economy-wide rebound effects, contributing to meeting the fourth carbon budget.
- 4) Investment in energy efficiency in the domestic sector will result in 26% reduction in imports of natural gas in 2030 worth £2.7bn in that year.
- 5) As the economy becomes less gas intensive, the more resilient it becomes to shock changes in gas prices. A 50% gas price spike in 2030, leads to a 0.2% GDP decrease in the baseline scenario, but only a 0.15% decline in the Energy Efficiency scenario.

4.2 Approach to assessing Value for Money

Infrastructure projects are assessed on a Value for Money indicator called the Cost Benefit Ratio (CBR), which represents the ratio of discounted benefits to discounted investments over the lifetime of a project, using the economic tool of Cost Benefit Analysis (CBA). It is an attempt to compare, in monetary terms, the investment cost by government against the benefits to society (welfare). Often the benefits are not monetary and can include things such as health benefits and reduced greenhouse gas emissions. The purpose of the CBA calculation and the CBR indicator is to provide a metric that allows for comparison across projects.

Macroeconomic modelling, of the sort undertaken here, does not lend itself readily to this concept of Value for Money. The central indicator from the economic modelling, GDP, is an aggregate of all production in the economy and does not therefore distinguish what is being produced. The implication of this is that if society became less healthy and required more healthcare expenditure, this would show up as an increase in GDP but would clearly not be a societal (welfare) benefit.

Consumer spending is a better measure of welfare than GDP but it is not a perfect measure. Real (i.e. adjusted for inflation) consumer spending is a measure of the goods and services that households buy. If it is assumed that households derive utility from what the household buys, then higher spending suggests higher utility and welfare. There are, however, various caveats to this and each of them can be considered in the context of this analysis.

- Firstly, homes may increase their spending to try to compensate for some change in circumstances. In a year when the weather is colder, homes spend more on heating, but they are not better off than during the previous (warmer) year. However, in this analysis, between the baseline and scenario modelled there are no changes in external circumstances.

- Secondly, if the increase in spending is financed out of saving or by higher borrowing, homes are not better off even if spending is higher, but again, this is not the case in the scenario analysis presented here; in fact savings are increased (slightly) and so there is an additional net benefit.
- Thirdly, if the increase in spending has been achieved through a subsidy financed by government borrowing, this can be regarded as homes borrowing from the future (because eventually taxes will have to be raised). This is not applicable in this analysis since governments are able to more than recoup the financing and are better off in net present value terms as a result of the energy efficiency investment. The net benefit to government (after the investment in the measures) should therefore be included as a net benefit since taxes could otherwise be lowered and consumption further increased.
- Finally, if the increase in spending is financed by lower company profits, homes will eventually be affected through, for example, a reduction in the value of wealth held in equities (e.g. through pensions). This is not the case in this analysis as profits (in real terms) increase and so the discounted net change in profits (after corporation tax) should also be included.

The latter three points all relate to the distribution of income, and show the weakness of assuming that shifts in consumer spending can always be treated as a measure of welfare when income and income distribution are changing. Overall, it is argued that the change in consumer spending (with the other balance sheet adjustments), is a suitable measure of welfare, in this context.

The approach to assessing Value for Money does not account for the distribution of benefits across households. However, as low income homes receive grants directly, it is reasonable to assume that the distribution of net benefits accrue disproportionately to low income homes. Moreover, the programme envisages treating all homes that are currently below EPC band C, which is a large proportion of the UK housing stock. Since the net benefits are therefore reasonably well distributed it is reasonable to proxy the increase in consumer spending as a measure of improved societal welfare, which would not *necessarily* be the case if the benefits accrued directly to a small subset of society.

Given the above, our approach to assessing the Value for Money of the energy efficiency programme is to calculate the benefit as the net impact on consumer spending and subtract any net impacts on balance sheets (government, commercial or households). The impact on consumer spending is net of the loan repayments on the energy efficiency measures by households because it would not be valid to include the loan repayment (the purchase of the energy efficiency measures) in the net benefit stream.

4.3 Value for Money

The energy efficiency programme envisaged in Section 2 impacts on consumer spending, and on government, company and household balance sheets, which along with a monetary valuation of the emissions reduction of the programme sum to the net societal (welfare) benefits of the programme. The discounted net benefit stream includes:

- the discounted net change in household consumption between scenarios (net of the investment by able-to-pay households)
- the monetised value of the carbon emissions savings using The Treasury's Green Book guidelines.⁴⁸
- the discounted net change in company profits (after corporation tax)
- the discounted net change in government balances
- the discounted net change in consumer savings

The aggregated net societal benefits are then compared to the direct investment cost to government (see Table 4-1) to determine the Value for Money CBR ratio of the programme. Following the Treasury's Green Book guidance, a social discount rate of 3.5% has been applied.

Table 4-1: Value for Money of the energy efficiency investment programme

Total discounted benefit of energy efficiency investment programme, of which:	£91,186m
<i>Discounted net benefit to consumer spending</i>	£60,651m
<i>Discounted benefit of net government balances</i>	£9,960m
<i>Discounted benefit of net increase in profit</i>	£15,111m
<i>Discounted benefit of net increase in savings</i>	£337m
<i>Discounted benefit of reduced emissions</i>	£5,127m
Total discounted investment in energy efficiency programme by government	£40,214m
Cost Benefit Ratio (CBR) (total benefit / total investment)	2.27

The value of health benefits of improved efficiency from the comfort, warmth, and improved air quality to homes, is uncertain to quantify in monetary terms (estimates from the literature are included in Section 4.4) and has therefore not been included in the formal Cost Benefit Ratio. However, there is evidence that health benefits will arise which would add to the central value of 2.27.

⁴⁸ HM Treasury, *The Green Book: Appraisal and Evaluation in Central Government*, 2011
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf

Given the uncertainty in calculating CBRs different qualitative assessments are made to the range of plausible CBR, by government,⁴⁹ such that:

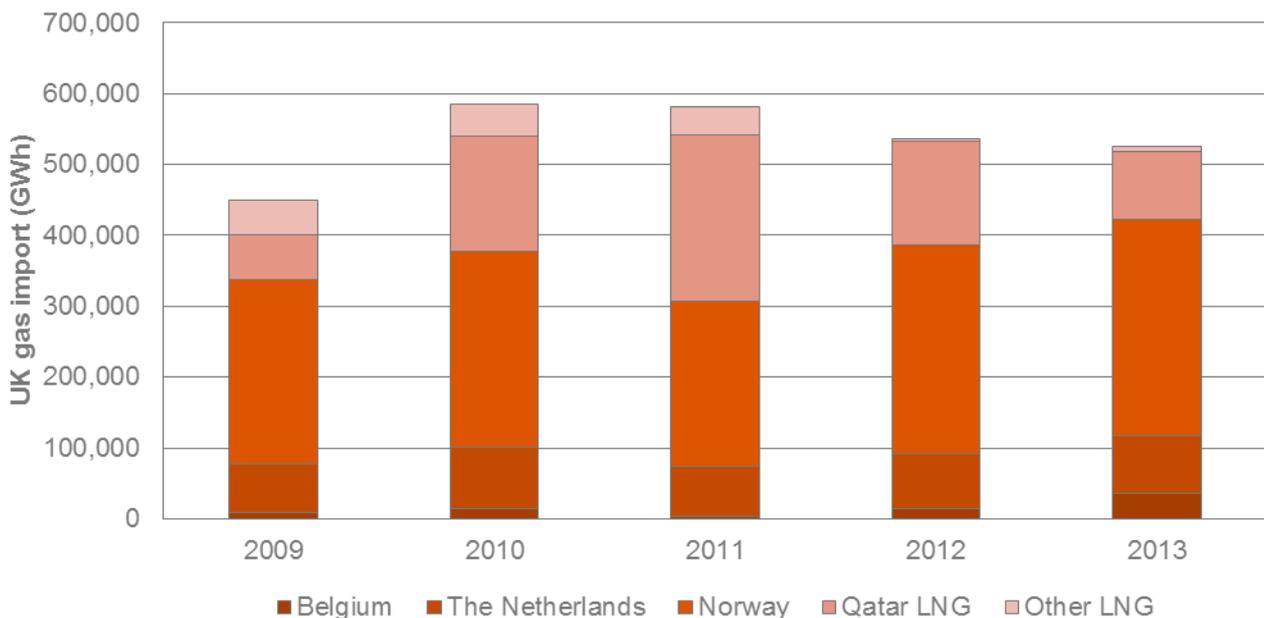
- a CBR between 0 and 1.0 represents 'poor' Value for Money
- a CBR between 1.0 and 1.5 represents 'low' Value for Money
- a CBR between 1.5 and 2.0 represents 'medium' Value for Money
- a CBR between 2.0 and 4.0 represents 'high' Value for Money
- a CBR above 4.0 represents 'very high' Value for Money

In this context, a programme of investing in energy efficiency measures in homes can be considered a 'high' Value for Money infrastructure programme.

4.4 Improved energy independence and economic resilience

The energy efficiency measures lead to a 19% decrease in natural gas consumption by 2030, which leads to a reduction of 26% in imports worth £2.7bn. Currently, most of the UK's imported gas is sourced from Qatar, in the form of liquefied natural gas (LNG), and from various pipelines to Europe (Norway, Belgium and the Netherlands), see Figure 4-1.

Figure 4-1: UK gas imports by source country



The energy system is also more resilient to gas price volatility as a result of the increased efficiency. In each of the scenarios (baseline and energy efficiency), the impact of a gas price spike in 2030 was assessed. In the baseline, a 50% price hike, led to a 0.2% GDP decrease, but only a 0.15% decline in the Energy Efficiency scenario. For consumers directly, the gas price spike leads to an increase in energy bills of £220 per home (in 2030) against the baseline. As a result of the efficiency measures, this is reduced by £60 to £160 per home.

⁴⁹ Department for Transport, *Value for money assessments*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/255126/value-for-money-external.pdf

4.5 Avoided cost of environmental externalities

Economy-wide CO₂ emissions are reduced by around 23.6MtCO₂ pa by 2030, after accounting for direct, indirect, and economy-wide rebound effects. For the central estimate of the social cost of carbon (see Table 4-2) this gives a discounted value (over the period 2014-30) of £5.1bn. Most of the emissions reductions come directly from reduced consumption of natural gas in homes, but around one-quarter come from the power sector, as a result of reduced demand for electricity.

Table 4-2: Central estimate of the social cost of carbon

	Annual net emissions reduction (MtCO ₂)	Social cost of carbon (£/tCO ₂ e)	Annual (undiscounted) benefit of reduced CO ₂ emissions (£2013m)	Annual (discounted) benefit of reduced CO ₂ emissions (£2013m)
2013	-	3.49	-	-
2014	-	3.59	-	-
2015	0.2	3.67	0.6	0.5
2016	0.4	3.79	1.6	1.4
2017	1.0	3.92	4.1	3.6
2018	2.0	4.22	8.5	7.2
2019	3.2	4.53	14.5	11.8
2020	6.3	4.87	30.7	24.1
2021	8.2	12.01	98.6	74.9
2022	10.2	19.14	194.7	142.9
2023	12.1	26.28	319.3	226.3
2024	14.1	33.41	470.5	322.3
2025	16.0	40.55	649.8	430.0
2026	17.9	47.69	852.0	544.7
2027	19.7	54.82	1,078.5	666.3
2028	21.1	61.96	1,304.8	778.8
2029	22.3	69.1	1,543.5	890.2
2030	23.6	76.23	1,798.9	1,002.3

4.6 Avoided health costs

The benefits of energy efficient homes go beyond simple carbon emissions and energy security arguments, as energy efficiency can improve the health and well-being of residents, thereby reducing excess winter deaths and lower social care costs and the burden on the NHS.

Children and young people

Children living in cold homes are significantly more likely to suffer from respiratory problems, such as asthma and bronchitis.⁵⁰ Cold homes have an adverse effect on the educational attainment and emotional well-being of young people. Fuel poverty has been linked with mental health complications, as more than 25% of adolescents living in cold homes are at risk of developing multiple mental health problems, compared with 5% of adolescents who have always lived in warm housing.⁵¹

The Disabled and those with health concerns

Many health conditions are aggravated by cold conditions; for example, cardiovascular (such as heart attacks) and respiratory diseases (such as asthma), are caused or worsened by living in cold homes.⁵² This can lengthen recovery periods, and extend the costs of care services. The NHS advises that one of the best ways to keep good health during the winter is to stay warm when at home.⁵³ However, for a person living with disability, there are a range of interlinked issues that make this difficult:⁵⁴

- the typical cost of living for a person with disabilities is 25% higher than average, due to equipment and care
- many are unable to keep active (and hence keep warm) during the winter months
- rates of unemployment are higher, and people are likely to spend more time at home

The elderly and winter deaths

It is estimated that there were 31,100 excess winter deaths in England and Wales over the winter of 2012/13,⁵⁵ and that 30-50% of these were due to cold homes or cold indoor temperatures.⁵⁶ The coldest quarter of housing accounted for 3 times the number of deaths than the warmest quarter of housing.⁵⁷ Whilst the difference between deaths in winter and deaths in summer is common among other European countries, the difference is much greater in the UK than it is for much colder climates, such as Sweden and Norway.

Most of the winter deaths are among the elderly, and are caused by respiratory conditions, strokes, and heart-attacks, due to cold temperatures. In addition to the excess winter deaths, there are many more people who become ill, requiring hospitalisation and social care.

⁵⁰ Marmot Review, *The Health Impacts of Cold Homes and Fuel Poverty*, May 2011

http://www.foe.co.uk/sites/default/files/downloads/cold_homes_health.pdf

⁵¹ Marmot Review, *The Health Impacts of Cold Homes and Fuel Poverty*, May 2011

http://www.foe.co.uk/sites/default/files/downloads/cold_homes_health.pdf

⁵² Energy Bill Revolution, *The human cost of cold homes*, 2014

<http://www.energybillrevolution.org/fuel-poverty/>

⁵³ NHS Choices, *Keep warm, keep well*, 2012 <http://www.nhs.uk/Livewell/winterhealth/Pages/KeepWarmKeepWell.aspx>

⁵⁴ Energy Bill Revolution, *The human cost of cold homes*, 2014

<http://www.energybillrevolution.org/fuel-poverty/>

⁵⁵ Office for National Statistics, *Excess Winter Mortality in England and Wales, 2012/13 (Provisional) and 2011/12 (Final)*, November 2013

http://www.ons.gov.uk/ons/dcp171778_337459.pdf

⁵⁶ World Health Organisation, *Environmental burden of disease associated with inadequate housing*, 2011,

http://www.euro.who.int/_data/assets/pdf_file/0003/142077/e95004.pdf

⁵⁷ Department of Health, *Public Health White Paper*, 2010

NHS and health costs

Cold homes can be very damaging to the physical and mental health of the occupants, and the association between poor housing and ill health is well established.⁵⁸ The charity supporting elderly people, Age UK, has reported that cold homes are costing the NHS in England £1.36 billion every year, in hospital and primary care, due to the impact on older people's health,⁵⁹ and this excludes the substantial associated costs of social care services. Research commissioned by the Chartered Institute of Environmental Health (CIEH) in 2008, estimated that the treatment of cold-related illnesses and conditions costs the NHS approximately £1bn per year.⁶⁰ It has also been shown that NHS expenditure rises by 2% in the cold months.⁶¹ The NHS budget for 2014-15 is planned to be £108.3bn, meaning that NHS savings potential from an energy efficiency programme is significant.⁶² Investing in energy efficiency measures in low income homes is likely to reduce spending in the NHS on cold-related illnesses. The Chief Medical Officer's Annual Report in 2009 estimated that, for every £1 spent on reducing fuel poverty, a return of 42 pence can be seen in NHS savings.^{63 64}

4.7 Benefits to local economy

Our modelling has demonstrated that investing in energy efficiency measures in homes has a number of distinct effects:

- it bolsters employment and output in the construction sector
- it reduces expenditure on energy
- it increases expenditure on consumer goods and services

This has a net impact of creating jobs and output. Furthermore, a large proportion of the jobs created will be closely linked to the locations where the measures are put into homes, bolstering local economies, and potentially assisting with the Government's stated aim of spatial rebalancing of the economy. The energy efficiency market currently accounts for over 136,000 jobs in the construction and manufacturing industries.⁶⁵ Our modelling estimates an increase of 91,000 additional jobs by 2020 as a result of the programme.

Local jobs

Typically an infrastructure project would generate direct jobs in one specific area or region, due to the fixed location of the project. However, a nationwide retrofit programme would create demand for services across the country, regardless of region. Refurbishing existing homes can be more employment intensive, requiring more labour, and less materials, than the construction of new buildings. The direct construction impact is highly concentrated around the installation location; the skilled tradesmen required to install the energy efficiency measures are distributed across the country,

⁵⁸ Consumer Focus, *Jobs growth and warmer homes*, 2012

<http://www.consumerfocus.org.uk/files/2012/11/Jobs-growth-and-warmer-homes-November-2012.pdf>

⁵⁹ Age UK, *The Cost of Cold*, November 2012

http://www.ageuk.org.uk/Documents/EN-GB/Campaigns/The_cost_of_cold_2012.pdf

⁶⁰ V. Mason, *Good Housing Leads To Good Health: A Toolkit for Environmental Health Practitioners*, Chartered Institute of Environmental Health (CIEH), 2008

http://www.cieh.org/uploadedfiles/core/policy/housing/good_housing_leads_to_good_health_2008.pdf

⁶¹ Marmot Review, *The Health Impacts of Cold Homes and Fuel Poverty*, May 2011

http://www.foe.co.uk/sites/default/files/downloads/cold_homes_health.pdf

⁶² HM Treasury, *Budget 2014*, 2014

⁶³ C. Liddell, *Estimating the impacts of Northern Ireland's warm homes scheme 2000-2008*, University of Ulster, 2008, <http://eprints.ulster.ac.uk/26173/1/FPcostbenefitsonweb.pdf>

⁶⁴ Chief Medical Officer, *2009 Annual Report*, 2009. http://www.sthc.co.uk/Documents/CMO_Report_2009.pdf

⁶⁵ Department of Energy and Climate Change, *Energy Efficiency Strategy: 2013*

Update, December 2013 <https://www.gov.uk/government/collections/energy-efficiency-strategy>

so it is likely that a given home will employ a local worker to install measures. However the boosts to the construction supply chain are likely to be more concentrated in certain areas, where large construction material plants are located. Labour can typically be sourced locally (while materials are often imported from elsewhere). Local businesses are well placed to benefit from this programme as most home improvement work is done by local contractors who have existing relationships with residents and who understand the local housing stock. Therefore, the result would be local jobs, local labour and benefits going to small and medium sized enterprises (SMEs); boosting employment and regional economic growth.⁶⁶ There are 142,536 SMEs (1-249 employees) in the construction sector in the UK, employing 876,897 people (an average of 6 employees each).⁶⁷

The Department for Energy and Climate Change stated, as an argument for introducing the Green Deal and Energy Companies Obligation (ECO), that “without further policy intervention, the installation rate of domestic insulation measures are [sic] projected to collapse”.⁶⁸ It could be argued that the underperformance of the Green Deal, and the reduction in ECO targets, that this is still a distinct threat, especially considering the recent announcement of a leading insulation company that 600 jobs are potentially at risk.⁶⁹ The impact on SMEs will take longer to reach the headlines.

The economic benefits of an energy efficiency programme go beyond job creation. The KfW Energy-efficient Construction and Refurbishment programme in Germany in 2010 leveraged €15 of private sector investment in construction and retrofit, and more than €4 went back to the Government in the form of taxes and reduced welfare spending, for every €1 of public funds spent on the programme.⁷⁰

Local economy

The home expenditure impacts will typically be felt in the local area. The reduction in energy usage will lead to a reduction in local jobs in this sector (e.g. engineers maintaining the local energy infrastructure). However, the impact of increasing consumer expenditure on other items is also likely to be felt locally, through increased spending in local shops and locally-based consumer services. Given that the modelling demonstrates a net positive impact on output and jobs in the UK, it is therefore expected that impacts would be fairly evenly distributed across the country (whether looking at a regional, local or constituency level).

Regional modelling results

As the results in Table 4-3 show, this is indeed the case in 2020. At this point in the modelling, the positive boost to the construction sector dominates the macroeconomic impact. Assuming an even distribution of homes requiring energy efficiency measures across the existing housing stock, it can be seen that all regions experience an increase in total employment of between 0.1 and 0.2%. Differences in the absolute increase in employment reflect largely the difference in home density between the regions.

⁶⁶ Department of Energy and Climate Change, *Energy Efficiency Strategy: 2013 Update*, December 2013 <https://www.gov.uk/government/collections/energy-efficiency-strategy>

⁶⁷ Department for Business Innovation & Skills, *Business population estimates for the UK and regions 2013*, October 2013

⁶⁸ Department of Energy and Climate Change, *Final Stage Impact Assessment for the Green Deal and Energy Company Obligation*, June 2012,

<https://www.gov.uk/government/consultations/the-green-deal-and-energy-company-obligation>

⁶⁹ Business Green, *Up to 600 jobs at risk at leading insulation company*, July 2014,

<http://www.businessgreen.com/bg/analysis/2353736/up-to-600-jobs-at-risk-at-leading-insulation-company>

⁷⁰ KfW, *Impact on public budgets of the KfW promotional programmes*, 2011

Table 4-3 New jobs in 2020

Region	Additional jobs (000s)	Additional jobs (%)
1 London	10.3	0.19%
2 South East	12.9	0.26%
3 East of England	9.6	0.31%
4 South West	8.4	0.28%
5 West Midlands	8.0	0.28%
6 East Midlands	7.3	0.31%
7 Yorkshire & the Humber	7.3	0.27%
8 North West	9.8	0.27%
9 North East	3.3	0.27%
10 Wales	3.9	0.27%
11 Scotland	7.5	0.26%
12 Northern Ireland	2.6	0.31%
Total	91.0	0.26%

This result also holds in 2030 (see Table 4-4). By 2030 the number of homes receiving treatment is much smaller than at the peak (indeed the grants to low income homes have stopped altogether, and only able-to-pay homes receiving interest free loans are still being treated), and as a result the increase in construction and manufacturing employment (relative to the baseline) is reduced. However, the benefits of homes reducing expenditure on energy, and increasing spending in other areas, result in boosts to some parts of manufacturing and consumer services, and the increase in jobs relative to the baseline remain relatively evenly-spread across the UK.

Table 4-4 New jobs in 2030

Region	Additional jobs (000s)	Additional jobs (%)
1 London	10.8	0.19%
2 South East	10.6	0.20%
3 East of England	7.4	0.22%
4 South West	6.4	0.21%
5 West Midlands	5.8	0.20%
6 East Midlands	4.4	0.18%
7 Yorkshire & the Humber	5.3	0.19%
8 North West	6.7	0.18%
9 North East	2.0	0.16%
10 Wales	2.2	0.14%
11 Scotland	6.4	0.21%
12 Northern Ireland	2.0	0.22%
Total	70.0	0.19%

5. Conclusions

The research has demonstrated the significant economic, fiscal, and environmental benefits of investing in domestic energy efficiency. The programme recommended by the Energy Bill Revolution would generate a three-fold return in GDP for every pound invested by government, deliver high 'Value for Money' as an infrastructure programme, provide warmer homes with lower healthcare expenditure, create local jobs across all UK regions, reduce gas imports by a quarter, while creating a more resilient economy and playing a critical role in ensuring progress towards medium to long term carbon budgets.

These benefits can be realised through a programme that will effectively be cost-neutral in the medium term and a net revenue generator for government in the longer term. The increased economic growth leads to higher tax intake, cumulatively £51.1bn by 2030 or £1.27 per £1 invested over the whole period.

The total energy bill savings across the housing stock equal £8.61 billion per annum (after comfort take and energy price inflation have been considered). The net benefit of the energy bill savings is £4.95 billion per annum (after able-to-pay energy efficiency loans repaid).

This programme should therefore be considered as a capital investment infrastructure priority.

6. Appendices

6.1 Appendix 1 – Data sources

Analysis	Data source
Energy efficiency investment scenario	
Housing stock data	Department for Communities and Local Government, <i>English Housing Survey (EHS)</i> , 2012
Projecting energy demand/ SAP score	Verco SAP modelling using NHER Plan Assessor software
Projecting energy prices/ fuel bills	Department of Energy and Climate Change, <i>Updated energy and emissions projections 2013</i> , September 2013
Carbon factor/ savings	Department of Energy and Climate Change, <i>Inter-departmental Analysts' Group (IAG) Guidance for Policy Appraisal</i> , 2011
Comfort take	Department of Energy and Climate Change, <i>Updated energy and emissions projections 2013</i> , September 2013
Macroeconomic modelling	
Baseline macroeconomic view	Office of Budgetary Responsibility projections for the UK in the medium-term
Data for key indicators: <ul style="list-style-type: none"> GVA and Wages Employment Unemployment Incomes 	<ul style="list-style-type: none"> Office of National Statistics (ONS) Supply and Use Tables ONS Workforce Jobs and Business Register and Employment Survey (BRES) NOMIS: official labour market statistics United Kingdom National Accounts, The Blue Book

6.2 Appendix 2 – MDM-E3 Model Description

The macroeconomic analysis is based on Cambridge Econometrics' (CE's) model of the UK energy-environment-economy (E3) system, MDM-E3. CE applies MDM-E3 for both scenario analysis and as part of CE's regular energy-economy-emissions forecasting service. It is well-suited for the analysis:

- The model covers the entire UK economy, identifying 87 economic sectors (and 45 explicitly within each of the regions and nations of the UK) and recognising the interdependencies between them (i.e. supply chains); this representation is fully consistent with official UK economic statistics.
- The model has a full representation of the energy system, both in physical flows of energy and monetary terms, with two-way linkages with the economy.
- The model contains behavioural equations to explain final energy demand for more than 20 final energy users.
- The model includes a representation of the UK's power sector by generating technology to explain changes in electricity supply.
- Energy-related emissions are projected as a consequence of energy use.
- The model is a dynamic model, with its behavioural parameters estimated on official UK data. Such a specification allows for non-equilibrium outcomes and path dependency, e.g. the possibility of sustained levels of unemployment in the medium-to-long term, which is a feature of CE's latest economic forecasts

MDM-E3 is used regularly to assess the relationships between economic development and the energy system and, conversely, the impact of energy and carbon reduction policies on the economy.

6.3 Appendix 3 – Technical modelling methodology

The research modelled 2012 English Housing Survey data to assess the investment requirement for improving low income and able-to-pay homes to mid EPC band C standard.

Energy archetypes

Each home in the EHS dataset is modelled as an ‘archetype’, based on energy consumption and key characteristics, as shown in Figure 6-1. Energy efficiency measures are modelled to be included within a package of measures until the post-retrofit SAP score is close to the target score (mid EPC band C). The energy efficiency measures in the package represent a cost-effective route to achieving the target SAP score, based on a marginal abatement cost (MAC) curve.

Figure 6-1: Verco’s ‘energy archetype’ structure

Dwelling size/type	Semi detached/ end terrace	Terrace	Flats (top floor)
		Detached	Flats (mid floor)
Fuel/boiler type	Gas – condensing boilers	Gas – standard boilers	Electric
	Communal heating		
Wall construction	Cavity filled	Solid	Cavity empty
Loft insulation	High	Medium	Low
Glazing type	Double	Single	
EPC Band	A/B	C/D	E/F/G

Energy efficient measures

The measures modelled are broadly those that are eligible under the current Green Deal mechanism. The list of measures is modelled to be applied to the archetype in sequential order. The order is based on: the energy bill savings payback period, investment requirements of measures, and the level of tenant disruption that is involved with installation. The list of measures is given below, and focusses on the key cost-effective measures that are not too invasive or disruptive to install.

- Cavity wall insulation
- Loft insulation
- Draught proofing
- Hot water cylinder insulation
- Combined heating controls, cylinder thermostats and hot water controls
- Double glazing
- Gas-fired condensing boilers
- No secondary heating post refurbishment

- Flue gas heat recovery devices
- Hot water measures – low-flow taps
- Solid wall insulation
- High performance external doors
- Under-floor insulation
- Heating ventilation and air-conditioning controls (including zoning controls) (only for semi- / detached homes)
- Triple glazing
- Waste water heat recovery devices attached to showers

Naturally, not all measures are modelled for all archetypes. The measures are only modelled to be installed if they are applicable to the archetype. For example, cavity wall insulation is only modelled for archetypes that currently have empty cavities, and boiler replacement is only modelled for the archetypes with standard gas boilers, and not in those that already have condensing gas boilers. Heating controls are only modelled to be installed to the least energy efficient homes, i.e. those with EPC bands of E, F, or G. Furthermore, the size of the package is capped based on the total investment. The investment-capping results in very few packages progressing further than the solid wall insulation measure, due to the higher investment requirements of the later measures.

Capping the investment

The SAP improvement targets can, in some cases, result in some high investment measures being included in the package, particularly if the target SAP score is high when compared to the pre-retrofit SAP score of the home. Without a cap on the investment in the retrofit package, 16% of the retrofitted dwellings would receive a package of measures greater than £10,000. Therefore, the capital investment in the package has been limited to a maximum of £10,000. The modelling incorporates this restriction when modelling the package of measures applicable; this decreases the average capital investment for a home, and also decreases the energy performance of that home. This £10,000 grant cap is intended to avoid a large amount of money potentially being spent on improving a relatively small number of extremely ‘hard-to-treat’ homes.

Calculating energy bill savings and carbon savings

The energy bill savings and carbon savings are calculated based on the SAP modelled reduction in energy consumption. Each energy efficient measure, added to the package sequentially, reduces the overall energy consumption of the home. The relevant in-use factors are incorporated for each measure, accounting for underperformance. For the low income homes, the energy savings are further reduced, by 40%, to account for comfort take.⁷¹

The energy consumption is converted into energy bill savings using the *Updated Energy and Emissions Projections* (DECC, September 2013), and converted into carbon savings using the *Interdepartmental Analysts’ Group (IAG) Guidance for Policy Appraisal* (DECC, 2011).

⁷¹ A comfort take factor of 40% was used for the impact assessment of the Community Energy Saving Programme (CESP), for energy efficient installations in low income areas. [Department of Energy and Climate Change, *Impact Assessment of proposals for implementation of the Community Energy Saving Programme (CESP)*, 2009]

Distinguishing ‘low income’ homes and ‘able-to-pay’ homes

In this research, improving the homes of ‘low income’ homes and ‘able-to-pay’ homes, are considered separately. The numbers of ‘low income’ homes for each modelling archetype are derived from the EHS database.

- Low income homes are modelled to receive grants to cover the full investment in the energy efficiency measures, so that packages can be delivered at zero-cost to the homes.
- Able-to-pay homes are modelled to receive 0% interest energy efficiency loans on the retrofit measures. The investment in the measures is financed by the private sector; the homes themselves.

Geographic coverage

This research only modelled English Housing Survey data. It does not provide detailed breakdowns of the investments required to improve homes in the devolved nations. Investment requirements per home, in the devolved nations, may differ from those identified for England due to the differences in the scale of the problem (for example, a high proportion of Welsh housing is off the gas grid) and differences in the nature of the housing stock (for example, a high proportion of Scottish housing is tenements).

Example packages of measures

Examples of low, medium, and high investment energy efficiency retrofit packages are shown in Figure 6-1. The properties are not to be seen as an ‘average flat’ or an ‘average semi-detached house’, but are shown merely as specific examples of package sizes. All three property types are within the low income and able-to-pay groups.

Table 6-1: Example packages of measures

Investment in energy efficiency	Property characteristics pre-retrofit	Retrofit measures	EPC rating change	Year 1 energy bill savings (£)
£691 (low investment)	<ul style="list-style-type: none"> • Top-floor flat • Electrically heated • Cavity wall (filled) • Low level of loft insulation • Double glazing 	<ul style="list-style-type: none"> • Loft insulation (Top up from 50mm) • Draught proofing 	Mid EPC band D to Low EPC band C	£153 (£81 after comfort take)
£4,238 (medium investment)	<ul style="list-style-type: none"> • Semi-detached • Standard gas boiler • Cavity wall (empty) • Low level of loft insulation • Double glazing 	<ul style="list-style-type: none"> • Cavity wall insulation; • Loft insulation (Top up from 50mm) • Draught proofing • Hot water cylinder jacket • Cylinder thermostats & heating controls • Gas-fired condensing boilers • Secondary heating removal 	Mid EPC band D to Mid EPC band C	£507 (£304 after comfort take)
£9,952 (high investment)	<ul style="list-style-type: none"> • Semi-detached • Condensing gas boiler • Solid brick wall (uninsulated) • Medium level of loft insulation • Double glazing 	<ul style="list-style-type: none"> • Loft insulation (Top up from 150mm) • FGHR devices • All hot water measures • External wall insulation 	High EPC band E to Low EPC band C	£202 (£121 after comfort take)

6.4 Appendix 4 – Programme investments by year

Table 6-2: Programme investments by government and private sector, by year (excludes Energy Companies Obligation (ECO))

Year	In year government investment in low income scheme (£bn)	Cumulative government investment in low income scheme (£bn)	In year government investment in able-to-pay scheme (£bn)	Cumulative government investment in able-to-pay scheme (£bn)	In year private sector investment in able-to-pay scheme (£bn)	Cumulative private sector investment in able-to-pay scheme (£bn)	In year government investment in all schemes (£bn)	Cumulative government investment in all schemes (£bn)	Total in year investment (£bn)	Total cumulative investment (£bn)
15/16	£0.6	£0.6	£0.3	£0.3	£0.9	£0.9	£0.9	£0.9	£1.9	£1.9
16/17	£0.6	£1.1	£0.3	£0.7	£0.9	£1.9	£0.9	£1.8	£1.9	£3.7
17/18	£1.9	£3.0	£1.2	£1.9	£3.1	£5.0	£3.0	£4.9	£6.1	£9.9
18/19	£2.3	£5.3	£1.4	£3.2	£3.7	£8.7	£3.7	£8.6	£7.4	£17.3
19/20	£2.7	£8.1	£1.7	£4.9	£4.5	£13.1	£4.4	£13.0	£8.9	£26.1
20/21	£3.4	£11.5	£1.7	£6.6	£4.5	£17.6	£5.1	£18.1	£9.5	£35.7
21/22	£3.8	£15.3	£1.7	£8.3	£4.5	£22.1	£5.5	£23.5	£9.9	£45.6
22/23	£3.8	£19.0	£1.7	£9.9	£4.5	£26.5	£5.5	£29.0	£9.9	£55.5
23/24	£3.8	£22.8	£1.7	£11.6	£4.5	£31.0	£5.5	£34.4	£9.9	£65.4
24/25	£3.3	£26.1	£1.7	£13.3	£4.5	£35.5	£5.0	£39.4	£9.4	£74.9
25/26	£0.0	£26.1	£2.3	£15.5	£6.0	£41.5	£2.3	£41.7	£8.3	£83.2
26/27	£0.0	£26.1	£2.3	£17.8	£6.0	£47.5	£2.3	£43.9	£8.3	£91.4
27/28	£0.0	£26.1	£2.3	£20.0	£6.0	£53.6	£2.3	£46.2	£8.3	£99.7
28/29	£0.0	£26.1	£1.6	£21.6	£4.2	£57.8	£1.6	£47.7	£5.8	£105.6
29/30	£0.0	£26.1	£1.6	£23.2	£4.2	£62.1	£1.6	£49.3	£5.8	£111.4
30/31	£0.0	£26.1	£1.6	£24.8	£4.2	£66.3	£1.6	£50.9	£5.8	£117.2
31/32	£0.0	£26.1	£0.8	£25.5	£2.0	£68.3	£0.8	£51.7	£2.8	£120.0
32/33	£0.0	£26.1	£0.8	£26.3	£2.0	£70.3	£0.8	£52.4	£2.8	£122.7
33/34	£0.0	£26.1	£0.8	£27.0	£2.0	£72.3	£0.8	£53.2	£2.8	£125.5
34/35	£0.0	£26.1	£0.3	£27.4	£0.9	£73.2	£0.3	£53.5	£1.2	£126.7



Energy efficiency: An infrastructure priority

September 2015

Energy efficiency: An infrastructure priority

Acknowledgements	3
Executive Summary	4
1 Introduction	6
2 Energy efficiency is infrastructure	7
2.1 <i>Defining infrastructure</i>	7
2.2 <i>Characteristics of domestic energy efficiency investments</i>	9
2.3 <i>Functions of domestic energy efficiency investments</i>	12
2.4 <i>Findings</i>	13
3 Energy efficiency provides value for money	15
3.1 <i>Comparison of Green Book metrics</i>	15
3.2 <i>Unquantified benefits of an energy efficiency programme</i>	18
3.3 <i>Comparison according to Government's Top 40 criteria</i>	20
4 Energy efficiency can be delivered as infrastructure	21
4.1 <i>Why does Government need to be involved?</i>	21
4.2 <i>What does this mean for direct funding?</i>	23
5 Conclusions	25

Acknowledgements

Frontier Economics would like to thank Citizens Advice, Energy Bill Revolution, Energy Saving Trust, Kingfisher Plc and MIMA – Mineral Wool Insulation Manufacturers Association for helping to fund this research.

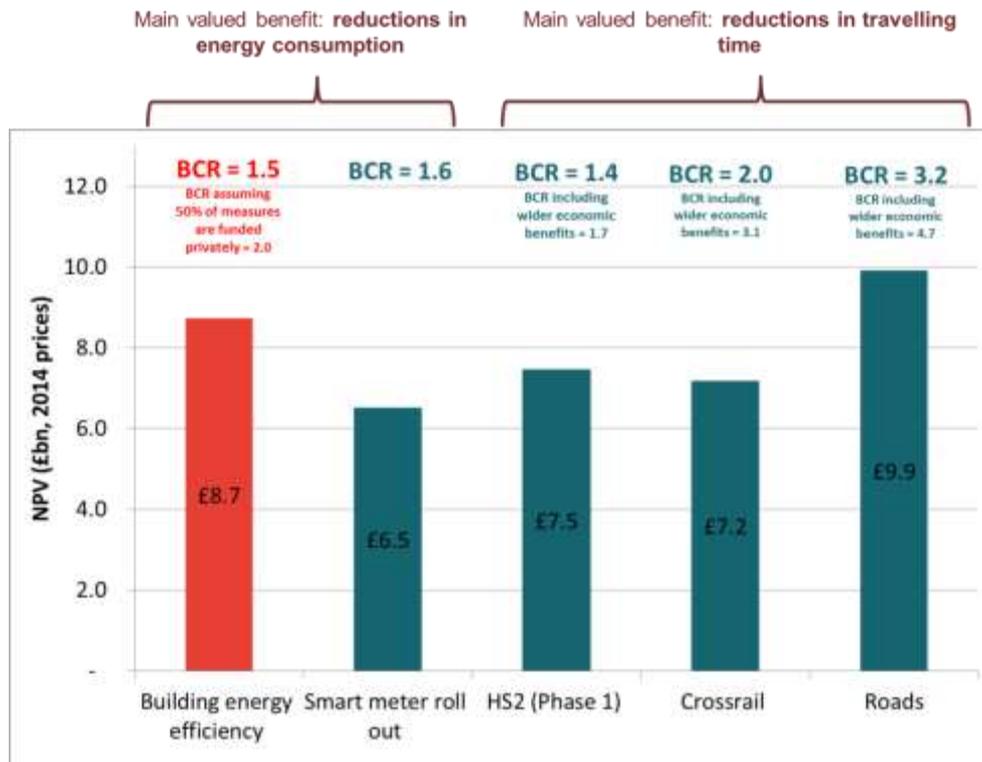


Executive Summary

There is a strong case for Government to make home energy efficiency an infrastructure investment priority and to develop an infrastructure programme to deliver it.

- **Energy efficiency investments constitute infrastructure.** Domestic energy efficiency investments can free up energy sector capacity just as effectively as delivering new generation plant, networks or storage would. Energy efficiency investments provide public services, by reducing carbon emissions and improving health and wellbeing. They also provide option value in the face of uncertainty over future energy sector conditions (e.g. uncertainty over future fuel prices)¹. An energy efficiency programme would meet the criteria HM Treasury apply for determining their top 40 infrastructure requirements. It would also fit with the eight characteristics of infrastructure identified in HM Treasury's valuation guidance. In addition, classifying energy efficiency as infrastructure is consistent with the way energy efficiency is considered by a range of international organisations, such as the European Investment Bank and the International Energy Agency (IEA).
- **Energy efficiency investments provide value for money.** Our analysis of Government Impact Assessments shows that they have comparable benefits to other major infrastructure investments. In fact, a programme to make British buildings more energy efficient would generate £8.7 billion of net benefits. This is comparable to benefits delivered by the first phase of HS2, Crossrail, smart meter roll out, or investment in new roads (Figure 1). This finding holds, even without quantifying many of the key social benefits of energy efficiency measures (for example health and wellbeing improvements).
- **An infrastructure programme to deliver energy efficiency measures can overcome key barriers to delivery.** The market failures around energy efficiency provide a strong case for Government intervention. As part of a broad energy efficiency programme there are benefits to delivering a coordinated area-based scheme under a directly funded approach. This could be used to target the consumers who would benefit the most.

¹ The incremental nature of energy efficiencies investments means that strategies can be changed as new information comes to light. This flexibility is not possible with more lumpy capital investments (for example nuclear power plants).

Figure 1. Summary of infrastructure scheme assessments

Source: Frontier Economics, based on sources detailed Box 1 on page 17. The NPV is the present value of the difference between the stream of costs and benefits of each scheme. The BCRs represent the ratio of societal benefits to Government costs (In line with Webtag guidance). The NPV figures do not include wider economic benefits. The base year for the present values varies between 2010 and 2013.

- **There is widespread support for making energy efficiency an infrastructure priority.** Making energy efficiency a public infrastructure priority is supported by leading UK business associations and businesses, including the CBI. It is also supported by core cities. Area-based programmes carried out by core cities are a natural fit with Government's aims to encourage resurgent cities and to support further devolution.

1 Introduction

This Government has identified productivity as one of the major economic challenges of our time. And it has recognised that investment in infrastructure is central to increasing the UK's productivity².

When thinking of infrastructure, it is often the major construction projects that come to mind – road and rail upgrades or investments in large new energy sector assets, like nuclear power stations or gas storage facilities.

But are we missing something by focussing on the big and visible projects? Are there alternative infrastructure investments that could provide greater benefits to the UK?

This report makes the case for classifying domestic energy efficiency as an infrastructure priority.

- Though less visible, domestic energy efficiency investments have many characteristics in common with supply side energy sector investments. In Section 2 we explain why domestic energy efficiency investments constitute infrastructure.
- Energy efficiency is a highly cost-effective way of meeting Government energy and climate change goals. Putting energy efficiency on a common footing with other major investment decisions allows a discussion on investment priorities. Section 3 assesses whether domestic energy efficiency investments provide value for money for the nation, when compared to other infrastructure investments.
- Thinking of energy efficiency as infrastructure will provide insights on how to overcome the market and policy failures that have prevented its widespread delivery. Section 4 describes the implications this has for delivery of energy efficiency.
- Based on this analysis, we conclude in Section 5 that there is a strong case for making domestic energy efficiency investments an infrastructure priority.

² HM Treasury (2015), *Fixing the Foundations*

2 Energy efficiency is infrastructure

Roads, railways, broadband networks, and energy supply investments are well understood to be infrastructure. Their importance to the UK economy is widely recognised³.

Though less visible, domestic energy efficiency investments have many characteristics in common with supply side energy sector investments. But do they constitute infrastructure?

In this section, we review definitions of infrastructure in the literature, and assess how well domestic energy efficiency fits with them.

We conclude that domestic energy efficiency constitutes infrastructure investment.

- **Domestic energy efficiency investments free up energy capacity for other uses, just as investment in new generation or network capacity would. In this way, they increase inputs to the production of goods and services across the economy.**
- **These investments also provide public services, by reducing carbon emissions and improving health and wellbeing.**

This finding is consistent with the way energy efficiency is considered by a range of international organisations, such as the European Investment Bank and the International Energy Agency (IEA). It is also consistent with the inclusion of the smart meter project in the Government's top infrastructure priorities.

2.1 Defining infrastructure

Figure 2 presents the four definitions we found in highly cited literature on infrastructure, alongside recent definitions from the LSE Growth Commission, and HM Treasury.

³ For example, HM Treasury (2015), *Fixing the Foundations*.

Figure 2. Definitions of infrastructure

Source: Frontier Economics

The definitions in Figure 2 cover two aspects of infrastructure: characteristics and functions.

- **Characteristics.** Infrastructure is generally described as capital, or as involving physical structures.
- **Functions.** The two most recent definitions (from HM Treasury and the LSE Growth Commission) describe infrastructure as an input to the production of goods and services and a requirement for the operation of the economy. The older definitions specify the function of infrastructure more narrowly, focusing on the provision of public services.

We have summarised these elements into broad and narrow definitions of infrastructure in Table 1.

Energy efficiency is infrastructure

Table 1. Broad and narrow definitions of infrastructure

	Broad definition	Narrow definition
Characteristics	Capital, physical structures	Large capital investments, with natural monopoly characteristics
Functions	Provides inputs to the production of goods and services	Provides public services

Source: Frontier Economics

We now consider how energy efficiency fits into each element of these definitions, looking first at its characteristics, and then at its functions.

2.2 Characteristics of domestic energy efficiency investments

Table 2 shows a range of common domestic energy efficiency investments, alongside information on their characteristics.

Table 2. Characteristics of common energy efficiency investments

	Cost (incurred upfront)	Lifetime (years)	Energy saving (kWh/year, semi- detached house)	Carbon saving (kg/year, semi- detached house)
Cavity wall insulation	£500 - £1,500	42	4,550	901
Draught proofing	£80-120	10	760	151
External wall insulation	£4,000- £14,000	36	9,373	1856
Heating controls	£350 - £450	12	3,927	797
High performance doors (per door)	£500	30	371	74
Gas-fired condensing boilers	£2,200 - £3,000	12	4,595	910
Internal wall insulation	£4,000- £14,000	36	10,033	1986
Loft insulation	£100 - £350	42	1,741	345
Replacement glazing	£3,300-£6,500	20	2,529	505
Roof insulation (flat roof)	£850 - £1,500	20	2,355	466
Secondary glazing	£1,000 - £1,500	20	1,753	391
Under-floor insulation	£800 - £1,200	42	1,269	252

Source: DECC (2013) *Information for the Supply Chain on Green Deal Measures*

Based on the information in Table 2, we argue that domestic energy efficiency measures fit with the broad definition of infrastructure characteristics, and partially fit with the narrow definition.

- **Broad definition of characteristics: Capital, physical structures.** *Domestic energy efficiency investments constitute physical capital.* Table 2 shows that domestic energy efficiency generally constitutes capital-intensive physical investments into the fabric of buildings. These investments tend to involve sunk costs incurred up front, and a return gained over a long asset lifetime.

Energy efficiency is infrastructure

- **Narrow definition of characteristics: Large capital investments, with natural monopoly characteristics.** *By delivering energy savings, domestic energy efficiency investments increase available energy sector capacity just as investing in large capital natural monopoly assets would.* Though an energy efficiency programme could constitute a major investment⁴, Table 2 shows that individual domestic energy efficiency investments are not large capital investments. Neither do these investments tend to have natural monopoly characteristics. **However, reductions in energy demand (delivered through an energy efficiency programme) can increase available energy sector capacity just as effectively as delivering new large capital investments (such as new generation plant, networks or gas storage)**⁵. Therefore, while domestic energy efficiency investments are not in themselves large monopoly assets, investing in them can have the equivalent impact on the economy as investing directly in large monopoly assets. This equivalence is recognised in supplementary guidance to HM Treasury's Green Book, which explicitly recognises that investment in energy efficiency reduces the need for investment in other energy system infrastructure⁶. The impacts of energy efficiency on energy sector capacity can be highly material: for example, following extensive policy intervention, domestic energy consumption per person has already fallen by 26% since 2000⁷, driven to a large extent by the delivery of energy efficiency measures.

We also note the narrow definition of infrastructure characteristics is more restrictive than that used by Government. For example, the smart meter programme and the Science & Innovation Catapults already form part of HM Treasury's Top 40 infrastructure priority list⁸.

A range of international organisations, such as the European Investment Bank and the IEA also use a less restrictive definition. The EIB has an infrastructure fund targeting energy efficiency and renewables, while the IEA advises infrastructure investment as one of several economic instruments that

⁴ For example, the Committee on Climate Change estimate that 4m investments in cavity wall insulation, 3.3m in solid wall insulation and 3.4m in loft insulation may be required to meet the UK's fourth carbon budget. CCC (2015) *Meeting Carbon Budgets – Progress in reducing the UK's emissions*.

⁵ We note that while these large assets are certainly viewed as infrastructure, not all of them have natural monopoly characteristics.

⁶ The guidance specifies that changes in energy use delivered by energy efficiency investments should be valued by taking the long run variable cost of energy supply. This long run variable cost includes the costs of investment in new capacity (for example, 90% of transmission costs are included). *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal*.

⁷ DECC (2015), *Energy Consumption in the UK*

⁸ HMT (2014), *National Infrastructure Plan 2014*

can be used to improve energy efficiency⁹. In addition, energy efficiency is being targeted by the European Fund for Strategic Investment, a €315 billion fund aimed at financing investment in infrastructure and innovation, and providing financing for SMEs. A French programme offering loans to support energy efficiency retrofits in residential buildings has already been announced under this fund¹⁰.

2.3 Functions of domestic energy efficiency investments

Domestic energy efficiency investments do two things.

- **They reduce energy use.** This reduces bills and frees up energy sector capacity to be used elsewhere in the economy, reducing the need to invest in new energy system capacity. This reduces carbon emissions (Table 2) and decreases the exposure of consumers to volatile fuel prices. In addition, these investments provide option value: because they involve multiple, small incremental investments, the scale and focus of the programme can be adjusted over time, as new information on the state of the world (including on the availability of new technologies) comes to light¹¹.
- **They result in warmer and more comfortable homes.** This increases health and wellbeing¹², and may also increase labour productivity¹³.

There are trade-offs here: if consumers respond to efficiency measures by heating their homes more, the energy and carbon savings associated with these investments are reduced, but greater health and wellbeing benefits are realised¹⁴. There is good evidence that a mix of both functions is delivered¹⁵.

⁹ IEA (2012), *Mobilising investment in energy efficiency*

¹⁰ Pending EFSI regulation. http://europa.eu/rapid/press-release_IP-15-5420_en.htm

¹¹ We discuss option value further in Section 3.

¹² There is both an income and a substitution effect: reduced bills mean more income is available to spend on heating, and heating the home is now relatively cheaper.

¹³ Mitchell, R. J., & Bates, P. (2011). Measuring Health-Related Productivity Loss. *Population Health Management*, 14(2), 93–98.

¹⁴ Analysis of energy efficiency measures tends to take this into account by reducing the energy savings by a ‘comfort factor’. For example, recent analysis by Cambridge Econometrics for E3G uses a comfort factor of 40% for fuel poor homes. Cambridge Econometrics, *The economic and fiscal impacts of making homes energy efficient*

¹⁵ UKERC (2007), *The Rebound Effect: An Assessment of the Evidence for Economy-wide Energy Savings from Improved Energy Efficiency*

Domestic energy efficiency investments fit with both the broad and narrow definition of infrastructure functions.

- **Broad definition of functions: Inputs to the production of goods and services.** By freeing up other energy system capacity, energy efficiency delivers an input to the production of goods and services. The fact that this improvement is made via the demand side, rather than by directly increasing supply side capacity does not affect the economic outcome. In fact, HM Treasury's recent productivity plan is clear that infrastructure can make a contribution to the economy, even when it involves making improvements at a domestic level¹⁶.
- **Narrow definition of functions: Provides public services.** Though homes are generally privately owned, investment in infrastructure measures provides public goods. Freeing up energy sector capacity provides services across the economy. Reducing carbon emissions provides a public service, given that the atmosphere is a public good¹⁷. Reductions in demand also contribute to energy security. In addition, by delivering warmer homes, energy efficiency provides a public service, resulting in fewer winter deaths and reduced cost to the NHS¹⁸. A healthier population is also likely to be a more productive one¹⁹.

2.4 Findings

Based on this analysis, we conclude that domestic energy efficiency is a form of infrastructure (Figure 3).

¹⁶ For example, it describes the contribution that digital infrastructure can make by removing barriers that prevent households from playing their full part in the digital economy. HM Treasury (2015), *Fixing the Foundations*.

¹⁷ While a carbon price is applied to emission from electricity generation, no price is applied on domestic gas use.

¹⁸ Hills J (2012), *Getting the measure of fuel poverty: Final Report of the Fuel Poverty Review*

¹⁹ Mitchell, R. J., & Bates, P. (2011). Measuring Health-Related Productivity Loss. *Population Health Management*, 14(2), 93–98.

Figure 3. Is domestic energy efficiency infrastructure?

	Broad definition of infrastructure	Narrow definition of infrastructure
Characteristics	<p>Capital, physical structures</p> <p>Fits: Domestic energy efficiency investments constitute physical capital</p>	<p>Large capital investments, with natural monopoly characteristics</p> <p>Partially fits: By delivering energy savings, domestic energy efficiency investments increase available energy sector capacity just as investing in large capital natural monopoly assets would</p>
Functions	<p>Provides inputs to the production of goods and services</p> <p>Fits: By freeing up other energy system capacity, energy efficiency delivers an input to the production of goods and services</p>	<p>Provides public services</p> <p>Fits: By delivering warmer homes, energy efficiency provides a public service, resulting in fewer winter deaths and reduced cost to the NHS</p>

Source: Frontier Economics

Energy efficiency is infrastructure

3 Energy efficiency provides value for money

We have shown that energy efficiency investments constitute infrastructure. However, these investments will require funding, at a time when pressure to manage budgets is very high. It is important, therefore, to ask whether energy efficiency investments deliver value for money.

In this section, we compare the estimates of the net benefits of energy efficiency schemes and with those of other schemes. We report on the standard outputs of the cost-benefit analysis of each project: the net present values (NPV) of benefits to society²⁰ and the benefit-cost ratios (BCRs)²¹.

- **This analysis finds that an energy efficiency programme can have comparable benefits to other major infrastructure investments outside the energy sector.**
- **These findings hold, even though many of the key social benefits of energy efficiency measures (for example in terms of health improvements, or option value) have not been quantified.**

This analysis is based on a review of Government Impact Assessments. We have not undertaken any new modelling work for this project.

3.1 Comparison of Green Book metrics

Figure 4 compares the net benefits and BCRs of an energy efficiency scheme with four other major schemes. This shows that an energy efficiency programme compares well to the alternative investments. An energy efficiency programme could deliver £8.7bn of benefits to the UK, compared to benefits in the range of £6.5bn-£9.9bn for smart meters, HS2 (Phase 1), Crossrail and new roads. These findings hold, even without quantifying many of the key social benefits of energy efficiency measures (for example in terms of health improvements) or the associated option value.

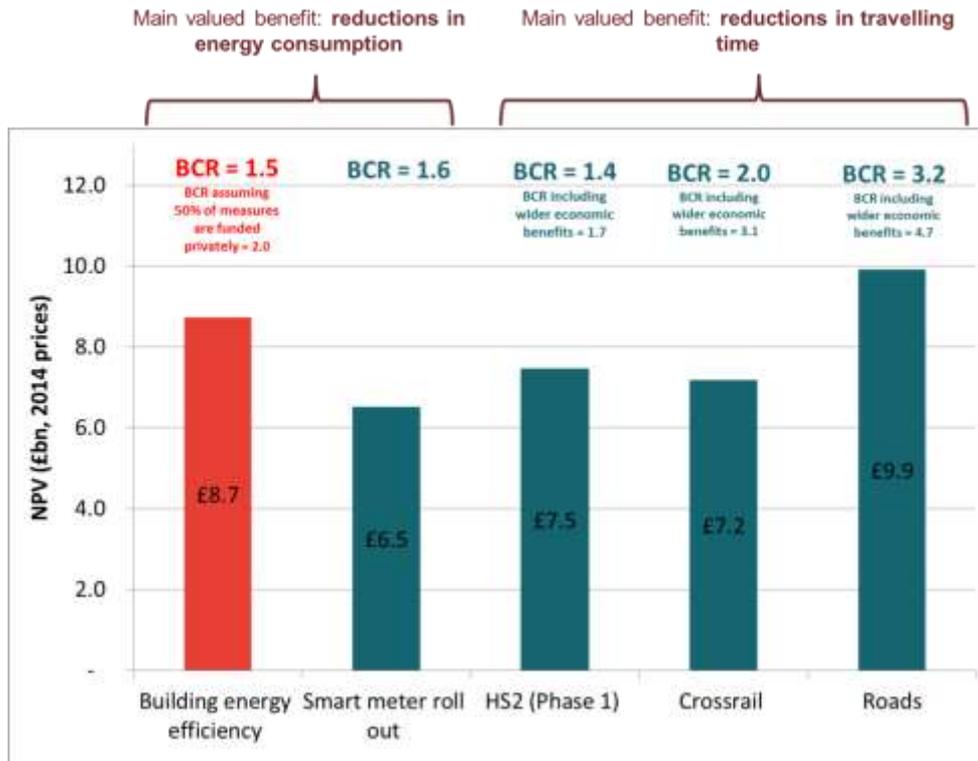
We also note the benefits of energy efficiency schemes are mainly made up of reductions in energy consumption. This is in contrast to the three transport schemes shown in Figure 4, where the core benefits are driven by reductions in travelling time. DfT acknowledges there are uncertainties around the values of time for business travellers in particular (for example, due to ongoing changes in

²⁰ The NPV is the present value of the difference between the stream of costs and benefits of scheme.

²¹ In line with Webtag guidance, the BCRs represent the ratio of societal benefits to Government costs.

working and commuting patterns), and is currently seeking to collect new empirical evidence to review these values²².

Figure 4. Summary of infrastructure scheme assessments



Source: Frontier Economics, based on sources detailed in Box 1, page 17. The NPV is the present value of the difference between the stream of costs and benefits of each scheme. The BCRs represent the ratio of societal benefits to Government costs (in line with Webtag guidance). The NPV figures do not include wider economic benefits. The base year for the present values varies between 2010 and 2013.

Figure 4 draws on a range of published Government impact assessments. We have made some adjustments to the published figures, to ensure the outputs are comparable.

- All figures have been uplifted to 2014 prices.
- Where impact assessments do not include BCRs, we have calculated these. In line with Webtag guidance, the BCRs represent the ratio of societal benefits to Government costs²³.

²² DfT (2014), *Webtag*

²³ DfT (2014), *TAG UNIT A1.1 Cost-Benefit Analysis*, page 7

Further details on the sources of these figures are set out in Box 1.

Box 1: Sources

Energy efficiency programme

This analysis is based on the Department for Energy and Climate Change's (DECC) final impact assessment of the Green Deal and ECO²⁴. This impact assessment analyses the costs and benefits of a major programme of energy efficiency measures in domestic and non-domestic properties to 2022 (the majority of the costs and benefits relate to domestic properties).

This package includes installation of cavity wall insulation (some of which is hard-to-treat) in 2.7m properties. It also includes loft insulation in 1.6m properties and solid wall insulation in 1.0m properties, as well 0.4m installations of draught-proofing, glazing or floor insulation^{25,26}. A small proportion of the costs reported in this impact assessment will be scheme specific costs relating to the Green Deal and ECO.

To calculate the BCR, we have assumed that 100% of the costs relating to the installation of measures are borne by Government. We have also included an estimate of the BCR that assumes 50% would be privately funded by able-to-pay consumers and businesses²⁷.

Other schemes

Figures for smart meter roll out were taken from DECC's final analysis of the programme, reported by the National Audit Office (NAO)²⁸. The HS2 (Phase 1) analysis is based on the HS2 Company's analysis²⁹. Figures for Crossrail are from the Department for Transport's analysis, reported in the NAO³⁰. Figures for roads are taken from DfT's analysis of the Road Investment Strategy, focussing on the benefits of schemes that go beyond existing commitments³¹.

²⁴ DECC (2012), *Final Stage Impact Assessment for the Green Deal and Energy Company Obligation*,

²⁵ DECC (2012), *Final Stage Impact Assessment for the Green Deal and Energy Company Obligation*, , page 164

²⁶ We note that the technical potential for these measures is much higher. For the example, the CCC estimate that the remaining potential to meet carbon budgets is 4.0m for cavity wall insulation, 3.3m for solid wall insulation and 3.4m for loft insulation, CCC (2015), *Meeting Carbon Budgets - Progress in reducing the UK's emissions*. Figure 2.4

²⁷ Whether the measures are privately or publically funded does affect the NPV since this calculated by subtracting total costs (including both private and public costs) from benefits.

²⁸ NAO (2014), *Update on preparations for Smart Metering*,

²⁹ HS2 (2013), *The Economic Case For HS 2*. page 85.

³⁰ NAO (2014), *Crossrail*

³¹ DfT (2015), *Road Investment Strategy: Economic analysis of the investment plan*

3.2 Unquantified benefits of an energy efficiency programme

Not all of the benefits associated with energy efficiency programmes have been quantified in Figure 4.

There are two main categories of direct benefits associated with energy efficiency improvements that are not valued in this assessment: option value and health benefits.

3.2.1 Option value

There is a large degree of uncertainty over future demand and supply conditions in the electricity sector to 2050. For example, global fuel prices can fluctuate significantly, and the future cost of energy generation technologies can be difficult to predict.

In the face of this uncertainty, a standard cost-benefit assessment (such as that carried out for Government Impact Assessments) may underestimate the benefits associated with schemes which can be rolled out incrementally, such as energy efficiency programmes. Because it involves multiple, small incremental investments, an energy efficiency programme has the advantage of flexibility. Unlike large, capital-intense projects (such as the construction of a nuclear plant, for example), the scale and focus of the programme can be adjusted over time, as new information on the state of the world comes to light³².

This option value has not been quantified in the analysis set out in Figure 4. Given the scale of the uncertainty associated with supply and demand in the energy sector, it may be significant.

3.2.2 Health benefits

In their analysis of the energy efficiency programme set out in Figure 4, DECC assume a level of ‘comfort take’³³. That is, they assume that consumers use some of the financial savings they have gained from energy efficiency, to purchase more heating. There are likely to be significant health benefits associated with this as living in cold conditions can be linked to a number of negative physical and mental health impacts. For example, the Hills Fuel Poverty Review found

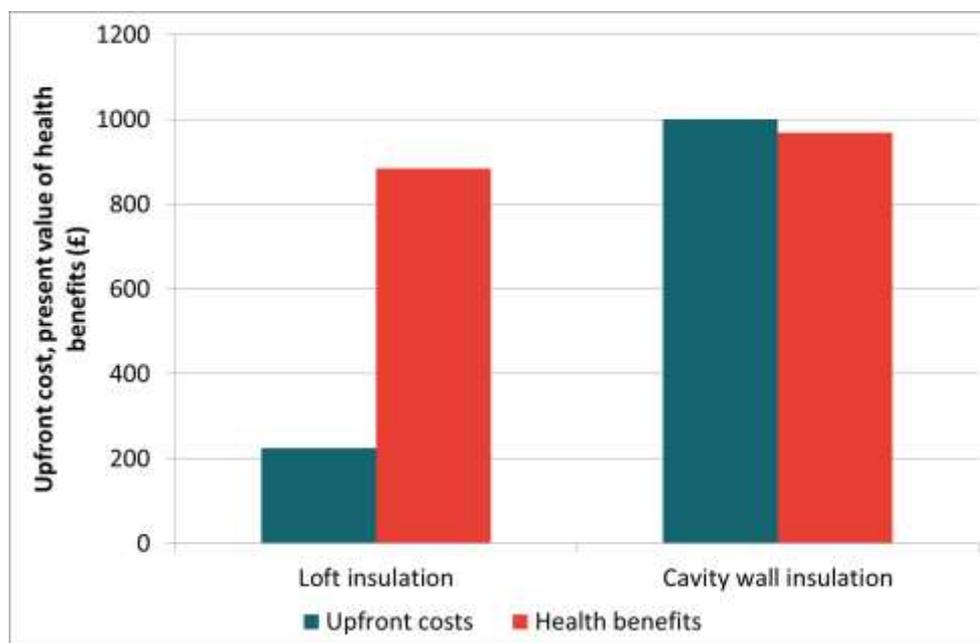
³² We note that it is important for the supply chain that these changes are well-planned and made with adequate notice.

³³ A given percentage level of comfort take means that the energy savings resulting from the installation of efficiency measures will be that percentage lower than they would have been in the absence of the comfort taking.

that low-temperatures in homes can create conditions which increase the likelihood of cardiovascular events, some of which may result in death, exacerbate the risk of respiratory disease and cause physical discomfort, which can contribute to mental health issues³⁴.

DECC has undertaken modelling to value the health benefits associated with some energy efficiency investments³⁵. Figure 5 shows that these can be significant. In fact, for loft insulation, these benefits alone outweigh the costs of installing the measures, even before energy savings are taken into account.

Figure 50. Estimated health benefits of loft and cavity wall insulation, compared to upfront costs



Source: DECC (2013), *Fuel Poverty: a Framework for Future Action – Analytical Annex*; DECC (2013) *Information for the Supply Chain on Green Deal Measures*.

These health benefits have not been valued in the assessment set out above. Again, this is likely to have led to an underestimate of benefits.

³⁴ Hills (2011), *Fuel poverty: The problem and its measurement*.

³⁵ DECC (2013), *Fuel Poverty: a Framework for Future Action – Analytical Annex*

3.3 Comparison according to Government's Top 40 criteria

The strategic benefits of energy efficiency investments may also be important.

Each year, the Government publishes a National Infrastructure Plan. This includes a list of the top 40 priority projects. Published analysis suggests that an energy efficiency programme performs well against the three criteria used in the selection of these projects³⁶.

- **Potential contribution to economic growth.** Macroeconomic modelling by Cambridge Econometrics and Verco for E3G suggests that an energy efficiency programme could have a significant positive impact on growth³⁷.
- **Nationally significant investment that delivers substantial new or replacement infrastructure with enhanced quality, sustainability and capacity.** An energy efficiency programme could be judged to meet this criterion just as well as other schemes which are included in the top 40, for example, the smart meter roll out programme, road investments or the Science & Innovation Catapults.
- **Projects that attract or unlock significant private investment.** An energy efficiency investment scheme has the potential to deliver private investment, where able-to-pay households fund at least some of the cost measures in their homes. Some but not all of the infrastructure schemes in the Top 40 attract private investment. For example, HS2 and most roads are publically funded.

³⁶ HMT (2014), *National Infrastructure Plan 2014*

³⁷ This modelling found that an energy efficiency programme could increase annual GDP in 2030 by around £14bn Cambridge Econometrics and Verco (2014), *Building the Future: The economic and fiscal impacts of making homes energy efficient*

4 Energy efficiency can be delivered as infrastructure

We have shown that energy efficiency investments are a type of infrastructure, and that they provide value for money. We now consider what this means for the delivery of these investments.

This analysis finds that the characteristics of energy efficiency as infrastructure mean that Government intervention is required to deliver the socially optimal³⁸ level of investment for the UK.

It also finds that there are benefits to an approach that is directly funded by Government. It may be easier to deliver a coordinated area-based scheme under this approach and to target the customers who would benefit the most. It is also less regressive to fund an increase in energy efficiency investment through general taxation, rather than through bills.

4.1 Why does Government need to be involved?

HM Treasury has identified eight characteristics of infrastructure that should be taken into account in appraisals of new policy decisions to support infrastructure³⁹. These are set out in Figure 6, along with an explanation of why they apply to energy efficiency decisions, and what this implies for Government intervention.

³⁸ The socially optimal level of investment refers to the level that maximises net social benefits for the UK.

³⁹ HM Treasury (2015), *Valuing infrastructure spend: Supplementary guidance to the Green Book*

Figure 6. Why is Government intervention required?

	Does this apply to energy efficiency?	What does this mean for delivery?
Long-term	Investments have long asset lives	In the absence of Government intervention, there will be underinvestment. Consumers and businesses tend to have a higher discount rate than society as a whole. This means that where costs are incurred upfront, and benefits accrue over long lifetimes, consumers and the private sector will tend to invest less than the optimal amount.
Location specific	Investments are tied to buildings in specific locations	In the absence of Government intervention, there will be underinvestment. The level of sunk costs associated with energy efficiency measures is important. It makes it difficult for businesses to offer credit to customers to install these measures, as to do so is akin to providing an unsecured loan (i.e. businesses cannot reclaim the insulation if the consumer defaults).
Interdependent	There is interdependency between energy efficiency infrastructure and the rest of the energy system	Government intervention can help ensure benefits are maximised. Energy efficiency investments may deliver the greatest system benefits when focussed on particular locations (e.g. where distribution networks are congested) or focussed on reducing energy consumption at a particular time of day (to reduce peak demand). Energy prices for domestic consumers do not currently deliver granular signals on location, and the majority do not deliver timing signals.
Scale effects	Supply chain impacts mean that the scale of energy efficiency programmes is important	Government intervention can help to ensure coordinated delivery. DECC's 2012 Energy Efficiency Strategy identified embryonic markets as one of the four main barriers to the roll out of energy efficiency measures, pointing out that a lack of expertise in a relatively immature market can increase costs and therefore slow roll out. A coordinated approach to roll out (for example, based on local areas) could help markets deliver.
Non marginal impacts	Supports and enables economic output by freeing up energy capacity for other uses	In the absence of Government intervention, there will be underinvestment. Analysis by Cambridge Econometrics suggests that an energy efficiency programme could help stimulate economic growth. Private individuals and business will not take the impact on the overall economy into account when making their decisions, and therefore may invest less than the optimal amount for society.
Shapes preferences	Can change how consumers heat their homes	Government intervention can help secure health benefits. If energy efficiency investments are targeted at the fuel poor, they may result in health benefits, and reductions in costs for the NHS.
Public good aspects	The atmosphere is a public good.	In the absence of Government intervention, there will be underinvestment. Investors in energy efficiency will not take their impact on emissions into account when making their investment decisions. This means that without Government intervention, consumers and the private sector will invest less than the optimal amount.
Market power	Not applicable	

Source: Frontier Economics.

Energy efficiency can be delivered as infrastructure

The analysis in Figure 6 shows that seven of the eight characteristics of infrastructure are relevant in the case of an energy efficiency programme. It also shows that these characteristics have implications for Government intervention.

- **In the absence of Government intervention, there will be under-delivery of energy efficiency investments.** This is the case both because of the infrastructure characteristics highlighted in Figure 6, and because of the well-known behavioural barriers associated with energy efficiency investments (for example those associated with lack of interest, low awareness, risk aversion and lack of trust)⁴⁰.
- A **targeted** approach can help maximise the benefits of an energy efficiency programme by focussing on:
 - the consumers that can gain the most from these investments (e.g. the fuel poor); and
 - interventions that tackle consumption at certain times of day (efficiency improvements that reduce peak demand).
- A **coordinated area-based approach** can also help maximise the benefits of an energy efficiency programme, by focussing on:
 - coordinating area-wide approaches that allow local markets to mature;
 - coordinated targeting of areas where the benefits to the energy system are greater (e.g. areas with network congestion).

An area-based approach can also help overcome behavioural barriers, for example by creating new social norms around efficiency measures.

4.2 What does this mean for direct funding?

At the moment, policy-driven energy efficiency measures are largely financed through ECO and delivered by suppliers. This supplier-led approach can tackle many of the issues identified in Figure 6.

But would a supplier-led approach be the most efficient way of delivering a further increase in energy efficiency investments? There are three reasons why an infrastructure investment programme, directly funded by Government may add value.

⁴⁰ See for example, the discussion in DECC (2012), *The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK*

- **A direct Government approach could be more effective in delivering a coordinated, area-based approach.** This type of approach may be difficult to deliver through suppliers, given the number of suppliers that compete in the energy market, their uneven distribution across different localities, and the transaction costs associated with specifying very narrowly who suppliers should target⁴¹.
- **A scheme targeting those customers that will benefit the most in terms of health and wellbeing may be easier to deliver directly through an infrastructure programme, led by cities.** While suppliers can be incentivised to focus on vulnerable customers and the fuel poor, the design of such a scheme can become complex and again can lead to inefficiently high transaction costs. Some of these transaction costs could be avoided by drawing on the knowledge that Government, and in particular Local Government, already has on housing stock and vulnerability of occupants.
- **Bill-payers may be reluctant accept a further increase in the costs of a supplier obligation.** Funding through energy bills (with ECO) is consistent with the polluter pays principle and provides an added incentive for efficiency. However, it will generally be less regressive to fund schemes through general taxation (as is common in Europe)⁴².

⁴¹ We note that internationally, many obligation schemes are delivered through distribution network operators, and these issues do not apply. The UK is the only EU country to use a supplier obligation to tackle fuel poverty.

⁴² CEER (2015), *Status Review of Renewable and Energy Efficiency Support Schemes*

5 Conclusions

There is a strong case for Government to make energy efficiency investments an infrastructure priority, and to introduce a further programme of energy efficiency investments.

- **Energy efficiency investments constitute infrastructure.** Domestic energy efficiency investments can free up energy sector capacity just as effectively as delivering new generation plant, networks or storage would. Energy efficiency investments provide public services, by reducing carbon emissions and improving health and wellbeing. They also provide option value in the face of uncertainty over future energy sector conditions (e.g. fuel prices)⁴³. An energy efficiency programme would meet the criteria HM Treasury apply for determining their top 40 infrastructure requirements. It would also fit with the eight characteristics of infrastructure identified in HM Treasury's valuation guidance. In addition, classifying energy efficiency as infrastructure is consistent with the way energy efficiency is considered by a range of international organisations, such as the European Investment Bank and the International Energy Agency (IEA).
- **Energy efficiency investments provide value for money.** Our analysis of Government Impact Assessments shows that an energy efficiency programme can have comparable benefits to other major infrastructure investments. In fact, a programme to make British buildings more energy efficient would generate £8.7 billion of net benefits. This finding holds, even without quantifying many of the key social benefits of energy efficiency measures (for example health improvements and option value).
- **There is a case for Government intervention, in the form of a publicly funded investment programme and there are benefits to an approach that is directly funded by Government.** It may be easier to deliver a coordinated area-based scheme under this approach and to target the customers who would benefit the most. It is also less regressive to fund an increase in energy efficiency investment through general taxation, rather than through bills.

⁴³ The incremental nature of energy efficiencies investments means that strategies can be changed as new information comes to light. This flexibility is not possible with more lumpy capital investments (for example nuclear power plants).

FRONTIER ECONOMICS EUROPE

BRUSSELS | COLOGNE | LONDON | MADRID

Frontier Economics Ltd 71 High Holborn London WC1V 6DA

Tel. +44 (0)20 7031 7000 Fax. +44 (0)20 7031 7001 www.frontier-economics.com

PROJECT N° 62103750

INFLUENCING STRATEGIC TRANSPORT IN THE SOUTH EAST

FINAL REPORT

MARCH 2016

INFLUENCING STRATEGIC TRANSPORT IN THE SOUTH EAST

FINAL REPORT

**Thames Valley Berkshire LEP
Enterprise M3 LEP
Coast to Capital LEP
Solent LEP**

Final Report

Project no: 62103750
Date: March 2016

WSP | Parsons Brinckerhoff
70 Chancery Lane
London
WC2A 1AF

Tel: +020 7914 4587

www.wspgroup.com
www.pbworld.com

QUALITY MANAGEMENT

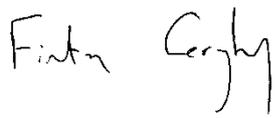
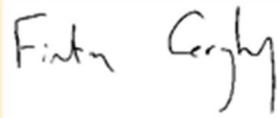
ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2
Remarks	Draft Report	Draft Final Report	Final Report
Date	14 th December 2015	26 th February 2016	25 th March 2016
Prepared by	F Geraghty	F Geraghty	F Geraghty
Signature			
Checked by	D Carter	D Carter	D Carter
Signature			
Project number	3516677A-PTL (PB number)	62103750 (WSP number)	62103750
Report number	1	1	1
File reference	H:\Thames Valley Strategic Transport\Influencing Strategic Transport in the South East_Draft Report_141215.docx	Influencing Strategic Transport in the South East_Draft Final Report_260216.docx	Influencing Strategic Transport in the South East_Final Report_250316.docx

TABLE OF CONTENTS

	Quality Management.....	1
	tables	v
	Figures.....	v
	EXECUTIVE SUMMARY	1
1	INTRODUCTION.....	4
1.1	SCOPE OF THE WORK.....	4
1.2	STRATEGIC MOVEMENT CORRIDORS	5
1.3	OBJECTIVES OF THE DRAFT REPORT.....	5
2	STAKEHOLDER ENGAGEMENT AND DATA COLLATION.....	6
2.1	INTRODUCTION.....	6
2.2	STAKEHOLDER ENGAGEMENT	6
2.3	DATA COLLECTION AND COLLATION.....	7
2.4	COLLATION OF ECONOMIC DATA.....	9
	ONS GVA DATA	10
	NOMIS DATA.....	12
	DFT “WIDER IMPACTS” DATA	12
3	METHODOLOGY.....	14
3.1	INTRODUCTION.....	14
3.2	OVERVIEW OF METHOD.....	16
3.3	DATA SOURCES USED.....	20
4	IDENTIFICATION OF MOVEMENT CORRIDORS	21
4.1	INTRODUCTION.....	21
4.2	BASIS FOR SELECTING CORRIDORS	21
4.3	CORRIDORS EVALUATED.....	22
5	PRIORITISATION OF CORRIDORS	25
5.1	INTRODUCTION.....	25

5.2	RESULTS	25
	A3 CORRIDOR IMPROVEMENT	26
	A22 EASTBOURNE - LEWES - UCKFIELD - SURREY CORRIDOR IMPROVEMENT	26
	A27 CORRIDOR UPGRADE	26
	A31 HOG'S BACK - FARNHAM - ALTON CORRIDOR IMPROVEMENT	27
	A33 BASINGSTOKE - READING CORRIDOR UPGRADE	27
	A34 CORRIDOR UPGRADE (SOUTHAMPTON - NEWBURY / M4 J13)	27
	A320 CORRIDOR UPGRADE	28
	BRIGHTON MAIN LINE UPGRADE	28
	MID-SUSSEX TO THAMES VALLEY NEW CORRIDOR	28
	NEWHAVEN - LEWES - BRIGHTON CORRIDOR UPGRADE	29
	NORTH DOWNS LINE UPGRADE	29
	READING - WATERLOO RAIL UPGRADE	29
	SOUTHERN ACCESS TO HEATHROW	30
	SOUTHAMPTON - NEW FOREST CORRIDOR UPGRADE (M27 / A31)	30
	SOUTHAMPTON TO PORTSMOUTH CORRIDOR UPGRADE	30
	“SOUTH SUSSEX WAY” – NEW CORRIDOR	31
	“SOUTH COAST RELIEF ROAD” – NEW CORRIDOR	31
5.3	PRIORITISATION	32
5.4	HOW THE CORRIDORS RELATE TO EACH OTHER	34
6	IDENTIFICATION OF POTENTIAL SOLUTIONS	36
6.1	INTRODUCTION	36
6.2	ANALYSIS OF POTENTIAL SOLUTIONS	36
6.3	MODAL OPTIONS AND ACCESS TO THE CORRIDORS	41
7	PRIORITISATION OF POTENTIAL INFRASTRUCTURE IMPROVEMENTS	42
7.1	INTRODUCTION	42
7.2	HIGH LEVEL COST DATA	43
7.3	ANALYSIS AND RESULTS	44
8	HOUSING, GROWTH AND FUTURE DEVELOPMENT	49
8.1	INTRODUCTION	49
8.2	KEY DEVELOPMENTS IN EACH LEP AREA	49
	THAMES VALLEY BERKSHIRE	49
	SOLENT	50

	ENTERPRISE M3	52
	COAST TO CAPITAL	53
8.3	HOW THE STRATEGIC CORRIDORS WILL SUPPORT GROWTH.....	54
9	SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK.....	58
9.1	SUMMARY OF WORK.....	58
	OTHER CONSIDERATIONS	58
9.2	ACCOMMODATING HOUSING GROWTH	58
9.3	REFINING OPTIONS AND DEFINING SCHEMES.....	59
9.4	STRATEGIC PLANNING – PAN PUBLIC SECTOR APPROACH.....	59
9.5	URBAN CONNECTIVITY AND PUBLIC TRANSPORT PROVISION.....	60
9.6	RECOMMENDED FUTURE WORK – MODAL SHIFT.....	60
9.7	RECOMMENDATIONS – STRATEGIC TRANSPORT MODELLING.....	61

TABLES

TABLE 2-1	DATA RECEIVED	8
TABLE 2-2	LOCAL AUTHORITY DISTRICTS IN DFT DATASET.....	13
TABLE 3-1	DATA SOURCES	20
TABLE 4-1	CORRIDORS SELECTED FOR EVALUATION.....	22
TABLE 5-1	A3 CORRIDOR RESULTS	26
TABLE 5-2	A22 CORRIDOR UPGRADE RESULTS	26
TABLE 5-3	A27 CORRIDOR UPGRADE RESULTS	26
TABLE 5-4	A31 CORRIDOR UPGRADE RESULTS	27
TABLE 5-5	A33 CORRIDOR UPGRADE RESULTS	27
TABLE 5-6	A34 CORRIDOR UPGRADE RESULTS	27
TABLE 5-7	A320 CORRIDOR UPGRADE RESULTS	28
TABLE 5-8	BML UPGRADE RESULTS	28
TABLE 5-9	MID-SUSSEX TO THAMES VALLEY RESULTS	28
TABLE 5-10	NEWHAVEN –LEWES – BRIGHTON CORRIDOR UPGRADE RESULTS	29
TABLE 5-11	NORTH DOWNS LINE RESULTS	29
TABLE 5-12	READING TO WATERLOO RESULTS.....	29
TABLE 5-13	SOUTHERN ACCESS TO HEATHROW RESULTS.....	30
TABLE 5-14	M27 / A31 CORRIDOR UPGRADE RESULTS.....	30
TABLE 5-15	SOUTHAMPTON TO PORTSMOUTH CORRIDOR UPGRADE.....	30
TABLE 5-16	“SOUTH SUSSEX WAY” RESULTS	31
TABLE 5-17	“SOUTH COAST RELIEF ROAD” RESULTS.....	31
TABLE 5-18	INITIAL PRIORITISATION OF CORRIDORS.....	32
TABLE 6-1	IDENTIFICATION OF POTENTIAL SOLUTIONS.....	37
TABLE 7-1	HIGH LEVEL COST DATA	43
TABLE 7-2	POTENTIAL INFRASTRUCTURE INVESTMENTS.....	44

FIGURES

FIGURE 1-1	ECONOMIC ACTIVITY AND THE INFLUENCE OF TRANSPORT.....	4
FIGURE 2-1	NOMINAL GVA PER HOUR WORKED - HIGHEST RANKING NUTS3 SUB-REGIONS, 2013	11
FIGURE 2-2	NOMINAL GVA PER HOUR WORKED - HIGHEST RANKING LEPS, 2013.....	12
FIGURE 3-1	COMPONENTS OF METHODOLOGY	14
FIGURE 3-2	CONVENTIONAL AND WIDER ECONOMIC IMPACTS OF TRANSPORT SCHEMES.....	15
FIGURE 3-3	OVERVIEW OF METHOD.....	16
FIGURE 3-4	EXAMPLE OF CORRIDOR IMPROVEMENT METHOD.....	17
FIGURE 4-1	SELECTED CORRIDORS IN THE STUDY AREA	24
FIGURE 8-1	NORTH DOWNS LINE	55

FIGURE 8-2	A27 CORRIDOR UPGRADE	55
FIGURE 8-3	BASINGSTOKE TO READING CORRIDOR UPGRADE	55
FIGURE 8-4	SOUTHERN ACCESS TO HEATHROW AIRPORT	56
FIGURE 8-5	READING – WATERLOO LINE UPGRADE (IN KEY BERKSHIRE CORRIDOR)	56
FIGURE 8-6	READING – WATERLOO LINE UPGRADE (IN KEY BERKSHIRE CORRIDOR)	57
FIGURE 8-7	A3 CORRIDOR UPGRADE	57

EXECUTIVE SUMMARY

WSP | Parsons Brinckerhoff were commissioned by Thames Valley Berkshire, Enterprise M3, Solent and Coast to Capital Local Enterprise Partnerships (working closely with the local highway authorities) to undertake an assessment of the economic benefits of strategic transport corridors. As well as enhancing connectivity within the area covered by the four LEPs, the corridors will also provide strategic links to neighbouring LEP areas such as Dorset, points north of Berkshire and the Greater London area.

For clarity, this is not a 'traditional' transport economics as monetised journey time savings and accident reduction benefits have not been calculated. Instead, the focus is on the wider economic impacts of the strategic corridors and specifically, how these can help boost connectivity and productivity in the region.

The geographical area covered by the four LEPs is of significant national economic importance as a large proportion of national wealth is generated here. As an example, the economy in Berkshire and the Thames Valley is one of the highest performing in the country given the very high levels of Gross Value Added (GVA) per head generated. Put simply, this means the area produces a significant share of national wealth - thus it is thus in the national interest for this to continue given how much is contributed to the "national economic cause".

Similarly, the economy of the Solent area is thriving with emphasis on the maritime and related specialist sectors near to Southampton and Portsmouth. For these to continue thriving, enhanced transport connectivity is essential, both between the two cities as well as between the Solent area and other areas of economic importance.

In addition, there is a fast-developing 'hi tech' sector within Surrey that is characterised by very high levels of productivity (GVA per worker). Given this is forecast to increase considerably in the future as these sectors expand, enhanced transport connectivity will be essential. However, without intervention, the very high levels of usage of the county's transport system is causing increasing amounts of delay and congestion and therefore acting as a block to full growth potential.

The 'Gatwick Diamond' agglomeration of industry in Sussex is another major generator of economic wealth. With key transport corridors such as the Brighton Main Line and the M23 / A23 corridor already operating at or near full capacity, corridor enhancements will generate significant economic benefits by enabling the area's growth potential to be realised.

The strategic transport corridors also address the lack of point-to-point connectivity across the region. This is the case for strategic links between Sussex and the Thames Valley where there is presently very poor transport access given the lack of direct links. This is why proposals to significantly enhance the North Downs Line (linking Redhill, Reigate and Guildford with the Thames Valley) are so important. Also, a new corridor between Horsham and the Thames Valley will offer significant economic benefits.

As well as generating economic wealth, the corridors will provide much-needed connectivity between some of the more peripheral areas of the region and centres of high economic growth. In East Sussex, for example, the coastal areas near Eastbourne and Hastings will benefit from much improved connectivity to mid-Sussex, Surrey and the Greater London area.

Improved connectivity is therefore essential for the following **two** key reasons:

- To facilitate continued economic expansion in the region via increased productivity and the national economic benefits this generates; and
- Improved access for workers accessing labour markets and areas of high productivity – this also works ‘both ways’ as firms will have improved access to a larger pool of suitably qualified workers.

The methodology used is based on current DfT guidance whereby agglomeration improvements stem from the enhanced productivity generated by better transport links. This is particularly applicable in the South East where there is a very high level of travel to / from places of employment. The concentrations of residential areas and areas of employment throughout the region mean that long-distance journeys to work are regularly made.

All of the major existing corridors see high levels of journeys being made and therefore if connectivity is improved, productivity will be also enhanced with all the consequent economic benefits this produces.

The wider benefits calculated include the following: **1)** increased agglomeration (through enhanced productivity), **2)** the employment the additional GVA supports and **3)** the various taxation benefits generated from additional employment.

Based on the strategic corridor analysis, the results provide a powerful indicator of the economic benefits that could be generated. The results below show the “Top Ten” corridors and the impacts generated.

SUMMARY RESULTS BY “TOP TEN” CORRIDORS

<u>Corridor</u>	GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATION TAX GAIN
South Coast Relief Road	£5.9 billion	36,000 jobs	£430 million	£282 million
South Sussex Way	£4.4 billion	29,000 jobs	£346 million	£211 million
Mid Sussex to Thames Valley	£3.6 billion	15,700 jobs	£189 million	£174 million
Southampton to Portsmouth	£2 billion	12,300 jobs	£150 million	£95 million
Reading to Waterloo	£1.9 billion	7,500 jobs	£90 million	£90 million
North Downs Line	£1.9 billion	8,000 jobs	£97 million	£89 million
Southern Access to Heathrow	£1.8 billion	8,200 jobs	£100 million	£88 million
A27 Corridor Upgrade	£1.5 billion	9,300 jobs	£111 million	£75 million
Brighton Main Line	£1.5 billion	7,500 jobs	£90 million	£70 million
A3 Corridor Upgrade	£1.1 billion	6,000 jobs	£71 million	£55 million

In overall economic impact terms (ensuring there is no ‘double counting’ of benefits across corridors serving similar geographies), total additional annual GVA would exceed £19.5 billion with over 100,000 additional jobs supported by this additional economic activity. Government would also gain annual additional revenue of £1.2 billion from personal income taxation and just under £1 billion per annum from corporation taxation.

It is important to point out that the above impacts represent the typical impact if this were to happen at the current time. In reality, these impacts will be realised every year from scheme implementation as they represent the difference between the ‘status quo’ (i.e. doing nothing) and the impact with these corridors in place.

There are also **major synergies** between the corridors:

- **Enhancing connectivity along the South Coast:** There are several major conurbations and centres of economic activity along the South Coast. These generate significant levels of economic activity and are forecast to grow in several different ways. Traffic levels and congestion on key corridors has reached a point whereby delays are commonplace. Corridor improvements along the A27, M27 and A31 will therefore enhance overall connectivity on an east-west axis.

In addition, the cities of Southampton and Portsmouth in the Solent area are economic 'powerhouses' in their own right and will benefit significantly from enhanced connectivity between them;

- **Enhancing the links between the South Coast and points further north:** Due to relatively long journey times and the comparative peripherality of the South Coast, several of the corridors put forward will enhance connectivity to London and other major centres of economic activity

The proposed upgrade of the 'A3' (Portsmouth – London) corridor as well as the upgraded Brighton Main Line and upgraded connection between Eastbourne and Surrey will all provide enhanced connectivity

In addition, there will also be considerable synergy between 'north – south' and 'east – west' corridors. Examples include better access to Portsmouth and the Solent area from the A3 corridor and subsequent better connectivity to points east and west (using the upgraded A27 and M27 corridors). Improving the A34 between Southampton and points north will also help to take 'pressure' off some of the other corridors;

- **Enhancing 'north – south' connectivity in the region:** In the Hampshire, Surrey and Mid-Sussex areas, historical corridor development has focussed on the main routes into London. Good north – south connectivity has therefore been difficult to achieve and this has been compounded in recent years by high levels of traffic on the north – south corridors

By proposing new corridors that link Mid-Sussex (Horsham) with the Thames Valley (Bracknell/Reading) as well as upgraded existing corridors (such as the upgraded North Downs Line), connectivity will be enhanced

Better north – south links will enable workers in these major centres to live further away as their commute times will be significantly enhanced. Similarly, improved connectivity between Basingstoke and Reading as well as between Southampton and Newbury will support growth in the region;

- **Enhancing connectivity between the South West / West of the region and London:** Although there are several major transport corridors linking the study area to London, there remain 'pockets' of population and economic activity that are comparatively poorly served. By improving connectivity in these corridors, workers will be able to access a much wider range of employment opportunities.

There is also potential for the corridors to provide strong linkages with neighbouring LEP areas and the wider South East / South West regions.

The analysis has also shown that although the costs of these improvements will be high, the extent of the potential benefits could exceed these by some margin. Although several of these corridors will be major undertakings requiring significant planning, construction works and expenditure, the 'goal' of greatly enhanced economic activity will have major national and not just regional importance. This is why it is vital that these improvements be considered and developed further.

1

INTRODUCTION

1.1 SCOPE OF THE WORK

Enterprise M3, Coast to Capital, Solent and Thames Valley Berkshire Local Enterprise Partnerships, working closely with the local highway authorities, have appointed WSP | Parsons Brinckerhoff to identify, describe and quantify the economic case for improving connectivity in major strategic movement corridors across South East England.

Rather than developing a traditional transport economic case, the objective is to identify outputs that set out the role of transport in raising productivity and supporting economic growth at a transformational level within the South East. As well as recognising the need to strengthen connectivity with London, another key objective is to strengthen existing and promote new corridors that will drive economic growth.

The focus on productivity is important as in the recent HM Treasury publication, "Fixing the Foundations", the Government has set out its 15 point plan to raise productivity, centred on two pillars:

- Encouraging long-term investment in economic capital, including infrastructure, skills and knowledge; and
- Promoting a dynamic economy that encourages innovation and helps resources flow to their most productive use.

The development of a "Modern Transport System with a Secure Future" is identified within the plan as one of the 15 areas of focus.

There are several different types of economic activity that take place and the extent to which transport can influence these is illustrated in Figure 1-1 below. Several of the transport-related impacts shown below are incorporated as part of this study.

Figure 1-1 Economic Activity and the Influence of Transport



1.2 STRATEGIC MOVEMENT CORRIDORS

The development of the movement corridors will be expected to address known and forecast problems and issues and to deliver the following benefits:

- Provision of new homes and business space in appropriate locations;
- Enhanced economic interactions and labour mobility through connectivity improvements;
- Better road and rail access to nationally important ports and airports;
- Improved cross country road and rail routes linking South East economic areas without the need to travel via Central London;
- Reducing congestion and removing bottlenecks on strategic road corridors;
- Improved journey times on the major rail lines into London; and
- Enhancements to the attractiveness of the area for new investment.

1.3 OBJECTIVES OF THE DRAFT REPORT

This report sets out the work undertaken, the methodology used and the findings across the range of issues and topics specified in the study brief.

The remainder of the report contains the following chapters:

- Chapter Two summarises the stakeholder engagement and data collation;
- Chapter Three describes the methodology used;
- Chapter Four identifies the movement corridors;
- Chapter Five contains the initial prioritisation of corridors;
- Chapter Six contains a preliminary identification of potential solutions;
- Chapter Seven contains a summary of potential infrastructure improvements;
- Chapter Eight contains descriptions and diagrams showing how the corridors will link areas of planned housing development; and
- Chapter Nine contains a summary, conclusions and recommendations for further work.

2 STAKEHOLDER ENGAGEMENT AND DATA COLLATION

2.1 INTRODUCTION

A major element of the work has been stakeholder engagement and the collation of relevant data and information. The purpose of this chapter is to summarise the findings from the stakeholder engagement and to provide details of the various items of data obtained.

2.2 STAKEHOLDER ENGAGEMENT

Given the wide geographical area covered by the study and the large number of stakeholders involved and interested in the study, it was important to consult and engage with a variety of organisations at the earliest opportunity.

We set out to do this through the following:

→ Stakeholder Consultation Events:

- Event 1 was held on Tuesday 3rd November 2015 in Horsham and was attended by representatives from local authorities in the study area as well as the organisation representing South East England Councils (SEEC), DfT and public transport operators (such as Stagecoach Rail, operators of South West Trains). The session outlined the objectives of the study and the proposed approach with useful feedback being provided by the attendees
- Event 2 was held on Monday 7th December 2015 in Basingstoke. This was attended by a large number of stakeholders from local authorities and other organisations. WSP | Parsons Brinckerhoff ran through progress to date, including discussion of the economic metrics used and data collated. The preliminary findings for the selected strategic movements were also discussed

→ Individual Meetings with Stakeholders:

- DfT meeting, Thursday 19th November 2015. WSP | Parsons Brinckerhoff met David Bull and economist Jago Penrose at DfT's Great Minster House offices to discuss the objectives of the study and the methodology to be used to calculate economic benefits. The use of current DfT WebTAG guidance as the "building blocks" to the analysis was discussed as well as the way in which other economic impacts not typically associated with transport scheme appraisals
- Surrey County Council meeting (freight issues), Wednesday 25th November 2015. This meeting with Peter Hitchings of SCC's freight team was important as it highlighted the extent of freight and logistics movements in both Surrey and the wider region. Key issues discussed including the extent that freight movements are generated in the area (both road and rail) and the key freight movement corridors
- AECOM meeting, Friday 27th November 2015. AECOM are currently working on the 'Solent Strategic Transport Investment Plan' for Solent LEP and given the synergies between the two studies, a meeting took place where both parties discussed their respective work. AECOM offered to review any Solent-specific corridor proposals and issues emerging from our work
- Stagecoach Rail (South West Trains) meeting, Tuesday 1st December 2015. This meeting with Phil Dominey, Stakeholder Engagement Manager, was extremely useful as Stagecoach are preparing for the upcoming South Western franchise bid and are collating

data across the South East region on forecast housing developments and employment growth. There are clearly synergies between their work and our's. We therefore agreed to remain in regular contact as both workstreams progress.

- Heathrow Hub meeting, Tuesday 2nd February 2016. This meeting with Steve Costello enabled the study team to understand the aspirations of Heathrow Hub (the independent organisation proposing to extend the northern runway at Heathrow Airport). These aspirations include several major transport corridor proposals in the region, including new rail links to the airport that are not dissimilar to some of new rail corridors proposed here
- Highways England meeting, Tuesday 9th February 2016. Meeting with John Henderson to discuss HE's current insight into potential corridor developments in the South East. Again, several of the corridors discussed were not dissimilar to those being proposed here, especially those corridors providing enhanced connectivity between the south coast and points further north as well as better linkage between Sussex and the Thames Valley.

→ **Discussions with Other Organisations:**

- Office of National Statistics (ONS). Given the importance of ONS data covering GVA at a sub-regional level and employment / wage data, WSP | Parsons Brinckerhoff have maintained regular contact with key contacts there (Richard Prothero and Trevor Fenton). Richard has advised on GVA data and other more detailed economic data whilst Trevor has advised on the proportions of GVA data that very broadly represent companies' profits (for corporation tax increase calculations)
- Local Authority Economic Data teams. As well as collating the information described in 2.3, we have obtained useful economic metrics from discussions with various other organisations, including Hampshire County Council's Social and Economic Research Manager (Alan Cole, already well known to WSP | Parsons Brinckerhoff from previous work) and TV Berkshire's Economic Research Analyst (Caroline Perkins).

2.3 DATA COLLECTION AND COLLATION

A major part of the work has been the collation of all relevant data, information and studies. The 'data request' to all stakeholders (including various agencies and local authorities) was issued by each respective member of the LEP Steering Group and covered the following:

→ **Request to Highway Authorities:**

- Transport flow data (by key mode, particularly road and rail)
- Relevant studies and reports covering transport movements and economic development
- Data relating to key freight movements
- Any other information that you consider relevant to this work

→ **Request to Planning Authorities:**

- Relevant Local Plans
- Relevant local economic data where this has been collated (such as local GVA and employment data)
- Any other relevant information covering economic development and trends / projections

Several items were received from local authorities and other agencies, including key data from District Councils in the study area. These are summarised in Table 2-1 below.

Table 2-1 Data Received

SOURCE	KEY ITEMS
Woking BC	Adopted Core Strategy Anticipated Capacity of Allocated Sites
Winchester CC	Local Plan Economic Plan Employment Study
Thames Valley Berkshire LEP	Various economic / employment / industry studies
Test Valley BC	Revised Local Plan 2015
Surrey CC	Surface Access to Airports Study North Downs Railway Study Surrey Rail Strategy (Issues and Options Studies)
Spelthorne BC	Allocations Development Plan Core Strategies and Policies Economic Strategy 2013 Local Economic Assessment September 2013
South Downs National Park	Census 2011: SDNPA Districts Comparison Employment Land Review 2015 Local Plan Master (24/08/15 – Whole Document) Local Economy – Economic Indicators 2011
Solent LEP	Solent Strategic Economic Plan Solent Growth Deal “Connecting Growth” document “Transforming Solent” - Marine and Maritime Supplement Economic Evidence Base Economic Evidence Base – Technical Annex “Transforming Solent” - Growth Strategy, October 2014
Rushmoor BC	Core Strategy October 2011 Key Employment Sites November 2012
New Forest DC	Local Plan Core Strategy Local Plan Part 2 (Development Management Policies and Site Specific Details)
Network Rail	London and South East Market Study South East Route - Sussex Area Route Study Wessex Route Study (<i>also provided by Enterprise M3</i>)
Enterprise M3 LEP	EM3 Annual Report EM3 Growth Deal EM3 Growth Deal - First and Second Tranche Highways England Strategic Business Plan 2015-2020 DfT Road Investment Strategy Strategic Economic Plan 2014-2020
Basingstoke and Deane BC	Local Plan Economic Projections April 2015 BRES Employee and Employment Trends 2014
Hampshire CC	Hampshire Economic Assessment 2011 Hampshire Economic Area Topic Paper: Gross Value Added Hampshire Economic Area Topic Paper: Economic Projections Business Register and Employment Survey (BRES): Employee Jobs in Hampshire (July 2014) Commuter Flow Data for each LAD
Reigate and Banstead BC	Various Local Plan data and demographic / employment / economic projections
Portsmouth CC	Portsmouth City Local Plan 2001 – 2011 (adopted 21st July 2006, amended - July 2007, July 2009 & January 2012)
Isle of Wight Council	Core Strategy (adopted March 2012, updated May 2013) The Island Plan Proposals Map (Overview Map, adopted March 2012) IoW Employment Land Study, GL Hearn, March 2015

Havant BC	Economic Profile for Havant
Gosport BC	Gosport Borough Local Plan 2011-2029 (adopted October 2015) Transport for South Hampshire and Isle of Wight Evidence Base - Gosport Borough Local Plan (2011-2029), March 2014 Local Plan – Employment Background Paper, June 2014
Gatwick Diamond	Gatwick Diamond BIS Statistics, August 2015 (various economic / demographic metrics for Gatwick Diamond area)
Fareham BC	Fareham Local Plan Part 2: Development Sites and Policies, June 2015 Fareham Local Development Framework, Core Strategy, adopted August 2011 Various employment and transport strategies
East Hampshire DC	East Hampshire District Local Plan Joint Core Strategy Proposed Submission: East Hampshire District Local Plan - Housing and Employment Allocations (incorporating minor modifications), June 2015
Coast to Capital LEP	Strategic Economic Plan (SEP), March 2014 Coast to Capital Housing Policy, September 2013 Various items from local authorities and other organisations (such as Gatwick Diamond – see above)

This data from the District Councils helped inform the housing and future growth analysis reported in Chapter 8. The Local Plan data provided indications of future plans, including new housing and employment site developments in key areas.

To supplement the data received in Table 2-1, we collated additional information from all local authorities in the study area. This meant that we were able to cover the plans of 45 different local authorities.

The figures in Chapter 8 indicate how the corridors will provide essential links and access to new developments throughout the region.

2.4 COLLATION OF ECONOMIC DATA

As well as the data from local authorities and various agencies, we have also collated economic data from sources such as ONS and DfT (the latter via the WebTAG Wider Impacts Dataset). This covers the following:

- **ONS GVA data** (from the most recent dataset available – the 2014 data was made available from ONS on 9th December 2015). The dataset includes:
 - 2014 Workplace GVA by NUTS3 area (see below for further explanation of NUTS3 areas)
 - 2014 Workplace GVA per head (by NUTS3 area) – this represents productivity
 - 2014 Workplace GVA by industry (NUTS3 level)
 - 2012 Workplace-based compensation of employees (NUTS2) – this represents the amount of GVA accounted for by incomes paid to employees and is used, amongst other purposes, as part of the process to calculate corporation tax benefits
- **ONS NOMIS data** (from the latest online dataset available). The dataset includes:
 - Employment data per Local Authority (July 2014 to June 2015 annual data)
 - Earnings data per Local Authority (2015 data)
 - Data on JSA claimants and numbers of businesses per Local Authority
- **DfT Employment / GDP per worker data** (from the current WebTAG “Wider Impacts” dataset). This includes:

- Total employment by Local Authority District (LAD) at five year intervals between 2006 and 2076
- Employment by sector (by LAD) at five year intervals between 2006 and 2076
- GDP per worker by sector (by LAD) for each five year interval as above

Given the importance of this data, further details are provided below.

ONS GVA DATA

The “NUTS3” level is the lowest geography by which ONS produces GVA and productivity data. NUTS stands for Nomenclature of Territorial Units for Statistics and is a standard ‘economic geography’ mapping system used throughout the EU.

To demonstrate this, the NUTS1 level covers the South East region as a whole whilst under this, NUTS2 covers 1) “Berkshire, Buckinghamshire and Oxfordshire”, 2) “Surrey, East and West Sussex”, 3) “Hampshire and Isle of Wight” and 4) “Kent”.

For the analysis we are undertaking, we have compiled data for the following NUTS3 areas in the study geography (highlighted in underscored bold). This also covers the more disaggregated geography incorporated in the December 2014 ONS updates:

→ Berkshire, Buckinghamshire and Oxfordshire:

- **Berkshire**

→ Surrey, East and West Sussex:

- **Brighton and Hove**
- **East Sussex CC**
- **West Surrey**
- **East Surrey**
- **West Sussex (South West)**
- **West Sussex (North West)**

→ Hampshire and the Isle of Wight:

- **Portsmouth**
- **Southampton**
- **North Hampshire**
- **Central Hampshire**
- **South Hampshire**
- **Isle of Wight**

The final NUTS2 area (“Kent”) has not been used as this comprises two sub-regions in the county that are outside our study area (Medway and Kent CC).

We do, however, use GVA data from outside the above NUTS3 areas when looking at corridors that link the study area with ‘outside’ areas. Examples include Wiltshire, Tunbridge Wells, Christchurch and Bournemouth.

As well as the study area defined above, ONS data is also available for the neighbouring LEP areas as defined in the study brief. The ONS datasets are the most comprehensive and up to

date available (note that due to the complexity of collating GVA data, each annual release represents one year in arrears – i.e. the data released in December 2015 was for 2014).

As well as the headline GVA data, productivity metrics are also available from ONS in the form of 'GVA per capita' data. GVA data is also disaggregated by 'worker compensation' (i.e. incomes) and by industrial sector in each area. Both are important datasets and have been used in this analysis. This is explained in more detail in Chapter 3.

ONS have also recently expanded their dataset to cover GVA and productivity for each of the LEPs. As an illustration of just how important the South East (and study area) is in terms of economic activity at a national level, the following two charts from ONS illustrate high performance relative to the UK average.

Figure 2-1 Nominal GVA per Hour Worked - Highest Ranking NUTS3 Sub-regions, 2013

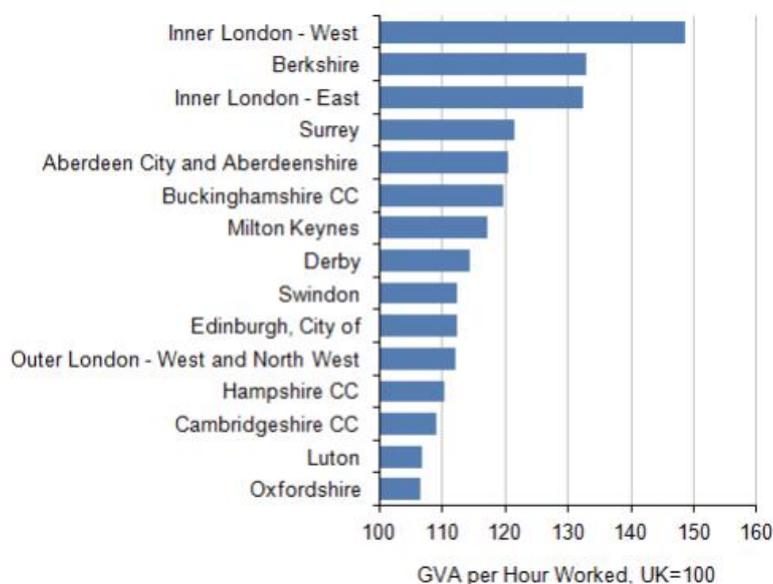
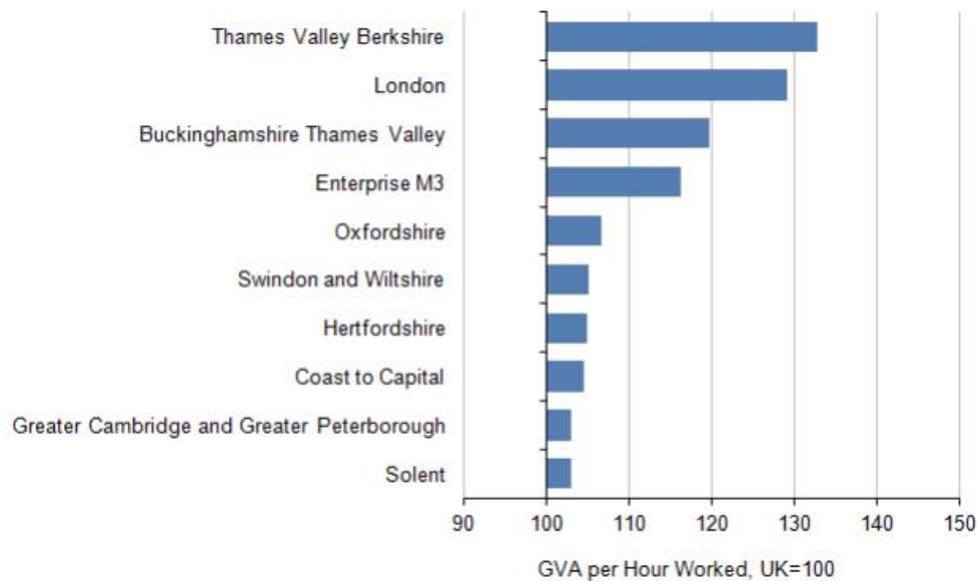


Figure 2-1 clearly shows how three of the areas in study area (Berkshire, Surrey and Hampshire) out-perform the UK average with Berkshire only second to Inner London West. This clearly shows the 'economic importance' of key areas in the South East as more GVA is produced per hour worked compared to many other parts of the country. The South East therefore has the potential to continue contributing substantially to national wealth and the consequent economic benefits this provides to the country as a whole. As a further example of this, Berkshire's GVA per head (based on the most recent ONS data) is almost 85% higher than that in Birmingham.

Figure 2-2 shows similar data, this time for the highest-ranking LEPs, with all four 'study LEPs' ranked in the Top Ten in terms of productivity performance (relative to the national average).

Figure 2-2 Nominal GVA per Hour Worked - Highest Ranking LEPs, 2013



Even before any corridor analysis is undertaken, these are extremely powerful metrics and indicate that with improved transport infrastructure in place, the already strong economic performance (with consequent national benefits) will improve even further.

NOMIS DATA

ONS also publishes NOMIS (“National Online Manpower Information System”) demographic and labour market data. This is up to date data and is important for our work as we use it to disaggregate the available GVA data to more localised areas.

In Berkshire, for example, NOMIS data for employment in each Local Authority District (LAD) can be used alongside workplace earnings data to enable us to apportion Berkshire GVA data to each LAD. Unsurprisingly, the highest proportion of GVA is generated in Reading.

The use of NOMIS is explained in more detail in Chapter 3.

DfT “WIDER IMPACTS” DATA

“Wider Impacts” is the term used by DfT in its WebTAG guidance for transport appraisal. Wider Impacts in this context cover Agglomeration and Labour Market impacts. The former refers to improvements in economic activity in a certain area due to transport improvements whilst the latter labour market changes due to these improvements (i.e. the national benefit of more workers becoming economically active as a result of the transport intervention).

The dataset developed by DfT to calculate these impacts will be used for this study and covers each Local Authority District in the country as well as four key industrial sectors in the economy (Construction, Consumer Services, Manufacturing and Producer Services).

Unlike the ONS data described above (based on out-turn metrics), the DfT WebTAG dataset is provided as a forecast up to 2076.

One key proviso made clear in the dataset is that these forecasts should not be used for any purpose other than estimating Wider Impacts. Their usage for this work is described in Chapter 3.

At the time of writing (February 2016), the DfT's wider economic impacts guidance is being updated to reflect TIEP report recommendations. The update will cover 1) more context-specific appraisals, 2) more transparent reporting and 3) greater consideration of land use change. The elasticities used for Wider Impacts calculation will also be updated with the final guidance update scheduled for November 2016.

Finally, the extent of geographical coverage in the dataset is shown in Table 2-2 below.

Table 2-2 Local Authority Districts in DfT Dataset

COUNTY LEVEL	LOCAL AUTHORITY DISTRICT (LAD)	LEP
West Sussex	Adur	Coast to Capital
	Arun	Coast to Capital
	Chichester	Coast to Capital
	Crawley	Coast to Capital
	Horsham	Coast to Capital
	Mid Sussex	Coast to Capital
	Worthing	Coast to Capital
Berkshire	Bracknell Forest	Thames Valley Berkshire
	Reading	Thames Valley Berkshire
	Slough	Thames Valley Berkshire
	West Berkshire	Thames Valley Berkshire
	Windsor and Maidenhead	Thames Valley Berkshire
	Wokingham	Thames Valley Berkshire
East Sussex	Brighton and Hove	Coast to Capital
	Eastbourne	(rest of East CC area)
	Hastings	(rest of East CC area)
	Lewes	Coast to Capital
	Rother	(rest of East CC area)
	Wealden	(rest of East CC area)
Hampshire	Basingstoke and Deane	Enterprise M3
	East Hampshire	Enterprise M3 / Solent
	Eastleigh	Solent
	Fareham	Solent
	Gosport	Solent
	Hart	Enterprise M3
	Havant	Solent
	New Forest	Enterprise M3 / Solent
	Portsmouth	Solent
	Rushmoor	Enterprise M3
	Southampton	Solent
	Test Valley	Enterprise M3 / Solent
	Winchester	Enterprise M3 / Solent
	+ Isle of Wight	Solent
Surrey	Elmbridge	Enterprise M3
	Epsom and Ewell	Coast to Capital
	Guildford	Enterprise M3
	Mole Valley	Coast to Capital
	Reigate and Banstead	Coast to Capital
	Runnymede	Enterprise M3
	Spelthorne	Enterprise M3
	Surrey Heath	Enterprise M3
	Tandridge	Coast to Capital
	Waverley	Enterprise M3
	Woking	Enterprise M3

3 METHODOLOGY

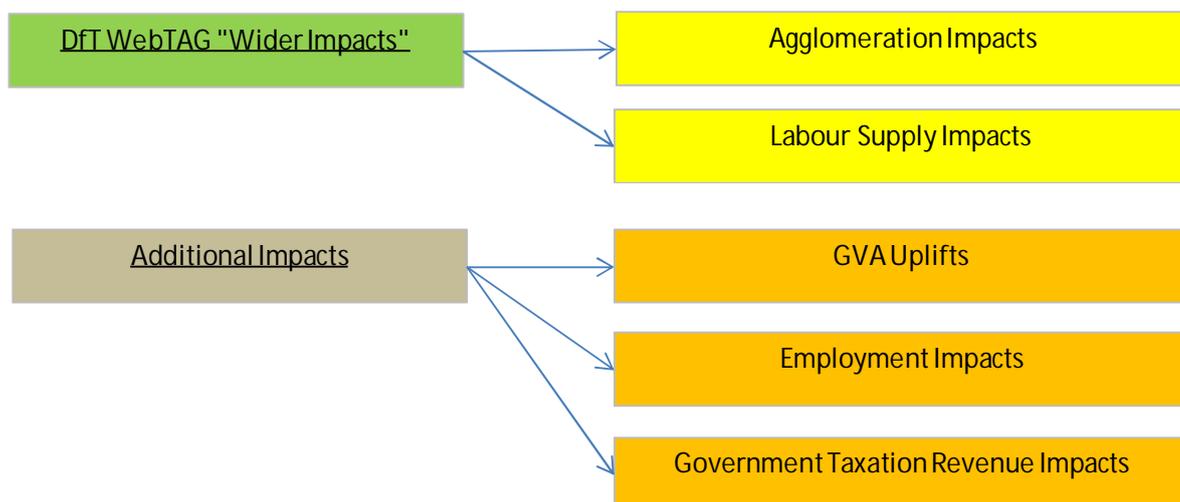
3.1 INTRODUCTION

In this chapter, we set out the methodology used. There are several key features:

1. The “building blocks” of the analysis use recognised guidance based on Treasury Green Book principles (i.e. DfT’s WebTAG approach covering Wider Impacts is itself based on Green Book guidance);
2. Although founded on WebTAG principles, several add-on economic impacts and metrics are derived (such as the impacts improved productivity has on regional GVA, employment and taxation revenues);
3. The impacts are calculated in two ways: 1) firstly, as a “snapshot” of current impacts (i.e. what is the economic impact if the change took place now?) and 2) what is the “longer term” (or forecast) impact over time? – this is explained in more detail below;
4. The approach is used at a high level to identify and prioritise corridors before more detailed analysis takes place for shortlisted corridors (i.e. to include proposed residential developments etc.); and
5. The method is designed to be flexible enough to be able to test several different strategic movement corridors.

To broadly demonstrate which elements of the approach are based on current DfT guidance and which are additional to this current guidance, Figure 3-1 illustrates the various types of impacts and on what basis they are derived.

Figure 3-1 Components of Methodology



We recognised the importance of gaining stakeholder acceptance of the method and in particular, acceptance from DfT given their ongoing work on assessing the wider impacts of transport schemes.

As noted in Section 2.2, we met with DfT on Thursday 19th November at which the following was discussed:

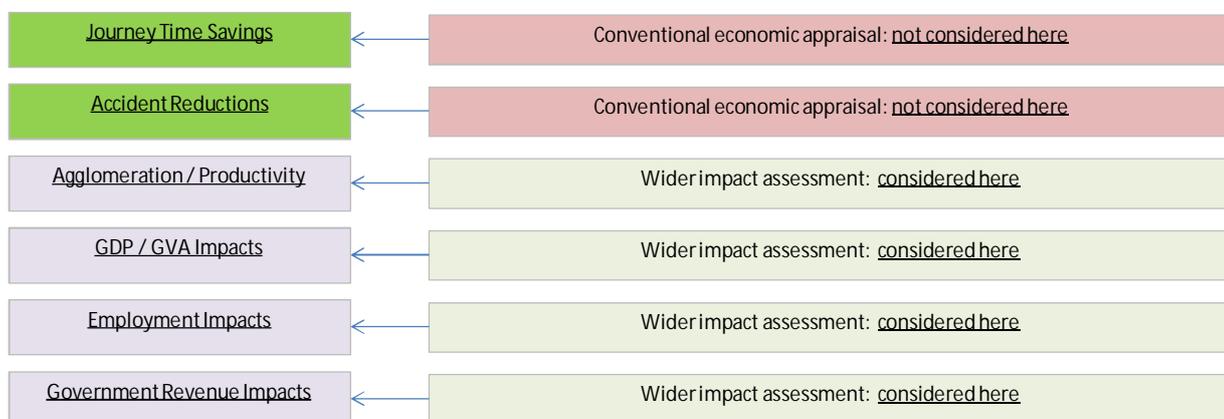
- The intended outcomes of the study;
- The method to be used for this study; and
- Discussion of DfT's own "direction of travel" on assessing the impact of transport on economic development and productivity.

DfT noted the proposed approach, especially the use of current WebTAG guidance and the use of changes in generalised costs of travel to calculate a range of productivity-based economic benefits. We also sought clarification from DfT on a number of data source issues.

Before setting out the approach, it is important to state that transport schemes also generate 'conventional' benefits as well as the wider impacts we are assessing here. Although conventional impacts such as monetised journey time savings and the value of reduced accidents are not quantified here, they nevertheless form part of the justification for transport schemes and when included as part of a full business case, are likely to boost the overall justification for the schemes.

Figure 3-2 sets out the key types of impacts of a transport scheme and those that are quantified as part of this study.

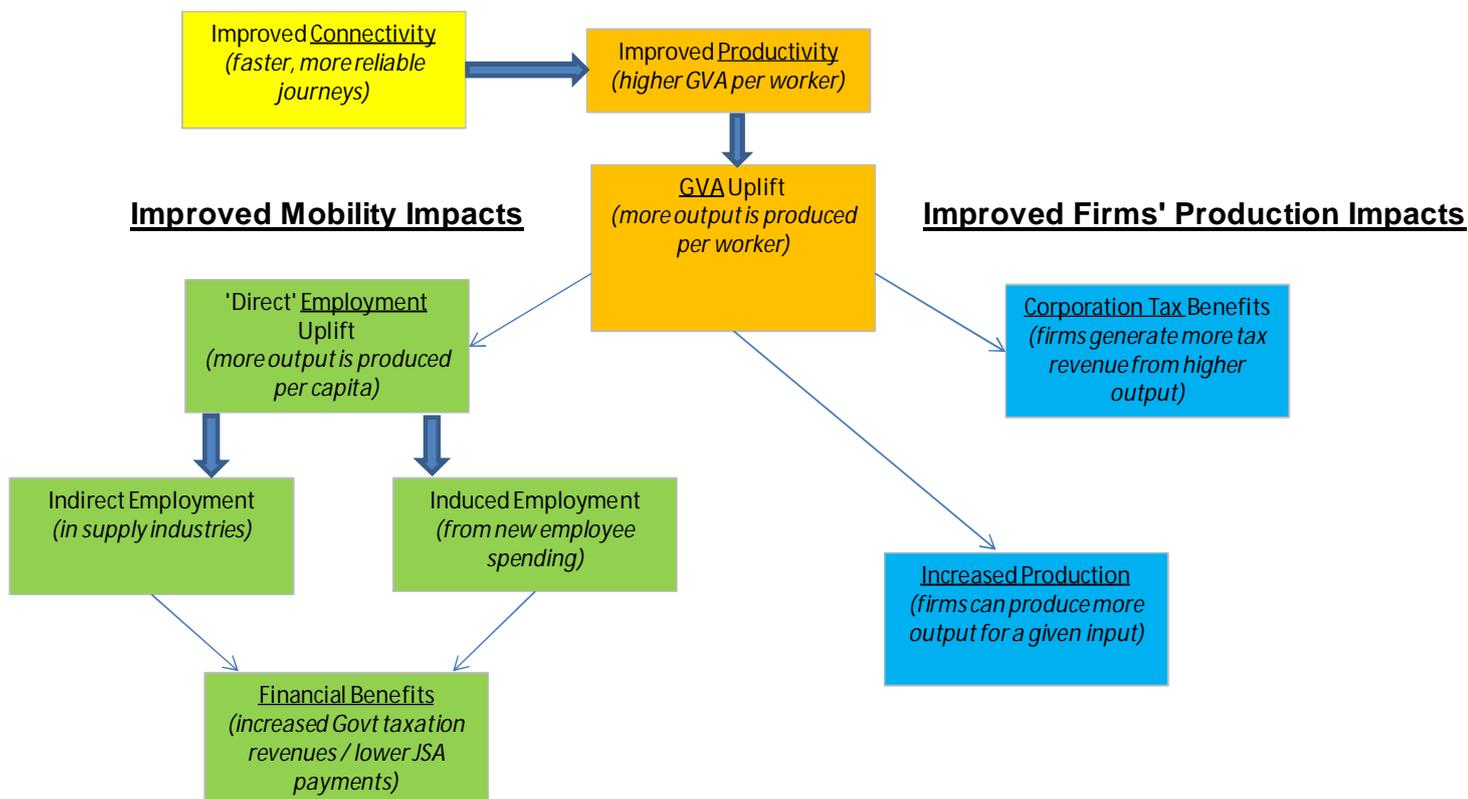
Figure 3-2 Conventional and Wider Economic Impacts of Transport Schemes



3.2 OVERVIEW OF METHOD

To provide an overview of the method, Figure 3-3 shows the key economic impacts that flow from improved connectivity.

Figure 3-3 Overview of Method



The following describes this process:

- In the yellow box, this shows that the principal driver of change (and economic benefits) is the improvement in connectivity in each corridor;
- In the orange boxes, the key effects of improved connectivity are 1) **increased productivity** (due to agglomeration benefits as workers now have better access to higher value jobs and businesses now have better access to a larger pool of suitably skilled workers) and 2) **increased GVA** stemming from higher productivity per worker;
- The green boxes labelled under “Improved Mobility Impacts” refer to the benefits that are primarily due to the improvements in personal mobility (such as better access to / from labour markets) arising from corridor improvements. As well as additional employment supported by increased economic activity, there will be financial benefits to Government in the form of increased income taxation; and
- The blue boxes (under “Improved Firms’ Production Impacts”) indicate the types of impacts associated with improved corporate and business activity. These impacts include 1) increased corporation tax due increased profits from enhanced activity and 2) potential gains from decreases in firms’ production costs (i.e. with reduced transport costs, firms can produce the same level of output at lower costs).

Whereas Figure 3-3 sets out the range of economic impacts stemming from better connectivity, the key steps in the method are as follows:

- The study area (i.e. the area covered by the four LEPs plus the rest of the East Sussex County Council areas as well as the linkages to neighbouring LEPs and London) is mapped with the respective Local Authority Districts (LADs) acting as zones;
- Each potential strategic movement corridor is represented by a link between Origin Point A and Destination Point B (for example, the Brighton Main Line is one such corridor with the A3 road corridor between Guildford and Portsmouth being another);
- Given current DfT “agglomeration” guidance, a productivity impact of improving journey time / journey reliability can be used in each corridor for two purposes:
 - To identify and prioritise corridors relative to each other (i.e. a transformative 15 minute journey time improvement in one corridor may have a very different impact compared to the same improvement in another corridor)
 - To calculate the economic impacts of improvements in each corridor
- Once the productivity impact has been calculated, this can be used to calculate a series of economic benefits, including increased GVA, employment and Government financial benefits; and
- Using graphics and figures, these impacts can be shown on a series of diagrams and maps.

Figure 3-4 shows an example of how this process works in practice. The example chosen is the A3 corridor improvement between M25 Junction 10 (in Elmbridge Borough Council) and Portsmouth.

Figure 3-4 Example of Corridor Improvement Method

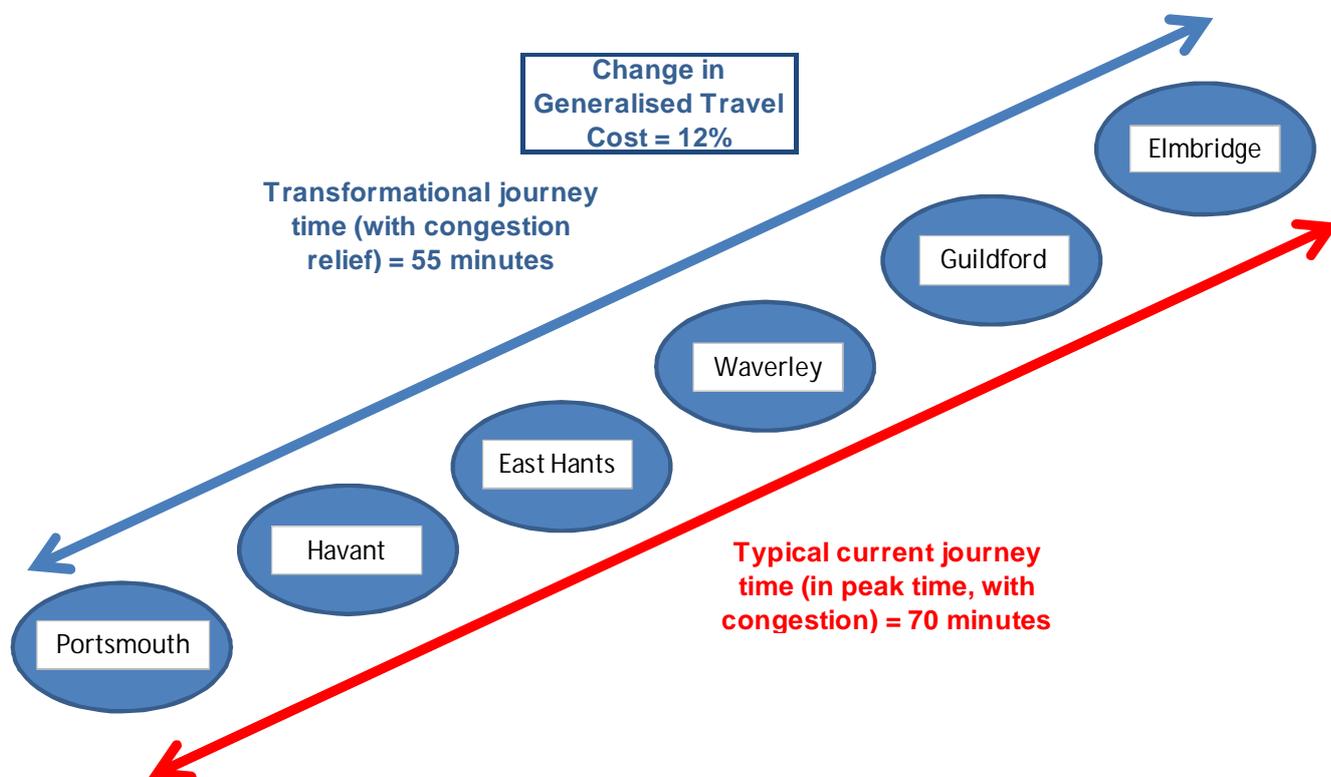


Figure 3-4 shows the Local Authority Districts that the A3 corridor passes through. Assuming a current 'worst case' (congested) journey time of 70 minutes – including, for example, severe delays in the Guildford area – a transformative corridor improvement (suitable widening of the Guildford section etc.) could give a journey time / journey reliability improvement of 15 minutes.

Taking into account given travel values of time and fuel costs, the change in generalised costs (i.e. the monetised value of all key elements of the journey) will be approximately 12% - *in other words, a 12% reduction in generalised costs.*

There are published elasticities by each different sector of the economy (WebTAG categorises these as 1) Construction, 2) Consumer Services, 3) Manufacturing and 4) Producer Services). The elasticities are ratios that are used to calculate the percentage change in productivity based on the percentage change in generalised costs.

The following shows how this process works for each of the four sectors:

- **Construction:** elasticity = -0.057: i.e. a 10% *decrease* in generalised costs gives an 0.6% *increase* in productivity;
- **Consumer Services:** elasticity = -0.047: i.e. a 10% *decrease* in generalised costs gives an 0.5% *increase* in productivity;
- **Manufacturing:** elasticity -0.025: i.e. a 10% *decrease* in generalised costs gives an 0.3% *increase* in productivity;
- **Producer Services:** elasticity -0.157: i.e. a 10% *decrease* in generalised costs gives an 1.6% *increase* in productivity.

To establish whether these 'national' elasticities could be adjusted to reflect more local factors, the Transport Appraisal and Strategic Modelling (TASM) team at DfT were contacted. Their advice was that although agglomeration elasticities are estimated nationally, where a robust case is made for it, it is possible for scheme promoters to utilise more context-specific (for example regional) elasticities. These would be drawn from the literature or estimated from available data. Results from such an approach should be reported as a sensitivity test alongside results using WebTAG elasticities. For this analysis, this could form the basis of more detailed corridor assessment where this is required in future.

It is the changes (reductions) in the generalised cost of travel within each corridor that drives changes in productivity, GVA and the various other economic and financial metrics. Taking the A3 corridor improvement in Figure 3-4, for example, the impacts will be calculated for all LADs in the corridor and not just the 'origin' (e.g. Elmbridge) and 'destination' (e.g. Portsmouth) areas.

For each LAD and for each of the four sectors, the following is calculated:

- The total GVA uplift based on the percentage increase in productivity multiplied by a) GVA per worker, b) total number of workers and c) the proportion of economic activity in that particular sector;
- Direct employment based on the uplift in GVA divided by the amount of GVA required to support each worker in each LAD (the proportion of GVA spent on employee incomes and the proportion of GVA 'spend' retained in each area is also taken into account); and
- Indirect and induced employment is calculated by applying standard employment multipliers to the direct employment totals.

The employment impacts are used to derive **income taxation benefits** to Government as well as the **JSA payment savings** resulting from more workers moving into employment. Both these impacts demonstrate the 'wider' financial gains for Government and use income distribution and JSA data from official statistical sources.

Corporation taxation benefits are calculated by applying the proportion of GVA representing corporate profits and the corporation tax rate to the uplift in GVA.

The economic value of the **increase in production** due to corridor improvements applies to the two sectors most likely to benefit from these impacts; a) the Construction sector and b) the Manufacturing sector. Activities in each of these sectors comprises some form of physical output that can be produced for a lower unit cost when transportation improves within each corridor.

The economic value of these impacts is calculated by applying an elasticity value (-0.052) to the change in generalised cost in each corridor and to the total GVA representing each of the two sectors. The resulting value is a further uplift in GVA.

The above method has several advantages:

- It is based on recognised methods and can be calculated relatively quickly given the information already available;
- It is flexible and can be used to assess different types and lengths of corridors (featuring different modes);
- Once the productivity impacts have been calculated, these can be applied to the latest ONS GVA data to give a regional and national impact; and
- There is sufficient flexibility in the input assumptions for each corridor so that these can be adjusted for sensitivity testing.

It is also important to emphasise that the types of economic benefit described above are based on a “snapshot” of the impacts. In other words, it is possible to calculate the benefits that are likely to occur using current year data for each corridor.

“**Long term**” forecasts have also been produced and these form part of the high level cost-benefit appraisal of each shortlisted proposal. This enables the benefits to be forecast over a given period.

3.3 DATA SOURCES USED

There are several different data sources used. To summarise these and to indicate the geographical disaggregation of the data, Table 3-1 shows each key item and its source.

Table 3-1 Data Sources

DATA CATEGORY	GEOGRAPHY	SOURCE
GVA (includes GVA by industry sector)	NUTS3 level (2013 data released in December 2014)	ONS
GVA (includes GVA by workplace income)	NUTS2 level (2012 data released in December 2014)	ONS
Employment and average earnings data	Local Authority District (LAD) level	ONS NOMIS
Agglomeration elasticities	(By four key sectors in the economy)	DfT WebTAG (Unit A2.1)
Economic output (expenditure) retained in region	General UK data	ONS: detailed household expenditure by gross income quintile group for all households, 2010-2012
Percentage of GVA representative of corporate profit	General UK data	ONS: discussion with Trevor Fenton, Regional Accounts, 27.11.15
UK income distribution by earnings bands	South East data	Govt statistics: https://www.gov.uk/government/statistics/income-and-tax-by-gender-region-and-country-2010-to-2011
UK JSA data	General UK data	Govt statistics: https://www.gov.uk/jobseekers-allowance/what-youll-get

4 IDENTIFICATION OF MOVEMENT CORRIDORS

4.1 INTRODUCTION

We have used a combination of economic data, transport information and general knowledge of the South East region to identify and define strategic movement corridors. The corridors are defined at a high strategic level and comprise both **existing** and **potential** corridors.

This chapter contains a summary of these corridors and the rationale for their selection and further analysis. Once the corridors have been identified, they are prioritised based on the further analyses reported in Chapter 5.

4.2 BASIS FOR SELECTING CORRIDORS

The selection of corridors was based on several factors, including an in-depth appreciation of the key centres of economic activity in the study region and the key transport issues affecting the region. The basis for selecting the corridors is as follows:

- For **existing** corridors, corridors were selected on the basis of known high traffic flows, capacity constraints (especially during busy 'peak' periods) and the extent to which the corridors have a major 'connectivity' purpose. Examples include:
 - **A3 Corridor:** despite the opening of the Hindhead Tunnel in 2011, the A3 continues to experience significant congestion on key sections
 - **Brighton Main Line:** the rail link between Brighton and London provides essential connectivity not only between the South Coast and the capital, but also between major towns on the route
 - **A27 Corridor:** this major road corridor is one of the key transport arteries along the South Coast and experiences significant congestion at key pinchpoints

- For **potential** corridors, a slightly different set of criteria applied as the objective here was to identify corridors where there was unlikely to be major existing flows but nevertheless considerable potential for providing transformative links between major centres. Examples include:
 - **Mid-Sussex to Thames Valley Road Corridor:** linking Horsham with Reading and the Thames Valley, this road would provide a vital new north-south corridor linking mid-Sussex with the economic powerhouse in the Thames Valley
 - **Southern Access to Heathrow:** this new corridor (including use of key sections of existing rail links) would provide crucial southern access to Heathrow Airport from locations such as Guildford, Woking and Staines
 - **"South Sussex Way"** – this is a transformational corridor linking Salisbury (via the A36) with Winchester, Petersfield, Horsham and Tunbridge Wells (to connect with the A21)

The corridors selected do not include some of the principal motorway corridors (such as the M25) as these are currently the subject of other major studies, including Highways England's "M25 South West Quadrant Study" and the various Route Based Strategy (RBS) analyses being undertaken.

The selection of corridors also reflected discussions with stakeholders with the second consultation event on Monday 7th December 2015 providing useful feedback on the initial series of corridors selected.

The corridors also reflected the work already being undertaken in certain LEP areas. We have liaised, for example, with the AECOM team working on Solent's Transport Investment Plan and have therefore selected corridors that reflected their emerging findings.

Examples include improvements in the crucial Southampton to Portsmouth corridor as well as improved links between the Solent area and the other LEP areas (such as the M3 / A34 corridor north of Southampton).

As part of the stakeholder consultation events, the transport mode to be assessed for each corridor was discussed. Taking the 'A3' corridor improvement as an example, the analysis could either focus on the upgrade being based on a single mode (such as road) or could cover both rail and road improvements.

It was agreed that the initial high level economic impact analysis would focus on each corridor initially with further work at the feasibility stage focussing on the most appropriate mode to take forwards.

Rather than view the corridor improvements as low-key, we have assumed that the changes will be 'transformational' in that major journey opportunity, time and reliability enhancements will take place.

Also, the advantage of our method is that we have sufficient flexibility to make quick adjustments to our input assumptions so that the economic impacts can be readily tested.

Finally, the list of corridors is not exhaustive and is primarily intended to demonstrate the economic potential of a series of major transformative corridors across a large area in the South East.

4.3 CORRIDORS EVALUATED

The series of corridors evaluated are summarised in Table 4-1.

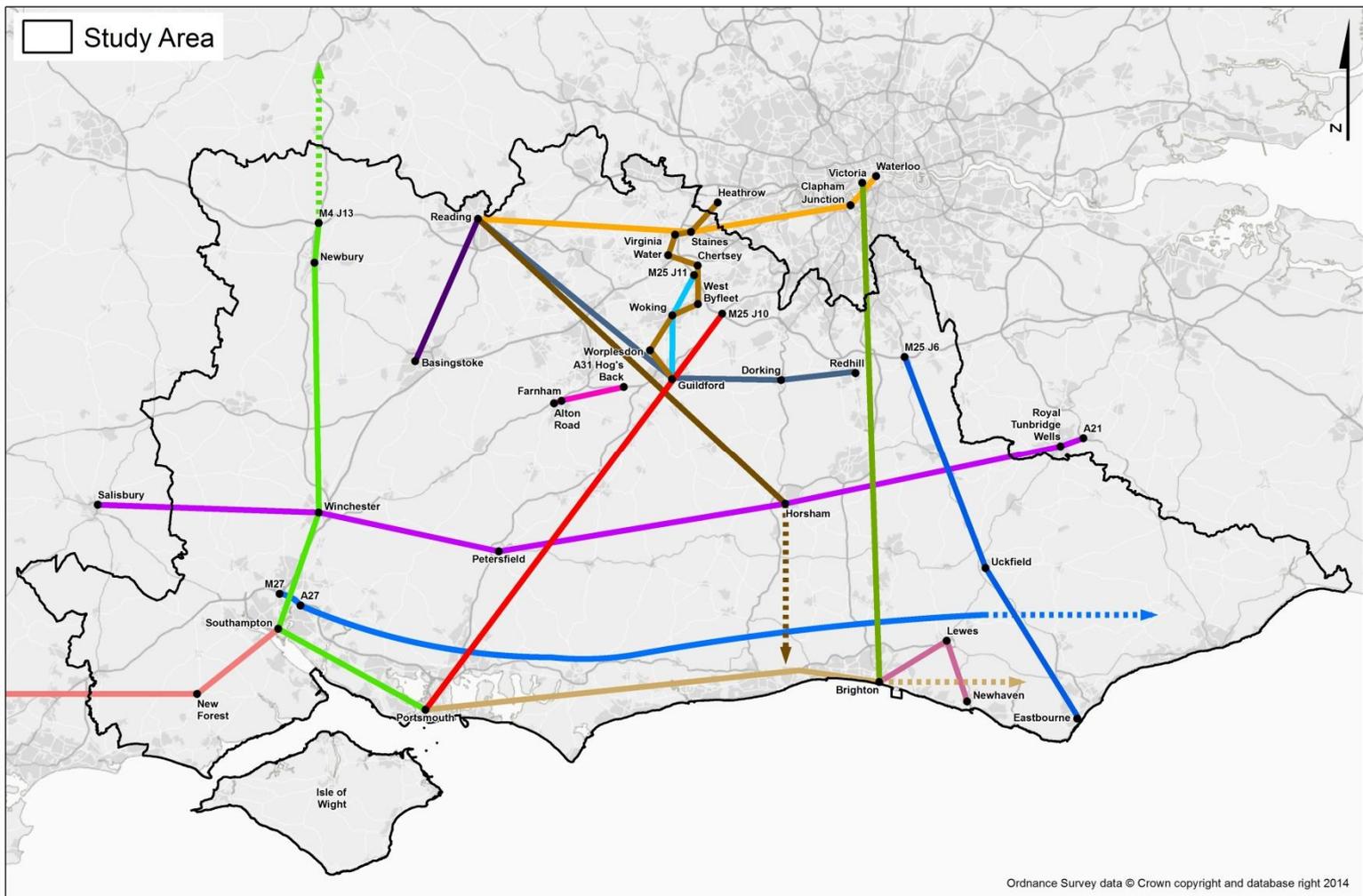
Table 4-1 Corridors Selected for Evaluation

SCHEME	DESCRIPTION / STATUS	RATIONALE
A3 Corridor Improvement	Upgrade of corridor between Surrey and the outskirts of Portsmouth	The corridor between London and Portsmouth – whether by rail or road – is a key transport artery and experiences severe delays at busy periods
A22 Corridor Upgrade	An improvement in the corridor linking Eastbourne on the South Coast with Surrey, the M25 and points further north	The existing A22 road corridor (and parallel rail routes) does not offer good connectivity between this part of East Sussex and points further north (including the M25 and London)
A27 Corridor Improvement	Upgrade of the corridor between Brighton and Portsmouth	There are several 'bottlenecks' on the A27 (e.g. at Arundel and Chichester) – this is a major east-west corridor near the South Coast (note also that the 'Coastway' rail route parallels the A27)
A31 Upgrade	An improvement to the Hog's Back - Farnham - Alton road corridor	The A31 (and its intersection with the A3 near Guildford) is one of the main 'bottlenecks' in this part of Surrey and Hampshire

A33 Road Upgrade (Basingstoke – Reading)	An upgrade of this key road corridor	Traffic data shows how busy this corridor is between two of the key centres of employment in the region
A34 Corridor Upgrade (Southampton to Newbury and M4 J13)	An upgrade of this key road corridor	This is another busy, 'economically important' corridor in the region (traffic data also shows high flows)
A320 Corridor Upgrade	An upgrade of the A320 road corridor linking Guildford with Woking and M25 Junction 11	Based on previous WSP PB work for Surrey CC, Guildford BC and Woking BC, this is one of the key congested corridors in the area
Brighton Main Line Upgrade	Upgrade of the main rail link between Brighton and London	This is one of the main transport corridors in the region (note that the parallel road corridor is the M23 via Gatwick Airport)
Mid-Sussex to Thames Valley New Corridor	A new 'transformative' corridor between mid-Sussex and the Thames Valley	Given the lack of north-south corridors in the region, this transformative corridor will link these two key areas – note that there is also some overlap with the proposed 'North Downs Line' upgrade
Newhaven - Lewes - Brighton Corridor Upgrade	An upgrade of this important corridor between Newhaven and Lewes	The links between these major towns on the South Coast currently involves a time-consuming journey, including the very busy junction between the A26 and A27
North Downs Line Upgrade	Upgrading the current diesel-operated line between Redhill, Reigate, Dorking, Guildford and Reading (this route also provides a direct link between Redhill and Gatwick Airport)	This upgrade would involve enhancing connectivity on this critical corridor – although this has some similarities with the proposed Mid-Sussex to Thames Valley corridor described above, the rail route travels on an east-west axis before heading north between Guildford and Reading
Reading - Waterloo Rail Upgrade	An upgrade of the line between Reading, Bracknell and London Waterloo	Given continued economic growth in the Thames Valley area and relatively slow rail journey times in this corridor, these improvements will allow the key towns in Berkshire to be better connected to various locations on the line into Waterloo
'Southern Access to Heathrow'	A new rail link between Guildford and Heathrow (via Woking, Virginia Water, Staines & Heathrow Airport)	This new corridor will open up new journey opportunities between Guildford, Gatwick - and points south of Heathrow - and the airport
Southampton - New Forest Corridor Upgrade (M27 / A31)	An improvement on the M27 and A31 heading west out of Southampton and the Solent area	This is a busy transport artery connecting Southampton with the New Forest and all points west (such as Poole and Bournemouth)
Southampton to Portsmouth Corridor Upgrade	Both cities in the Solent area are economic 'powerhouses' in their own right and improved connectivity between them will offer significant agglomeration benefits	By improving the existing rail corridor significantly, journey times will be reduced allowing far better connectivity for businesses and workers
"South Sussex Way"	Salisbury (A36) – Winchester – Petersfield –Horsham - Tunbridge Wells to connect with the A21	This is a transformational corridor that will link Wiltshire with Hampshire, Sussex and Kent
"South Coast Relief Road"	This comprises a bypass to the M27 and A27 for traffic not wishing to access Portsmouth, Southampton and Brighton	This transformational corridor will enable drivers to bypass the already congested centres in Portsmouth, Southampton and Brighton

Figure 4-1 shows the geographical location of the corridors across the study area. The figure also shows how the corridors can combine to form a transport movement 'network' across the region and by implication, how important this will be in terms of supporting economic growth (at both the regional and national level).

Figure 4-1 Selected Corridors in the Study Area



5 PRIORITISATION OF CORRIDORS

5.1 INTRODUCTION

The purpose of this chapter is to summarise the findings from the corridor analysis and to use the outcomes of this analysis to prioritise the corridors in terms of the economic benefits they generate.

This process uses the economic methodology described in Chapter 3 and covers the sectoral make-up of the individual economies (in this context, individual economies are those of the Local Authority Districts, LADs, in the study area).

In the final part of the chapter, we address how the movement corridors relate to each other to address issues across the South East and the wider area.

5.2 RESULTS

The results are presented in a series of tables that show the key economic metrics for each corridor.

In overall economic impact terms (ensuring there is no double counting of benefits across corridors serving similar geographies), total additional annual GVA would exceed £19.5 billion with over 100,000 additional jobs supported by this additional economic activity. Government would also gain annual additional revenue of £1.2 billion from personal income taxation and just under £1 billion per annum from corporation taxation.

The values shown in the tables below represent the *additional* benefits generated by the improvements in each corridor. These additional benefits cover the improvements in existing corridors as well as the transformative improvements associated with the new corridors.

The 'headline' impact is the additional GVA generated with the other monetary values shown not necessarily additive to this but nevertheless demonstrating the extent of potential additional revenues accruing to Government.

Before prioritising the corridors, the results for each corridor are presented in the order shown in Table 5-1 onwards. Short descriptions per corridor are also given.

It is also important to emphasise that the results shown overleaf represent those in a single year, i.e. they show what the net impact would be if the change in each corridor took place at the present time. These are powerful impact metrics and they demonstrate the magnitude of the potential benefits of each strategic corridor.

A3 CORRIDOR IMPROVEMENT

Table 5-1 A3 Corridor Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£1.1 billion	6,000 jobs	£71 million	£55 million	£34 million	£19.6 million

The results show the impact of a significant improvement in a long-distance corridor connecting not only two major conurbations (London / Surrey and Portsmouth) but also the intermediate local authority areas affected by the upgrade.

A22 EASTBOURNE - LEWES - UCKFIELD - SURREY CORRIDOR IMPROVEMENT

Table 5-2 A22 Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£250 million	1,600 jobs	£19 million	£12 million	£14 million	£5.7 million

This corridor upgrade is based on improving the A22 corridor as far north as the M25 interchange near Godstone in Tandridge. The impacts are therefore concentrated in the boroughs of Eastbourne, Wealden, Mid Sussex and Tandridge. The improvement will also, however, enhance connectivity via the M25 and thus a much wider range of journey opportunities will be opened up.

A27 CORRIDOR UPGRADE

Table 5-3 A27 Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£1.5 billion	9,300 jobs	£111 million	£75 million	£32 million	£31.3 million

Upgrading the existing A27 corridor between Brighton and Portsmouth has been a major regional objective for a significant period of time. By improving connectivity through eliminating the bottlenecks at Arundel and Chichester, for example, a large number of economic benefits will accrue. The upgrade also gives much needed connectivity improvements to the fast-growing Solent economic area.

A31 HOG'S BACK - FARNHAM - ALTON CORRIDOR IMPROVEMENT

Table 5-4 A31 Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£188 million	1,000 jobs	£12 million	£9 million	£19 million	£9.4 million

Compared to some of the other corridor improvements, this proposed upgrade has one of the lowest levels of impact. At this stage we have considered the benefits as accruing in the LADs of Guildford and East Hampshire given that these are the areas most affected by current congestion levels.

A33 BASINGSTOKE - READING CORRIDOR UPGRADE

Table 5-5 A33 Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£728 million	3,400 jobs	£41 million	£35 million	£39 million	£42.8 million

The A33 connects two of the principal centres of economic activity in the South East and by upgrading this corridor, various benefits will accrue. These include GVA uplifts from increased agglomeration and firms' production increases as well as the financial gains to Government shown in Table 5-5.

A34 CORRIDOR UPGRADE (SOUTHAMPTON - NEWBURY / M4 J13)

Table 5-6 A34 Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£1 billion	5,900 jobs	£70 million	£50 million	£22 million	£23.9 million

As well as having high traffic flows, the A34 corridor between Southampton, Newbury and Junction 13 of the M4 (and then points further north) has a very important strategic role to play. This strategic role encompasses the connectivity the corridor provides between Southampton (and its major port) and points north, including the Midlands and beyond. Given that this is one of the most important 'north – south' corridors in the region, its upgrade will not only improve north – south connectivity but will also help relieve the pressure on some of the more 'east to west'-facing corridors.

A320 CORRIDOR UPGRADE

Table 5-7 A320 Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£545 million	2,500 jobs	£29 million	£26 million	£20 million	£42.3 million

Although one of the shorter corridor upgrades in terms of distance, the A320 remains one of the most important (and most congested) routes in Surrey. As well as congestion coming on / off the A3 and on to the A320, traffic volumes are also very high on this main route to Woking and the M25. As Table 5-7 indicates, even in this comparatively 'localised' area, there will be significant benefits.

BRIGHTON MAIN LINE UPGRADE

Table 5-8 BML Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£1.5 billion	7,500 jobs	£90 million	£70 million	£30 million	£21.9 million

Upgrading the Brighton Main Line (in the key "A23 / M23" corridor) will have significant benefits in Brighton, the Mid Sussex area, Crawley and Croydon. Agglomeration benefits will also accrue from improved access to the 'high value' jobs market in the City of Westminster.

MID-SUSSEX TO THAMES VALLEY NEW CORRIDOR

Table 5-9 Mid-Sussex to Thames Valley Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£3.6 billion	15,700 jobs	£189 million	£174 million	£85 million	£53.8 million

With such a major 'transformational' corridor, there will be significant economic benefits as workers will have much better connectivity with the Thames Valley area whilst workers will also be able to access high value jobs in the Gatwick Diamond area. Companies will also benefit from the transformational corridor as transport access and delivery times will be significantly reduced.

NEWHAVEN - LEWES - BRIGHTON CORRIDOR UPGRADE

Table 5-10 Newhaven –Lewes – Brighton Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£139 million	900 jobs	£11 million	£7 million	£7 million	£8.5 million

The results shown in Table 5-10 indicate the range and scale of the 'localised' economic impacts when the busy route between Newhaven and Brighton (via Lewes) is upgraded.

NORTH DOWNS LINE UPGRADE

Table 5-11 North Downs Line Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£1.9 billion	8,000 jobs	£97 million	£89 million	£27 million	£32.5 million

This rail corridor upgrade will also generate substantial economic benefits as much better connectivity will be provided between Surrey (on an east – west axis linking Redhill, Reigate, Dorking and Guildford) and Reading / the Thames Valley. The route also connects with Gatwick Airport via the section of line south of Redhill. As with the Reading – Waterloo line, current journey times are comparatively slow and the step change provided by this corridor improvement will generate a range of benefits.

READING - WATERLOO RAIL UPGRADE

Table 5-12 Reading to Waterloo Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£1.9 billion	7,500 jobs	£90 million	£90 million	£28 million	£43.5 million

This upgrade of the existing rail corridor between Reading and Waterloo will have several benefits, not least by providing much better connectivity for those travelling between the Thames Valley area and the west London suburbs as well as central London. The comparatively slow journey times on this corridor have been recognised as having a detrimental impact on the economic potential of the area.

SOUTHERN ACCESS TO HEATHROW

Table 5-13 Southern Access to Heathrow Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£1.8 billion	8,200 jobs	£100 million	£88 million	£38 million	£70.5 million

By upgrading existing lines and building new sections of line direct to Heathrow Airport, a large number of new journey opportunities will be opened up. Economic benefits will be generated as much needed access from key locations such as Guildford and Woking direct to Heathrow will be provided.

SOUTHAMPTON - NEW FOREST CORRIDOR UPGRADE (M27 / A31)

Table 5-14 M27 / A31 Corridor Upgrade Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£715 million	4,700 jobs	£56 million	£34 million	£20 million	£21.5 million

The corridor linking Southampton and the Solent area with points west is one of the most important corridors in the region and has been identified in current work being undertaken for Solent LEP. Given that congestion occurs regularly on the capacity constrained sections of the A31, a significant corridor enhancement will unlock significant economic benefits.

SOUTHAMPTON TO PORTSMOUTH CORRIDOR UPGRADE

Table 5-15 Southampton to Portsmouth Corridor Upgrade

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	GVA PER MILE
£2 billion	12,300 jobs	£150 million	£95 million	£65 million	£89.8 million

This corridor upgrade focuses on a major improvement to the existing rail line between the two cities (both being key economic 'powerhouses' in the region). With current rail services characterised by comparatively slow journey times and several stops en route, a major upgrade will not only provide enhanced connectivity but will also relieve the pressure (and traffic congestion) on the nearby road corridors. To meet its economic growth trajectory, the Solent area needs significantly improved transport connectivity and an upgrade of this corridor will help achieve this.

“SOUTH SUSSEX WAY” – NEW CORRIDOR

Table 5-16 “South Sussex Way” Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£4.4 billion	29,000 jobs	£346 million	£211 million	£113 million	£38.2 million

By constructing a transformative corridor in an alignment to the north of the existing M27 and A27 corridors (and therefore bypassing existing points of congestion), significant economic benefits will be generated. This reflects both the transformative effect of the corridor as well as the scale of the impacts realised in all affected local authority areas. These impacts are summarised in Table 5-16.

“SOUTH COAST RELIEF ROAD” – NEW CORRIDOR

Table 5-17 “South Coast Relief Road” Results

GVA	EMPLOYMENT	INCOME TAX GAIN	CORPORATE TAX GAIN	FIRMS' PRODUCTION GAIN	<u>GVA PER MILE</u>
£5.9 billion	36,000 jobs	£430 million	£282 million	£65 million	£86.3 million

This transformative corridor improvement demonstrates the highest level of economic benefits. There are several reasons for this: 1) the corridor covers a long distance and thus there will be benefits experienced across several local authority areas, 2) the transformative nature of the corridor means that compared to the present travel experience, significantly better connectivity will be generated. It is the scale of this differential (and the long distance nature of the corridor) that generates the large benefits shown in Table 5-17.

5.3 PRIORITISATION

Based on the analysis and results reported above, a ‘corridor prioritisation’ exercise has been undertaken. Based on the scale of high level economic benefits that have been estimated, the corridors are ranked as shown in Table 5-18 below.

Table 5-18 Initial Prioritisation of Corridors

SCHEME / RANKING	DESCRIPTION / STATUS	RATIONALE
1) “South Coast Relief Road”	This comprises a bypass to the M27 and A27 for traffic not wishing to access Portsmouth, Southampton and Brighton	This transformational corridor will enable drivers to bypass the already congested centres in Portsmouth, Southampton and Brighton
2) “South Sussex Way”	Salisbury (A36) – Winchester – Petersfield –Horsham - Tunbridge Wells to connect with the A21	This is a transformational corridor that will link Wiltshire with Hampshire, Sussex and Kent
3) Horsham - Reading New Road Corridor	A new ‘transformative’ corridor between mid-Sussex and the Thames Valley	Given the lack of north-south corridors in the region, this transformative corridor will link these two key areas – note that there is also some overlap with the proposed ‘North Downs Line’ upgrade
4) Southampton to Portsmouth Corridor Upgrade	A major upgrading of the existing rail corridor between these two key cities on the south coast	Current rail journey times are ‘uncompetitive’ compared to road (the road links themselves are heavily congested) – this transformative upgrade will thus provide much-needed connectivity enhancements
5) Reading - Waterloo Rail Upgrade	An upgrade of the line between Reading, Bracknell and London Waterloo	Given continued economic growth in the Thames Valley area and relatively slow rail journey times in this corridor, these improvements will allow the key towns in Berkshire to be better connected to various locations on the line into Waterloo
6) North Downs Line Upgrade	Upgrading the current diesel-operated line between Redhill (with onward connection to Gatwick Airport), Reigate, Dorking, Guildford and Reading	This upgrade would involve enhancing connectivity on this critical corridor – although this has some similarities with the proposed Mid-Sussex to Thames Valley corridor described above, the rail route travels on an east-west axis before heading north between Guildford and Reading
7) ‘Southern Access to Heathrow’	A new rail link between Guildford and Heathrow (via Woking, Virginia Water, Staines & Heathrow Airport)	This new corridor will open up new journey opportunities between Guildford, Gatwick - and points south of Heathrow - and the airport
8) A27 Corridor Improvement	Upgrade of the corridor between Brighton and Portsmouth	There are several ‘bottlenecks’ on the A27 (e.g. at Arundel and Chichester) – this is a major east-west corridor near the South Coast (note also that the ‘Coastway’ rail route parallels the A27)
9) Brighton Main Line Upgrade	Upgrade of the main rail link between Brighton and London	This is one of the main transport corridors in the region (note that the parallel road corridor is the M23 via Gatwick Airport)

10) A3 Corridor Improvement	Upgrade of corridor between Surrey and the outskirts of Portsmouth	The corridor between London and Portsmouth – whether by rail or road – is a key transport artery and experiences severe delays at busy periods
11) A34 Corridor Upgrade (Southampton to Newbury and M4 J13)	An upgrade of this key road corridor linking the strategically important area around Southampton (including the major port) and points north	This is another busy, 'economically important' corridor in the region. The 'north – south' route linking Southampton with Berkshire and all points north (including Oxford and the Midlands) has a major national and regional strategic role. Traffic flows are also very high in the existing corridor and thus an upgrade will be very timely
12) A33 Road Upgrade (Basingstoke – Reading)	An upgrade of this key road corridor	Traffic data shows how busy this corridor is between two of the key centres of employment in the region
13) Southampton - New Forest Corridor Upgrade (M27 / A31)	An improvement on the M27 and A31 heading west out of Southampton and the Solent area	This is a busy transport artery connecting Southampton with the New Forest and all points west (such as Poole and Bournemouth)
14) A320 Corridor Upgrade	An upgrade of the A320 road corridor linking Guildford with Woking and M25 Junction 11	Based on previous WSP PB work for Surrey CC, Guildford BC and Woking BC, this is one of the key congested corridors in the area
15) A22 Corridor Upgrade	An improvement in the corridor linking Eastbourne on the South Coast with Surrey, the M25 and points further north	The existing A22 road corridor (and parallel rail routes) does not offer good connectivity between this part of East Sussex and points further north (including the M25 and London)
16) A31 Upgrade	An improvement to the Hog's Back - Farnham - Alton road corridor	The A31 (and its intersection with the A3 near Guildford) is one of the main 'bottlenecks' in this part of Surrey and Hampshire
17) Newhaven - Lewes - Brighton Corridor Upgrade	An upgrade of this important corridor between Newhaven and Lewes	The links between these major towns on the South Coast currently involves a time-consuming journey, including the very busy junction between the A26 and A27

5.4 HOW THE CORRIDORS RELATE TO EACH OTHER

Although the impacts of the corridors have been assessed individually, there are clearly major synergies between the corridors. Similarly, when regarded as 'clusters' of corridors, they will have a significant local and regional impact.

The various relationships between the corridors are described below:

- **Enhancing connectivity along the South Coast:** There are several major conurbations and centres of economic activity along the South Coast. From Eastbourne and Brighton in the east to Portsmouth and Southampton in the west, these areas generate significant levels of economic activity and are forecast to grow in several different ways – not least in terms of new housing developments and continued growth in employment.

Traffic levels and congestion on key corridors has reached a point whereby delays are commonplace. Corridor improvements along the A27, M27 and A31 will therefore enhance overall connectivity on an east-west axis whilst the transformational concepts of an 'A27' relief road bypassing the major centres of population (and congestion) will also enhance economic activity in this area.

In addition, the cities of Southampton and Portsmouth in the Solent area are economic 'powerhouses' in their own right and will benefit significantly from enhanced connectivity between them. The improved connectivity between the two cities will then link in with the other improved corridors to offer a major regional enhancement.

- **Enhancing the links between the South Coast and points further north:** Due to relatively long journey times and the comparative peripherality of the South Coast, several of the corridors put forward will enhance connectivity to London and other major centres of economic activity away from the coast.

The proposed upgrade of the 'A3' (Portsmouth – London) corridor as well as the upgraded Brighton Main Line and upgraded connection between Eastbourne and Surrey will all provide enhanced connectivity.

In addition, there will also be considerable synergy between these 'north – south' corridors and those proposed on an 'east – west' axis. This will significantly enhance journey opportunities for those travelling into the area from the north and who then want to travel east or west on the South Coast to their final destinations.

Examples include better access to Portsmouth and the Solent area from the A3 corridor and subsequent better connectivity to points east and west (using the upgraded A27 and M27 corridors). Improving the A34 between Southampton and points north will also help to take 'pressure' off some of the other corridors such as the M23 and A3 corridors;

- **Enhancing 'north – south' connectivity in the region:** In the Hampshire, Surrey and Mid-Sussex areas, historical transport corridor development has focussed on the main arterial routes into Greater and Central London. This applies to the main rail and road corridors (such as the main lines between Southampton and London and Portsmouth and London). Good north – south connectivity has therefore been difficult to achieve and this has been compounded in recent years by high levels of traffic on those north – south corridors that do exist

By proposing new corridors that link Mid-Sussex (Horsham) with the Thames Valley (Bracknell/Reading) as well as upgraded existing corridors (such as the upgraded North Downs Line), connectivity will be enhanced

This is essential for a variety of economic and growth reasons, not least the enhanced connectivity between major centres such as those in Berkshire and the 'Gatwick Diamond' area. Better north – south links will enable workers in these major centres to live further away as their commute will be significantly enhanced. 'Knock-on' benefits will include positive impacts on housing development

Similarly, improved connectivity between Basingstoke and Reading as well as between Southampton and Newbury (and points further north as noted previously) will support growth in the region;

- **Enhancing connectivity between the South West / West of the region and London:**
Although there are several major transport corridors linking the study area to London, there remain 'pockets' of population and economic activity that are comparatively poorly served. Examples include the Reading to London Waterloo route where journey times are much longer than those on other main line routes into London whilst major centres of economic activity (such as those near Bracknell) face long journey times into London

By improving connectivity in these corridors, workers will be able to access a much wider array of employment opportunities in London, Reading and elsewhere. These improvements will be captured in the agglomeration analysis reported previously with productivity being enhanced and a range of economic benefits stemming from this.

The movement corridors therefore enhance connectivity across a range of complementary geographies with several of the east – west corridors having major synergies with the north – south corridors.

There is also potential for the corridors to provide strong linkages with neighbouring LEP areas and the wider South East / South West regions. For the main ports in Portsmouth and Southampton, good connectivity for freight traffic will be essential, especially given the forecast increase in containerised flows and the need to have good linkages between the ports and the Midlands / the North.

6 IDENTIFICATION OF POTENTIAL SOLUTIONS

6.1 INTRODUCTION

In this chapter, a range of options is set out for each of the short-listed corridors. This covers the following:

- Identification of a range of options for addressing known problems in each corridor; and
- An assessment of 'deliverability' of each corridor.

For presentational purposes, the deliverability of a "Top Fifteen" of corridors has been assessed with the key issues covered including engineering, planning and other technical constraints. In reality, all the corridors selected will have different levels of 'deliverability' with the smaller schemes tending to be more deliverable in terms of the lesser amounts of physical works required.

This means that the deliverability "gradings" given in this chapter are independent of the extent of the likely economic benefits that will be generated. An analysis of high level costs and benefits is the subject of analysis in Chapter 7.

6.2 ANALYSIS OF POTENTIAL SOLUTIONS

To make this part of the work as clear and transparent as possible, the findings are reported in tabular format.

In Table 6-1, the range of options and deliverability issues is summarised for each corridor with the colour coding on the right-hand side indicating how the 'grading' of deliverability (i.e. **green** = achievable, **amber** = deliverable but with caveats / key issues and **red** = problematic).

Table 6-1 Identification of Potential Solutions

CORRIDOR	DELIVERABILITY ISSUES				DELIVERABILITY GRADING
DESCRIPTION	OPTIONS	ENGINEERING	PLANNING	OTHER	
“South Coast Relief Road”	A new transformative corridor situated on an alignment to the north of the existing M27 / A27 corridor (i.e. the new corridor would bypass all the major towns on the route)	This has been evaluated on the basis of a new road corridor being built (although rail could also be considered) – <u>this is a major engineering undertaking</u> passing through key areas	The corridor will pass through some areas of high environmental sensitivity, not least in the South Downs National Park (SDNP) area. This will therefore require careful planning consideration	The scale of this undertaking should be not underestimated, although the economic analysis has shown the extent of potential benefits in this key east-west corridor	
“South Sussex Way”	As with the ‘South Coast Relief Road’, this transformative corridor will require significant infrastructure works across a considerable distance	<u>This will be a major engineering undertaking</u> requiring a long term programme of construction works throughout the proposed corridor. The considered has been considered as a road project although a rail corridor will also offer the same level of improved connectivity	As with any infrastructure of this scope and size, extensive planning will be required over a long term period. Environmental considerations and concerns will also need to be dealt with through accepted procedures	This is clearly a significant infrastructure project that will require careful evaluation and planning. Given the importance of continued good connectivity into the major towns and cities on the coast, suitable connecting links should also be provided with these	
Mid Sussex to Thames Valley New Corridor	A transformational corridor (considered as a road corridor at this stage). Would pass through an area of very high environmental sensitivity before accessing the Thames Valley area	This corridor will require significant works and significant investment (whether as a road or rail link). Given that there are very few such ‘north – south’ corridors in this part of the study area, the works will involve the forging of a new alignment	By taking a ‘direct’ route between Horsham and Reading, the corridor passes through the Surrey Hills Area of Outstanding Natural Beauty (near Dorking etc.). This will require significant mitigation (such as tunnelling) as possible re-routing away from the ‘optimal’ corridor	Although of clear economic benefit, this proposed corridor does pass through some highly ‘sensitive’ areas and there may be scope to compromise and realise at least a high proportion of these benefits through the upgrade of similar corridors such as the North Downs Line (see below)	
Southampton to Portsmouth Corridor Upgrade	A major upgrade of the existing rail corridor between the two cities – to facilitate much faster journey times through faster journey times and fewer station calls	Will require significant works to a level similar to that scoped for the full Brighton Main Line (BML) upgrade – to enhance capacity, this could feature some form of ‘passing loops’ so that faster services could overtake ‘stopping’ services on the corridor	As with all major rail upgrades, significant time and expenditure would be needed for the planning and feasibility stages. A demonstration of very clear economic benefits could accelerate this process by placing the scheme higher in the DfT’s “list of priorities”	Although the scale and scope of a major upgrade of this rail corridor is significant (and needs to take account of the stations that are on the line), the corridor and infrastructure does already exist and this will make implementation easier compared to some of the other corridors	
North Downs Line Upgrade	A major upgrade of the existing diesel-only corridor linking Gatwick Airport, Redhill, Reigate, Dorking and Guildford with Reading (this has already been extensively evaluated by Surrey CC and their consultants,	From an engineering perspective, this is feasible given that no major new corridor construction is required – the technical aspects of what is proposed are covered in the extensive feasibility work undertaken by Arup.	Major rail upgrades require an extensive and time-consuming planning horizon that will mean this upgrade is likely to take several years before fruition	Given the current climate of rail funding constraints (both in this Control Period, CP5 and the next, CP6), there may be concerns about obtaining the level of funds necessary for this upgrade. The demonstration of all benefits will therefore be essential	

CORRIDOR	DELIVERABILITY ISSUES				DELIVERABILITY GRADING
DESCRIPTION	OPTIONS	ENGINEERING	PLANNING	OTHER	
	Arup)				
Reading - Waterloo Rail Upgrade	To improve journey times on this key rail artery between Reading, Bracknell and London Waterloo. Suitable capacity enhancements will also open up the possibility of selected trains making fewer stops	A number of engineering solutions could enable journey times to improve on this corridor although as with several rail enhancements in the South East, the very high capacity utilisation towards the London end of the route may make this difficult (and very expensive)	As noted for other rail corridor improvements, these types of enhancements require significant planning and evaluation before Government approval (and funding) is given	Although this does not involve the construction of new corridor infrastructure, the characteristics of the current service (i.e. several station stops and relatively slow journey times) are not easily enhanced without major works, disruption to existing services and expenditure	
'Southern Access to Heathrow'	This will comprise a new rail corridor between Guildford, Woking and Heathrow Airport (using several sections of existing lines on different routes)	Although a significant undertaking, the use of several sections of existing lines will assist the feasibility and deliverability of the overall programme. Where new sections of line are required, however, extensive works will be needed	As with the North Downs upgrade, this corridor will require a significant amount of planning across a number of different stakeholders. Adherence to all current rail planning guidelines and procedures must also be followed	The proposed corridor passes through several densely populated areas and will therefore require a significant consultation programme before the proposals are accepted – previous initiatives such as the 'Airtrack' proposal did not proceed for a number of reasons, including issues surrounding the number of level crossings on the route	
A27 Corridor Upgrade	Targeted <u>road</u> improvements at key locations, including the long proposed bypass at Arundel and capacity enhancements near Chichester (as well as other capacity enhancements currently being evaluated by Highways England)	The works proposed on the A27 corridor have been evaluated in detail in recent years, with the proposed works at Arundel, for example, being developed over several years. In general terms, the engineering aspects of this corridor upgrade are feasible	The A27 corridor passes through some relatively dense / well populated areas – there are also areas of environmental sensitivity with the Arundel Bypass, for example, being frequently opposed on environmental grounds in the past	Highways England has been developing plans for the A27 corridor over several years – work is currently ongoing. As one of the main east-west arteries in the region, its upgrade will be feasible and will generate significant benefits	
Brighton Main Line Upgrade (A23 / M23 Corridor)	An upgrade of this key economic artery linking the South Coast with London (as well as several 'intermediate' centres of economic activity such as the Gatwick Diamond area)	The Brighton Main Line is currently the subject of a major upgrade study by DfT (Coast to Capital are heavily involved with this). The line is currently operating at the limits of its capacity and any enhancement will require major infrastructure works	Planning for the BML upgrade will require lengthy procedures to be followed, including Network Rail's full range of project feasibility analysis. There will also be several stakeholders who need to be consulted, including the local authorities and train operating companies	By requesting that the current BML study be undertaken, the Government (and the Treasury) have shown clear intent that the line's upgrade will play a key part in generating economic growth in the region. The upgrade can also be linked to the plans to develop a secondary link between Brighton and London ("BML2")	
A3 Corridor Upgrade	Targeted <u>road</u> improvements at key locations, including capacity enhancements in the vicinity of the M25	These works will require significant enhancement works, especially in the Guildford area where the 'narrowness' of the existing corridor will necessitate	Given that a significant proportion of the works will be in a relatively dense, urban area, extensive planning consent will be required	In the Guildford area, the A3 improvements will need to be accompanied by works on 'feeder' and connecting roads as current problems are not	

CORRIDOR	DELIVERABILITY ISSUES				DELIVERABILITY GRADING
DESCRIPTION	OPTIONS	ENGINEERING	PLANNING	OTHER	
	interchange and in the Guildford area	major works		just constrained to the main corridor	
A34 Southampton – Newbury / M4 J13 Upgrade	Major road corridor improvement on this section of the A34 – to include appropriate widening and junction works where required	Selected works have already commenced on sections of the A34 and this will continue this process, albeit throughout the whole section of the road. Key ‘pinch points’ and ‘bottlenecks’ will be addressed and suitable widening works / dualling will provide additional capacity	As well as passing through / near urban areas, the A34 also passes through areas of extensive countryside in both Hampshire and Berkshire – any planning of the upgrade works will therefore need to take account of these factors and the sensitivities associated with them	The entire A34 corridor linking the Solent area with Berkshire, Oxford and points north has long been identified as a critical transport link in the region (covering both freight and light vehicle movements). Although the works required for such a major upgrade will be expensive and time consuming in terms of planning, the regional (and national) benefits are likely to be significant	
Basingstoke to Reading Corridor Upgrade	Currently focussed on the A33 road corridor between these two centres of economic activity, the corridor is also served by a rail link (operated by both GWR and Arriva Cross Country)	The engineering works will focus on the enhancement of the existing corridor with any capacity constraints dealt with accordingly (such as carriageway widening and other works that will enhance journey times)	Planning of the works in this corridor can follow on from the consultation and preparation already undertaken for the “Basingstoke A33 corridor improvements” programme (being supported / promoted by Hants CC as well as EM3)	With the “Basingstoke A33 corridor improvements” scheme already comprising £9.5m of improvements along the A33 in Basingstoke (major works at the Crockford and Binfields Roundabouts, along with a minor potential scheme at Taylor’s Farm roundabout), this upgrade could follow on from these planned works	
M27 / A31 Corridor Upgrade	To upgrade this east - west road corridor to eliminate major bottlenecks and ‘pinch points’	To implement widening / dualling works where necessary and to address locations where capacity is constrained (such as some of the major junctions, including that at Ringwood). The works would build on the proposals already developed by Highways England for this corridor	Several schemes in this crucial corridor (such as the Ringwood improvements) have already reached the planning / feasibility stage and the upgrading works could build on this to offer a complete strategic corridor upgrade (subject to environmental and related considerations)	As well as generating economic benefits to the region, an upgraded A31 corridor will also reduce the high level of accidents currently observed on certain sections of the road	
A320 Upgrade	Given the very high levels of traffic observed on this key road corridor linking Guildford with Woking and the M25, works will cover junction improvements as well as capacity enhancements where these improve travel times and journey reliability (through	The A320 corridor passes through densely populated, urban areas – this means that major upgrading works will be disruptive, time-consuming and expensive (although the subsequent benefits to local and regional traffic will be substantial)	Given the characteristics and location of the A320 corridor, the works will need to be carefully planned with consideration given to the disruptiveness of the works and the potential environmental impacts	Improvements to the A320 in this relatively short but strategically important corridor have been seen as necessary for several years (given the level of congestion and delays that occur). Improving this corridor will also help relieve knock-on delays on the A3 corridor near Guildford and will thus have significant regional benefit	

CORRIDOR		DELIVERABILITY ISSUES			DELIVERABILITY GRADING
DESCRIPTION	OPTIONS	ENGINEERING	PLANNING	OTHER	
	reduced congestion levels)				
A22 Corridor Upgrade	The A22 corridor between Eastbourne on the South Coast and the M25 intersection at Godstone in Surrey is a strategically important route – its upgrade (through capacity enhancements to improve journey times) will significantly enhance connectivity to / from East Sussex	The A22 would require significant works to enhance capacity through suitable widening and dualling (as well as a programme to address key junctions that cause delays and lengthen journey times)	This will be a major upgrade over a relatively long distance and will thus require extensive planning and feasibility analysis. Passing through both urban and rural areas, any environmental issues will also need to be addressed and mitigated	Certain parts of the South Coast experience peripherality from the 'high growth' areas in Surrey and the Greater London area. This corridor upgrade is therefore of major regional importance. It will also provide better connectivity between the South Coast and the 'mid Sussex' towns	
A31 Upgrade	The A31 Hog's Back section of road and its intersection with the A3 near Guildford experiences considerable congestion and delays (and is also dangerous given the nature of the gradients and merging movements). An upgrade of this section of the A31 will thus make traffic movements considerably better	The A31 Hog's Back improvement would require significant works, especially in terms of the topography of the area and the complex nature of the current intersection with the A3. However, this proposed upgrade is relatively short and is situated in an existing corridor – this will make the improvements easier to implement	A major planning and feasibility exercise will be necessary, including appropriate environmental impact assessments	The A31 Hog's Back section of road and its intersection with the A3 has long been seen as a major bottleneck in the area and its improvement will generate significant benefits	
Newhaven - Lewes - Brighton Corridor Upgrade	This upgrade will provided much-needed better connectivity between Newhaven, Lewes and Brighton in East Sussex	The current junction between the A26 and A27 is a major 'bottleneck' in the area and its removal through suitable upgrade works will be a major undertaking	A major planning and feasibility exercise will be necessary, including appropriate environmental impact assessments given the characteristics of the local area	Given the need to improve connectivity to the important regional economic centre in Brighton, this will be an important upgrade.	

6.3 MODAL OPTIONS AND ACCESS TO THE CORRIDORS

Table 6.1 shows that where new corridors have been identified as having a large positive economic impact, the deliverability of any modal solution will be challenging e.g. South Sussex Way and Mid Sussex to Thames Valley Corridor. The reasons for the new corridors having large calculated benefits are fundamental to understand when developing any proposed solution.

The existing transport infrastructure (any mode) that gives the current level of access and connectivity between the centres of population in the new corridors is either direct or convenient and the hypothetical transport infrastructure solutions assume that there would be significant improvements in journey times and direct access to and from the new corridor from residential areas and employment areas. This means that in the development of any modal options, the accessibility on to and off the corridor will be a key consideration.

The corridors identified are either a single mode or appear as a default choice for the given corridor. However, the access to and from the improved corridor will similarly need to be a key consideration when generating physical schemes to ensure that the improvements generate the desired outcomes.

In the course of writing this report, Highways England produced a complimentary report '*Orbital Connectivity - Orbital Strategic Public Transport in the West and South Beyond the M25*'. This report highlighted the current difference in modal share depending on the twin variables of inter-urban journey times and the provision of public transport services within an urban area. The report is appended as an Annex to this report.

7 PRIORITISATION OF POTENTIAL INFRASTRUCTURE IMPROVEMENTS

7.1 INTRODUCTION

Based on the analysis of potential solutions identified in Chapter 6, this chapter contains a further prioritisation assessment whereby the overall financial and economic feasibility of the infrastructure investments is evaluated at a high level.

The term 'infrastructure investments' reflects the following:

- An 'investment' to cover the outline capital (and operating) costs that need to be incurred to realise the economic benefits over a specified period of time;
- The high level economic benefits likely to accrue over the appraisal timescale – in this case, up to both 30 and 60 years (similar to other appraisal timescales); and
- The particular characteristics of the corridor upgrade (its rationale and timetable for construction etc.).

To develop this high level economic and financial analysis, we have taken the 'snap shot' economic analysis reported in Chapter 5 and have extended this so that a 30 to 60 year forecasting period is covered. The estimated high level cost of each corridor also forms part of the analysis and is one of the key input assumptions. All costs and benefit values are subject to standard discounting methods. This is as follows:

- A discount rate of 3.5% per annum is applied for the first 30 years of the appraisal period; and
- A discount rate of 3% is applied for the remaining 30 years in the period.

For the purposes of this high level analysis, the calculations assume that the corridor upgrades take place in the near future with the stream of benefits following on after scheme opening. The metrics shown in Table 7-2 therefore reflect this assumption although in reality, the corridors are long term propositions and several years will elapse before construction / upgrade work can take place. The right-hand column in Table 7-2 therefore provides commentary on the realistic timeframes anticipated for each corridor.

The high level analysis is not a 'conventional transport economics' appraisal as we are not quantifying traditional benefits such as monetised journey time savings (to users of the corridors) nor are we calculating the economic benefit of reduced accidents due to transport improvements.

The monetised benefits included here are those described in Chapter 3 (such as GVA increases and various financial returns to Government). In a fully compliant DfT appraisal, it would be necessary to also include more 'traditional' transport economics impact as well as these wider impacts. This issue has also been addressed in Section 3.1.

These initial results do, however, show the extent to which high level scheme costs compare with forecast economic benefits.

We have evaluated both a 30 year appraisal time horizon as well as the longer 60 year period to give a broader range of feasibility indicators.

7.2 HIGH LEVEL COST DATA

For this high level cost benefit assessment, a series of cost estimates have been drawn from existing data sources. These cover both road and rail with differentiation between 'upgrade' and 'new corridor' schemes (and costs).

This is summarised in Table 7-1 below.

Table 7-1 High Level Cost Data

DATA SOURCE	DESCRIPTION	COST PER KILOMETRE (£ MILLION)
New Road: Arundel Bypass	This comprises a major new section of dual carriageway constructed away from the existing A27 alignment. The cost shown here is based on Bypass Option B (and an average of the 'low' and 'high' estimates)	£37.5 million
Upgraded Road: A303 / A358	This comprises upgrades of sections of the A358 and A303 (Ilchester – Sparkford) roads. The cost here is thus an average of the two	£17 million
New Rail Corridor: Brighton Main Line (BML)	This per km cost is based on the full upgrade cost (£15 billion) of the BML programme as recently evaluated on behalf of DfT	£174.2 million
Reopened / Upgraded Rail Corridor: Uckfield - Lewes	This is based on the estimated cost per km of reopening the Uckfield to Lewes line (this is a complete upgrade cost and includes a new tunnel). The estimate is also based on an average of a 'low' and 'high' estimates	£53.5 million

These costs have also been augmented with additional data where this is available. For example, the North Downs Line upgrade cost estimate includes an 'operating cost' element covering the cost of additional train services and rolling stock.

In addition, some scheme cost estimates are a composite of the data shown in Table 7-1. To demonstrate this, the proposed new rail corridor between Guildford and Heathrow Airport incorporates elements of both upgraded existing lines as well as sections of new corridor.

Two economic output metrics are used to indicate feasibility: 1) a Net Present Value (NPV) and 2) what is termed a 'high level economic benefit to cost ratio'.

7.3 ANALYSIS AND RESULTS

Table 7-2 below contains a summary of the infrastructure investments analysis. As well as the rationale for each corridor project, summary costs and benefits are indicated (in discounted form).

An indicative timetable for delivery is also shown in Table 7-2.

Table 7-2 Potential Infrastructure Investments

CORRIDOR TITLE	RATIONALE	ECONOMIC METRICS		IMPLEMENTATION
		COSTS	BENEFITS	LIKELY TIMESCALES
“South Coast Relief Road”	A transformative, new corridor linking Southampton with Brighton (and providing a alternative corridor to the current M27 / A27)	A high capital cost of circa £4.1 billion (with annual operating expenditure of £3 million) could be supported by the very high economic impacts forecast. In high level economic benefit to cost ratio terms, these could be as high as: 1) 30 years: 24.7 2) 60 years: 38.0	The benefits are the highest of all the corridors evaluated and total £95 billion over 30 years and £145 billion over 60 years (both total are based on discounted amounts)	This is a long term corridor concept and could take up to 20 to 30 years before fruition (reflecting planning and feasibility time horizons)
“South Sussex Way”	Another transformational, new corridor – this will cover a considerable distance and will link Salisbury in Wiltshire with Hampshire, Sussex and Kent	A high capital cost of circa £6.4 billion (with annual operating expenditure of £3 million) could be supported by the very high economic impacts forecast. In high level economic benefit to cost ratio terms, although not as high as the ‘South Coast Relief Road’, these could be as high as: 1) 30 years: 12.1 2) 60 years: 18.6	Forecast (discounted) benefits are also high: 1) 30 years: £71 billion 2) 60 years: £110 billion	This is another long term, transformational corridor concept. Its total distance is likely to mean that it would need to be planned and built in phases / stages (20 to 30 years for full scheme implementation). Its construction will, however, relieve pressure on the M27 / A27 upgrade proposals
Mid-Sussex to Thames Valley Corridor	To provide a much-needed north-south corridor linking the Thames Valley with mid-Sussex	A capital cost of circa £3.1 billion (with annual operating expenditure of £1 million) would be supported by the forecast benefits to achieve the following high level economic benefit to cost ratios: 1) 30 years: 19.8 2) 60 years: 30.6	Total forecast (discounted) wider economic benefits are as follows: 1) 30 years: £56.8 billion 2) 60 years: £87.9 billion	Although likely to generate substantial economic benefits, the environmental and engineering issues surrounding construction of this corridor mean it is a long term proposition (taking up to 15 to 20 years to deliver)

CORRIDOR	ECONOMIC METRICS			IMPLEMENTATION
TITLE	RATIONALE	COSTS	BENEFITS	LIKELY TIMESCALES
Southampton to Portsmouth Rail Corridor Upgrade	To radically improve connectivity between these two key cities in the Solent area by means of a major rail corridor upgrade	A capital cost of circa £5.2 billion (with annual operating expenditure of £0.5 million) would be supported by the forecast benefits to achieve the following high level economic benefit to cost ratios: 3) 30 years: 6.6 4) 60 years: 10.3	Total forecast (discounted) wider economic benefits are as follows: 3) 30 years: £31.8 billion 4) 60 years: £49.3 billion	As this corridor and rail infrastructure already exists, timescales to complete this upgrade could be comparatively short (could be implemented in the next 15 to 20 years)
Reading to Waterloo Upgrade	Given relatively slow journey times between key towns in Berkshire and London (on the Reading to Waterloo route), this upgrade envisages significant capacity enhancements on the route so that faster journey times are possible	Even with a very high capital cost estimate of £8.4 billion (with annual operating expenditure of £2 million), the following high level economic benefit to cost ratios would be achieved given the extent of potential wider benefits in this key corridor: 1) 30 years: 3.8 2) 60 years: 5.9	Total forecast (discounted) wider economic benefits are: 1) 30 years: £29.2 billion 2) 60 years: £45.2 billion	Significant rail infrastructure enhancement would be required, particularly to accommodate faster / more frequent train services towards the eastern end of the route (i.e. closer to Waterloo) – for this reason, it is likely to take 15 to 20 years to build
North Downs Line	To greatly improve rail connectivity on this economically important artery linking the 'North Downs' area (and Guildford) with the Thames Valley	Depending on the scale of upgrade envisaged, a high capital cost (£4.3 billion) investment would still generate significant returns on investment as shown by these high level economic benefit to cost ratios: 1) 30 years: 7.3 2) 60 years: 11.3	Total forecast (discounted) wider economic benefits are: 1) 30 years: £29.1 billion 2) 60 years: 45.1 billion	Given the long timescales typically required for major rail upgrades (to cover planning and feasibility as well as construction), this could take 10 to 15 years to build
'Southern Access to Heathrow'	To build on former proposals to build a new rail link into Heathrow Airport (via a spur off the existing Reading – Waterloo route). The proposed corridor would link as far south as Guildford and would use existing sections of line where necessary	Based on capital costs of £3.9 billion and £1 million p.a. operating costs, the resulting high level economic benefit to cost ratios based on the wider benefits generated would be: 1) 30 years: 8.1 2) 60 years: 12.5	Total forecast wider economic benefits are very similar to those of the proposed North Downs Line upgrade: 1) 30 years: £28.8 billion 2) 60 years: £44.6 billion	This is another major infrastructure scheme where extensive planning and further feasibility analyses are required before any funding / implementation decisions are made – as with the North Downs upgrade, this could take 10 to 15 years to build

CORRIDOR TITLE	RATIONALE	ECONOMIC METRICS		IMPLEMENTATION
		COSTS	BENEFITS	LIKELY TIMESCALES
A27 Corridor Upgrade	To bring to fruition long-standing plans to upgrade the A27 corridor between Brighton and Portsmouth (and to address key 'bottlenecks' in the corridor)	If the total upgrade cost was £1.4 billion, for example (with operating expenditure of £1 million per annum), the following high level economic benefit to cost ratios would be achieved 1) 30 years: 19.8 2) 60 years: 30.4	Based on this preliminary evaluation, total (discounted) wider economic benefits are: 1) 30 years: £25.0 billion 2) 60 years: £38.7 billion	Depending on the current work being undertaken by Highways England on the overall feasibility of the A27 corridor upgrade, it is possible that works could commence in the next 5 to 10 years. The Government stated in December 2014 that the corridor would receive investment as part of its Strategic Road Network (SRN) and this may mean that implementation could happen sooner compared to other corridors
Brighton Main Line Upgrade	The transport link between Brighton and London is of strategic importance to the region – although this proposal has focussed on the main Brighton to London rail link, the corridor is also served by the A23 / M23	Based on the "full scale" upgrade cost of £15 billion (with assumed £3 million annual operating expenditure), the following high level economic benefit to cost ratios would be achieved – these ratios could potentially be higher if some of the more 'intermediate' upgrade proposals were used as the basis for the corridor upgrade: 1) 30 years: 1.1 2) 60 years: 2.6	Based on this preliminary evaluation, total (discounted) wider economic benefits are: 1) 30 years: £23.4 billion 2) 60 years: £36.3 billion	The BML upgrade is currently being assessed by DfT and depending on the results of this study, further work could be undertaken on this major upgrade. Timescales for implementation are likely to remain in the 'long term' category given the nature and scale of the works (next 10 to 15 years)
A3 Corridor Upgrade	To improve connectivity in the A3 corridor (Surrey – Portsmouth / Solent area) by addressing key sections where there are capacity constraints (such as the section near Guildford as well as adjoining feeder roads)	Based on a high level estimate of capital expenditure for total corridor improvement (£1.4 billion), the following high level economic benefit to cost ratios could be achieved: 1) 30 years: 14.5 2) 60 years: 22.3	Based on this preliminary evaluation, total (discounted) wider economic benefits are: 1) 30 years: £18.4 billion 2) 60 years: £28.4 billion	Following on from the Hindhead Tunnel opening in 2011, further proposals for the A3 corridor include major widening works in the Guildford area as well as improvements near the Hog's Back junction. The scale of these (and the necessary planning requirements) will mean that it could be 10 to 15 years before scheme implementation

CORRIDOR		ECONOMIC METRICS		IMPLEMENTATION
TITLE	RATIONALE	COSTS	BENEFITS	LIKELY TIMESCALES
Southampton to Newbury A34 Corridor Upgrade	To improve this key strategic route linking Southampton with Berkshire, Oxford and points north	With an upgrade cost between Southampton and J13 of the M4 of approximately £1 billion, the following high level economic benefit to cost ratios would be achieved: 1) 30 years: 17.4 2) 60 years: 26.7	Based on this preliminary evaluation, total (discounted) wider economic benefits are: 3) 30 years: £16.5 billion 4) 60 years: £25.6 billion	This is a major corridor upgrade that could take 15 to 20 years to fully implement. Nevertheless, incremental improvements over time could help achieve the overall goal of a complete corridor upgrade (with the high economic benefits this will generate)
Basingstoke to Reading Corridor	To improve connectivity between Basingstoke and Reading by upgrading the A33 corridor	Based on a high level capital cost estimate of £460 million, the following high level economic benefit to cost ratios could be achieved: 1) 30 years: 26.3 2) 60 years: 40.1	The evaluation of the A33 upgrade indicates the following wider economic benefits: 1) 30 years: £11.5 billion 2) 60 years: £17.8 billion	Work on upgrading the A33 north of Basingstoke has already been evaluated and subject to consultation. The additional works proposed for this corridor upgrade could therefore be scheduled within the next 5 to 10 years
M27 – A31 Corridor Upgrade	To upgrade sections of the M27 – A31 corridor between Southampton and Dorset (Poole / Bournemouth) – to facilitate improved journey times and connectivity	Based on a capital cost estimate of just under £1 billion, the following high level economic benefit to cost ratios could be achieved: 1) 30 years: 13.6 2) 60 years: 20.9	Significant wider economic benefits would be generated: 1) 30 years: £11.9 billion 2) 60 years: £17.5 billion	Some works on this busy, important corridor are already being evaluated / planned and this proposed corridor upgrade can be developed from this (and could be completed in the next 5 to 10 years)
A320 Corridor Upgrade	To provide significant capacity enhancements on this comparatively short but very highly used section of road	Given a capital cost estimate of approximately £335 million, the following high level economic benefit to cost ratios reflect the high level of agglomeration increase-based (and other) economic benefits that could potentially be achieved: 1) 30 years: 27.3 2) 60 years: 41.9	Significant wider economic benefits would be generated: 1) 30 years: £8.5 billion 2) 60 years: £13.3 billion	This corridor upgrade is over a relatively short distance compared to other corridors and could therefore be implemented in a shorter timescale (10 to 15 years). The upgrade could be linked with improvements to the A3 near Guildford

CORRIDOR TITLE	RATIONALE	ECONOMIC METRICS		IMPLEMENTATION
		COSTS	BENEFITS	LIKELY TIMESCALES
A22 Corridor Upgrade	This corridor upgrade will enable Eastbourne and the East Sussex coast area to have significantly enhanced connectivity with Surrey, Greater London and other areas of economic importance in the region	Based on capital costs of £1.2 billion, the following high level economic benefit to cost ratios could potentially be achieved: 1) 30 years: 3.6 2) 60 years: 5.6	The following wider economic benefits could be generated: 1) 30 years: £4.0 billion 2) 60 years: £6.2 billion	This is major corridor upgrade and given its length, could be upgraded in stages (over the next 15 to 20 years), with the key capacity 'bottlenecks' addressed first before other strategic widening and dualling works takes place. This is very much a long term corridor proposal
A31 Upgrade	This upgrade is required given that this section of the A31 and its intersection with the A3 is the source of much congestion and delays (as well as being a major accident risk)	Based on capital costs of £550 million, the following high level economic benefit to cost ratios could potentially be achieved: 1) 30 years: 5.7 2) 60 years: 8.8	The following wider economic benefits could be generated: 1) 30 years: £2.9 billion 2) 60 years: £4.6 billion	Compared to some of the other strategic corridors, this upgrade covers a comparatively short distance and could be implemented within relatively short timescales (10 to 15 years)
Newhaven - Lewes - Brighton Corridor Upgrade	This upgrade will facilitate much better connectivity between Newhaven and Brighton as well as providing better links to Lewes (both Newhaven and Lewes will also gain better access to jobs in Brighton)	Based on capital costs of £440 million, the following high level economic benefit to cost ratios could potentially be achieved: 1) 30 years: 5.4 2) 60 years: 8.3	The following wider economic benefits could be generated: 1) 30 years: £2.2 billion 2) 60 years: £3.5 billion	As with the A31 upgrade, this is a comparatively short-distance corridor (although major works will still be required, especially in terms of addressing the existing 'bottleneck' at the busy A26 / A27 junction). This could take 10 to 15 years.

8

HOUSING, GROWTH AND FUTURE DEVELOPMENT

8.1 INTRODUCTION

The analysis described up to this point has addressed the economic impact of developing strategic transport corridors in terms of key economic metrics such as additional GVA and employment opportunities.

In addition, and to reflect that the corridors will be developed in the future, several background factors need to be taken into account. These include:

- **Housing developments:** the study area is one of the fastest-growing in the UK with forecast growth in population putting increasing levels of pressure on the need to develop new housing;
- **Growth in key sectors:** as well as background economic growth, several “high tech” and “high value” sectors across the study area will continue to expand. Taking the information technology sector as an example, growth in this sector will not only generate higher levels of GVA but will also generate higher productivity levels as each worker will produce more GVA; and;
- **Other developments:** in addition to housing developments, other major developments are also planned across the region and these will be impacted by / have an impact on the strategic corridors proposed.

The purpose of this chapter is to describe the types of developments taking place, the urgent need for these developments in the study area (particularly housing that is affordable to workers in the region) and ultimately, how the strategic corridors will have a crucial role to play in terms of 1) helping facilitate the developments in the first place and 2) how the developments themselves will support the impacts generated by the corridors.

8.2 KEY DEVELOPMENTS IN EACH LEP AREA

Each LEP area has clear, distinct objectives with respect to economic and housing development. By summarising the key objectives and aims of each LEP area, the types of developments proposed are made clear.

THAMES VALLEY BERKSHIRE

Berkshire and the Thames Valley has continued to display strong employment growth in recent years and this growth is likely to continue into the future given the concentration of employment in the key ‘high value’ sectors that continue to perform well. These include telecoms, IT, professional services and the utilities sectors. There are clusters of professional services activity within Bracknell Forest and Reading with workers very much reliant on good transport access (both rail and road) to access these high value jobs.

The impact of the different employment clusters on travel patterns in the TVB LEP area is demonstrated by the three broad ‘travel to work areas’ (TTWAs) defined below:

- **“Reading TTWA”:** this comprises all of Reading and Wokingham boroughs as well as the majority of Bracknell Forest (and includes parts of South Oxfordshire, West Berkshire, Windsor and Maidenhead and Hart);

- **“Slough and Heathrow TTWA”**: as well as including all of Slough borough and parts of Windsor and Maidenhead, most of this area is situated towards the east of the LEP and covers Runnymede, Spelthorne, South Buckinghamshire and the London Boroughs of Hillingdon and Kingston upon Thames; and
- **“Newbury TTWA”**: this area covers most of West Berkshire and parts of Wiltshire, Basingstoke and Deane and Test Valley.

These travel to work areas have a major influence on the housing market given that the location and development of housing in Berkshire reflects both household migration and travel to work patterns from surrounding local authority areas.

Given that growth in working age population is forecast to decrease across the majority of Berkshire authorities whilst growth rates increase across a number of nearby authorities, these anticipated trends are also likely to have an impact on travel to work patterns to, from and within Berkshire. The likely outcome that travel flows into Berkshire will increase over time as a result of these developments places even greater emphasis on the need to improve key movement corridors.

To accommodate future population growth in the LEP area and to ensure there is sufficient housing (at affordable levels) for the workers needed in the future, there are extensive plans for housing development across the various local authorities in the area.

As stated in the LEP’s Strategic Economic Plan (SEP), it is crucial that housing availability and affordability do not constrain the future growth of Berkshire’s economy. The SEP also makes it clear that plans for housing growth *must* take account of wider infrastructure constraints. As evidence of this, the LEP’s Infrastructure Programme states that it is imperative to invest in transport to unlock some major housing developments.

Similarly, to ensure that economic potential is not constrained by labour supply issues, congestion problems must be addressed and planned housing - some of which is dependent on upfront infrastructure investment – must be delivered as quickly as possible.

Through the Thames Valley Berkshire Local Growth Deal, the LEP is supporting seven transport schemes in 2015/16 (out of 22 in the whole Growth Deal). The purpose of these investments is to unlock housing development sites (for example, there are over 16,500 houses linked to these schemes) and to increase the overall capacity of the network to deliver the level of reliable journeys the economy requires.

Although these are relatively small, ‘localised’ schemes compared to strategic movement corridors, they nevertheless provide clear evidence of the importance of transport infrastructure as a means of unlocking development and more importantly, the fact that these schemes are being strongly promoted indicates the urgency with which infrastructure is required.

SOLENT

The Solent LEP area is an internationally-recognised economic hub incorporating the Isle of Wight, the major cities of Portsmouth and Southampton, the M27 corridor and the Solent waterway. The area has particular strengths in key economic sectors and also has world-class universities, a strong base of high quality Further Education colleges and excellent transport links.

The continued economic success of the area is very much dependent on the communications inter-dependencies between the cities and the wider Solent area with the Solent economy’s significance extending considerably beyond the LEP area (and thus making an important contribution to the national economy).

Continued and improved transport access to the major hubs centred around Southampton and Portsmouth is critical given the economic importance of these hubs as well as the centres of economic activity within the LEP area.

In its evidence base to support the Solent Strategic Economic Plan (SEP), the LEP's "Connecting Growth" initiative sets out how strategic (and local) transport links impact on the Solent economy both now and in the future. One of the key outcomes from the analysis is that new housing and employment floor space will support growth whilst transport infrastructure will perform a critical role unlocking these sites (and thus encouraging and accelerating inward investment).

There are already several examples of where strategic growth opportunities have been identified and some of these are shown below:

- In the Fareham and Gosport peninsula, there is a requirement for a package of transport investments that unlock opportunities for strategic housing and employment growth at the Solent Enterprise Zone at Daedalus and at the 6,000 home Welborne development (the transport schemes include an upgrade to Junction 10 of the M27, associated junction improvements on the local road network and new highway access to the Solent Enterprise Zone);
- To accelerate the delivery of the strategic housing site at North Whiteley (located near to Junction 9 of the M27), there is a requirement for a new highway to be constructed joining the existing Whiteley Way with the highway network to the north. This will unlock the 3,500 new homes proposed; and
- As well as road connectivity improvements, the rail corridor between Portsmouth and Southampton has a significant role to play enhancing movements across the sub-region whilst also providing better connections to Southampton Airport and points east.

Improvements to this rail corridor will 1) relieve pressure on the already busy M27, 2) improve labour and business interaction between the two cities (and the areas in between) and 3) provide improved rail access to the airport from the east. As rail journey times in this corridor are comparatively long, movements are still concentrated on the M27 corridor and this increases delays and congestion.

A more detailed list of sites where 'unlocking' is essential for development is provided below:

- **Welborne:** a planned 6,000 home development situated to the north of Fareham (112,000 square metres of employment floor space is also proposed). Unlocking the site will require infrastructure developments, specifically new and improved strategic transport infrastructure at Junction 10 on the M27 - this is essential to initiate the development;
- **North Whiteley:** as described above, this strategic growth area will provide 3,500 new homes and associated infrastructure. Support is required for a major new transport link serving both the proposed growth area and the existing community (which at present has only one main highway access on to the M27);
- **Marchwood military port:** the Sea Mounting Facility at Marchwood has been taken on by Solent Gateways Limited, who will be operating the site. There are opportunities for growth at this site through port-related activity other than the sea mounting facility that will continue to operate here;
- **Solent Enterprise Zone:** the first phase of development is already underway and further phases are being planned. Although road improvements are underway to enhance accessibility between the M27 and the Enterprise Zone, "transformational" schemes are also needed to provide an alternative route to the Gosport Peninsula (i.e. the current route from the M27 via the A32 is extremely congested at certain times of the day); and

- Other sites, including the **Ford Site**, **Eastleigh Riverside** and **Southampton Airport** (the redeveloped site will provide a prestigious and attractive new gateway to Southampton), **Gosport Waterfront** (a priority site in the Solent Strategic Economic Plan) and **Itchen Riverside** (a regeneration project in Southampton covering an area of 105 hectares on both sides of the River Itchen - a draft Master Plan is currently being prepared).

Although this list is not exhaustive, it does provide an indication of the types of development sites that are needed to accommodate the area's growth plans and the transport / infrastructure interventions necessary to unlock them.

At a more strategic level, the demands placed on the main transport networks, combined with the impact of planned housing and employment growth, will severely constrain the Solent economy if not addressed.

This is why strategic movement corridors will play a key role in an integrated transport network that enables forecast growth at the three International Gateways (the ports of Southampton and Portsmouth and Southampton International Airport) as well as at key housing and employment sites.

ENTERPRISE M3

Although the economy of the Enterprise M3 area is very powerful in its own right (e.g. Enterprise M3 is ranked second out of 39 LEPs in terms of the local business base), there is a relatively restricted employment market and when this is combined with a growing demand for higher level and Science, Technology, Engineering and Mathematics (STEM) skills, along with an ageing population, high levels of out-commuting and low graduate retention, there is a strong risk that future economic growth will be impeded.

This will have both regional and national impacts given the strength of the economy in the area and how much it contributes in terms of GVA and productivity.

The labour market restrictions are being exacerbated by a shortage of housing and in particular, housing that is affordable to workers. This means that 1) the Enterprise M3 area cannot offer suitably priced housing to those workers who are needed to support economic growth and 2) the area is unable to compete effectively with the employment opportunities available in London.

It is for these reasons that the LEP and stakeholders in the region are supporting sustainable economic development solutions and the creation of more balanced communities. A series of focused sustainable transport measures are also being pursued to reduce the very high levels of congestion experienced in the LEP area.

To help facilitate economic growth and to realise the potential of the area, housing provision must be accelerated. The LEP's strategic ambition is to therefore support and accelerate (via infrastructure provision) the delivery of housing by up to 25% above the baseline achieved between 2003 and 2013 (typical annual baseline delivery was approximately 920 units per annum). This means that with Government support, up to 11,500 new homes will be delivered over the next 10 years. This acceleration of delivery would be achieved without an increase in the Local Plan targets set by individual local authorities. There are two factors in achieving this goal:

- The infrastructure funding contained in the LEP's Local Growth Deal submission; and
- Support for strategic transport interventions.

To help achieve these targets, a number of strategic development sites are in Enterprise M3's **Growth Towns** and **Step-up Towns** whilst a series of targeted interventions – including transport interventions - will play a key part in realising their potential.

One key message from the LEP's Strategic Economic Plan is that to facilitate the necessary housing growth, it is vital that Government not only invests in the infrastructure schemes set out within the Growth Packages and more widely, but also that it commits to working to help accelerate those strategic schemes being delivered by Highways England and Network Rail.

Specific projects include Junction 9 of the M3 and the A3 corridor improvements near Guildford.

The two largest sites in the Enterprise M3 area – Whitehill and Bordon (4,000 homes) and Wellesey in Aldershot (3,850 homes) were both due to start on site in 2014/15 and present a considerable opportunity for the area. Further examples of the Growth Towns and Step-up Towns (and their respective infrastructure schemes) are shown below:

→ **Growth Towns:**

- Basingstoke: includes packages of highways projects to improve capacity and support housing development such as the 'Basingstoke North' and 'South West Corridors to Growth' schemes
- Farnborough: includes a package of highway projects to address congestion in Farnborough such as the capacity improvements on the A325, A327 and A3011
- Guildford: includes a sustainable transport package for Guildford and a package of highways projects including improvements to the Guildford gyratory and a Sustainable Transport Package
- Woking: includes an investment package to tackle major congestion issues (such as Victoria Arch capacity improvements), a sustainable transport package and A320 / A322 road improvements to help progress plans to accelerate housing delivery, including the regeneration of Woking Town Centre

→ **Step-up Towns:**

- Aldershot: includes a sustainable transport package
- Andover: includes a sustainable transport package
- Camberley: includes highway improvement schemes to ease congestion on the A30 / A331 corridor and the approach to the M3 approach plus sustainable transport packages for Frimley and Camberley
- Staines: includes the Wider Staines-upon-Thames sustainable transport package - aimed at improving access to Heathrow and employment sites
- Whitehill and Bordon: includes an Inner Relief Road (to accelerate development and regeneration of the green town and development of housing and large scale commercial and retail development) plus a sustainable transport package

COAST TO CAPITAL

In its Strategic Economic Plan (SEP), Coast to Capital LEP states that essential infrastructure - particularly transport infrastructure - is reaching capacity and is no longer robust enough to support future growth. In addition, the housing market needs unblocking if there is to be sufficient capacity for economic growth.

In other words, there cannot be sustainable economic growth without housing growth since shortages of housing (at affordable prices) makes it difficult for employers to attract and retain the workers needed to grow their businesses.

As part of the Coast to Capital Transport Programme, three types of transport schemes have been identified. The aim of these is to unlock stalled economic growth across the LEP area:

- **Connectivity and capacity schemes** to unlock new land by providing new and/or enhanced transport connections;
- **Sustainable transport packages** which regenerate areas by tackling congestion and improving journey quality and reliability; and
- **Resilience schemes** to help keep the network operating at all times of the day and week.

The LEP has also identified 20 schemes which would directly unlock new housing, jobs and/or employment floor space. These schemes provide the transport capacity or connectivity needed for one or more new developments to be viable. In many cases, these schemes would tackle problems that cause severance and delays.

There are thus several schemes already put forward to enhance connectivity and unlock new development. In several cases, schemes have been implemented and to the west of Horsham in West Sussex, for example, new junction and road links connect the A24 with new housing developments.

Coast to Capital's Strategic Economic Plan also sets out how the LEP will invest in infrastructure (including transport) to bring forward existing housing permissions that are currently blocked and to also enable an increase in new permissions. Based on the LEP's strategic ambitions for new housing, these initiatives will bring forward an *additional* 7,331 homes.

To demonstrate the magnitude of housing need in the Coast to Capital area – and thus the urgent requirement for improved transport infrastructure to unlock these sites - interim findings from ONS and the Department of Communities and Local Government (DCLG) suggest that the LEP area will need to accommodate an additional 95,000 households between 2011 and 2021 to meet future demand. This is because an additional 190,000 residents are expected in the area.

The local authorities in the area have identified potential sites with a capacity to deliver 62,800 new homes over the first 10 years of the Local Plan period and 98,851 new homes up to 2031. Over an assumed 20 year period, this equates to approximately 5,400 new homes per annum, Given that a much smaller build rate was achieved over the previous ten years (4,350 new dwellings per annum), there is a clear role for new infrastructure to play in increasing this.

8.3 HOW THE STRATEGIC CORRIDORS WILL SUPPORT GROWTH

From the above, it is evident that there is **a)** an urgent requirement for new housing in the region to support growth and **b)** a need to increase the rate of house building so that this growth potential can be realised.

Provision of strategic transport corridors will help unlock much needed housing development as the enhanced connectivity between local authority areas will be one of the main enabling factors. This will be particularly applicable as the housing programme looks to gather pace and will reflect the polycentric nature of the study geography.

There will be a dynamic relationship between the corridors and the new developments as several of the proposed housing sites (such as Whitehill and Bordon) are of a significant size and scale - not only are the corridors therefore essential to help improve connectivity to these new sites in the first place, they are also necessary to accommodate to the increased movements generated by the developments.

To indicate how the strategic corridors interact with housing development plans in each local authority area, the figures below show the basic alignment of each corridor together with what level of housing development is required / proposed.

Figure 8-1 North Downs Line

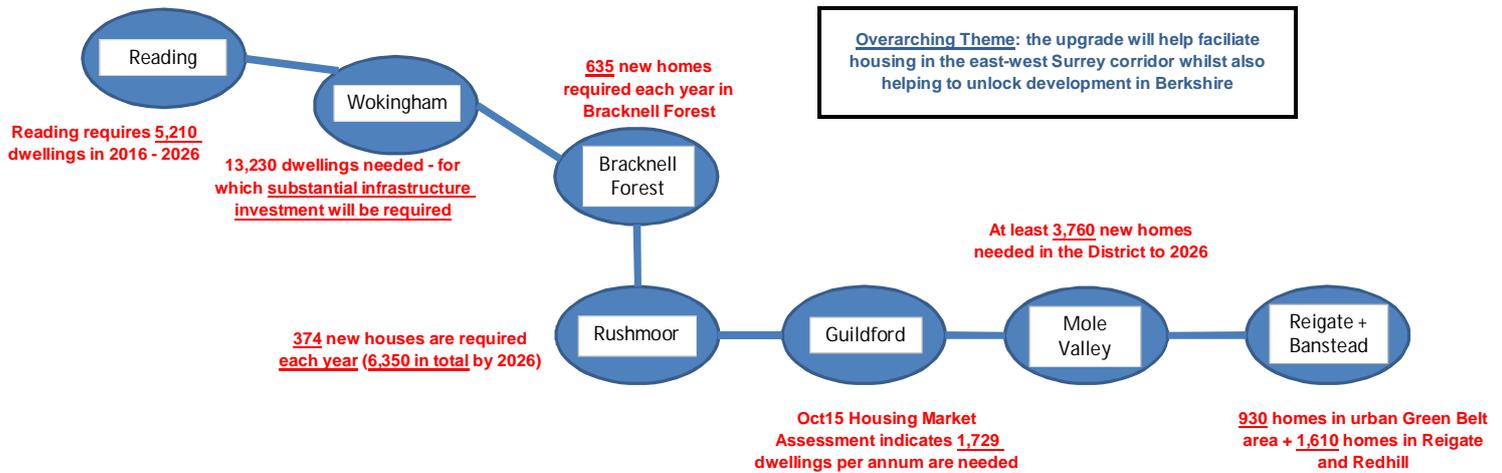


Figure 8-2 A27 Corridor Upgrade

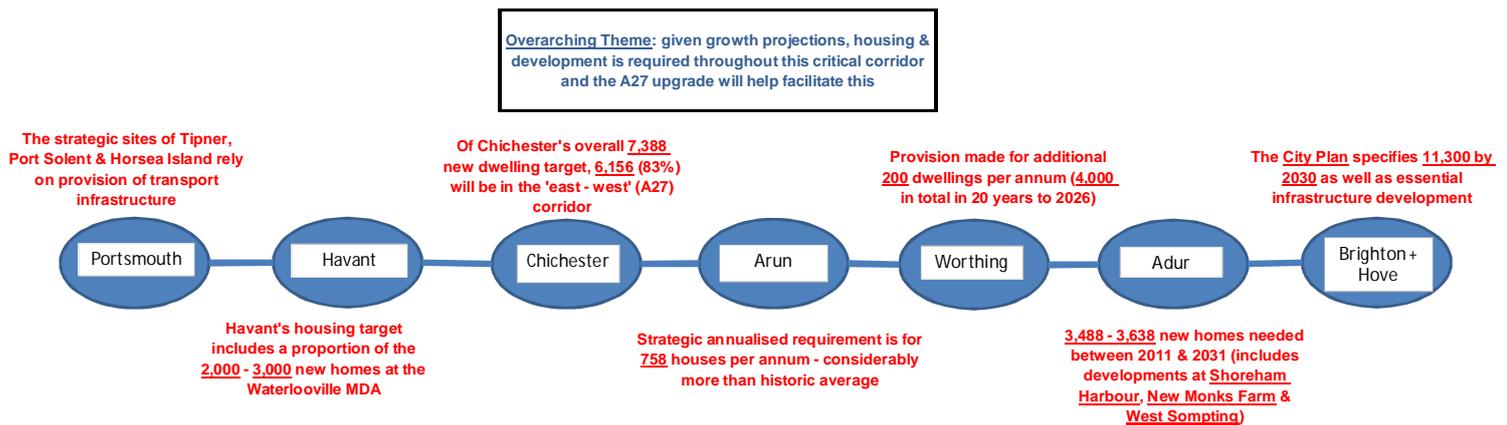


Figure 8-3 Basingstoke to Reading Corridor Upgrade

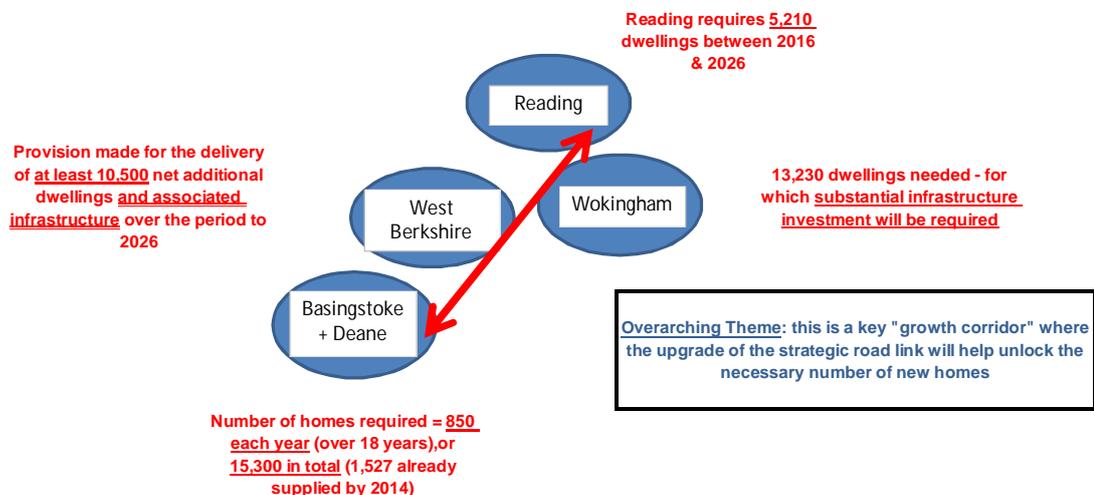


Figure 8-4 Southern Access to Heathrow Airport

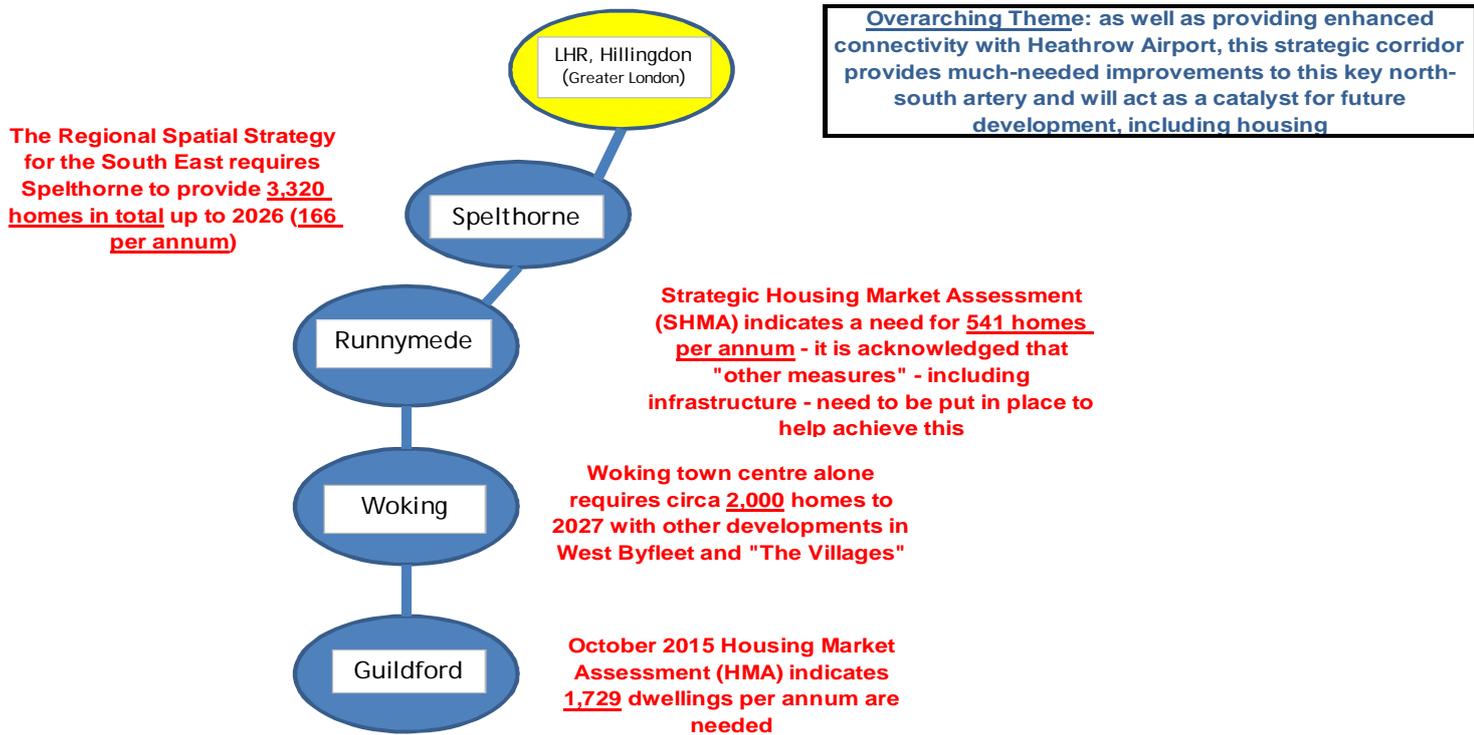


Figure 8-5 Reading – Waterloo Line Upgrade (in key Berkshire corridor)

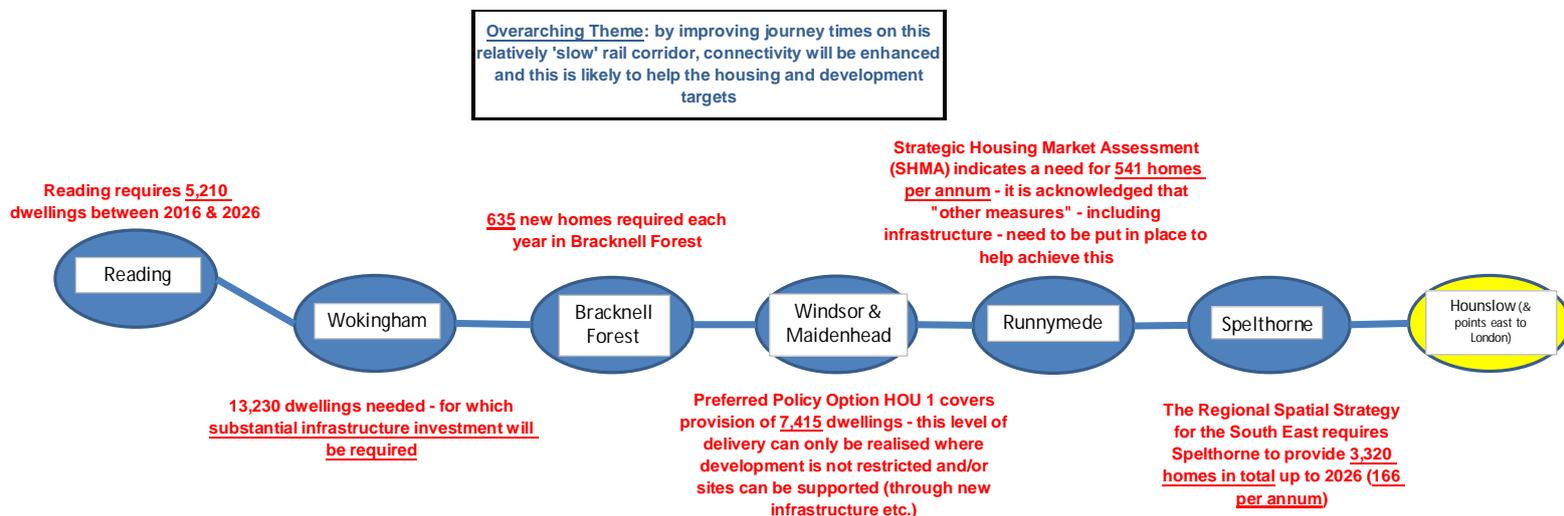


Figure 8-6 Reading – Waterloo Line Upgrade (in key Berkshire corridor)

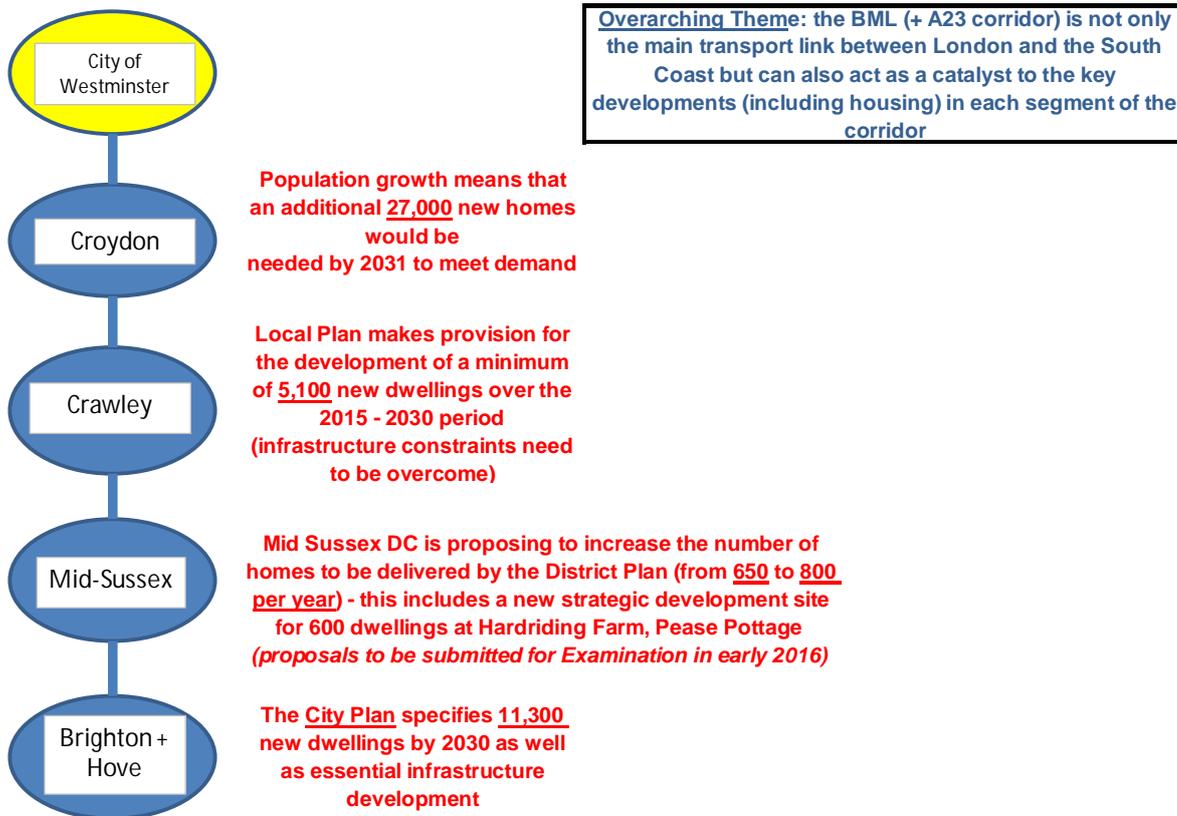
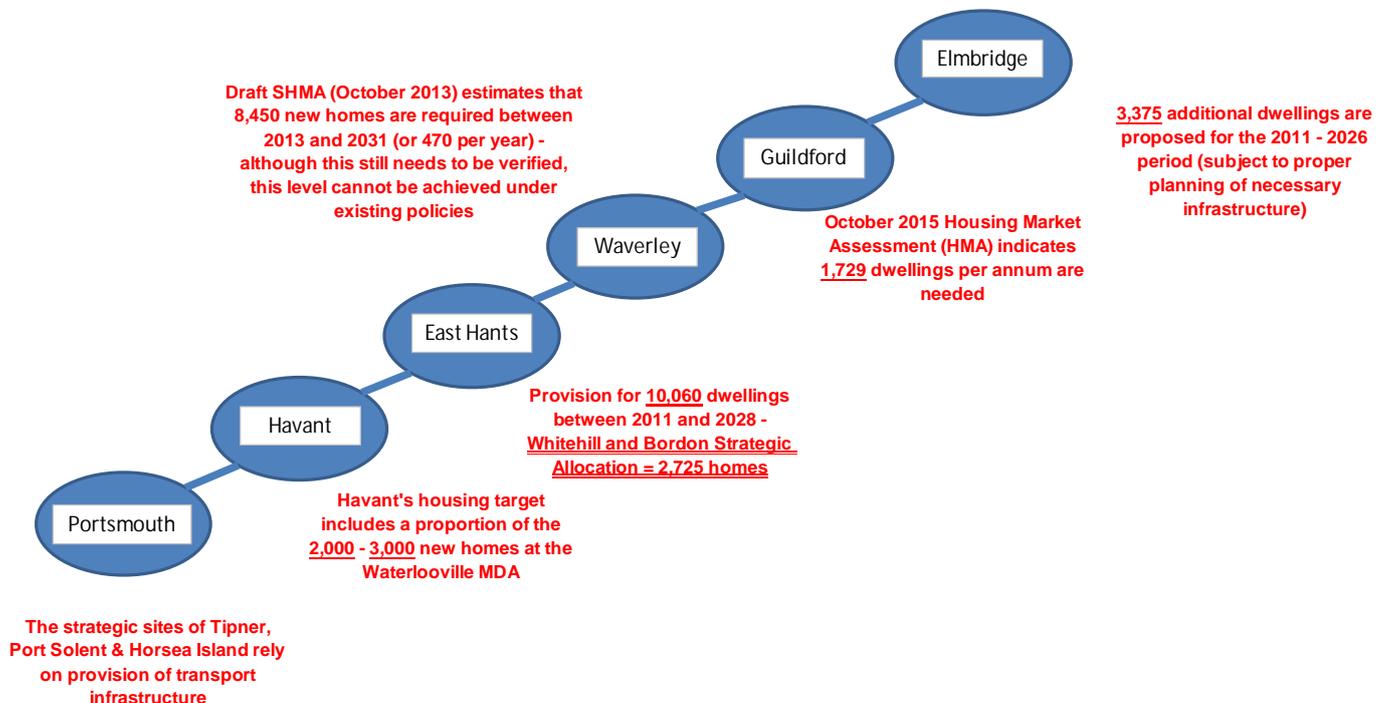


Figure 8-7 A3 Corridor Upgrade



9 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK

9.1 SUMMARY OF WORK

We have developed a quantitative approach that uses recognised DfT “Wider Impacts” guidance as the main building block to establishing how strategic corridor improvements can generate a range of benefits. These impacts include those not typically captured in conventional transport scheme appraisals.

The approach has been developed so that different corridor concepts can be tested quickly and across different geographies (and distances) in the study area. Based on improvements in connectivity, a series of economic benefits have been calculated covering increases in GVA at a ‘local’ level (based on improvements in productivity), increases in employment (supported by the increased GVA) and increases in taxation-based revenue streams to Government.

The work has focussed on the impact of a change to current travel characteristics in each corridor. These impacts are then extrapolated forward over a 60-year appraisal period so that the high level cost-benefit assessment can be undertaken.

For the high level cost benefit assessment, a series of cost estimates were taken from existing data sources. These cover both road and rail schemes with differentiation between ‘upgrade’ and ‘new corridor’ schemes (and costs).

The initial findings have shown that large-scale ‘transformational’ corridors could generate a high level of wider economic impacts, especially when the corridor serves several Local Authority Districts (LADs). These benefits do, however, need to be traded off against the feasibility of the corridor, both in terms of cost (likely to be very high for major schemes) and deliverability. The latter reflects the various engineering and environmental characteristics of each scheme.

OTHER CONSIDERATIONS

9.2 ACCOMMODATING HOUSING GROWTH

Data from the local authorities, including Local Plan data on housing requirements across the region, were also collated. Where major housing developments are proposed (such as at Whitehill and Bordon near the A3 corridor), these have been placed in the context of the strategic corridors put forward. As shown in the series of figures in Chapter 8, there are major housing requirements at strategic points within each corridor.

Although the interaction between transport infrastructure, housing and economic growth is a complex one (with transport infrastructure often being a prerequisite for new housing development), there is no doubt that the South East region requires a level of housing provision significantly above what has been delivered historically.

The new corridors can therefore help unlock these developments and thus boost the rate of supply of new housing.

9.3 REFINING OPTIONS AND DEFINING SCHEMES

Having demonstrated the potential economic impacts of the new corridor proposals, further work will be required to investigate each option in more detail. This will include more detailed costing of the proposals as well as more in-depth analyses of land use impacts and the impacts on housing / employment sites.

The modal choice for improvement schemes needs careful consideration and will be highly dependent on the existing configuration of the transport network in each town or city along a corridor. This will necessitate a different local solution to ensure that any corridor improvement adds full value to each location.

9.4 STRATEGIC PLANNING – PAN PUBLIC SECTOR APPROACH

This report has highlighted the potentially large economic benefit from investing in transformational transport infrastructure schemes in the study area. By its nature, the work assumes that 1) the different transport infrastructure providers responsible for the proposed improvements would be the 'deliverers' of the schemes and that 2) the other important subsidiary issues that need to be addressed would be in place or planned by other infrastructure providers or planning authorities.

Each corridor identified in this study will therefore need a 'Joint Investment Plan' involving both national and local authorities. This joint planning approach will help identify the overall corridor improvement and the local changes necessary to accommodate and maximise its benefits. In undertaking such joint working, all options for solutions should be considered using the principal of 'fundability' (i.e. that investment capital is a single pot from the public and private sector) and that the most cost effective deliverable solutions are prioritised.

The joint working between national and local authorities will also encompass all issues that affect socio-economic well-being, including interdependencies and trade-offs between local authority areas.

The need for a pan-public sector approach to strategic planning would ideally also directly influence spatial planning policy in whatever arrangement (and in whose jurisdiction it manifests itself in the future). Some current transport demand, particularly on the highway network, is a result of uncoordinated planning and transport policy both between the local planning authorities and the planning authorities' transport infrastructure providers.

A particular example is encouraging development and higher densities of residential development around existing or proposed public transport services and interchanges to maximise their use and create additional public transport services for neighbouring areas. This policy has reduced existing demand on the highway network and has freed up capacity for other uses in several examples in the UK and globally.

Joint spatial/land use planning across geography similar to this study area could also help refine the strategic infrastructure requirements and allow local authorities to trade housing and employment allocations so that new development can be located in the most economically advantageous areas and maximise the benefits of any transport infrastructure investment.

9.5 URBAN CONNECTIVITY AND PUBLIC TRANSPORT PROVISION

The four LEPs and transport authorities that commissioned this study consulted with interested parties and stakeholders before appointing WSP | Parsons Brinckerhoff. As a result of this consultation, Highways England commissioned a complementary study that considered the existing differences in modal share depending on the twin variables of inter-urban journey times and the provision of public transport services within an urban area. This is the *Orbital Strategic Public Transport in the West and South West beyond the M25* study referred to earlier.

The findings of the report should also be taken into consideration when considering the issues discussed in 9.3 and 9.4. The report was commissioned by Highways England to highlight that the investment and improvement in the Strategic Road Network (SRN) will not in isolation provide the enhancement in capacity and improvements in access necessary to realise the economic potential of the study area, and that consideration to all modal solutions and access to and from the strategic corridors was of equal importance.

A key finding was that where existing inter-urban journey times were better for rail compared to road, user numbers were markedly higher on rail than in similar areas. In addition, a high density of public transport provision within an urban area also increased the percentage of users using rail for inter-urban journeys. The reason for this is assumed to be that more people access rail stations by public transport making the end to end journey on public transport easier and more attractive (hence the higher modal share).

To bring this into the context of the issues discussed in 9.3 and 9.4, urban areas need to be of a minimum size and population density to generate sufficient demand to have a dense public transport network that is financially sustainable for operators. This is to ensure long term planning policies enable the concentration of housing growth in existing urban areas, as opposed to distributing growth to smaller towns and villages where public transport provision cannot cater for the majority of new demand created.

In consultation with Highways England, the concept of parkway stations, park and ride and park share facilities is also an area they wish to be explored as part of any corridor improvement schemes. Such facilities constructed upstream of existing congestion “hot spots” could provide some degree of relief by allowing people to meet at convenient rendezvous locations and share onward journeys. Other options include 1) transferring to public transport for access to town and city centres and 2) when situated next to a rail line, provide a parkway interchange for people making longer distance rail journeys, particularly into London. It is appreciated that there needs to be spare peak time rail capacity to allow the concept to work in terms of parkway stations and that the infrastructure necessary could be costly.

The report is appended as an Annex to this report

9.6 RECOMMENDED FUTURE WORK – MODAL SHIFT

The existing highway and rail network in the study area serves to allow movements within the economic geography and through it. Although this is true of most areas in the UK, the presence of London, the Channel Ports and Heathrow and Gatwick airports makes the situation more extreme compared to other areas. Therefore it will also be important to consider investment in options and solutions further afield that could free up capacity on the existing network.

An example would be for the LEPs and local authorities to influence the recently commissioned M25 SW Quadrant Study to look at traffic using the network to access Heathrow and Gatwick airport that has to travel through the study area and to investigate options for modal substitution that result in demand reduction. The previously mentioned Heathrow Southern Rail access could also be evaluated in terms of creating direct access from the Great Western Main Line and the Basingstoke to Woking Line.

The North Downs Line improvement would encourage some modal shift for accessing Gatwick Airport but could also be enhanced by the creation of direct interchange at Farnborough between the North Downs Line and the Basingstoke to Waterloo Main Line. The interchange will also help connectivity between Basingstoke and Guildford.

9.7 RECOMMENDATIONS – STRATEGIC TRANSPORT MODELLING

This study has deliberately not considered the monetised journey time savings and accident reductions of standard transport economic benefits and has focused on the wider benefits. This means that the value of the corridor improvements in terms of a Benefit Cost Ratio (HIGH LEVEL ECONOMIC BENEFIT TO COST RATIO) will be higher than has been estimated in this study. In addition, any new corridor or improved corridor will attract strategic traffic passing through the area and this economic impact has been not been calculated. Transfer of strategic traffic could also reduce the available capacity for movement in the area.

These three issues could be broadly calculated by a Strategic Transport Model which is a recommended next step in prioritising the corridors for scheme development and investment across the study area. Highways England's Regional Transport Models may be suitable for this purpose when they are available later this year.



SEVERN TIDAL POWER

Supply Chain Survey Report

JULY 2010

Contents

Executive Summary	p.3
I - Introduction	p.6
II - Vessels	p.14
III - Main Civil Works	p.20
A – Aggregates & armour stone	p.24
A1 – Primary aggregates	p.24
A2 – Marine aggregates	p.35
A3 – Secondary and recycled aggregates	p.36
A4 – Dredged materials for a STP scheme (preparation works)	p.38
A5 – Aggregates and armour stone for a STP scheme	p.41
B – Caissons construction yards	p.47
C – Concrete	p.50
D – General points	p.54
E – Conclusion	p.54
IV - Main Mechanical and Electrical Equipments	p.55
A – Turbines and generators	p.55
B – Gates – Cranes – Bascule bridge	p.63
C – Other technical equipment	p.63
D – General points	p.64
E – Conclusion	p.64
V - Labour and Skills	p.65
VI - Possible Further Studies	p.76
Appendix 1 – Severn Tidal Power Questionnaire	p.77
Appendix 2 – List of contacts (Questionnaire)	p.83
Appendix 3 – Sources of information	p.86

EXECUTIVE SUMMARY

Alongside the various studies being carried out as part of the Government's Severn tidal power feasibility study, the assessment of the possible constraints in terms of supply chain is also an important consideration in any decision on whether the Government could support any option.

The implementation of a tidal scheme in the Severn estuary, especially a large one (or a combination of smaller schemes), would require not only a great amount of materials and equipment but also large scale innovative construction design and installation processes (numerous caissons, long embankments, sluices, locks etc). Although most of the technologies and construction design are proven and mature, the magnitude of the largest schemes would require a multi-national joint venture.

In order to make sure the regional, national and international market will be able to meet the project's likely level of demand, a supply chain survey has been undertaken. This survey is based on the responses to a specific questionnaire sent to Trade Associations, Manufacturers, Contractors, Ports and other bodies, and also on existing reports.

The survey is mainly focused on the following topics which have been considered as the most sensitive in terms of supply chain and which could stall the project and/or increase the costs and lead-time:

- Vessels for dredging, caisson installation, embankment construction...
- Aggregates for concrete, ballast and embankment fill (sand and gravel, crushed rock and armour stone)
- Concrete for caissons and other civil works (cement, rebar...)
- Caisson construction yards
- Turbines and generators
- Availability of skilled labour

As for the other construction materials and mechanical or electrical equipment (e.g. sluice-gates, cranes, transformers, cables, switch gear...), even for the larger schemes, the magnitude of the demand is not considered as a major concern on the international market. Provided the procurement process is adequately managed, securing these materials and equipments should not be a particular problem either on the UK market or on the international one.

However, at this stage of the study some questions remain due to the lack of detailed information and data. In particular, the report does not provide relevant information on the impact on road and rail transport during the construction phase. This impact depends heavily on the location of the construction and manufacturing sites (caisson, precast facility etc), and of the quarries and ports where materials and equipment will be landed. Sea and rail transport are likely to be preferred so as to meet sustainability objectives.

Vessels

As vessels will play a major role in the preparation works (dredging) and in the installation or construction of the various structures, their availability on the international market is a key factor.

The current demand for marine equipment remains critical, due to a steady demand from the oil and gas industry and an increasing demand for offshore wind deployment, in particular in Europe. Nevertheless, a Severn scheme would require mainly dredgers, tugs and crane-barges for the installation of caissons and equipments and these types of vessels are unlikely to compete with the demand for vessels for offshore wind deployment (e.g. Jack-Up barges...).

Most of the vessels required for a Severn scheme are available on the UK and European market but orders would have to be placed well in advance (from 1 to 2 years) to ensure availability at the required time and to secure the appropriate or specific vessels. Due to the harsh conditions in the Estuary (currents, waves...) or to the specific requirements (e.g. deep dredging), some existing vessels would have to be adapted or modified.

The Dutch Eastern Scheldt storm surge barrier, commissioned in 1986, is a good example of innovative construction technologies which lead to the development of various purpose-built vessels. The building of a Severn tidal scheme would also rely on innovation and new dedicated vessels could be envisaged so as to be independent from the current market.

Aggregates

Aggregates (sand and gravel or crushed rock) are by far the largest quantities of construction material required for the Severn schemes, in particular for the Cardiff-Weston barrage but also for the lagoons (embankment).

As the demand for aggregates for construction fill (embankment) and ballast is very high, the use of suitable dredged materials from foundation and navigation channels works could significantly relieve the pressure on the market. Mainly dredged sand and gravel could be considered as a substitution of ballast and construction fill for the barrage schemes (for the Cardiff-Weston barrage, these dredged materials could replace all the sand and gravel required). On the other hand, for the lagoon schemes, the volume of suitable dredged materials is too low (or even non-existent for the Bridgwater Bay lagoon) and it is unlikely that the remaining aggregates for construction fill and ballast could be sourced from the UK market. In order to meet this demand, several possibilities could be envisaged: significant increase in the current extraction capacity or additional imports from overseas quarries. New licenses for dredging could also be considered, in particular in the Bristol Channel.

The demand for armour stone (which cannot be sourced in large quantities in the UK) is far beyond the current imports from Northern Europe, apart from the Beachley barrage. For the other schemes, only a significant increase in the delivery rate of existing rock quarries (e.g. Glensanda) and in overseas imports (e.g. Norway) could meet this demand.

Secondary and recycled aggregates could also make an important contribution to the supply of construction aggregates, in particular for ballast. China clay and slate waste could be used for a STP project, as the main quarries are respectively located in Devon and Cornwall or in North Wales.

Concrete

Aggregates for concrete could all be sourced from the national market, and for the smaller barrages (Shoots and Beachley) as well as for the Welsh Grounds lagoon, the regional markets could provide most of these materials.

The other concrete components (cement, rebar...) can be easily sourced from the UK market and for steel from the national and international market. Various concrete batch plants would have to be installed on each construction site, in particular for the caissons construction, but this is standard practice for any large construction project.

Caisson construction yards

The location of the caisson construction yards is critical and should take into account various parameters such as: environmental impacts, consent process, caisson transport cost, site characteristics (e.g. water depth, transport network for material and equipment delivery) and carbon footprint. At this stage, it is difficult to confirm that the potential identified sites (existing ports or shipyards and coastal sites) are suitable.

For the smaller schemes, potential sites could be envisaged along the Bristol Channel, but for the Cardiff-Weston barrage several sites would be required either around the UK coast or elsewhere in Europe (e.g. Netherlands or Northern Spain).

Turbines and generators

Only three European turbine manufacturers have the expertise and capacity to deliver specific tidal range turbines (bulb turbine or Straflo turbine) as well as their generators. The major Chinese turbine manufacturers also might be able to deliver a % of bulb turbines, provided they work under the supervision of one of the European turbine leaders.

The ongoing experience of a consortium of these 3 manufactures for the Brazilian Madeira hydro project (delivery of 72 bulb turbines) would provide interesting feedback and would confirm soon that procuring about 100 turbines is feasible for the smaller schemes.

As for the Cardiff-Weston barrage, delivering such a large number of turbines (more than 200) is considered as very challenging by the manufacturers using only existing facilities. A consortium between them is not the only key to success. So as to increase the delivery rate and the manufacturing capacity, a development and procurement strategy is likely to be set up by these manufacturers and investment in a new plant or in an assembly facility could be envisaged.

Skilled labour

The report also addresses labour and skills issues and provides additional information from existing surveys. According to the various respondents, it is confirmed that shortage of workforce in marine and civil engineering, mechanical and electrical installation, as well as in site supervision, are likely to occur. The various energy projects scheduled/proposed in the UK in the period to 2030 (nuclear plants, wind farms...) would all be competing for similarly skilled people.

The current economic downturn brings about many skill transfers within the industry and construction sectors and a significant shortage of labour and skill might be expected when the economy recovers. However, locating the caisson construction yards in various sites in the UK (or in Europe) would minimise labour shortages and international joint-ventures set up on purpose for the construction may well mitigate the remaining labour problems.

I - INTRODUCTION

STP Feasibility study

The feasibility study of tidal range power development in the Severn Estuary is being managed by a cross-government group led by the Severn Tidal Power (STP) team from the Department of Energy & Climate Change (DECC). The Terms of Reference of this study are as follows:

- assess in broad terms the costs, benefits and impact of a project to generate power from the tidal range of the Severn Estuary, including environmental, social, regional, economic, and energy market impacts;
- identify a single preferred tidal range project (which may be a single technology/location or a combination of these) from the number of options that have been proposed
- consider what measures the Government could put in place to bring forward a project that fulfils regulatory requirements, and the steps that are necessary to achieve this
- decide, in the context of the Government's energy and climate change goals and the alternative options for achieving these, and after public consultation, whether the Government could support a tidal power project in the Severn Estuary and on what terms

Public Consultation

In Phase 1 of the study, 10 potential development options (the long-list) have been considered (including barrages, lagoons, a tidal reef and tidal fence) and the Government carried out the first public consultation (January-April 2009), on the following:

- a recommended shortlist of 5 schemes for more detailed analysis this year
- the scope of the Strategic Environmental Assessment (SEA) that is being carried out within the feasibility study
- the issues the feasibility study is considering and how these are being approached

Over 730 responses were received from this 1st Public Consultation and most of them agreed with the scope of the SEA work proposed. Some detailed changes have been suggested and made to the SEA objectives, including to the Resources and Waste topic which is closely linked to the supply chain issues:

- to promote sustainable use of resources particularly with respect to aggregate
- to reduce waste generation and disposal, increase re-use and recycling and achieve the sustainable management of waste

Additional points most frequently raised in consultation responses will be also assessed by the feasibility study:

- the impact of any scheme would have on the local infrastructure and on local communities, including on roads and services, navigation, the Severn Bore, and construction effects
- compliance with the environmental and other legislation that applies to the Estuary and related areas
- where and how raw materials and skills needed to build a scheme would be sourced
- the overall CO₂ balance of a scheme including emissions associated with construction, and knock-effects on infrastructure and services
- the impact on the environment, including the geomorphology of the Estuary and how sedimentation might affect scheme feasibility

Supply Chain Study

The implementation of a tidal scheme in the Severn estuary, especially a large one, would create considerable demand across the entire supply chain. The project would generate supply chain issues, including securing:

- sufficient basic materials (steel, concrete, aggregates...)
- suitable marine and land equipment
- caisson fabrication capacity and yards
- timely supply of mechanical equipment, in particular turbines
- timely supply of electrical equipment, in particular generators, transformers...
- suitable logistics and installation plant

- skilled and experienced contractors and sub-contractors
- access to skilled and experienced labour forces, scientific advisors and project supervisors

Moreover, the location of the construction sites (including caisson yards), quarries and manufacturing plants may also impact the existing regional and even national transport network (road & rail).

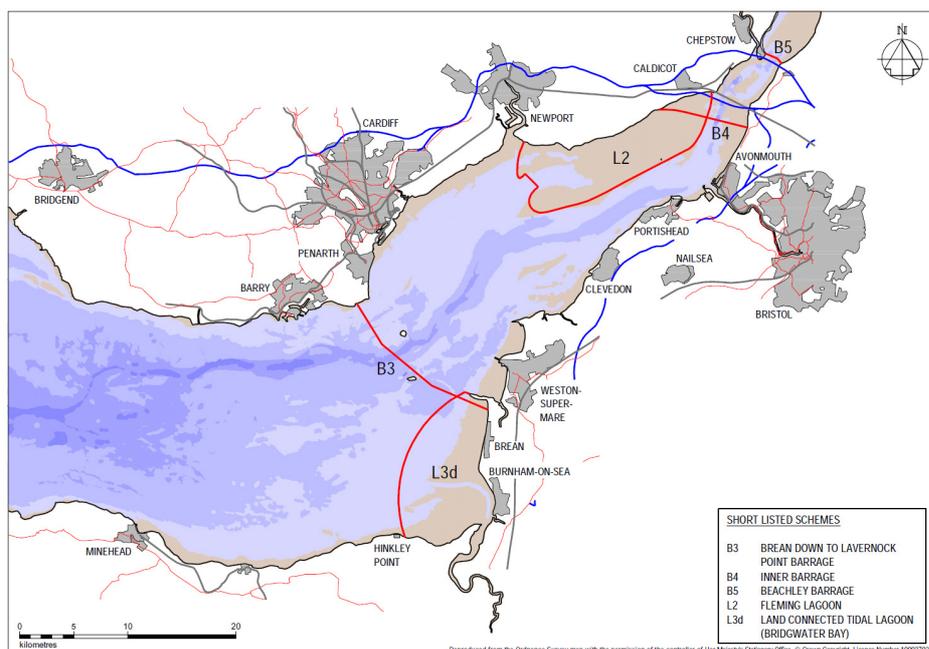
The availability of materials could impact upon overall project costs through both direct cost increases and time overruns. A lack of materials would stall the project and could also add a premium onto material prices. This is especially true for the larger schemes due to the vast quantities of materials required.

Difficulties in procuring marine plant equipment and turbines could also occur due to resource competition from other projects in European countries (and elsewhere) which all have to meet similar renewable energy targets. Competition for plant could increase costs through the creation of a price premium as well as delay project completion.

We propose to test the market's capability to meet the potential demand for a range of Severn tidal power schemes - this would also give manufacturers and suppliers advance notice of possible future demand, thus allowing them time to gear up their production capacity (provided a scheme is decided and planning permission obtained). This is why the STP Team decided to launch an overall study on supply chain issues in addition to the work being done by the Parsons Brinckerhoff-led consortium under the SEA contract.

The conclusions of this report should help inform the choice of the preferred scheme so as to mitigate the risks of delay and cost increases. The report is mainly focused on the 5 proposed short-listed schemes (base case); the interim results of the ongoing optimisation study of the schemes have been taken into account in this survey, particularly the embankment design (tonnage of materials) and number of turbines:

- **Cardiff-Weston Barrage:** A barrage crossing the Severn estuary from Brean Down, near Weston super Mare, to Lavernock Point, near Cardiff. It could generate 8.6GW –nearly 5% of UK electricity and twice the capacity of the UK's largest fossil fuel plant.
- **Shoots Barrage:** Further upstream to the Cardiff-Weston scheme. It could generate 1.05GW, equivalent to around the size of a large fossil fuel plant.
- **Beachley Barrage:** The smallest barrage on the proposed shortlist, just above the Wye River. It could generate 625MW, equivalent to around the size of medium fossil fuel plant.
- **Bridgwater Bay Lagoon:** Lagoons are new concepts which impound a section of the estuary without damming it. This scheme is sited on the English shore between east of Hinkley Point and Weston super Mare. It could generate 1.36GW (base case)
- **Welsh Grounds Lagoon:** An impoundment on the Welsh shore of the estuary between Newport and the Severn road crossings. It too could generate 1.36GW (base case)



Map of the 5 short-listed schemes

According to the size of the schemes and also to their design, the report tackles the supply chain issues for the 2 categories of schemes (a lagoon has a longer length of impoundment construction than a barrage relative to the impounded area):

- Barrage: Cardiff-Weston, Shoots and Beachley
- Lagoon: Bridgwater Bay and Welsh Grounds

During the preliminary optimisation analysis of the feasibility study, the design of each scheme has been improved (alignment, number and size of turbines...). For lagoons, cost and resource estimates have been based on conventional rockfill embankment construction. Although other forms of construction, e.g. the Fleming Group's tied wall proposal and geosynthetic reinforced embankments, have been considered, conventional rockfill has the greatest certainty of technical feasibility and represents a worst case form of construction in terms of material and labour resources. A better estimate of the quantities of construction materials has been made available for all shortlisted schemes and this report is based on this updated assessment.

The report is focused mainly on the following critical supply chain topics:

- Vessels
- Main civil works
 - concrete (cement + aggregates + rebar)
 - materials for embankments (aggregates & armour stone)
- Main mechanical equipment
 - turbines
 - other steelworks: gates, cranes and sluices
- Main electrical equipment
 - generators, transformers, switchgear...
- Labour and skills

In order to identify the major constraints in terms of supply chain and resources, a questionnaire was prepared for the above list of topics (see Appendix 1). The questionnaire also tackles labour and skills issues and specific questions are asked, including comments on the DTZ survey undertaken in Phase 1 of the STP feasibility study, so as to update some data.

This questionnaire was split into 2 parts:

- a short presentation of each scheme, including an estimation of the quantities of materials required for the construction as well as the main characteristics of the various equipment to be manufactured (base case).
- a list of questions for each topic

This questionnaire was sent in June 2009 to various Manufacturers, Contractors, Trade Associations, Ports and other bodies (see list – Appendix 2); about 100 questionnaires were emailed.

About 25% of recipients sent a detailed and comprehensive response in relation to their core activity. It is interesting to note that very few responses came from Electrical and Mechanical (excluding Turbines) bodies, mainly because the delivery of such equipment is not considered as a concern. Regarding Labour & Skills issues, very few responses were sent due to the difficulty at this level of study to estimate the real skill needs and to assess skill shortages. Phone calls, meetings and additional emails with the respondents provided further information.

Additional information was also found from various documents (books, brochures, websites...) and published reports and surveys (see Appendix 3 "Sources of Information").

For each question, a summary of the most relevant responses is set out in the report as well as some recommendations or proposals suggested by some respondents.

The level of supply chain constraints is assessed and summarised for each short-listed scheme according to the following scale within the regional, national and international markets:

- ☺ : no particular concern – available according to scheduled timescale
- ☹ : medium concern – high demand but enough resources or suppliers/manufacturers
- ⊗ : major concern – very high demand and/or lack of resources or suppliers/manufacturers – high risk of delay (lead time)
- ☹^{sc} : critical concern – no resource or shortage of supplier/manufacture – serious risk of delay (lead time)

☺ : no particular concern – available according to scheduled timescale
 ☹ : medium concern – high demand but enough resources or suppliers/manufacturers
 ☹☹ : major concern – very high demand and/or lack of resources or suppliers/manufacturers – high risk of delay (lead time)
 ☹☹☹ : critical concern – no resource or shortage of suppliers/manufacturers – serious risk of delay (lead time)

Severn Tidal Power - Supply Chain Issues Shoots Barrage Scheme - Summary

Major Components	Main Constraints	Alternative Solutions	Availability in the Market												Overall Supply Chain Level			
			Regional				National				International				☺	☹	☹☹	☹☹☹
			☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹				
Vessels																		
Dredgers	Suitable for deep water dredging				X				X		X						X	
Tugs				X			X				X				X			
Barges (ballast, rock...)				X			X				X				X			
Heavy barge cranes...	High demand, very few vessels				X			X				X					X	
Jack up	High demand, very few vessels				X			X				X					X	
Civil Works																		
Caisson construction yards	Very few sites, far from Severn estuary				X			X				X					X	
Concrete																		
- cement				X			X				X				X			
- aggregates				X			X				X				X			
- rebar	High demand	Worldwide imports			X			X			X						X	
Aggregates (embankment & ballast)	Shortage of sand in the UK	Additional dredging in the Bristol Channel or use of dredged materials from foundation preparation			X			X			X							X
Armourstone (embankment)	Shortage in the UK	Imports from Europe				X			X		X						X	
Main Mechanical Equipments																		
Turbines (+ Generators)	Only 3 manufacturers. Delivery rate	Construction of a new facility				X			X		X				X			
Dam/Turbine gates	International market					X			X		X				X			
Lock gates	International market					X			X		X				X			
Bascule bridges	International market					X			X		X				X			
Gantry/Goliath cranes	International market					X			X		X				X			
Main Electrical Components																		
Transformers	Very few suppliers					X			X		X				X			
Generator breakers	High demand					X			X		X				X			
Cables	High demand					X			X				X				X	

Aggregates supply takes into account available dredged materials

☺ : no particular concern – available according to scheduled timescale
 ☹ : medium concern – high demand but enough resources or suppliers/manufacturers
 ☹☹ : major concern – very high demand and/or lack of resources or suppliers/manufacturers – high risk of delay (lead time)
 ☹☹☹ : critical concern – no resource or shortage of suppliers/manufacturers – serious risk of delay (lead time)

Severn Tidal Power - Supply Chain Issues Beachley Barrage - Summary

Major Components	Main Constraints	Alternative Solutions	Availability in the Market												Overall Supply Chain Level			
			Regional				National				International				☺	☹	☹☹	☹☹☹
			☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹				
Vessels																		
Dredgers	Suitable for deep water dredging				X			X			X						X	
Tugs					X			X			X				X			
Barges (ballast, rock...)					X			X			X				X			
Heavy barge cranes...	High demand, very few vessels				X			X			X						X	
Jack up	High demand, very few vessels				X			X			X						X	
Civil Works																		
Caisson construction yards	Very few sites, far from Severn estuary	Constraints due to the Severn crossings			X			X			X							X
Concrete																		
- cement				X				X			X				X			
- aggregates				X				X			X				X			
- rebar	High demand	Worldwide imports		X				X			X				X			
Aggregates (embankment & ballast)	Shortage of sand in the UK	Use of dredged materials from foundation preparation		X				X			X				X			
Armourstone (embankment)	Shortage in the UK	Imports from Europe			X			X			X				X			
Main Mechanical Equipments																		
Turbines (+ Generators)	Only 3 manufacturers. Delivery rate	Construction of a new facility			X			X			X						X	
Dam/Turbine gates	International market				X			X			X				X			
Lock gates	International market				X			X			X				X			
Bascule bridges	International market				X			X			X				X			
Gantry/Goliath cranes	International market				X			X			X				X			
Main Electrical Components																		
Transformers	Very few suppliers				X			X			X				X			
Generator breakers	High demand				X			X			X				X			
Cables	High demand				X			X					X				X	

Aggregates supply takes into account available dredged materials

☺ : no particular concern – available according to scheduled timescale
 ☹ : medium concern – high demand but enough resources or suppliers/manufacturers
 ☹☹ : major concern – very high demand and/or lack of resources or suppliers/manufacturers – high risk of delay (lead time)
 ☹☹☹ : critical concern – no resource or shortage of suppliers/manufacturers – serious risk of delay (lead time)

Severn Tidal Power - Supply Chain Issues Welsh Grounds Lagoon - Summary

Major Components	Main Constraints	Alternative Solutions	Availability in the Market												Overall Supply Chain Level							
			Regional				National				International				☺	☹	☹☹	☹☹☹				
			☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹								
Vessels																						
Dredgers	Suitable for deep water dredging																				X	
Tugs					X			X				X							X			
Barges (ballast, rock...)					X			X				X							X			
Heavy barge cranes...	High demand, very few vessels					X			X				X								X	
Jack up	High demand, very few vessels					X			X				X								X	
Civil Works																						
Caisson construction yards	Very few sites, far from Severn estuary				X			X				X									X	
Concrete																						
- cement				X				X				X							X			
- aggregates				X				X				X							X			
- rebar	High demand	Worldwide imports		X				X				X							X			
Aggregates (embankment & ballast)	Shortage of sand in the UK	Additional dredging in the Bristol Channel				X			X				X									X
Armourstone (embankment)	Shortage in the UK	Imports from Europe				X			X				X								X	
Main Mechanical Equipments																						
Turbines (+ Generators)	Only 3 manufacturers. Delivery rate	Construction of a new facility				X			X				X						X			
Dam/Turbine gates	International market					X			X				X						X			
Lock gates	International market					X			X				X						X			
Bascule bridges	International market					X			X				X						X			
Gantry/Goliath cranes	International market				X				X				X						X			
Main Electrical Components																						
Transformers	Very few suppliers					X			X				X						X			
Generator breakers	High demand				X				X				X						X			
Cables	High demand				X				X				X								X	

Aggregates supply takes into account available dredged materials

☺ : no particular concern – available according to scheduled timescale
 ☹ : medium concern – high demand but enough resources or suppliers/manufacturers
 ☹☹ : major concern – very high demand and/or lack of resources or suppliers/manufacturers – high risk of delay (lead time)
 ☹☹☹ : critical concern – no resource or shortage of suppliers/manufacturers – serious risk of delay (lead time)

Severn Tidal Power - Supply Chain Issues Bridgwater Bay Lagoon - Summary

Major Components	Main Constraints	Alternative Solutions	Availability in the Market												Overall Supply Chain Level				
			Regional				National				International				☺	☹	☹☹	☹☹☹	
			☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹	☺	☹	☹☹	☹☹☹					
Vessels																			
Dredgers	Suitable for deep water dredging				X				X									X	
Tugs					X			X									X		
Barges (ballast, rock...)					X			X									X		
Heavy barge cranes...	High demand, very few vessels					X			X			X						X	
Jack up	High demand, very few vessels					X			X			X						X	
Civil Works																			
Caisson construction yards	Very few sites, far from Severn estuary				X			X				X						X	
Concrete																			
- cement				X				X				X						X	
- aggregates					X			X				X						X	
- rebar	High demand	Worldwide imports			X			X				X						X	
Aggregates (embankment & ballast)	Shortage of sand in the UK	Additional dredging in the Bristol Channel. No suitable dredged materials from foundation preparation				X			X			X							X
Armourstone (embankment)	Shortage in the UK	Imports from Europe				X			X			X						X	
Main Mechanical Equipments																			
Turbines (+ Generators)	Only 3 manufacturers. Delivery rate	Construction of a new facility				X			X			X							X
Dam/Turbine gates	International market					X			X			X						X	
Lock gates	International market					X			X			X						X	
Bascule bridges	International market					X			X			X						X	
Gantry/Goliath cranes	International market				X				X			X						X	
Main Electrical Components																			
Transformers	Very few suppliers					X			X			X						X	
Generator breakers	High demand				X				X			X						X	
Cables	High demand				X				X			X							X

Aggregates supply takes into account available dredged materials

II - VESSELS

Introduction

For the construction of each scheme, various vessels should be required for the following tasks:

- dredgers for foundation preparation, caissons installation (in particular for turbine caissons so as to provide sufficient submergence for the turbines), navigation channels (also caisson towing channels from construction yards): trailer suction hopper dredgers, large cutter suction dredgers, grab dredgers (clamshell), dragline, ladder or continuous flight bucket dredgers...
- jack-up construction crane barges (e.g. for rock dredging pre-treatment by drilling and blasting),
- towboats, tugs (e.g. for caissons towing),
- vessels for caissons ballast filling,
- floating cranes or cranes barges for light equipment installation, bulkheads removal...(fully rotating crane)
- heavy load crane barges or heavy lift crane vessels (e.g. heavy derrick barge, sheer-legs cranes) for turbines, transformers, gates installation,
- bottom-dump or side-dump barges/split hopper barges for embankment construction and placement of underwater fills
- rock transport (pontoons, barges...) for embankments and armouring construction,
- supply, services, safety and crew boats

Due to the specificity of these tidal schemes located in a harsh sea environment (high tidal velocity at spring tides, waves...), all the marine vessels will play an essential role in the project development. The construction method, seabed preparation and transportation of materials and equipments will rely on the availability of these vessels and also on their performance and ability to achieve specific tasks.

Since sea embankments and breakwaters are being constructed in ever more severe environments, their designs are becoming increasingly sophisticated as a result of advanced understanding of hydrodynamics of wave interaction with the structure and the sloping bottom. Experience has been accumulated worldwide and translated into these improved and complex designs. For the constructor, this means the positioning and placement are very demanding. Large crane barges with high stability and greater reach are required; mooring systems are used with increased holding capacity for taut-line moorings.

Availability of these types of vessels in the national and international market

According to the Marine Contractors responses, it is difficult to give precise figures at this stage if the exact requirements of the vessels are not yet defined. The duration of the project, the scope of work and the requirements of warranty surveyors would be vital for the definition of the requirements, also of importance are e.g. sailing distances, water depth, lifting heights and weights, crew requirements (with regards to nationality or Health and Safety requirements).

The availability of large and specialised marine equipment (trailer suction hopper dredgers, large cutter suction dredgers, heavy load crane barges...) is under pressure in the international market. Only small equipments such as small dredgers, tugs, barges, pontoons, cranes can be easily sourced within the national market.

Vessels of the types and sizes required for a Severn Tidal Power scheme operate on an international scale. Very few of the above listed vessels are available inside the UK national market at present but most of major European Dredging and Marine contractors (mainly from Belgium and the Netherlands) have a representation in UK (e.g. Boskalis, BAM, Van Oord, DEME...) and all are capable of undertaking these works and would have the appropriate equipments given sufficient lead in times. A worldwide mobilisation could be also possible, in particular from the Middle and Far East market where new suppliers have been created. Consortia or Joint Ventures could be envisaged between European Dredging and Marine Contractors.

For large projects, contracts are generally placed well in advance (from 0.5 year up to 2 years) so as to ensure availability at the required time and to secure the appropriate or specific vessels. Key to success is proper advance sourcing, contracting and planning hand in hand with the suppliers. Marine Contractors are unable to predict for future periods further away than 2-3 years and spot markets such as "Salvage projects" which are unpredictable but may have some duration, may also disrupt their forecast. Moreover, ongoing international long term contracts might pose a

problem in terms of availability: some vessels can operate several years in the same country for different projects in order to make cost-effective their transportation and deployment.

Here are some examples of advance booking requirements:

- Vessels requiring from 18 to 24 months advanced booking:
 - Jack-ups are limited in availability (very small fleets) and generally booked well in advance (> 1.5 to 2 years)
 - Sheer-legs cranes with high capacity (e.g. >1000T) are limited and should be booked > 1.5 year in advance
 - Dredgers, in particular for deep water, are also limited in availability (very few suitable vessels) and generally booked well in advance (> 1.5 year)
- Vessels requiring at least 6 months advanced booking:
 - Tugs are a commodity, availability is generally not a problem.
 - Lifting barges (flattop with crawler crane)
 - Barges, workboats ...etc.

Nowadays, there is limited availability of dredging equipment within the world (particularly grab dredger; the only UK based seagoing commercial grab dredger is operated by UK Dredging, in Cardiff) due to large developments in the Middle East and Africa currently employing much of the available plant (marina and ports projects); India and China are also future large dredging markets but the existing fleets and planned vessel construction in the Far East would meet this new demand but not add to the European resource. Nevertheless, the current collapse in the worldwide property market could slow development in the Gulf (e.g. Dubai projects) and in parts of South East Asia, which might release dredgers for use in the Bristol Channel if the economic recession remains long-term.

Moreover, those dredging vessels capable of working in the Severn Estuary environment, and with the ability to address the deep dredged depth, are critical. Some existing dredgers could be modified so as to meet these technical requirements: e.g. cutter suction dredgers may need to be re-fitted for the Cardiff-Weston barrage to reach the maximum depths required.

**Case study - The large rock cutter section dredger “D’Artagnan”
Example of a large dredger**

A large rock cutter suction dredger (“D’Artagnan”) has been commissioned, built (2003-2005) and is in operation by the French subsidiary (Société de Dragage International - SDI) of the Belgium Marine Contractor DEME (Dredging, Environmental & Marine Contractor). This dredger is one of the largest in the world and it can dredge to a depth of 35m, and is equipped with two inboard dredge pumps and one submerged dredge pump on the cutter ladder. The dredged material can be pumped ashore through a 1,000mm discharge pipe (at a distance of up to 10km). The ship is equipped with a modern barge loading system which can load barges moored alongside the dredger. It includes among other things a buffer system which enables dredging for a longer period under unfavourable weather conditions. The dredger is equipped with two propellers (3,700kW each) that can generate a speed of nearly 12.5 knots.



Nevertheless, the specification requirements of a STP project in respect of rock dredging and cutter deployment should be studied so as to make sure this vessel is appropriate.

The rock barges and rock transportation ships which are very specific vessels would generally be chartered on the international market, or be provided by the rock suppliers. As the sources of large size rocks are not in the UK but mainly in northern Europe (Norway...), these barges and vessels are in great demand, mainly for port construction or refurbishment (breakwater dykes...). The long distance rock transportation vessels might have to be supplemented by additional vessels, chartered in, modified or built from new. Rock barges are routinely repaired and re-fitted most seasons, and this work can be done around UK shores.

Jack-up vessels are certainly the most critical due to the small number of existing vessels in Europe and the steady demand for offshore wind farm installation. But installation processes (in particular for caissons) are unlikely to rely on Jack-up vessels, maybe with the exception of final placement.

The caissons will be floated into position, and will mainly require tugs. Tugs are relatively easy to source, and are not routinely used for wind farms.

Work barges, inshore craft and safety vessels are available in the UK, but may be in increasingly short supply as the offshore wind market ramps up.

Need for specific built or retro-fitted vessels

It is normal practice on a large project for construction equipment, including vessels, to be modified or adapted to suit the particular requirements of the project, e.g. the harsh marine conditions of the Severn estuary. Yards in UK such as A&P Tyne and North European shipyards have capability to undertake such works. Modifications or re-fits vary widely, but could typically take from six months to a year to procure, and execute.

As with the Dutch Delta Scheme (e.g. Eastern Scheldt storm surge barrier), it is also possible that purpose-built vessels will be required for sea bed preparation and for caisson placing. These new vessels are likely to be built in the following places, China, South Korea or Latvia or Poland. New vessels typically take from two to three years to procure. It was common place to buy Build Slots in recent years but this is now not the case because the vessel construction market is now weakening after seeing several years of extremely high activity.

Compatibility of the harsh site conditions with vessels

The unique environment of the Severn Estuary with high current velocities at spring tides, the extreme tidal range and the sediment load are bound to present several significant challenges to the designers and constructors for station keeping, manoeuvring and operations (e.g. high bollard pull vessels engaged to tow caissons do not normally have to cope with such conditions). Accurate positioning and placement of caissons is likely to be a challenge (mooring and winching robust systems). The particularly high volume of suspended material within the estuary would be a significant challenge in relation to a number of issues and would be a considerable factor influencing how the caissons are placed. The installation methods outlined by STPG in their 1989 report addressed these issues in some detail and showed how existing technology and vessel types could be used (modified / fitted out for the purpose).

Most existing jack-ups can only move at wave heights of 1.5 m and below. In the Bristol Channel these conditions are much shorter in duration than most other near shore locations around the UK. The wind speeds encountered would also limit operating hours and also the number and lengths of time when movement of the barges is possible. It is possible to design Jack-Ups to move in wave heights up to 2.5 metres, and this is increasingly the standard for offshore wind farm vessels.

The bigger challenge would however be the preparation of the surfaces onto which the caissons will have to be landed. These will have to be accurately levelled, to tight tolerances, and these graded surfaces will be very vulnerable until such time as the caissons have been sunk onto them during neap tides. It is very possible that this levelling work will have to be performed more than once on many caissons, because it will often be the case that a week to ten days may pass when it is not possible to sink a caisson due to bad weather condition. During the time between weather windows, the tidal currents are likely to move large amounts of sand and silt along the seabed into any excavations.

Therefore innovative solutions for the foundation preparation could be envisaged like those used for the Eastern Scheldt storm surge barrier in the 1980s (see below case study; prefabricated mattress consisting of reinforced geotextile fabrics and graded stone layers laid out by a specific vessel - Cardium).

The offshore wind and offshore oil and gas industries have already developed construction capabilities in harsh marine environments which could be helpful for the Severn estuary.

Although the conditions will reflect the equipment choice, it will be more of a factor on the installation methods and constraints rather than on the equipment itself.

Ports

Further study of the available vessels, their dimensions and requirements, will determine the ability of the existing ports to accommodate them. Port operators will seek to continue all existing cargo movements and will thus seek to accommodate new opportunities on other berths (this will also depend on the international trade situation). Most of the Severn estuary ports are able to provide facilities for a wide range of vessels of varying sizes (Port Talbot, Bristol,

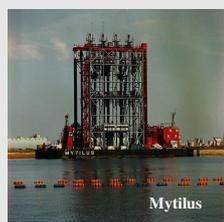
Cardiff...). A number of alongside facilities exist at these ports but depending on requirements, some bespoke facilities may need to be developed to meet the project requirements. Upgrade and improvement might be required at any of the Severn estuary ports to accommodate large and numerous vessels (e.g. dredgers) or to deal with heavy loads (e.g. turbines) as it is unlikely that the existing infrastructure and cargo facilities will be adequate for them. Development land at these ports is also available to support the vessels requirements.

Case study - The Eastern Scheldt storm surge barrier (Oosterschelde – Delta Works) Example of construction innovation

The Eastern Scheldt storm surge barrier (completed in 1986), was the most ambitious part of the Delta project. The original plan was to build a 9km dam in the mouth of the Eastern Scheldt (20 to 40m depth; 3m tidal range). Preparatory works started in 1967 with the construction of 3 islands: Roggenplaat, Neeltje Jans and Noordland. In 1973, 5km of dam had been built but, under pressure from scientists, the fishing industry and environmental associations, parliament decided to launch further studies so as to protect this unique natural habitat. In 1975, the government decided that a storm surge barrier with sliding gates should replace the initial dam. This scheme would protect against flooding while conserving the ecosystem: the barrier would remain open when conditions were normal (3/4 of the original tidal movement is therefore maintained) and would be closed when sea water levels were high. The technology needed to construct this huge barrier had yet to be invented and the experience gained building the other Delta dams was not suitable. The idea was to place 65 prefabricated concrete piers in a very firm stone foundation and to insert 62 large steel sluice-gates between them. The final project consisted in constructing 3 barriers implemented in the 3 remaining channels: the Hammen, the Schaar van Roggenplaat and the Roompot (total length: 3km). Parliament approved this plan in 1979.



The Eastern Scheldt storm surge barrier was such an exceptional project that a new approach had to be taken to every part of its construction. A consortium of Dutch contractors was formed (Dosbouw) and cutting-edge methods and materials were used. Most of the prefabricated and construction works (piers, foundation mattress, storage of armour stone...) were carried out in the Neeltje Jans and a temporary bridge was built to connect the island to shore.



First, at the construction site, large diameter dolphin and anchor piles (steel cylinder piles) were driven to serve as moorings for the extensive floating construction operations to come. The loose sands in the top 10-20m of the foundation under the barrier were then compacted by vibratory means. A special floating rig, the **Mytilus**, jetted and vibrated 4 large diameter vibrating needles (2.1m diameter – 18m length) down to a depth up to 50m below sea level. The entire compression process took place under water and continued 24h per day. The ship consists of five pontoons: a main pontoon of 18.9m long and four auxiliary pontoons with a total length of 32.9m. On the ship were lifting cranes 55m high. The lifting winches which were fixed to them had a pulling power of 120t. The construction cost of the Mytilus was €15.9m in 1986 (about £29m in 2009).



As bed protection, improvement and depth compaction were not enough to ensure that the piers could be placed safely, a foundation had to be constructed to prevent scouring. Polypropylene mattresses filled with graded layers of gravels were used (36cm thick, 42m wide and 200m long). They were made at a factory specially built for their production in the Neeltje Jans island. The mattresses were winched up on a huge floating reel and then placed on the specially-designed vessel, the **Cardium** which laid them at a rate of 10m per hour during slack water period. This vessel was also able to dredge the upper seams of the seabed before laying the protection mattress. An additional gravel ballast mattress was finally laid over the sands to prevent erosion so as to protect the mattresses against wear, which could be developed through the opening and closure of the gates. The construction cost of the Cardium was €49.9m in 1986 (about £96m in 2009); the actual cost was eighty percent higher than expected.

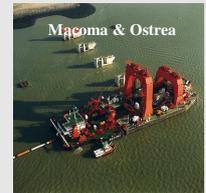
The 65 concrete piers were constructed inside 3 large construction docks 15m deep which were excavated, diked off and dewatered using 320 underwater pumps. The piers are colossal structures made of prestressed concrete: 30 to 40m high and their dry weight was up to 18,000t. A purpose-built factory produced 450,000m³ of concrete over 4 years. The piers were hollow and were filled with sand when they were in position. As all the piers had to be completed in only 4 years, they were produced in staggered batches with work beginning on a new pier every 2 weeks. At the peak of the activity 30 piers were being constructed simultaneously.



When all the piers in a construction dock were completed, the dock was flooded and the encircling dike was opened so that they could be towed to one of the channels in the mouth of the Eastern Scheldt. A giant catamaran crane barge, the **Ostrea** vessel was designed and built to lift the piers in the construction dock, transport them to the channels and then place them with great precision on the foundation mattress (margin error of a few cm). The Ostrea was the flagship of the Delta fleet. With its

length of eighty-seven metres, the typical U-shape and a capability of 8,000 horsepower, it was a most impressive ship. With the open side of the 'U', the ship manoeuvred around the pier. The ship could steer easily, thanks to its four screw propellers. On both sides there were two giant goliath cranes 50m high. The piers were fixed to these cranes. As the cranes could not lift more than 12,000t whereas the piers weighed 18,000 tonnes, the piers were only half-lifted and transported to their final location. It took 1 year to place all the 65 piers. The construction cost of the Ostrea was €34m in 1986 (about €65m in 2009).

The **Macoma** vessel was specially built to moor the Ostrea while it was placing the piers and to clean the site immediately beforehand. The piers were positioned with a pin-point accuracy at slack water using very sophisticated measuring equipments. It took a year to place them all. This pontoon was situated exactly in front of the place where a pier would be placed. When the Ostrea had taken a pier, it moored against the Macoma. To offer the Ostrea some stability, the pontoon had a coupling mechanism with a power of 600 tonnes. The Macoma also had a second function: an enormous vacuum cleaner was used to ensure there was no sand between the pier and the bottom. This was an extremely difficult



task, because the tidal movements moved large amounts of sand each day. The construction cost of the Macoma was €20.4m in 1986 (about €38m in 2009).

For even greater stability and protection from the powerful tidal currents, the piers were embedded in sills made up of armourstone (up to 10t each). A specific vessel, the Trias was designed specially to lay the top layer so as to avoid any damage to the piers. This vessel was equipped with a long, extendable arm that could place the heaviest stones accurately. 5m tonnes of stones were needed and since they were not available in the Netherlands, they were shipped over a 4 year period from Germany, Finland, Sweden and Belgium. The construction cost of the Trias was €11.3m in 1986 (about €20m in 2009).



At the final stage, the service ducts, pier capping units, sluice-gates, sill beam and upper beam had to be put in place. The hollow service ducts, which would later be covered by a road, were laid on top of the piers. The ducts contain the operating and control equipment for the gates. The steel gates (from 6 to 12m high) were suspended between piers. The biggest sluice-gate weighs 480t. A specific barge-crane, the Taklift 4 was used for the installation of the gates.

Many other specific vessels were used for this project: Portulus, control vessel with underwater vehicle for controlling proper mattress installation, 2 self positioning stone dumpers (2,000t load), Johan V geotechnical reconnaissance pontoon, Jan Heijmans vessel which helped the Cardium place the mattress, the Sepia and Donax I vessels which worked with the Macoma during the placement of gravel ballast on the mattresses...

The total construction cost of the scheme was €2.7bn in 1986 (about €5bn in 2009) and the cost of all the purpose-built vessels accounted for about 6% of budget. The maximum workforce was 1,600 people for the construction.

The barrier had a revolutionary design. Many techniques had not been used before and if they had, it was not during such a large-scale project as this one. There were no ships suitable for the construction of the storm surge barrier. For the building of the dam, several vessels were designed, which were individual tours de force. The ships were all "state-of-the-art". Most of the ships were provided with a system which could automatically and very precisely determine the location of the ship. The bearing techniques for orientation were quite new. In addition, new techniques were used to identify the surface and the structure of the sea bottom. Equipment such as gyroscopes and accelerometers would have been indispensable. To process the data flows provided by the equipment, large computers were necessary.

The main purpose-built vessels like the Cardium, Ostrea and Macoma, have never been used on other projects because of their specific design. Nevertheless, this Delta project has proved that challenging works can be overcome thanks to innovative construction solutions and also to specific tools and dedicated vessels.

Competition from other offshore construction projects

The increasing focus on offshore wind, wave, tidal stream and European Super Grids is likely to increase the pressure on the existing vessel resource. However, firm commitment to these programmes will make sure that new investment is brought in to alleviate the current scarcity of supply. As offshore wind turbines are increasing in size (to 5 or 6 MW and even 8 MW, in particular floating wind turbines which are currently being developed in Norway), new cost effective and fast installation methods are likely to be developed in the short term. So as to take advantage of the short weather windows and to optimise the duration of the mast and nacelle installation, Marine Contractors envisage now to build specific vessels able to lift and transport a pre-assembled wind turbine (mast + nacelle + blades) and to fix it to the foundation structure or to anchor it. Therefore, very few of the existing installation vessels would be adequate for installing turbines or foundations in the years after 2020 (or maybe earlier). This may actually release some of the existing vessels back onto the market, as they become redundant, through lack of sufficient lifting capacity at the hub heights that will be required for 6 MW and above turbines. Nevertheless, these vessels might also then move to the Far

East to service countries like India and the Philippines that are looking to install large scale wind farms off their coasts using smaller wind turbines; but this scenario is not confirmed. Therefore, the availability of heavy lift barges or transportation vessels for a STP scheme could be better than expected.

Competition from concurrent large construction projects may increase costs as demand for the resources of plant, labour and materials surpasses supply. Early involvement of the contractor(s) and suppliers would contribute to the project's success by engaging those parties in the development process and providing, at the relevant stage, certainty by securing resources.

It is relevant to note that if the London Gateway Project is resumed (initially scheduled in 2009-2013 but postponed), the demand for Marine equipment might be slightly put under strain (30 million m³ dredging, 1,300 m quay construction...).

Conclusion

Availability of dredging and marine equipment changes to satisfy global demand and the major vessels likely to be required for the STP scheme would need to be assessed in more detail now so as to provide an input to the overall scheme selection process. The particular environment of the Severn Estuary is likely to influence the type of vessels and their fittings. Forward planning and early engagement with suppliers would address the vessel availability, modifications to suit the demands of the environment and the timeframes.

The demand for specialised marine equipment is likely to remain steady (in particular due to planned offshore wind energy projects but also due to forthcoming wave and tidal developments), the long lead-in times of a STP project should provide an opportunity to address potential equipment capacity gaps. Anticipated changes are more likely to occur in the geographical location of the equipment rather than due to change of workload.

Also, the construction method must be optimised or even innovated so as not to be too dependent on the international vessels market (e.g. many moles or similar rock walls in the past have been serviced by rail mounted Goliath cranes installed on the crest of the structure; it is possible that a similar approach could be used on the barrages or lagoons to supplement crane vessels).

The Eastern Scheldt case study has proved that innovation can bring efficient responses to technical challenges and purpose-built vessels can also be envisaged for specific tasks.

III - MAIN CIVIL WORKS

Introduction

During the preliminary optimisation analysis of the feasibility study, the design of embankments and breakwaters for navigation locks were modified and based on conventional embankment fill and rubble mound. All the figures have been updated and the results come from the best variant of each short-listed scheme. The volume and tonnage of materials, in particular for the embankments, has been re-assessed according to the most suitable alignment, taking into account the sea-bed quality (volume of dredged materials required) and the water depth. Further studies on alternative solutions for embankment design (e.g. Fleming wall proposal for the Welsh Grounds lagoon) are being undertaken as potential alternative forms but conventional embankment fill and rubble mound is the worst case scenario in terms of labour and material resources and provides greater technical certainty.

The summary of the main construction materials required for each scheme is set out as follows:

Barrage schemes - Embankment and breakwater (lock) construction

	Barrages					
	Cardiff-Weston		Shoots		Beachley	
Embankments						
Overall crest length (km)	3.8		5.46		0.57	
Foundation preparation	million m ³	million ton	million m ³	million ton	million m ³	million ton
Sand bed (on dredged surface)	0.479	0.814	0.271	0.461	0.043	0.073
Embankment Structure	million m ³	million ton	million m ³	million ton	million m ³	million ton
Control structure rockfill (0.1 - 1t; 70% crushed rock - 30% armour stone)	1.598	3.516	0.401	0.882	0.103	0.227
Containment mounds (tonne quarry-run rock; crushed rock)	1.385	3.047	1.806	3.973	0.144	0.317
Filter Type 1 (0.6 - 35mm; gravel)	0.789	1.499	0.843	1.602	0.085	0.162
Filter Type 2 (50 - 250mm; gravel)	0.191	0.363	0.237	0.450	0.022	0.042
Sand core	6.359	10.810	3.337	5.673	0.364	0.619
Armour stone (0.3 - 1t)	0.038	0.084	0.346	0.761	0.036	0.079
Armour stone (1 - 3t)	0.600	1.320	0.525	1.155	0.044	0.097
Breakwater for locks (rubble mound)	million m ³	million ton				
Sand core and bed	0.096	0.163				
Derrick stone (<1t; 70% crushed rock – 30% armour stone)	0.115	0.253				
Armour stone (0.3 - 1t)	0.021	0.046				
Armour stone (1 - 3t)	2.839	6.246				
Rock armour (3 - 6t)	0.424	0.933				
Total materials for embankments	million m ³	million ton	million m ³	million ton	million m ³	million ton
Total sand	6.934	11.788	3.608	6.134	0.407	0.692
Total gravel	0.980	1.862	1.080	2.052	0.107	0.203
Total sand & gravel	7.914	13.650	4.688	8.186	0.514	0.895
Total crushed rock	2.584	5.685	2.087	4.591	0.216	0.475
Total sand & gravel & crushed rock	10.498	19.335	6.775	12.776	0.730	1.371
Total armour stone	4.436	9.759	0.991	2.181	0.111	0.244
Filling materials (landing area for locks)	3	5.7	3	5.7	0	0

Sources: Parsons Brinckerhoff & DECC

In order to compare the demand for construction aggregates with the regional and national output capacity statistics (breakdown: sand & gravel – crushed rock – armour stone), each category of materials required has been classified according to this breakdown. It has been assessed that control structure rockfill and derrick stone are made of 70%

crushed rock and 30% armour stone; filter type 1 (0.6 – 35mm) are supposed to be gravels in the survey but they could also be small crushed rocks.

As for landing areas for the navigation lock (estimate: 3 million m³), dredged materials from foundation preparation are likely to be suitable.

Barrage schemes - Concrete structures (caissons...) and pre-cast armour units construction

	Barrages					
	Cardiff-Weston		Shoots		Beachley	
Pre-cast armour units (Dolosse)						
Number of 5t units Dolosse	60,501		0		0	
Concrete for Dolosse (4m ³ /unit)	0.242	0.605				
Rebar		0.05				
Cement for Dolosse units (320kg/m ³)		0.077				
Concrete structures						
Form surfaces (incl. Caisson lock)	million m ²	14.749	million m ²	1.843	million m ²	1.166
Crest works	million m ³	million ton	million m ³	million ton	million m ³	million ton
Reinforced concrete (Wave wall)	0.097	0.243	0.089	0.223	0.009	0.023
Cement (350kg/m ³)		0.034		0.031		0.003
Rebar		0.020		0.019		0.002
Caissons						
Caissons (turbines & gates)	129 caissons		46 caissons		31 caissons	
Structural concrete	6.332	15.830	0.673	1.683	0.338	0.845
Cement (350kg/m ³)		2.216		0.236		0.118
Rebar		1.299		0.134		0.065
Sand ballast	8.062	12.093	0.825	1.2375	0.392	0.588
Concrete ballast	0.746	1.641	0.111	0.244	0.049	0.108
Cement for ballast (315kg/m ³)		0.235		0.035		0.015
Caissons (lock & breakwater)	35 caissons		6 caissons		6 caissons	
Structural concrete	0.898	2.245	0.073	0.183	0.073	0.183
Cement (350kg/m ³)		0.314		0.026		0.026
Rebar		0.184		0.015		0.016
Sand ballast	1.271	1.907	0.158	0.237	0.158	0.237
Concrete ballast	0.328	0.722	0	0	0	0
Cement for ballast (315kg/m ³)		0.103	0	0	0	0
Total materials for concrete structures	million m ³	million ton	million m ³	million ton	million m ³	million ton
Total sand ballast	9.333	14.000	0.983	1.475	0.550	0.825
Total concrete	8.401	20.680	0.946	2.332	0.469	1.159
Total concrete aggregates (sand & gravel & crushed rock)		11.374		1.283		0.637
Total cement		2.903		0.327		0.163
Total rebar		1.503		0.168		0.083

Sources: Parsons Brinckerhoff & DECC

The total tonnage of construction aggregates (concrete aggregates, aggregates for embankment fill, sand ballast, sand bed...) and armour stone is as follows:

	Barrages		
	Cardiff-Weston	Shoots	Beachley
	million tonnes	million tonnes	million tonnes
Total aggregates for construction fill (embankment fill/sand ballast/sand bed)	33.334	14.251	2.196
Sand & gravel	27.649	9.660	1.721
Crushed rock	5.685	4.591	0.475
Total aggregates for concrete (structures & precast armouring)	11.707	1.283	0.637
Total armour stone	9.759	2.181	0.244

Barrage schemes – Tonnage of construction materials
Sources: Parsons Brinckerhoff & DECC

Lagoon schemes - Embankment and breakwater (lock) construction

	Lagoons			
	Welsh Grounds		Bridgwater Bay	
Embankments				
Overall crest length (km)	25.85		14.94	
Foundation preparation	million m ³	million ton	million m ³	million ton
Sand bed (on dredged surface)	1.089	1.851	2.125	3.613
Embankment Structure				
Control structure rockfill (0.25 – 2.5t; 70% crushed rock - 30% armour stone)	0.400	0.880	1.405	3.091
Containment mounds (tonne quarry-run rock; crushed rock)	9.107	20.035	8.561	18.834
Filter Type 1 (0.6 - 35mm; gravel)	4.484	8.520	3.661	6.956
Filter Type 2 (50 - 250mm; gravel)	1.243	2.362	0.957	1.818
Sand core	13.977	23.761	22.378	38.043
Armour stone (0.3 - 1t)	1.759	3.870	1.458	3.208
Armour stone (1 - 3t)	3.252	7.154	1.454	3.199
Total materials for embankments	million m ³	million ton	million m ³	million ton
Total sand	15.066	25.612	24.503	41.655
Total gravel	5.727	10.881	4.618	8.774
Total sand & gravel	20.793	36.494	29.121	50.429
Total crushed rock	9.387	20.651	9.545	20.998
Total sand & gravel & crushed rock	30.180	57.145	38.666	71.427
Total armour stone	5.131	11.288	3.334	7.334

Sources: Parsons Brinckerhoff & DECC

Lagoon schemes - Concrete structures (caissons...) and pre-cast armour units construction

	Lagoons			
	Welsh Grounds		Bridgwater Bay	
Precast armour units (Dolosse)				
Number of 5t units Dolosse	0		468,667	
Concrete for Dolosse (4m ³ /unit)			1.875	4.687
Rebar for Dolosse				0.389
Cement for Dolosse units (320kg/m ³)				0.600
Concrete structures				
Form surfaces (incl. Caisson lock)	million m ²	2.886	million m ²	4.735
Embankment crest works	million m ³	million ton	million m ³	million ton
Reinforced concrete (Wave wall)	0.294	0.735	0.213	0.533
Cement (350kg/m ³)		0.103		0.075
Rebar		0.061		0.045
Caissons				
Caissons (turbines & gates)	32 caissons		42 caissons	
Structural concrete	1.057	2.643	2.027	5.068
Cement (350kg/m ³)		0.370		0.709
Rebar		0.216		0.416
Sand ballast	1.991	2.986	3.094	4.641
Concrete ballast	0.049	0.108	0.247	0.543
Cement for ballast (315kg/m ³)		0.015		0.078
Caissons (lock & breakwater)	6 caissons		6 caissons	
Structural concrete	0.076	0.190	0.077	0.193
Cement (350kg/m ³)		0.027		0.027
Rebar		0.016		0.016
Sand ballast	0.154	0.232	0.161	0.241
Total materials for concrete structures	million m ³	million ton	million m ³	million ton
Total sand ballast	2.145	3.218	3.255	4.882
Total concrete	1.476	3.675	2.564	6.337
Total concrete aggregates (sand & gravel & crushed rock)		2.021		3.485
Total cement		0.515		0.889
Total rebar		0.293		0.477

Sources: Parsons Brinckerhoff & DECC

The total tonnage of construction aggregates (concrete aggregates, aggregates for embankment fill, sand ballast, sand bed...) and armour stone is as follows:

	Lagoons	
	Welsh Grounds	Bridgwater bay
	million tonnes	million tonnes
Total aggregates for construction fill (embankment fill/sand ballast/sand bed)	60.363	76.309
Sand & gravel	39.712	55.311
Crushed rock	20.651	20.998
Total aggregates for concrete (structures & precast armouring)	2.021	6.063
Total armour stone	11.288	7.334

Lagoon schemes – Tonnage of construction materials

Sources: Parsons Brinckerhoff & DECC

A – Aggregates and armour stone

Introduction

In this report, the word “aggregates” refers to the following materials for civil works:

- aggregates for concrete (sand & gravel; crushed rock)
- materials used as fill for embankments (sand core, crushed rock), caissons (sand ballast) and sand bed on dredged surface

Armour stone (and rock armour) are large stones (> 1t) used for embankment and breakwater slope protection.

The supply of aggregates for construction (concrete aggregates, ballast, embankment fill, armour stone...) is one of the major issues for each STP scheme due to the very large volume of materials required.

There are two main streams of aggregates supply: “primary” aggregates (sand, gravel and crushed rock), extracted from the ground (quarry or gravel pit) or dredged from the seabed (marine aggregates), and “recycled and secondary” aggregates.

Primary aggregates are produced from naturally occurring mineral deposits, extracted specifically. Most construction aggregates come from hard, strong rock formations by crushing to produce crushed rock aggregate or from naturally occurring particulate deposits such as sand and gravel (either land-won or marine dredged). The most important sources of crushed rock in Britain are limestone (including dolomite), igneous rock and sandstone.

Recycled aggregates generally arise as a result of reusing materials, such as concrete and brick, from demolished buildings, roads and hard-standings. **Secondary aggregates** are the by-products of other processes, either minerals-related, such as waste material from slate and china clay extraction, or from electricity generation and manufacturing, such as ash from coal-fired power stations and slag from iron and steelmaking.

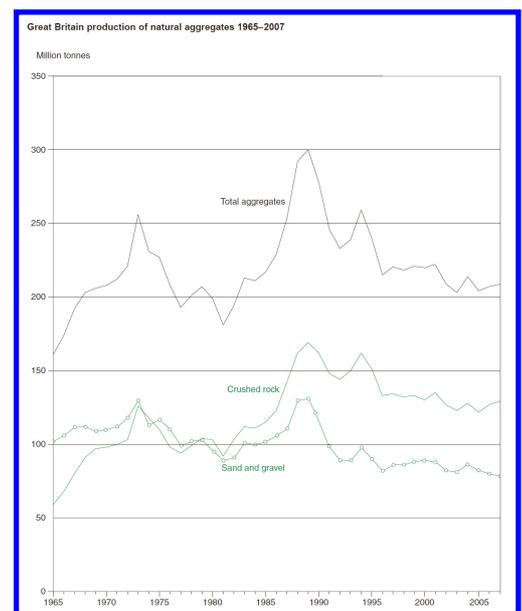
Data for 2005 has been used throughout this report because this is the year for which most complete information is available. Updated data from 2007 or even 2008 (when available) are also mentioned.

A-1 Primary aggregates

Primary aggregates production in the UK - Background

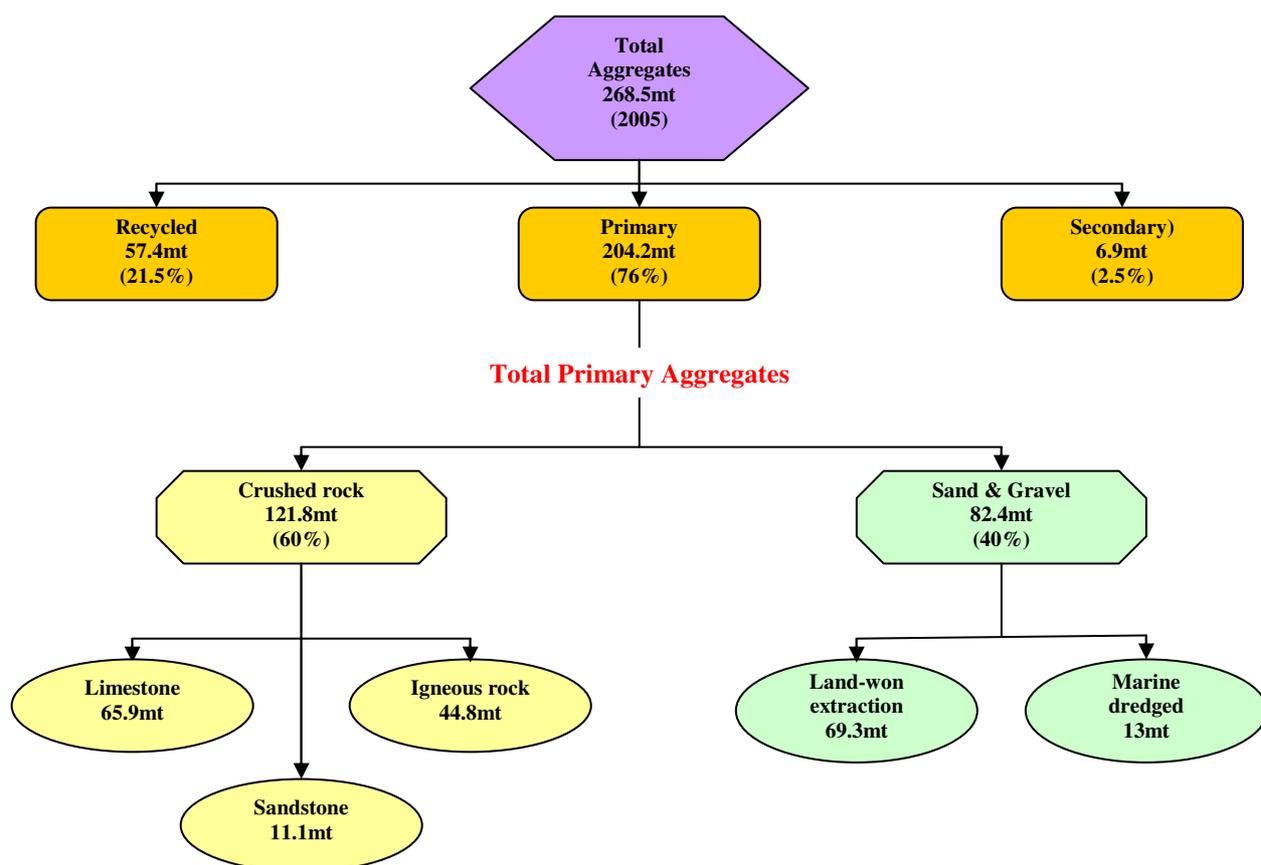
Sales of primary aggregates peaked at 300mt in 1989 but have since declined considerably. In 2007 about 208mt of primary aggregates were extracted for sale in Great Britain, comprising 62% of crushed rock, 31% of land-won sand and gravel and 7% of marine dredged sand and gravel. In 2005 the data were as follows: 204mt of primary aggregates, including 60% of crushed rock and 40% of sand and gravel (including marine dredged); see “GB - aggregates supply chain” figure below.

In England and Wales, the principal source of crushed rock is limestone, accounting for about 67% of supply, whereas in Scotland igneous rock is the dominant source of crushed rock (93%). No marine dredged sand and gravel is landed in Scotland, whilst in England and Wales marine sources accounted for 17% and 40% of total sales of sand and gravel, respectively. Northern Ireland produces sand and gravel only from land-won and also crushed rock (average output of 20mt; 27.1mt in 2007).



Great Britain – Production of primary aggregates
1965–2007

Source: British Geological Survey – UK Mineral Yearbook 2008



Great Britain: Aggregates supply chain (excluding imports - 2005)
Sources: Annual Minerals Raised Inquiry 2005, ONS

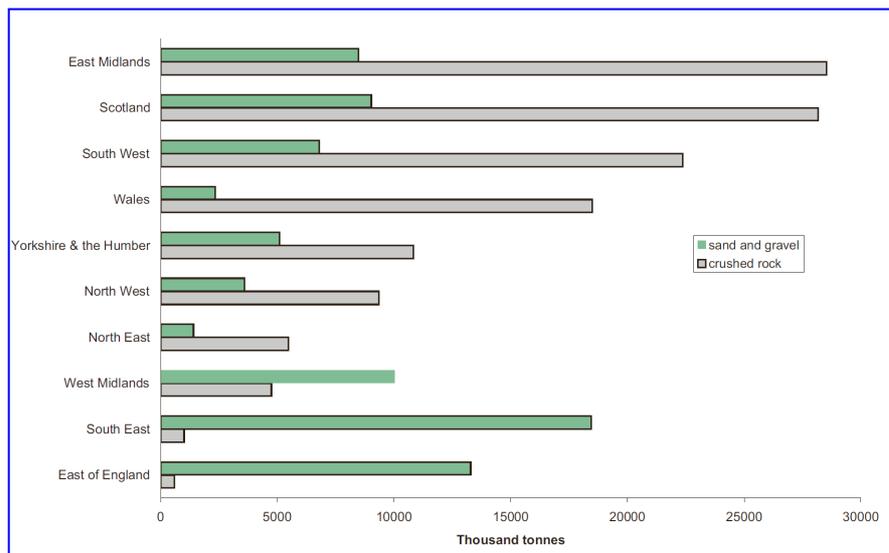
The various sources of primary aggregates in the UK are set out in the following table (2005 data):

	Land-won	Marine	Total	Crushed	Total primary
	Sand & Gravel	Sand & Gravel	Sand & Gravel	Rock	Aggregates
Million Tonnes					
North East	1.15	0.43	1.58	5.33	6.91
North West	3.41	0.26	3.67	7.99	11.66
Yorks & the Humber	5.1	0.15	5.25	10.87	16.12
East Midlands	9.23	0	9.23	27.47	36.70
West Midlands	9.25	0	9.25	4.42	13.67
East of England	13.23	2.33	15.56	0.24	15.80
South East	7.24	8.11	15.35	1.09	16.44
London			4.01	0	4.01
South West	6.31	0.62	6.93	23.18	30.11
England	58.93	11.90	70.84	80.59	151.43
Wales	1.63	1.11	2.74	16.53	19.28
Scotland	8.08	0	8.08	24.73	33.54
Great Britain	69.37	13.02	82.39	121.86	204.25
Northern Ireland	5.80	0	5.80	19.78	25.58
UK	75.17	13.02	88.19	141.64	229.83

UK: sales of primary aggregates by Region and Country – 2005

Sources: Annual Minerals Raised Inquiry 2005, ONS for GB. Department of Enterprise, Trade and Investment for Northern Ireland

The latest available data in 2007 are set out in the following chart:



Great Britain – Production of primary aggregates (sand and gravel – crushed rock) by Region – 2007
 Source: British Geological Survey – UK Mineral Yearbook 2008

The relatively stable sales of recent years ended abruptly towards the end of 2008 with the global economic decline causing a significant fall in the demand for aggregates. The Mineral Products Association estimate that sales of crushed rock aggregates fell by 12% in 2008 as a whole, while sand and gravel sales fell by 15% compared to 2007. The outlook for 2009 is not good with demand predicted to be at its lowest level since 1997. The economic crisis and the downturn in aggregate sales have had a significant impact on many operators with sharp falls in profit, plant closures and job losses being announced by most companies.

As the development of a Severn Tidal Scheme (if decided in 2010) could not start before 2015 (or even later), this gives us hope of a construction market recovery and an improvement of the aggregates production in the UK.

Primary aggregates consumption in the UK

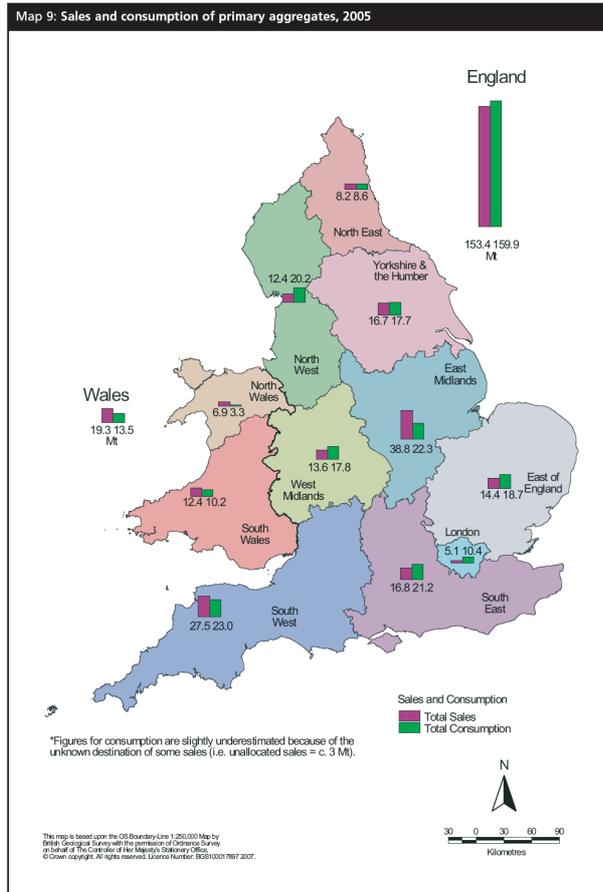
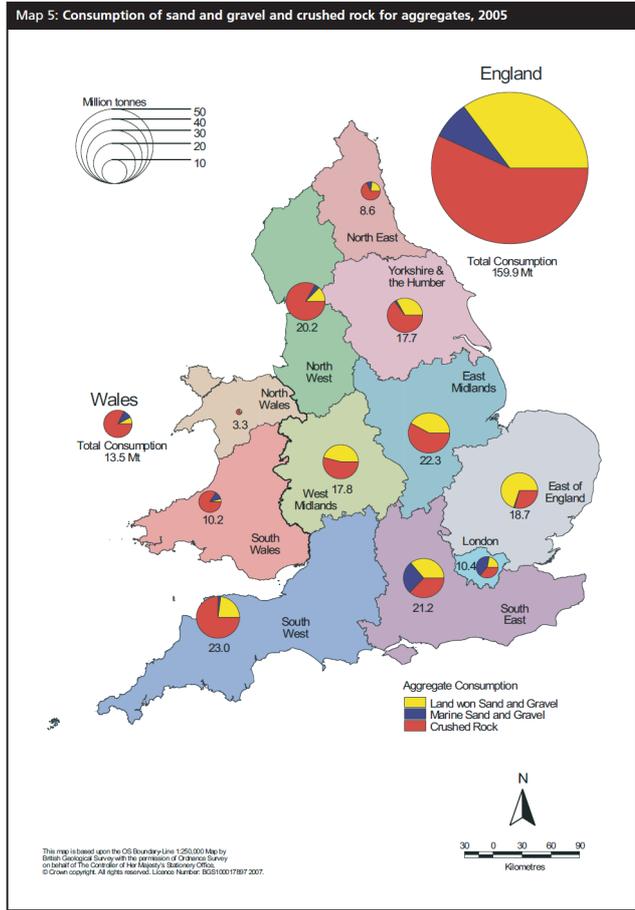
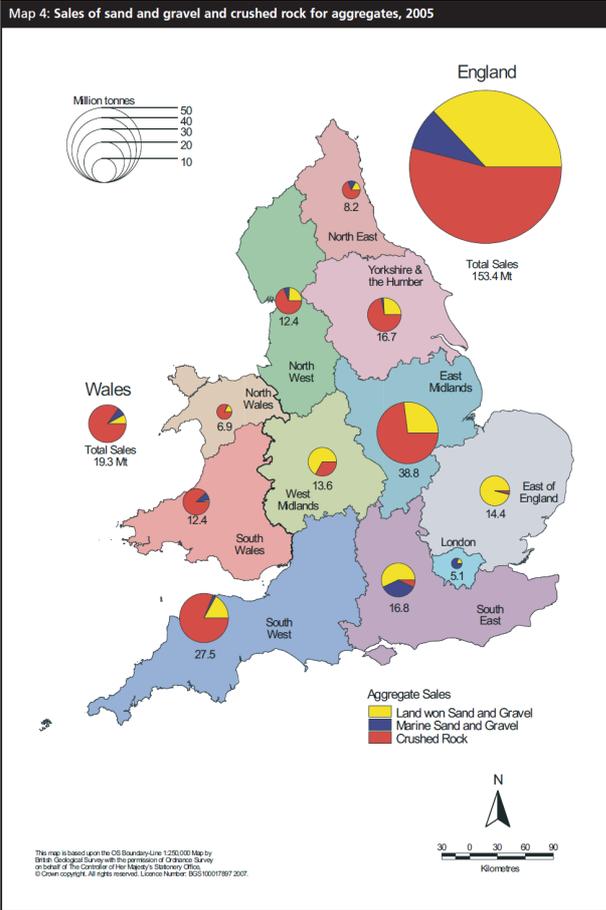
The UK has large resources of material suitable for use as aggregates. Historically, the UK has been self sufficient in the supply of primary aggregates and imports have not been necessary (excluding armourstone). The average total consumption of primary aggregates in the UK is about 220mt per year (production plus imports less exports; about 208mt in Great Britain). The total consumption of primary aggregates in Great Britain is set out in the following table:

Year	Crushed rock (mt)				Sand and gravel (mt)			Total Aggregates (mt)
	Limestone	Igneous rock	Sandstone	Total	Sand	Gravel	Total	
2005	66	46	11	123	43	39	82	205
2006	70	46	11	127	42	38	80	207
2007	67	51	12	130	42	36	79	208

Consumption of primary aggregates in Great Britain – 2005 - 2007
 Sources: British Geological Survey and ONS

In 2005, 205mt of primary aggregates were consumed in Great Britain, including 160mt in England and 13.5mt in Wales.

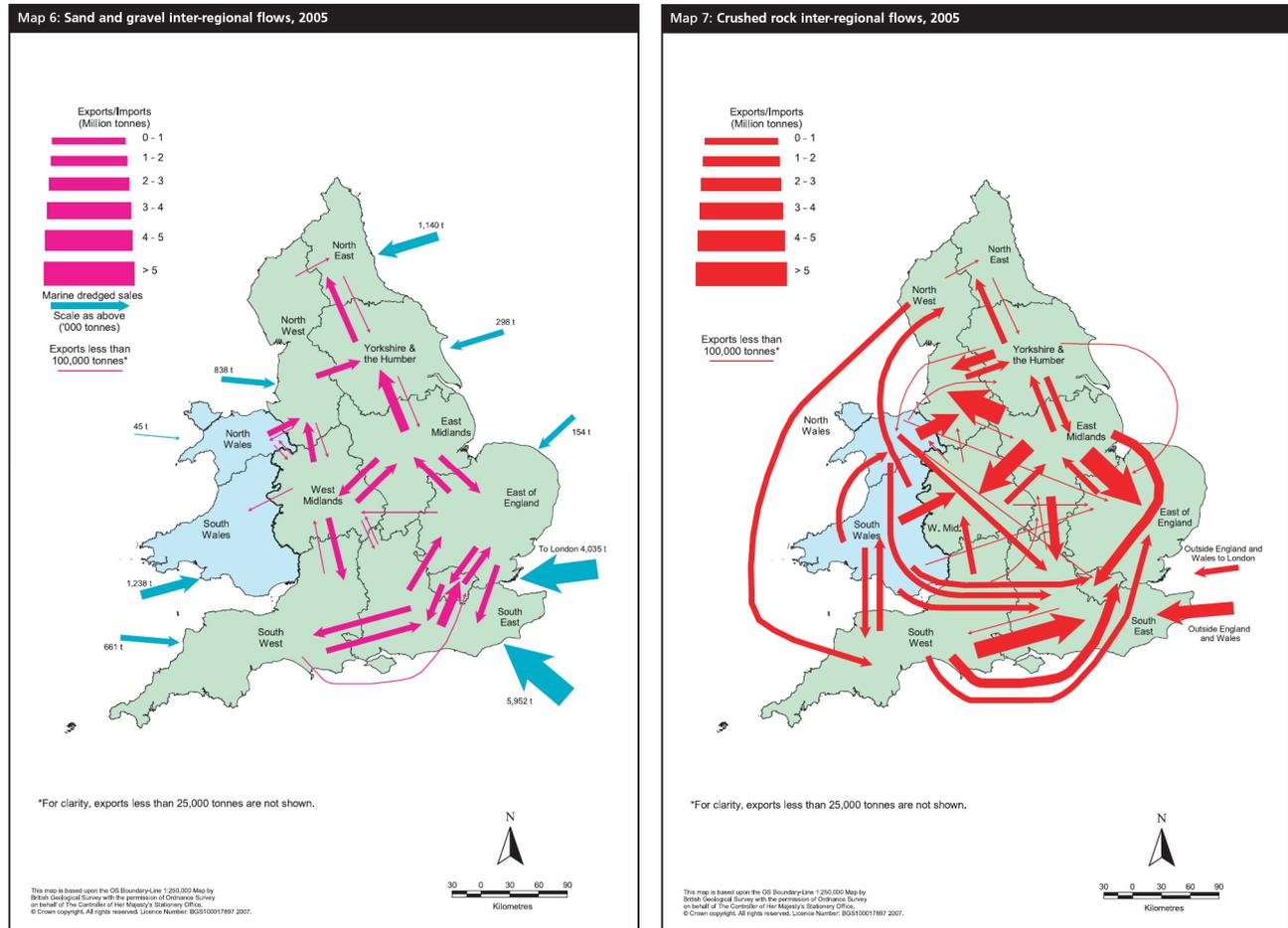
The following maps summarizes the sales and consumption of primary aggregates in England and Wales:



Sales and consumption of primary aggregates - 2005
 Source: Collation of the results of the 2005 Aggregate Mineral Survey for England and Wales
 British Geological Survey - May 2007

Inter-regional flows of primary aggregates

However, the distribution of these primary aggregates resources is uneven. In particular, there is an almost total absence of hard rock suitable for crushed rock aggregates in Southern and Eastern England, where demand is high. Consequently, there is substantial and increasing movement of aggregates within the UK and especially to these areas by rail and road. To a more limited extent, there is also shipment from Scotland and, on a lesser scale, from Wales and Northern Ireland.



Primary aggregates inter-regional flows - 2005

Source: Collation of the results of the 2005 Aggregate Mineral Survey for England and Wales
British Geological Survey - May 2007

There are over 1,600 aggregates quarries in the UK, roughly split 40:60 between sand and gravel sites and crushed rock (1,300 quarries in Great Britain and a fleet of 28 marine aggregate dredgers). Wales and South West England together have 124 quarries and 22 wharves for marine dredged aggregates. There are also a large number of aggregates producers, which range from single quarry owners to multi-national companies operating many sites throughout the country. Five multi-national companies (Tarmac Group, Hanson Aggregates, Aggregates Industry, CEMEX and Lafarge Aggregates) currently account for more than 70% of total aggregates production in the UK.

The principal modes of transport employed for the distribution of aggregates sales from quarries and wharves are as follows: 90% road, 9% rail and 1% shipment by water. Crushed rock is very often transported by sea from coastal quarries in the UK (Scotland – Glensanda, Wales and Northern Ireland) to destinations principally in England (average of 3mt/year; 90% of the crushed rock is from outside England). For crushed rock the proportion of rail deliveries increased to about 15%.

End-use of aggregates

Generally, primary aggregates are used for the following purposes:

- Concrete aggregates
- Asphalt and roadstone
- Construction and fill (e.g. embankment, dyke...)
- Rail ballast

- Mortar...

The breakdown of primary aggregates production (including marine aggregates) by end-use in Great Britain, Wales and in the South West is set out in the following table (based on 2007 data):

Region/Country	Production of primary aggregates by end-use (mt & %) - 2007			
	Concrete aggregates	Construction uses & fill	Other uses (roadstone, railway ballast...)	Total (mt)
South West	9.5 (32.5%)	9.3 (31.9%)	10.4 (35.6%)	29.2
Wales	4.6 (22.1%)	8.5 (40.9%)	7.7 (37%)	20.8
England	63.3 (42.2%)	40.6 (27.1%)	46.1 (30.7%)	150
Scotland	10.4 (28.1%)	12.4 (33.4%)	14.3 (38.5%)	37.1
Great Britain	78.3 (37.6%)	61.5 (29.6%)	68.3 (32.8%)	208.1

Production of primary aggregates (sand, gravel & crushed rock) by end-use (2007)

Source: UK Mineral Yearbook 2008 - British Geological Survey

The specific breakdown of sand and gravel production (land-won and marine dredged) by end-use in Great Britain, Wales and in the South West is set out in the following table (based on 2007 data):

Region/Country	Production of sand & gravel by end-use (mt and %) - 2007					
	Sand		Gravel		Sand & Gravel for construction fill	Total sand & gravel (mt)
	Building Sand (mortar...)	Concreting Sand	Other uses (binder...)	Concreting Gravel		
South West	1.1 (16.2%)	2.9 (42.6%)	0.1 (1.5%)	1.2 (17.6%)	1.5 (22%)	6.8
Wales	0.7 (30.4%)	0.9 (39.1%)	0.1 (4.3%)	0.4 (17.4%)	0.2 (8.7%)	2.3
England	10 (14.9%)	25.9 (38.6%)	0.2 (0.3%)	21.2 (31.6%)	9.8 (14.6%)	67.1
Scotland	1.6 (17.8%)	3.4 (37.8%)	0.1 (1.1%)	1.9 (21.1%)	2 (22.2%)	9
Great Britain	12.3 (15.7%)	30.2 (38.5%)	0.4 (0.5%)	23.5 (30%)	12 (15.3%)	78.5*

Production of sand and gravel by end-use (2007)

Source: UK Mineral Yearbook 2008 - British Geological Survey

*78.5mt: land-won 64.7mt; marine 13.8mt

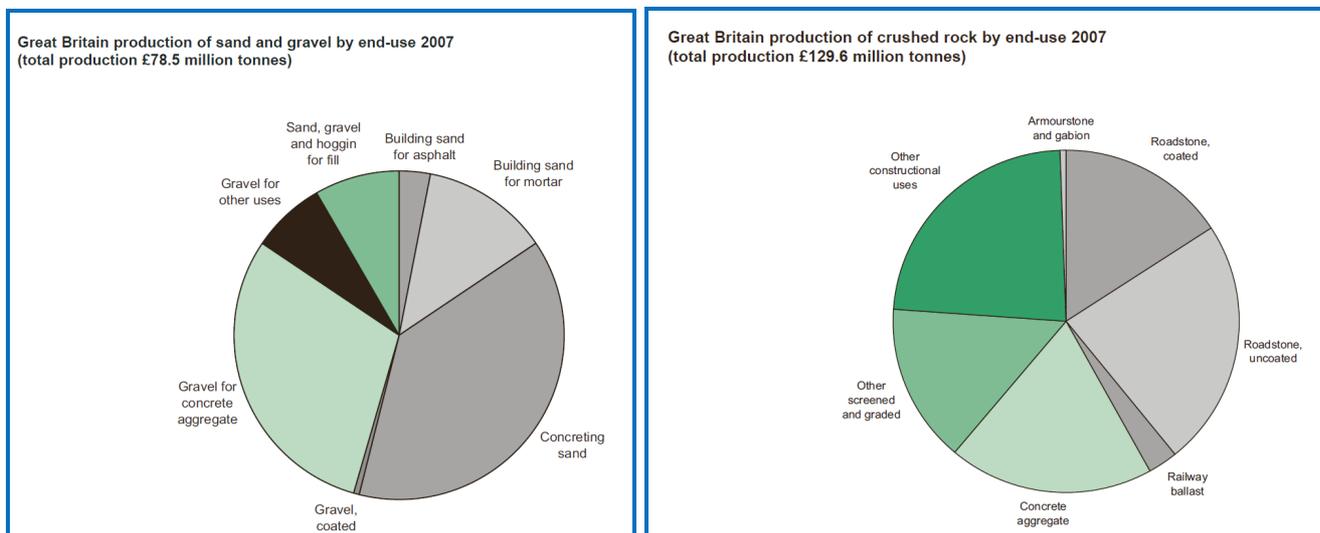
Finally, the specific breakdown of crushed rock production by end-use in Great Britain, Wales and in the South West is set out in the following table (based on 2007 data):

Region/Country	Production of crushed rock by end-use (mt and %) - 2007					Total crushed stone (mt)
	Roadstone	Railway ballast	Construction uses & fill	Concrete aggregate	Armourstone & gabion	
South West	8.8 (39.3%)	...	7.8 (34.8%)	5.4 (24.1%)	0.06 (0.3%)	22.4
Wales	6.4 (34.6%)	0.3 (1.6%)	8.3 (44.9%)	3.3 (17.8%)	0.07 (0.4%)	18.5
England	33.1 (39.9%)	2.3 (2.8%)	30.8 (37.1%)	16.2 (19.5%)	0.45 (0.5%)	82.9
Scotland	11 (39.1%)	1.3 (4.6%)	10.4 (37%)	5.1 (18.1%)	0.26 (0.9%)	28.1
Great Britain	50.5 (39%)	3.9 (3%)	49.5 (38.2%)	24.6 (19%)	0.78 (0.6%)	129.6

Production of crushed rock by end-use (2007)

Source: UK Mineral Yearbook 2008 - British Geological Survey

These tonnages and breakdowns of end-use will be used to assess the impact of the aggregates demand (aggregates for concrete, ballast and aggregates for embankment fill) for the shortlisted STP schemes on the regional and national market, assuming the breakdown in % remains the same. As an increase in the production capacity is likely to occur due to a better economic situation (higher demand expected), these 2007 figures will be increased by a few % so as to get a more relevant and realistic assessment.



Breakdown of sand-gravel and crushed rock production in Great Britain - 2007
 Source: UK Mineral Yearbook 2008 - British Geological Survey

Exports of aggregates

The UK is, in fact, a net exporter of aggregates. This is primarily due to export of sand and gravel dredged on the UK Continental Shelf but landed at foreign ports, principally in the Netherlands, Belgium and France (amounting to about 6mt/year). There are also exports of crushed rock from Glensanda, Britain's only coastal superquarry located on Loch Linnhe in western Scotland (Morvern Peninsular). The average exports of primary aggregates from the UK are 12mt/year (8mt of sand and gravel, including 6mt of marine dredged; 4mt of crushed rock).

United Kingdom summary 2003–2007										
Commodity	2003	2004	2005	2006	2007	2003	2004	2005	2006	2007
	Tonnes					£ thousand				
Aggregates										
<i>Production</i>										
Sand & gravel (a)	91 211 000	97 333 000	94 666 000	92 107 000	93 236 000					
Crushed rock (b)	122 885 000	127 674 000	121 860 000	126 895 000	129 577 000					
Total	214 096 000	225 007 000	216 526 000	219 002 000	222 813 000					
<i>Imports</i>										
Natural aggregates–										
Crushed rock (c)	632 792	619 076	1 516 919	2 270 355	1 909 733	10 064	10 661	19 037	27 202	27 501
Sand and gravel (d)	861 439	924 304	643 594	634 844	896 715	11 406	14 481	14 117	17 583	18 260
Total	1 494 230	1 543 380	2 160 513	2 905 198	2 806 448	21 470	25 142	33 154	44 785	45 761
<i>Exports</i>										
Natural aggregates–										
Crushed rock	3 188 232	4 528 231	4 850 971	5 322 099	5 959 212	13 275	22 865	25 141	25 773	33 637
Sand and gravel (d)	8 419 845	8 174 262	8 453 949	9 308 961	8 089 175	36 708	36 414	40 493	45 498	46 624
Total	11 608 077	12 702 493	13 304 920	14 631 060	14 048 387	49 983	59 279	65 634	71 271	80 261

(a) Including production from marine dredging.

(b) Great Britain only.

(c) For a number of years, a significant amount of armourstone imports are believed to be wrongly classified as 'granite, crude'. In 2007, this figure was 326 446 tonnes, and this has reduced from 1 331 520 tonnes in 2005, suggesting this issue is being addressed.

(d) Principally marine-dredged sand and gravel.

Source: HM Revenue and Customs.

However, the Crown Estate Commissioners give the following figures for marine-dredged sand and gravel landed at foreign ports (tonnes): 2003: 6 095 640; 2004: 6 191 867; 2005: 6 471 453; 2006: 6 714 659; 2007: 6 649 041.

UK – Imports and exports of primary aggregates (2003 – 2007)

Source: UK Mineral Yearbook 2008 - British Geological Survey

Imports of aggregates

The average imports of primary aggregates to the UK are 3mt/year (0.9mt of sand and gravel, 0.6mt of crushed rock and 1.5mt of armour stone).

Norway is by far the leading rock supplier for the UK and around 1.8mt of aggregates was imported from Norway in 2005: 0.2mt of sand and gravel, 0.3mt of armour stone and the remainder was crushed rock aggregates for railway ballast, concreting aggregates, asphalt aggregates and material for road sub base. Norway exports an average of 10 - 12mt of crushed rock aggregates (including armour stone) to Europe from 20 coastal hard rock quarries and exports also 0.2mt of gravel from 3 sand and gravel producers. There are currently 8 main quarries in Norway (Larvik, Jelsa, Tau, Askoy, Dirdal...) exporting crushed rock and armour stone to the UK and they have in excess of 2,000mt of reserves (igneous and metamorphic rocks).

Norwegian hard rock quarries have annual outputs in the range 1 to 2.5mt/year, with the largest quarry Jelsa (operated by Norsk Stein A/S) having annual production of about 3.5 to 5mt/year (350mt reserves). Norway has deep-water anchorage, low tidal range and a well developed infrastructure to allow for harbour facilities for medium to large bulk carriers.

The other overseas aggregates providers for the UK are Ireland (0.4mt in 2003), Denmark (0.3mt in 2003) and France (0.5mt in 2003).

The major constraint on the ability of overseas sources to export more rock aggregates to England or Wales is not the ability to supply but more the capacity of the receiving wharves to unload and distribute the aggregates (the cost of bulk aggregates is very sensitive to transport logistics). With the cost of a new large bulk carrier barge (97,000t) being around £50 million and smaller 30,000t ship £15 million, the industry requires a guaranteed long term market to justify such investments. Ships with a capacity in excess of 15,000t are required to be economical to import crushed rock aggregates or rock armour. There are not many wharves that have deep enough water to take these vessels. Moreover, a viable minimum of suitable land area to stockpile rocks is around 1.5 hectares so as to hold around 125,000t of single size crushed rock aggregate or 70,000t of mixed grades. In England, stockpile areas at wharves vary in size from 0.4 to 12 hectares.

There are currently 30 wharves where crushed rock aggregate is landed in England. The average amount of crushed rock imported through each of the medium to large crushed rock wharves in England ranges from 50,000 to 600,000t per year. Currently 62% of all crushed rock aggregates landed at wharves is distributed by road. The largest wharf unloading crushed rock aggregates is the Isle of Grain (North Kent) which is able to handle over 2mt/year; the majority of aggregates imported from the Glensanda quarry are landed at this wharf.

With current infrastructure and number of wharves and concerns over maintaining aggregates quality, the maximum additional amount of crushed rock aggregates that could be landed in England is estimated at an additional 2 to 3mt/year. If more rock aggregate is to be imported, then there will be a need for existing wharf capacity to increase. Several locations have been identified as additional wharves with potential to land crushed rock aggregates: 6 in the North West, one in the Bristol Channel (Barnstaple, Devon) and the bulk of the remainder in the South East. Issues to be considered in locating future wharf sites include:

- Access to adequate deep water
- Enough space to stockpile aggregates
- Access to suitable roads and rail with capacity to transport aggregates
- Neighbourhood issues

Another constraint to be considered will be the weather windows when this rock can sail from the main West and North European quarries, and more especially, be landed. Generally for rock supply to the UK East coast, vessels wait for a suitable weather window, before making a rapid crossing to the landing site. Special measures are taken to very rapidly unload the barges in as short a time as possible, to refloat them before the next weather system comes in. These short sea crossings will not be possible for the Severn estuary which is located too far, and it is likely that the rock will need re-handling from deep sea to shallow draft vessels.

It may prove necessary to modify some existing vessels in order to adapt them for rock handling. Rock is a very demanding cargo, and hulls and holds need considerable amounts of sacrificial steel plating to protect the structure of the vessel from damage from rock impact on loading and unloading.

Armour stone

The armour stone market is very variable, with possibly large tonnages imported in one year at one port and almost none in another. It is difficult to produce the large blocks of rock required from UK quarries because the rock is often fractured and, in most cases, it is not possible to load directly into ships or onto barges. Therefore, very little of the rock armouring used around the UK comes from Britain. The Scottish quarry Glensanda has a huge reserve of granite rock and large capacity of sea transport (and good rail connection to other mainland quarries); therefore, it could also be envisaged to extract more rock armouring from this site. Glensanda is Europe's largest granite quarry.

Due to the requirement for a dense and highly durable rock for this particular application, it is highly likely that the rock for these embankments or breakwaters would come from Norway or Northern Europe (Sweden...) and Western Europe (France, Spain; coastal quarries), where much of the existing rock armouring is currently sourced. Rock will be

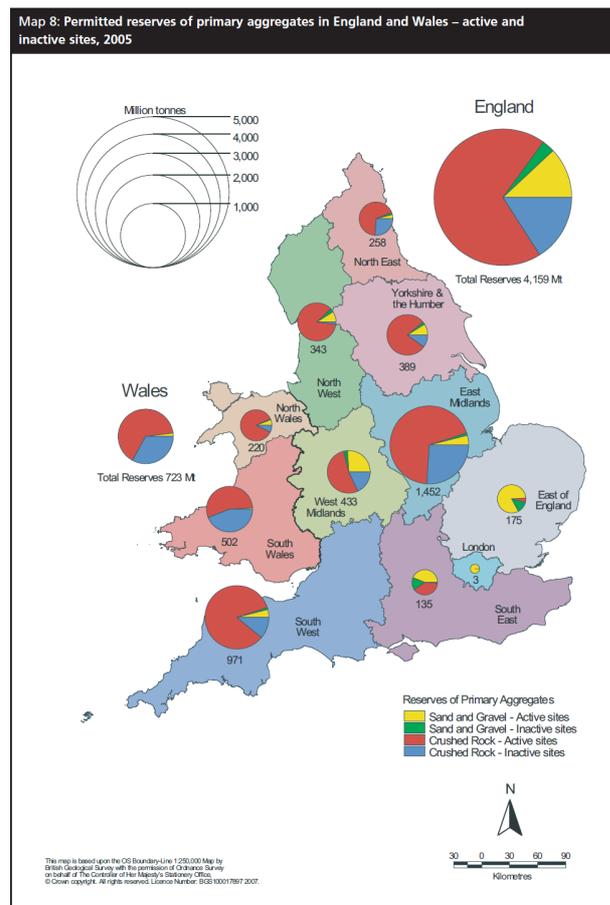
required in different sizes: the most critical will be the large armour rock. The development and blasting plans for the quarry have to ensure that an adequate quantity of each size can be obtained. These plans must include temporary roads so that the hauling to the sorting and stockpiling areas can be carried out efficiently. But most quarries are not prepared to drill and blast specifically for armour stone as it disrupts normal production.

Reserves of aggregates in the UK

Total permitted reserves for aggregate use in active and inactive sites in England and Wales (including sites that have not yet been opened at the end of 2005) were 4,882mt (4,159mt for England and 723mt for Wales).

In England, crushed rock accounted for 85% (3,556mt); sand and gravel the remaining 15% (603mt) whereas in Wales, crushed rock accounted for 97% (704mt); sand and gravel the remaining 3% (18mt). In Scotland, the reserves estimates were 1,491mt in 2005: crushed rock accounted for 92% (1,368mt) ; sand and gravel the remaining 8% (123mt).

Many of the UK quarries producing the highest quantities of aggregates have some, albeit limited, capacity to increase their supplies in the short term with the need for only minimal investment. This potentially could be in the order of 10 to 12mt/year. However, increasing the rate of extraction would also increase the depletion rates of the permitted reserves for these quarries. This is likely to result in an increase in applications for planning permission to release extra reserves in order that the individual companies could ensure long term viability.



Reserves of primary aggregates in England and Wales - 2005
Source: Collation of the results of the 2005 Aggregate Mineral Survey for England and Wales
British Geological Survey - May 2007

Aggregates production in England and Policy

In England there is a well established mineral planning system which includes the principle that the construction industry should receive the aggregates required, consistent with the principles of sustainable development (Department for Communities and Local Government – DCLG – Mineral Policy Statement 1: Planning and Minerals - 2006). A National and Regional Guidelines for Aggregates Provision in England is regularly published and revised and these guidelines indicate how provision for the supply of aggregates should be made to meet anticipated future need. The DCLG is committed to keeping these guidelines under review. The last National and Regional Guidelines for Aggregates Provision in England (2005-2020) recommend generally lower levels of provision than the previous set issued in 2003 due to an overall fall in national demand for aggregates and an increase in use of alternatives to primary aggregates, notably construction and demolition waste.

Nine Regional Aggregates Working Parties provide technical advice (e.g. assessment of the resources and demands) to the DCLG and to the Government Offices and Regional Assemblies.

Million tonnes per annum					
	Element of supply	2003 guidelines	New guidelines	% difference	
Guidelines	Land won sand and gravel	67	64	- 4	- 7
	Crushed rock	101	93	- 8	
Assumptions	Marine sand and gravel	14	16	+14	
	Net imports to England	11	9	- 18	
	Alternative materials	57	62	+ 9	
Total		250	244	- 2.4	

Changes between the 2003 guidelines for England and the 2005 one (expressed as average amounts per annum)

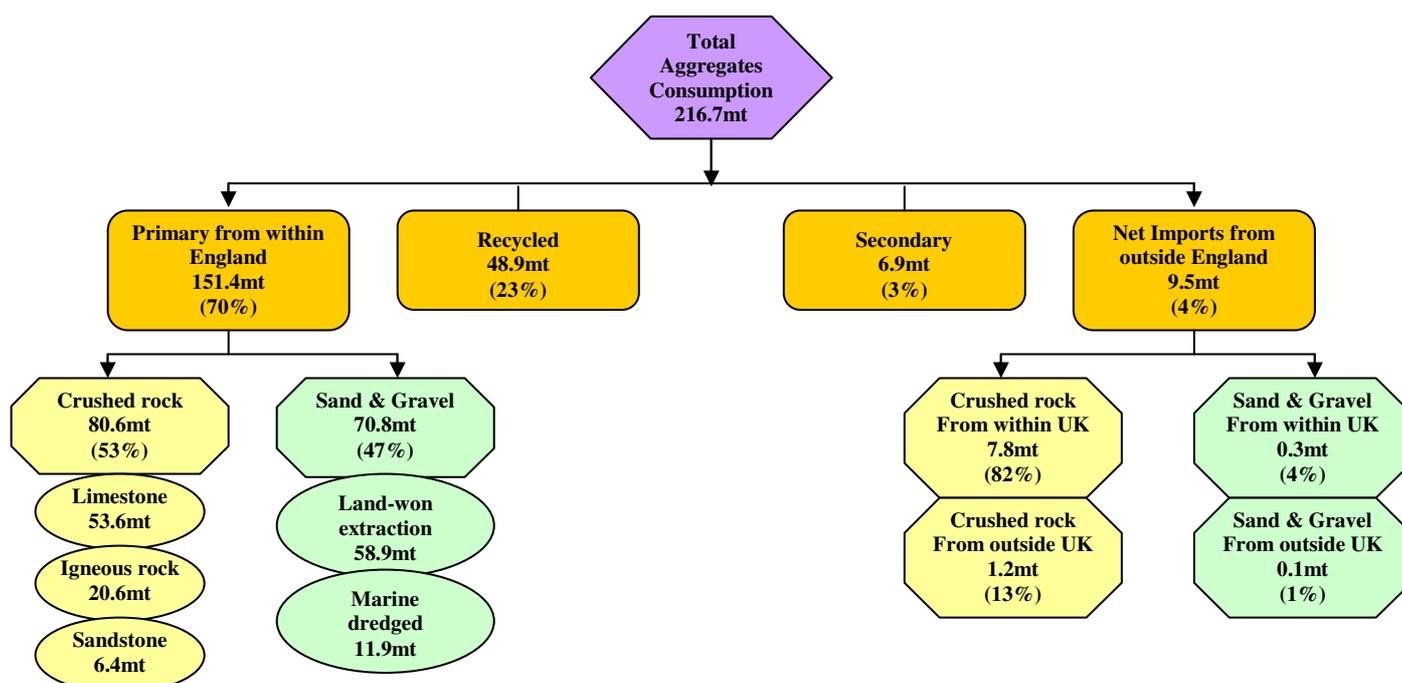
Source: National and regional guidelines for aggregates provision in England 2005-2020

New Regions	Guidelines for land-won production		Assumptions		
	Land-won Sand & Gravel	Land-won Crushed Rock	Marine Sand & Gravel	Alternative Materials	Net Imports to England
South East England	195	25	121	130	31
London	18	0	72	95	12
East of England	236	8	14	117	7
East Midlands	174	500	0	110	0
West Midlands	165	82	0	100	23
South West	85	412	12	142	5
North West	52	154	15	117	55
Yorkshire & the Humber	78	212	5	133	3
North East	24	99	20	50	0
England	1028	1412	259	993	136

National & Regional guidelines for aggregates provision in England 2005-2020 (Million tonnes)

Source: National and regional guidelines for aggregates provision in England 2005-2020

The aggregates supply chain in England is shown in the above figure:



England: Aggregates supply chain (2005)

Sources: Mineral Extraction in GB 2005, Collation of the results of the 2005 Aggregates Minerals Survey for England and Wales and Survey of arising and use of alternatives to primary aggregates in England 2005

Total imports into England in 2005 were 9.5mt (4% of its primary aggregates needs), of which 95% was crushed rock. The primary source for these imports is Wales (6.2mt: 5.6mt crushed rock and 0.5mt sand). Other sources include Norway (1.6mt), Scotland (1.5mt, mainly from the Glensanda quarry), Northern Ireland (1mt) and France (0.2mt).

Aggregates production in Wales and Policy

In Wales a new mineral planning system is under development which will seek to reconcile the demands for aggregates with sustainability issues. Mineral Planning Policy Wales (2000) sets out the land-use planning policy guidance of the Welsh Assembly Government in relation to minerals, extraction and development in Wales (it includes all minerals, except marine aggregates). Minerals Technical Advice Note 1 (MTAN1): Aggregates (2004) sets out detailed advice on the mechanisms for delivering policy for land-based aggregates extraction by Mineral Planning Authorities and the aggregate industry. The Welsh Assembly Interim Marine Aggregates Dredging Policy (2004) seeks to ensure sustainable, objective and transparent decision-making to meet society's needs for aggregates dredged from the Bristol Channel, Severn Estuary and River Severn. Primary aggregates production in Wales is about 19mt/year (2005) and is dominated by crushed rock. Policy contained within MTAN1 suggests the following recommendations:

- Aggregates should be worked in as close a proximity as possible to the market
- Rail and water modes are favoured over road transport
- The total level of production in Wales should not exceed 27mt/year before 2010

Primary aggregates production in Wales is dominated by crushed rock which represents about 86%. Crushed rock is made up of limestone and dolomite (73%), sandstone only in South Wales (15%) and igneous rock (12%). Land based sand and gravel extraction is far more developed in North Wales than in South Wales where marine dredging provides most of this material thanks to large deposits in the Severn Estuary and Bristol Channel.

There are also large quantities of mineral waste (slate, colliery spoil...) which can be used. Around 6mt of recycled aggregates are available and about 30% of them can be re-used for construction aggregates.

Aggregates production in Scotland and Policy

In Scotland, the National Planning Framework sets out the strategy for long term spatial development. Scottish Planning Policy (SPP) 4 – Planning for Minerals (Scottish Executive 2006) sets out planning policies that are intended to ensure that a steady supply of material is maintained to meet the demand and the economy in an acceptable and sustainable manner. Production levels are around 30-35mt/year; in 2005 the production output was 29.5mt (crushed rock: 22mt; sand and gravel: 7.5mt) and 5.5mt were exported, mainly from the large Glensanda coastal quarry (including 1.5mt to England). The overall contribution from recycled and secondary aggregates is around 18%.

Glensanda quarry, formerly owned by Foster Yeoman Ltd is now part of Aggregates Industries Ltd. Output from the Glensanda quarry is around 6 to 7mt/year (granite aggregate), of which 1.5mt is exported to England and the bulk of the remainder (about 70%) to other countries in Europe through ports in the Netherlands, Belgium, France, Denmark and Sweden and in depots in Germany and Poland. The quarry has permission to produce a maximum of 15mt/year (800mt reserves). This quarry serves the market both in the UK and beyond, with crushed rock aggregate being transported via the world's largest self loading transport ships (two 97,000t carrying capacity ships and one 37,000t ship owned by Yeoman Glensanda). Aggregate from Glensanda is used primarily for rail ballast and concreting aggregates (80%), with the remaining 20% being used for road sub base. Aggregates for the South East England market are discharged at a major terminal on the Isle of Grain in Kent (capable of handling over 2mt/year); material is then transhipped onto barges for transfer to Gibbs Wharf on the Thames in Essex, as well as other ports in southern and eastern England. Rock can also be landed directly at Robins Wharf on the Thames at Northfleet; other terminals include Liverpool, Greenock, Southampton and Great Yarmouth.

Other locations in Scotland have been identified as suitable for large quarries exporting aggregates. However, such developments raise substantial environmental concerns and the attempt to develop a major coastal quarry on Harris in the 1990s was unsuccessful.

A-2 Marine aggregates

The Crown Estate owns most of the mineral rights to the seabed and issues commercial licences to explore and extract sand and gravel in English and Welsh waters. The Crown Estate owns the territorial seabed (out to 12 nautical miles) and the rights to explore and utilise the non-energy mineral resources of the continental shelf (out to 200 nautical miles). An extraction licence is only issued if permission to dredge is given by the Marine and Fisheries Agency in England (shortly to become the new Marine Management Organisation - MMO - following the introduction of the Marine Bill) or the Welsh Assembly Government according to a Dredging Permission process. Any new licences to dredge would typically be subject to tendering and in places there are permitting constraints mainly arising from environmental concerns and conservation designations. Although licences are commonly acquired through tender rounds, it is also possible for a developer of a major project to apply for their own specific licence to The Crown Estate, particularly if existing licences are not capable of supplying required volumes and/or qualities. The developer would then obtain permission to dredge the sea bed, possibly linked with the Infrastructure Planning Commission (IPC) decision. Alternatively under “normal” circumstances it is estimated that it would take 3-4 years to get a permission to dredge under the new MMO-administered scheme.



licensed areas

The existing policy structure in the Welsh portion of the Bristol Channel is determined by the Interim Marine Aggregate Dredging Policy, published by the Welsh Assembly Government in 2004. This sets a cap on the marine extraction tonnage that is permitted in Welsh waters, and also sets a policy requirement for extraction to progressively move further offshore. There is no equivalent in English waters and the marine aggregates supply depends mainly on the market demand and is not constrained by ratio.

There are currently 80 Crown Estate licensed areas in the UK (50% on the East Coast) producing approximately 23mt of marine aggregates per year (21.54mt in 2008; 23mt in 2007 and 24,16mt in 2006). In 2008, 13.1mt was landed in England and Wales and of this total, 1.486mt landed in the Bristol Channel.

The potential supply of marine aggregates is not as constrained as this might suggested. In the Bristol Channel and Severn Estuary, the permissions are not resource-limited. Whilst permissions are typically issued for a maximum extraction from an area which is based on pro-rata across the term, it will often be possible to vary an existing permission to allow a more rapid extraction rate. There is also the possibility that additional tonnage may be approved with an updated environmental statement. Nevertheless, there are areas of environmental sensitivity, particularly in the upstream part of the Severn Estuary which may restrict dredging activities but these are likely to be mitigated.

Marine aggregates (sea-dredged sand and gravel) have made an important contribution to aggregates supply in the UK. In addition to landings at wharves for construction use (55 wharves throughout England and 13 in Wales), marine aggregates are also landed at numerous coastal locations for beach nourishment and contract fill or exported to Europe. In 2006, the amount of marine aggregates dredged along the UK coast was about 24.16mt/year and the main end-use was as follows:

- About 13.4mt (55%) for aggregates construction (concrete...) for the English and Welsh market
- About 6.7mt (28%) for exports to Europe
- About 4.2mt (17%) for beach nourishment and contract fill in the UK

There are substantial reserves of sand (no significant reserves of gravel) mainly in the Severn Estuary and the Bristol Channel suitable for construction aggregates and civil engineering purposes. The locations of sand reserves are well understood and concentrated in two areas:

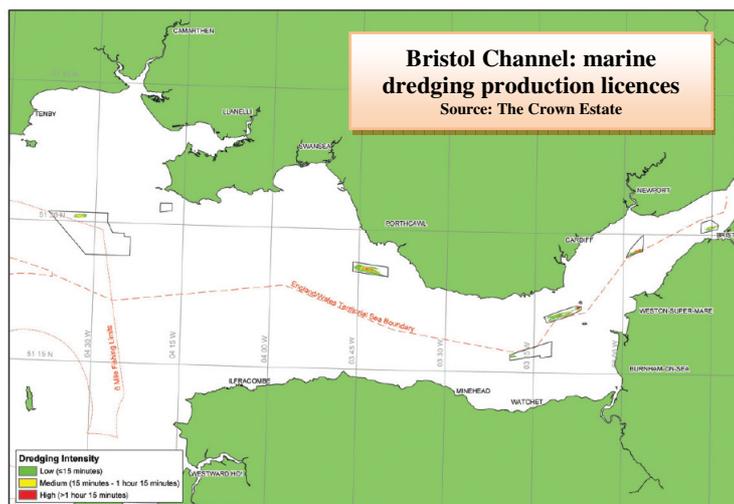
- Upstream in the Severn Estuary (westward to the Holms) and
- Significant resources farther offshore, lying in the central Bristol Channel, south of Carmarthen Bay

According to the Crown Estate, the national primary marine aggregates reserve (50:50 Sand/Gravel) is 120mt and the national primary marine sand reserve (less 20% gravel) is 83mt. These estimates (2008 survey) represent reserves available on consented production licence areas. The area of the seabed licensed for marine aggregates dredging in 2007 totalled 1,344km² (0.12% of the UK seabed) and only 137.6km² (11.7%) has been already dredged. The declared reserves significantly under-report the volumes of sand lying in the Bristol Channel as only permitted reserves are

presented. With additional permitting, enough marine aggregate resources are likely to be available to comfortably satisfy any of the development options.

Nevertheless, marine aggregates reserves are not directly comparable with terrestrial figures as these reserves are constrained by the relatively short term of environmental permissions, rather than the availability of the resource. In this region, the potential resource of marine aggregates (particularly sand) is substantial.

Around 21% of the sand and gravel used in England and Wales is now supplied by the marine aggregates industry. In the Bristol Channel, 11 production licences, operated by British Dredging Ltd, Hanson Aggregates Marine Ltd, Llanelli Sand Dredging Ltd and United marine Dredging Ltd extract about 1.5mt/year (1.77mt in 2007) from a permitted licensed tonnage of 2.62mt. In 2007, 1.05mt were landed at Welsh wharves and 0.72mt at English wharves. South Wales is uniquely dependent on marine dredged sand which accounts for more than 90% of its supply.



In the UK, the dredging fleet is operating today at capacity (28 purpose built dredgers with a total hopper capacity of 112,000t). Investment is required to maintain the dredging fleet in the near future. The age profile of this fleet shows that 81% are more than 15 years old and 26% of vessels are older than the generally accepted working life of 25 years. The cost of building a new vessel is in a range £25 to 40 million. Typically a 5,000t capacity vessel is able to dredge up to 1.2 million tonnes of aggregate a year, more than the largest sand and gravel quarries on land.

After landing at the wharf, transport by road is the main distribution method (93% of total landings) and this distribution is limited to, on average, 50km. Therefore, whilst the marine aggregates industry does have the ability to increase their proportion of aggregates supply, it is currently broadly limited to the geographical areas it already supplies. For a project of the magnitude of a STP scheme, as the demand for marine aggregates is high, changes in the transportation and/or landing points (wharves) would be required so as to ease the delivery of these materials to the construction sites. The Bristol Channel wharves are often in smaller ports (e.g. Newport), although aggregates are also delivered into Avonmouth.

As with many dredging projects, extraction rates may be accelerated by the relocation of vessels to the point of demand. On short turnarounds, associated with shorter transit times a single 5000t dredger would be able to produce significantly >2 million tonnes per annum of dry discharged sand or significantly more using wet discharge.

A-3 Secondary and recycled aggregates

Introduction

Secondary and recycled aggregates make an important contribution to the supply of aggregates and help reduce the rate at which primary aggregates resources are depleted. Maximising their use is a key objective of Government policy and supply from these sources has increased significantly in the last decade (e.g. 26% of total aggregates supply in England in 2005).

National and Regional policies seek to promote the use of secondary and recycled aggregates and are compatible with recycled aggregate demand. These materials are available in the UK, and transportation by sea from Cornwall to the Severn should be within economic reach. The amount of potentially available secondary and recycled aggregates being used is, however, felt to be reaching its maximum; additional material that could be supplied in the future is estimated to be around 7mt/year, based on 2005 sales rates (56mt in England: 48.9mt of recycled aggregates and 6.9mt of secondary aggregates; 67mt in the UK). The current market share of around 26% in England is expected to grow to 30% by 2011.

The % of secondary or recycled aggregate used for concrete construction is likely to remain low because the exposure conditions, environment and quality of concrete required for marine structures with a design life of 120 years plus may preclude the use of these materials. On the other hand, ballast for caissons could rely significantly on these materials.

China clay waste

China clay resources in Britain are confined to the granites of South West of England (Devon and Cornwall). There is, however, a significant volume of waste materials arising from china clay extraction available in the South West with the potential to be used in such projects.

China clay sales were 1.35mt in 2008 compared with 1.67mt in 2007 (peak output of 3.28mt in 1988). Today production is confined to the St Austell Granite (85% of sales), the south-western margin of the Dartmoor granite, and on the adjacent but separate Crownhill Down Granite. The UK is a major exporter of china clay and in 2008 1.19mt (88%) of sales were destined for export, including 0.75mt to Europe.

The extraction and processing of china clay involves the production of very large quantities of waste (22mt of waste material is generated for the extraction of 2.5mt of china clay) and about 90% is suitable for the recovery of secondary aggregates (sand and coarse aggregates), the remaining being a micaceous residue which is disposed of. China clay waste is exempt from the Aggregates Levy and sales for aggregates use have increased from 2.1mt in 2001 to 2.6mt in 2005. It is also estimated that 450-600mt of china clay waste are currently stockpiled in spoil pits, and the quantity is increasing year on year as more is tipped (about 15-20mt/year); an estimated 45-100mt is potentially useable.

Without any further investment, china clay waste could contribute at least 2-2.5mt/year to replace primary aggregates in a wide range of applications. Sales of china clay waste are mainly in the South West but small quantities are also shipped to London and the South East. Most of the china clay is transported by road and a marginal sea transportation (due to the rising cost of sea freight and fuel and the lack of available vessels) is done from ports facilities like the Port of Fowey (rail connected + deepwater, which has the capacity to load vessels with up to 6,000 tonnes of secondary aggregates) or Pomphlett docks (Plymouth). A higher contribution of china clay aggregates in a STP scheme would require investment so as to optimise the transportation (rail and sea).

PFA and GGBFS

PFA (Pulverised Fuel Ash from coal fired power stations) and GGBFS (Ground Granulated Blast Furnace Slag) are both likely to be considered as cement replacement. Availability to meet the construction programme would need to be investigated for the larger schemes and might not be adequate from UK sources. UK sources of slag for use as a cement replacement material were being fully utilised before the current recession. In recent years about 20% of the UK cement market has been met from slag and PFA sources (about 3mt/year). Nevertheless, there may be a shortage of PFA when a STP scheme construction is launched.

There are still significant stockpiles of fly-ash at UK coal-fired power stations and, aside from transport costs, there are unlikely to be any constraints in their supply in the medium term. GGBS is no longer produced in high quantities in the UK and importation from Europe is required now. If the supply is not sufficient, then sources outside the UK would be investigated (Many of the major suppliers are international companies and therefore able to secure these supplies from abroad) and alternative concrete mixes might be used for some of the concrete to provide the required durability in sea water. There are also possible new products which should be available in substantial quantities by the time construction of an STP scheme is likely to start.

Slate waste

In South West England, only four active slate quarries remain in Cornwall. From the average 2mt/year of slate waste arising from these quarries, approximately 0.2mt per year are available for use as aggregates but mainly for low grade applications (bulk fill, pipe bedding...) because they are considered as weak materials. This is why these materials are

generally used within short distance (20 miles) from the quarries; the exemption from the Aggregate Levy would now enable these materials to be transported further.

In North Wales, slate waste has a better quality and can be used in higher value application, such as sub-base, concrete... Nowadays only two quarries, Penrhyn and Oakeley, remain in operation. Permitted reserves of slate in North Wales were estimated at 42.5mt in 2005.

The process of slate quarrying generates vast amounts of waste rock. There are estimated to be 700-900mt of slate waste in North Wales (Gwynedd), and over half is constrained by a range of environmental designations or by distance from any possible bulk transport options. However, the remaining 270-370mt in the Bethesda and Blaenau Ffestiniog districts are suitable for use as aggregates. Current extraction is increasing this amount by 6mt a year. Slate waste could, theoretically, supply some 50% of UK crushed rock sales. This amounts to a market size of some 59mt/year. It is widely used in North Wales for general fill and road building and these applications represent the major future use of slate waste. Penrhyn quarry has recently started to send slate waste by sea from Port Penrhyn to Liverpool and Manchester and it is anticipated that up to 200,000t per year could be sent to each destination. It is also planned to establish a rail terminal at Blaenau Ffestiniog from where slate waste from Oakeley quarry will be sent to English markets.

Recycled & Secondary aggregates - England	Million tonnes / year	% supply of secondary and recycled aggregates	% total aggregates supply (207.2mt)
Recycled aggregates	48.9	88	23
<i>Construction & demolition waste</i>	42	75	20
<i>Spent rail ballast</i>	1.2	2	1
<i>Asphalt planings</i>	5.6	10	3
Secondary aggregates	6.9	12	3
<i>Power station ash</i>	1.8	3	1
<i>Iron and steelworks slag</i>	0.75	1	0.4
<i>China clay waste</i>	2.6	5	1
<i>Slate waste</i>	0.15	0.2	0.07
<i>Glass waste</i>	0.15	0.2	0.07
<i>Colliery spoil</i>	1	2	0.5
<i>Others</i>	0.45	0.8	0.2
Total recycled and secondary aggregates	55.8	100	26

England summary of recycled and secondary aggregates sales – 2005
Source: National and regional guidelines for aggregates provision in England 2005-2020

A-4 Dredged materials for a STP scheme (preparation works)

Dredged aggregates from preparation works

Extensive dredging would be required along the alignment of the barrage or the lagoon to provide not only a level foundation on sound rock but also a sufficient submergence for the turbines; dredging would be required as well for navigation channels (to provide access to and from the new navigation lock) or for caisson towing channels from construction yards.

The materials dredged should comprise mainly sand, gravel, soft rock (mudstone) and hard rock (limestone); mud and soft clay should also be dredged and disposed of as they would not be suitable for construction works. Due to their grading and potential contaminants (silt, clay...), these dredged materials in the Severn estuary would not meet the necessary high quality specifications for concrete aggregates; this is why they are not taken into account as a source of concreting aggregates for the STP schemes.

The sand and gravel marine aggregates would be the main materials suitable for embankment construction and caisson ballast. We assume in this survey that 80% of sand and gravel dredged for the preparation works could be used for embankment fill and ballast.

All the soft and hard rock dredged are likely to be weak materials which would break down and soften when worked as concrete aggregates. They could be used as fill materials for the landing areas for locks (Cardiff-Weston and Shoots barrage) or for the construction of compensatory habitat areas in the estuary.

According to the geology data and the optimisation of each alignment, the following tables set out the estimates of volume (and tonnage) of dredged materials as well as their category:

Dredging - Barrages	Cardiff-Weston		Shoots		Beachley	
Navigation channels	<i>million m³</i>	<i>million ton</i>	<i>million m³</i>	<i>million ton</i>	<i>million m³</i>	<i>million ton</i>
Mud and soft clay	0	0	0	0	0.043	0.073
Sand and gravel	22.340	33.510	3.600	5.400	1.200	1.800
Rock - soft (mudstones)	12.170	26.774	4.400	9.680	0.800	1.760
Rock - hard (limestones)	0.620	1.178	0	0	1.940	3.686
Caissons (incl. Lock) & embankments	<i>million m³</i>	<i>million ton</i>	<i>million m³</i>	<i>million ton</i>	<i>million m³</i>	<i>million ton</i>
Mud and soft clay	2.140	3.210	0	0	0.014	0.021
Sand and gravel	4.740	8.058	0.479	0.814	0.073	0.124
Rock - soft (mudstones)	9.968	21.930	1.710	3.762	0.600	1.320
Rock - hard (limestones)	0.065	0.143	0	0	0.482	1.060
Sub-totals	<i>million m³</i>	<i>million ton</i>	<i>million m³</i>	<i>million ton</i>	<i>million m³</i>	<i>million ton</i>
Mud and soft clay	2.140	3.210	0	0	0.014	0.021
Sand and gravel	27.080	41.568	4.079	6.214	1.273	1.924
Rock - soft (mudstones)	22.138	48.704	6.276	13,. 07	1.400	3.080
Rock - hard (limestones)	0.685	1.321	0	0	2.422	4.746
Total dredging	52.043	94.803	10.189	19.656	5.109	9.772
Total dredged materials likely to be used (ballast, land fill...)	49.903	91.593	10.189	19.656	5.095	9.751

Dredging - Lagoons	Welsh Grounds		Bridgwater Bay	
Navigation channels	<i>million m³</i>	<i>million tonnes</i>	<i>million m³</i>	<i>million tonnes</i>
Mud and soft clay	1.000	1.500	1.000	1.500
Sand and gravel	0	0	0	0
Rock - soft (mudstones)	0	0	0	0
Rock - hard (limestones)	0	0	0	0
Caissons (incl. lock) & embankments	<i>million m³</i>	<i>million tonnes</i>	<i>million m³</i>	<i>million tonnes</i>
Mud and soft clay	2.070	3.105	5.151	7.727
Sand and gravel	2.935	4.990	0	0
Rock - soft (mudstones)	2.171	4.776	1.811	3.984
Rock - hard (limestones)	0	0	0	0
Sub-totals	<i>million m³</i>	<i>million tonnes</i>	<i>million m³</i>	<i>million tonnes</i>
Mud and soft clay	3.070	4.605	6.151	9.227
Sand and gravel	2.935	4.990	0	0
Rock - soft (mudstones)	2.171	4.776	1.811	3.984
Rock - hard (limestones)	0	0	0	0
Total dredging	8.176	14.371	7.962	13.211
Total dredged materials likely to be used (ballast, land fill...)	5.106	9.766	1.811	3.984

Source: Parsons Brinckerhoff & DECC

These tables show that for Cardiff-Weston barrage and Beachley barrage, dredged sand and gravel could relieve significantly the demand for construction aggregates or ballast on the market (provided their quality meets the requirements). For the other schemes, dredged sand and gravel would not be considered as a major substitution of construction aggregates and for Bridgwater Bay lagoon, these dredged materials are purely and simply not available.

Main constraints for marine dredging in the Severn Estuary

Dredging and disposal licenses are highly regulated under a full range of policy and legislation. The main policy and guidance documents are: Welsh Assembly Interim Aggregates Dredging Policy; Marine Minerals Guidance Note 1: Guidance on the Extraction by Dredging of Sand, Gravel and Other Minerals from the English Seabed; Marine Minerals Guidance Note 2: The control of Marine Minerals Dredging from the British Seabed. The legislative control for marine aggregate is the Marine Mineral Dredging regulation 2007, for which there are separate pieces of legislation in England & Wales.

Capital dredging requires consent under Coastal Protection Act (CPA – 1985) and disposal of dredged materials are currently regulated together under the Food and Environmental Protection Act (FEPA – 1985). These consents are subject to the satisfactory completion of an Environmental Impact Assessment (EIA), stakeholder consultations etc.

However, this system is in the process of being rationalised into a new marine licensing regime under the Marine and Coastal Access Bill which is scheduled to be adopted in winter 2009. The proposed Marine Bill will introduce a new system of marine spatial planning that is considered essential for sustainable use of the sea and to deliver an effective and coherent approach to the management of the marine environment. Therefore the construction dredging and disposal operations for a Severn Tidal Power scheme would require a Marine Licence from the new Marine Management Organisation (which will be 2 separate bodies, one in England and one in Wales; new licensing regime is expected to be in place in Q.1 2011).

The main constraints with respect to marine aggregate extraction, capital dredging and disposal operations for the construction of the schemes, particularly for the Cardiff-Weston Barrage, are as follows:

- Finding and licensing new dredging areas mainly in the Severn Estuary (or the Bristol Channel) in order to supply additional marine aggregates for embankment construction (see chapter A-5).
- Finding and licensing suitable sites for the disposal of any dredged material that cannot be used within the construction works. The scale of the constraint would depend on the volume and nature (including type and quality) of the dredged material and the location and characteristics of the disposal site.
- Finding cost-effective beneficial uses for soft rocks (particularly mudstone): compensatory habitats works?
- Impacts of dredging and disposal on conservation features of the Severn Estuary SAC, SPA and Ramsar would need to be assessed, mitigated and compensated under the Habitats Regulations, for example loss/damage of sandbank resource, intertidal habitat and impact on *Sabellaria* reefs. Conservation agencies, generally, have a preference in the Severn Estuary for surficial (fine) sediments to be kept within the estuary system in order to maintain intertidal habitats
- Dredging operations in the vicinity of the main navigation channels would need to be carefully managed to ensure safety of navigation.
- Other constraints include impacts on coastal processes and sediment transport, ecology, water and sediment quality, marine archaeology, aggregate dredging, fisheries ...etc.

Main constraints for spoil or temporary disposal in the estuary

Limited options are available for disposing surplus spoil in the estuary or at sea. The best option would be to create a reclamation area within the vicinity of the works to be used as a lay down or processing area for the works. The reclamation area would require a marine facility for the import of materials.

The condition of untreated dredged material presents various problems for storage, principally the saturated nature of the material that requires suitable time and areas of land to enable dewatering to take place (which would vary depending on the type and amount of material). Direct transfer from excavation to final position is a preferable option, although may have implications on the construction programme. Storage would have to be carefully considered for any of the schemes at any location. Storage, and possibly treatment, of material on land would require licensing and consents, including by the Environment Agency under the Waste Management Regulations/Land Drainage Act.

Finding a suitable disposal site would depend on the type and quantity of dredged material. The key constraint would be in finding a suitably deep area of the Severn Estuary/Bristol Channel relatively close to the construction works; with a capacity to hold the required quantity of material to be disposed of; and without presenting a risk to navigation or the designated conservation features in the Estuary. In addition other constraints which would need to be given full consideration include impacts on coastal processes (sediment transport and budgets), ecology, water and sediment quality, marine archaeology, aggregate dredging, fisheries etc.

There are a number of licensed disposal sites in the Severn Estuary for the placement of maintenance dredged materials from the entrances and immediate approaches to ports. These disposal sites are licensed specifically for the disposal of relatively small quantities of maintenance dredged material (predominantly silts, some sands). It is unlikely that these sites would be suitable for the disposal of large quantities of capital dredged materials. There is a (now disused) disposal site that was used during the construction of the Cardiff Barrage. There is also a proposed disposal site in the outer estuary (Holm Deep) for the disposal of capital dredged material during the construction of the Bristol Deep Sea Container Terminal, which may possibly have capacity following the construction of the terminal. Detailed assessment would need to be undertaken in order to determine whether or not these sites would be suitable for the disposal of dredged material from the construction of the Cardiff-Weston Barrage.

We should be aware that baseline conditions in the Severn Estuary against which to consider disposal operations and the dispersal of material from existing disposal sites would change during and following the construction of the Cardiff-Weston Barrage, and to a lesser extent the other schemes. Careful consideration would need to be given as to whether dredged material is disposed upstream of the barrage within the Severn Estuary or downstream of the barrage in the Bristol Channel. The Conservation Agencies and CEFAS (Centre for Environment, Fisheries and Aquaculture Science) would be among the key advisors in making this decision.

As for the temporary disposal of dredged materials used for construction works, solutions exist to avoid large storage areas. Sand fill would not need to be landed onshore, techniques are available for placing the material directly into the works after being dredged; nevertheless it would require an efficient synchronisation between the dredging works and the embankment construction. Retaining bunds of rockfill construction with a central sealing zone can be formed initially to contain the dredge arisings.

Re-handling materials should be minimised as it would significantly increase the overall project cost. “Just in time” logistics should be adopted to ensure that materials are optimally used throughout the project.

A-5 Aggregates and armour stone for a STP scheme:

Introduction

At this stage, it is difficult to estimate the ratio of primary aggregates that would be sourced either from quarries or from dredging (including dredged materials from foundation preparation and navigation channels). Further work is necessary to consider the suitability of the aggregate sources and the associated transport links.

The local authorities which help regulate the industry and are responsible for approving (or not) applications for aggregates extraction have to operate in accordance with national policies and policy guidelines. These guidelines (in England) include assumptions about future aggregates demand so that the local authorities plans can make sufficient provision for future aggregates supply.

According to the Mineral Products Association (MPA), existing plans should have sufficient capacity to meet the aggregates needs of all the options – with the possible exception of the lagoon schemes. Given the scale of potential demand for concrete aggregates, crushed rock and fill materials there would need to be further analysis to determine if existing Government plans included sufficient supply capacity to meet the demand of this option. The Government’s policy guidance is regularly reviewed and there is the opportunity to revise forecasts of future aggregates demand to reflect the Severn Tidal Power scheme requirements. Moreover, very large schemes would have to be considered separately in terms of aggregates supply and exemption clauses for such projects could be applied.

The choice of the best quarries will depend also on the location of the caisson construction yards. For saving and for environmental reasons, these quarries should have a marine access for waterborne transport or even a good rail or road connection. Glensanda in Scotland, but also other smaller quarries in Great Britain, has access to marine wharves. Raynes quarry in North Wales supplies some crushed rock limestone into the South East and igneous rock from coastal quarries in Cornwall also supply small amounts to the South East. Nevertheless, the local ports may not have the infrastructure to assist in the movement of the bulk material and some upgrading works would be needed.

The demand for construction aggregates for each STP scheme has been compared to the future (2015-2020) regional and national annual output capacity based on the 2007 data slightly increased. This demand will be split during the construction timescale and at this stage of the study, it has been assessed that the average annual demand is equal to the total demand divided by the number of years required for civil engineering construction (this assumption is optimistic because at the beginning of the works a peak demand is likely to occur). This comparison only gives an idea of the impact on the current market.

For each type of aggregates (concrete aggregates, aggregates for embankment fill or for ballast), the demand has been compared to the regional and national breakdown capacity by end-use (assumption: the breakdown of primary aggregates production by end-use remains the same – see 2007 figures from table p29).

Due to the lack of available detailed data on aggregates production and end-use breakdown in Northern Ireland, the demand for materials of each STP scheme has been compared only to the Great Britain market and not the UK's.

Aggregates for concrete

In 2007, Great Britain produced 78.5mt of aggregates for concrete (72.7mt in 2005), including: 24.7mt of crushed rock and 53.8mt of sand and gravel (including marine dredged materials landed at British ports). By the time a STP scheme would be constructed (around 2015-2020), the production of concrete aggregates is estimated as: 5mt/year in Wales, 10mt/year in South West and 80mt/year in Great Britain.

The impact of the overall annual demand for concrete aggregates (caissons, crest wall, ballast, precast armour units...) of each STP scheme is as follows:

Demand for aggregates for concrete (structures, ballast & precast armour units)	Total demand for aggregates for concrete	Duration of civil engineering construction	Annual demand for aggregates for concrete	% of annual average production of concreting aggregates (forecast - 2020)		
				Wales Total average production	South West Total average production	GB Total average production
				5mt/y	10mt/y	80mt/y
Scheme	mt	Year	mt/year			
Cardiff-Weston barrage	11.71	6	1.95	39.0%	19.5%	2.4%
Shoots barrage	1.28	4	0.32	6.4%	3.2%	0.4%
Beachley barrage	0.64	4	0.16	3.2%	1.6%	0.2%
Welsh Grounds lagoon	2.02	5	0.40	8.1%	4.0%	0.5%
Bridgwater Bay lagoon	6.06	5	1.21	24.3%	12.1%	1.5%

Impact of the demand for aggregates for concrete (structures, ballast and precast armouring) on the national and regional market

Source: Parsons Brinckerhoff & DECC

If aggregates for precast armour units are not taken into account (i.e. these precast armour units could be directly imported from overseas facilities), the impact becomes:

Demand for aggregates for concrete (structures & ballast)	Total demand for aggregates for concrete	Duration of civil engineering construction	Annual demand for aggregates for concrete	% of annual average production of concreting aggregates (forecast - 2020)		
				Wales Total average production	South West Total average production	GB Total average production
				5mt/y	10mt/y	80mt/y
Scheme	mt	Year	mt/year			
Cardiff-Weston barrage	11.37	6	1.90	37.9%	19.0%	2.4%
Shoots barrage	1.28	4	0.32	6.4%	3.2%	0.4%
Beachley barrage	0.64	4	0.16	3.2%	1.6%	0.2%
Welsh Grounds lagoon	2.02	5	0.40	8.1%	4.0%	0.5%
Bridgwater Bay lagoon	3.49	5	0.70	13.9%	7.0%	0.9%

Impact of the demand for aggregates for concrete (structures, ballast) on the national and regional market

Source: Parsons Brinckerhoff & DECC

In both cases, these tables show that the demand for concrete aggregates for Cardiff-Weston barrage (and to a lesser extent for Bridgwater Bay lagoon) has a significant impact on the Welsh and South West production. On the other hand, the demand on the Great Britain market is much less.

The demand for concreting aggregates for the other schemes can be easily sourced in Great Britain and to a certain extent in Wales and in the South West.

As the current production of aggregates for concrete represents around 30-35% of the overall production of primary aggregates in Great Britain (total 229.8mt in 2005 and 204.2mt in 2007), this percentage could be slightly increased by shifting the end-use of aggregates extracted so as to better adapt the production to the demand (in particular for Cardiff-Weston barrage).

At this stage of the study, the % of sand and gravel for concrete sourced from marine aggregates cannot be easily assessed; nevertheless, as the tonnage required remains within the current dredging capacity, it is unlikely that additional dredging licences would be needed for concrete aggregates (unless marine dredging close to caissons construction yards would be more cost effective than transporting aggregates from distant quarries).

Nevertheless, the choice of these sources (quarry or marine dredging) will depend heavily on the location of the caisson construction yards. At this stage of the study, it is difficult to identify the exact regional or even national sources.

Primary aggregates for embankment/breakwater fill and sand ballast (caisson)

For each STP scheme, the impact of the overall demand for primary aggregates for embankments and breakwaters fill (excluding armour stone), ballast and seabed sand to the forecast (2015-2020) regional and national annual output capacity of all construction and fill aggregates is set out in the following table:

Demand for primary aggregates for embankment & breakwater fill, sand ballast & seabed (sand, gravel & crushed rock)	Total demand for aggregates	Duration of civil engineering construction	Annual demand for aggregates	% of annual average production of aggregates for construction fill (forecast - 2020)		
				Wales Total average production	South West Total average production	GB Total average production
Scheme	mt	Year	mt/year	9mt/y	10mt/y	63mt/y
Cardiff-Weston barrage	33.33	6	5.56	61.7%	55.6%	8.8%
Shoots barrage	14.25	4	3.56	39.6%	35.6%	5.7%
Beachley barrage	2.20	4	0.55	6.1%	5.5%	0.9%
Welsh Grounds lagoon	60.36	5	12.07	134%	121%	19.2%
Bridgwater Bay lagoon	76.31	5	15.26	170%	153%	24.2%

Impact of the demand for primary aggregates for embankment & breakwater fill, sand ballast & seabed on the national and regional market

Source: Parsons Brinckerhoff & DECC

This table shows that only the Beachley barrage has a small impact on the regional production of aggregates for construction and fill. For the other schemes, aggregates for construction and fill cannot be sourced on the regional markets and for the lagoon schemes, the impact on the national market is also very high.

We should also bear in mind that the classification “aggregates for construction fill” in the current surveys and statistics does not only encompass materials for embankment fill or ballast; therefore this comparison is likely to be pessimistic because the breakdown of end-use of all the aggregates produced in the regional and national market could change by the time a STP scheme is scheduled. Nevertheless, this comparison provides a relevant approach to the problem of aggregates supply.

The impact of the overall demand for sand and gravel for construction fill (ballast, embankment and breakwater core, seabed) is as follows:

Demand for sand & gravel for ballast, embankment core and seabed	Total demand for sand & gravel for construction fill	Duration of civil engineering construction	Annual demand for sand & gravel for construction fill	% of annual average production of sand and gravel for construction fill (forecast - 2020)		
				Wales Total average production	South West Total average production	GB Total average production
Scheme	mt	Year	mt/year	0.3mt/y	2mt/y	13mt/y
Cardiff-Weston barrage	27.65	6	4.61	1536%	230%	35.4%
Shoots barrage	9.66	4	2.42	805%	121%	18.6%
Beachley barrage	1.72	4	0.43	143%	21.5%	3.3%
Welsh Grounds lagoon	39.71	5	7.94	2647%	397%	61.1%
Bridgwater Bay lagoon	55.31	5	11.06	3688%	553%	85.1%

Impact of the demand for sand & gravel for embankment & breakwater fill, sand ballast & seabed on the national and regional market

Source: Parsons Brinckerhoff & DECC

And the impact of the overall demand for crushed rock for construction fill (embankment and breakwater fill) is as follows:

Demand for crushed rock for embankment and breakwater fill	Total demand for crushed rock for construction fill	Duration of civil engineering construction	Annual demand for crushed rock for construction fill	% of annual average production of crushed rock for construction fill (forecast - 2020)		
				Wales Total average production	South West Total average production	GB Total average production
Scheme	mt	Year	mt/year	9mt/y	8mt/y	50mt/y
Cardiff-Weston barrage	5.69	6	0.95	10.5%	11.8%	1.9%
Shoots barrage	4.59	4	1.15	12.8%	14.3%	2.3%
Beachley barrage	0.48	4	0.12	1.3%	1.5%	0.2%
Welsh Grounds lagoon	20.65	5	4.13	45.9%	51.6%	8.3%
Bridgwater Bay lagoon	21.00	5	4.20	46.7%	52.5%	8.4%

Impact of the demand for crushed rock for embankment & breakwater fill on the national and regional market

Source: Parsons Brinckerhoff & DECC

These tables highlight the very high impact of the demand for sand and gravel not only on the regional markets but also on the national one. Only sand and gravel required for the Beachley barrage for construction and fill could be easily sourced on the national market (mainly from dredging).

As for crushed rock, the demand for the lagoon schemes has a significant impact on the regional markets and to a lesser extent on the national one. Beachley barrage has less impact on the regional and national markets; for the other barrages, the demand for crushed rock could be easily met on the national market. The demand for crushed rock for the lagoon schemes could also rely either on an increase in the output capacity of existing quarries (e.g. Glensanda) or on additional imports from European quarries (e.g. Norway).

The use of dredged materials for the foundation preparation works and the navigation channels could relieve this high demand. As already mentioned, mainly sand and gravel dredged are likely to be suitable for construction aggregates.

Assuming that 80% of sand and gravel dredged for the preparation works could be used for embankment fill and ballast or seabed, the net demand for sand and gravel for construction and fill is as follows:

Demand for sand & gravel for ballast, embankment core and foundation preparation	Total demand for sand & gravel for construction fill	Dredged materials for foundation preparation used (80% sand & gravel)	Net demand for sand & gravel for construction fill	Duration of civil engineering construction	Net annual demand for sand & gravel for construction fill	% of annual average production of sand & gravel for construction fill (forecast - 2020)		
						Wales Total average production	South West Total average production	GB Total average production
Scheme	mt	mt	mt	Year	mt/year	0.3mt/y	2mt/y	13mt/y
Cardiff-Weston barrage	27.65	33.25	0	6	0	0%	0%	0%
Shoots barrage	9.66	4.97	4.69	4	1.17	391%	58.6%	9.0%
Beachley barrage	1.72	1.54	0.18	4	0.045	15.1%	2.3%	0.3%
Welsh Grounds lagoon	39.71	3.99	35.72	5	7.14	2381%	357%	55.0%
Bridgwater Bay lagoon	55.31	0	55.31	5	11.06	3688%	553%	85.1%

Impact of the demand for sand & gravel for embankment & breakwater fill, sand ballast & seabed on the national and regional market after deducting 80% sand and gravel dredged

Source: Parsons Brinckerhoff & DECC

When 80% of sand and gravel dredged for preparation works are used as aggregates for construction and fill, this table indicates that these dredged materials can relieve significantly the demand for sand and gravel for the barrage schemes. For the Cardiff-Weston barrage they can substitute for 100% of them.

As for the lagoons, due to the lack of sand and gravel on the seabed (particularly for the Bridgwater lagoon), the use of dredged materials has little or even no impact on the demand. Therefore, in order to meet this high demand, the alternative solutions are as follows:

- increase in the output capacity of existing sources of sand and gravel including marine dredging (within the current licensing framework)
- intensive use of secondary and recycled aggregates, in particular for ballast and seabed (e.g; china clay waste or slate waste)
- more imports from overseas sources
- additional dredging licenses, in particular in the Bristol Channel, so as to avoid transportation costs

Armour stone for embankment and breakwater

The second main concern for embankments and breakwaters in terms of materials is the availability of armour stone: rip rap or rock armouring (Class A or B rock). The annual demand for the largest STP schemes is between 1.4 and 2.3mt whereas the average imports of armour stone in Great Britain is about 1.5mt/year.

If we assume that by the time a STP scheme would be built about 2mt of armour stone can be produced and imported per year in Great Britain, the impact of this demand on the national market is set out in the following table:

Demand for armour stone for embankment & breakwater	Total demand for armour stone	Duration of civil engineering construction	Annual demand for armour stone	% of annual average production & imports of armour stone in GB (forecast - 2020)
Scheme	mt	Year	mt/year	2mt/y
Cardiff-Weston barrage	9.76	6	1.63	81.3%
Shoots barrage	2.18	4	0.55	27.3%
Beachley barrage	0.24	4	0.06	3.1%
Welsh Grounds lagoon	11.29	5	2.26	113%
Bridgwater Bay lagoon	7.33	5	1.47	73.3%

Impact of the demand for armour stone on the national and regional market

Source: Parsons Brinckerhoff & DECC

This table shows that for the Cardiff-Weston barrage and the lagoon schemes, the demand for armour stone is very high and would require additional sources or significant increases in extraction capacity.

Most of the rock armouring materials would be sourced from Scotland (Glensanda), provided the current size of extracted rock would be increased, and also from overseas quarries already specialized in rock armouring supply (Norway...). The total amount required cannot be extracted from the existing specific quarries without significant increase in delivery rates; the current volume of imported armour stone (1.5mt/year) would also be increased by a maximum of 50% (based on 3-year consumption of armour stone).

In order to cope with the shortage of rock in Great Britain, it would be worth comparing the use of precast armour units (fabrication, transport and placing cost) to the extraction and transportation of rock armouring from overseas.

Conclusion – Aggregates & armour stone

In order to meet the demand for aggregates for concrete, embankment fill and sand fill (caisson ballast) the existing UK sources (marine dredging and quarries) would have to take part in the delivery chain, provided their location is compatible with the construction sites. A more detailed study needs to be undertaken so as to identify the various sources in Great Britain and even in Europe, taking into account transportation (sea and land), materials quality and technical characteristics, as well as availability of permitted resources – on land and offshore.

In Great Britain, these aggregates could be extracted from existing quarries in South Wales and the Mendip Hills or even from coastal quarries in Southern Ireland (Arklow) and West coast of Scotland (mainly from the Glensanda coastal quarry). The large volume of aggregates needed would require a significant increase in the current UK delivery rate which could be reached either by stepping up the extraction output or by importing more aggregates from European quarries.

The location of the caisson construction yards would also determine the most suitable sources for concreting aggregates so as to optimise transportation.

The proportion of dredged materials from preparation works which could be used for construction aggregates has to be confirmed in particular for the Cardiff-Weston barrage and the lagoons.

Nevertheless, these global results do not highlight in detail the disparities of the impact of each type of aggregates (sand, gravel or crushed rock) on the regional and national market according to the current end-use of these materials. At this stage of the study, the volume of concreting aggregates cannot be assessed for each component (sand, gravel or crushed rock) and the official records of production of aggregates for construction and fill do not distinguish sand from gravel.

If we assume that the breakdown of end-use of aggregates extracted in the regions and in Great Britain cannot be significantly modified therefore, the impact of the demand of each type of aggregates can be summarized as follows:

- Concreting aggregates: the Welsh and South West market could provide these materials for the smaller barrage schemes and to a certain extent for the Welsh Grounds lagoon. For Cardiff-Weston barrage and Bridgwater bay lagoon, these materials would be sourced from the Great Britain market (quarries and land-won or marine dredging).
- Crushed rock for embankment and breakwater fill: only the demand for the Beachley barrage could be met on the regional market; for the other schemes, the Great Britain market could provide enough materials and additional imports from overseas could be envisaged for the two lagoons (or an increase in the output capacity of existing UK quarries).
- Sand and gravel for embankment and breakwater fill and for ballast or seabed: dredged materials for preparation works would relieve significantly the demand for the barrages and the Great Britain market would provide enough materials. As for the lagoons, additional sources would be required, including overseas imports (provided sea transport remains cost effective) or new dredging licenses (provided this way of supply is easier to set up and cost effective). The use of significant volumes of secondary and recycled aggregates would also be part of the possible solutions, in particular for ballast (e.g. china clay or slate waste).
- Armour stone for embankment and breakwater: only the demand for Beachley barrage can be met on the Great Britain market; for the other schemes, an increase in the capacity and delivery rate of existing quarries (e.g. Glensanda) would not be sufficient and a significant rise in imports from European rock quarries is likely to be the only solution.

B – Caisson construction yards

Introduction

The number of caissons for each scheme is as follows (Phase 2 estimates):

Number of Caisson	Turbine, sluice and plain caisson	Navigation lock caisson	Breakwater caisson	Total caisson
Scheme				
Cardiff-Weston barrage	129 (54/46/29)	18	17	164
Shoots barrage	46 (15/25/6)	4	2	52
Beachley barrage	31 (13/9/9)	4	2	37
Welsh Grounds lagoon	32 (10/14/8)	4	2	38
Bridgwater Bay lagoon	42 (36/0/6)	4	2	48

Number of caisson
Source: Parsons Brinckerhoff

The caissons would be constructed in dry dock, towed and floated out to their location on the barrage, lowered onto the pre-prepared foundations and ballasted with sand and/or concrete for stability. It might also be necessary to make provision for bringing the caissons to the site by sea tows, or semi submersible barges. The caissons might then be sunk at a nearby location, for re-floating and rapid deployment to their final locations during suitable weather windows.

The caissons can be built year-round in the yards and their shipment and installation on the site would mainly depend on the tides. Installation methods would be designed to allow placement throughout the year when the tides are suitable, subject to favourable weather. The caissons would be suitable for open sea tow.

For the Cardiff-Weston scheme, caisson manufacture would require coastal sites close to deep water and if possible, with good road and rail links so as to ease material and equipment delivery (to a certain extent, improvement of transportation network could be envisaged). Caisson floating draughts (which would vary from 10m for the shallowest plain caissons to 21m for the turbine caissons) would limit the choice of sites.

A typical site would contain 3 basins each large enough to accommodate 4 caissons and would have a total area of 140 hectares (dry and wet docks). STPG report mentioned 4 sites in the vicinity of the barrage and others in Scotland or England (see map).

Such caisson yards should be located in areas where key components could be easily sourced so as to reduce transport costs (e.g. sources of construction aggregates).

For the Shoots barrage, due to the proximity of Second Severn Crossing, and in order to avoid any collision of towed caissons on the bridge piers, the caisson yard should be located downstream of this bridge. Part of the English Stones embankment could be used as one side of the dry dock for caisson construction.

As for the Beachley barrage, for the same reasons (M48 bridge located downstream), the caisson yard should be implemented upstream of the barrage.

It is interesting to note that the Belgium Marine Consultant DEME (Dredging, Environmental & Marine Engineering) mentioned in its response a solution for the caisson construction yard. The solution would consist of building a very large casting yard within a cofferdam (like the one used for the construction of the Cardiff Bay Barrage). This casting yard would be implemented within the footprint of the future locks, where deep dredging would be required. In a final stage, the locks could then be built in a dry enclosure. However, the impact of this solution on navigation routes during the construction would need to be considered.

Potential coastal sites in UK/Europe suitable for the construction of caisson yards facilities

The feasibility of the caisson design depends heavily on the possibility of construction yards along the UK coast or even in Western Europe. It is certainly one of the major constraints for each scheme.

According to the responses, a detailed assessment is required to consider available draught, land and equipment and the associated supporting infrastructure. There would be issues to be addressed in relation to the environment and the cost, carbon footprint... associated with moving the caissons from the production facility to the site. The consent and permit process might lead to delay in the construction programme and therefore, the choice of the most suitable caisson yards sites must be studied and confirmed well in advance.

The 1989 STPG study found 11 caisson yard sites available around the UK (able to accommodate 12 caissons per site), but only 4 sites are located within the South West and Wales. Some respondents estimate that only about 35-40% of the caisson construction works could be done within Wales and South West region in the case of Cardiff-Weston Barrage, and smaller barrages or lagoons would need up to 3 and 4 caisson yards which may potentially keep all caisson yards within the South West and Wales area. However, this will largely depend on the economic conditions impacting the availability of such sites and therefore there still can be a leakage to the rest of the UK.

Several of the coastal sites identified in the STPG report still exist (but some of them are located on the east coast):

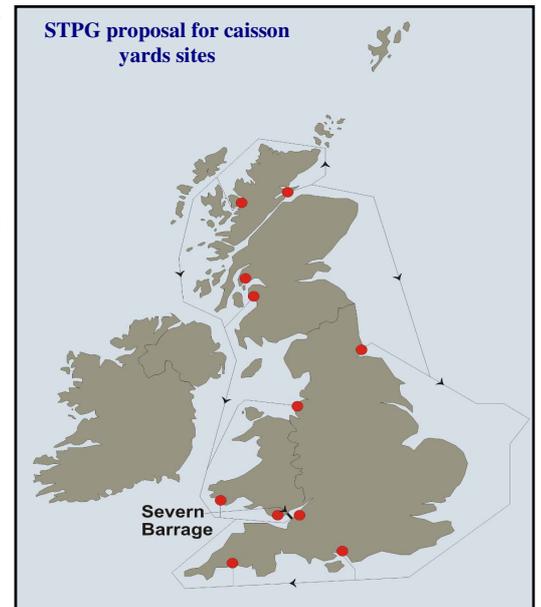
- Arnish, Isle of Raasay - Highland
- Campbeltown - Argyll
- Methil, Firth of Forth
- Nigg, Cromarty Firth
- Mostyn, Dee
- Swan Hunter - Middlesbrough

Suitability of existing port (in the UK or in Europe) for the implementation of a caisson yard facility

A further study would be required to consider the contemporary situation at candidate ports. Market demands at ports regularly change land-use patterns and it seems likely that once potential sites for a caisson yard facility (or facilities) have been identified it may be necessary to secure the site with a financial commitment. The availability of land and equipment to serve a caisson yard facility may exist at the time of a recession but would quickly disappear when trade increases and there is further demand for port facilities to move and store cargo. Access to Ports is restricted in relation to the draught, beam and length of the vessels that they can accommodate and these issues would limit the location of existing ports able to deal with the production and movement of caissons. The size of existing dry docks for caisson construction is also a constraint.

The DECC study on UK ports for the Offshore Wind Industry (2009) mentions some ports which might be suitable for the construction or the storage of caissons (further investigation is required so as to check water depth, locks, available space, sea conditions...):

- Hunterston Terminal (Firth of Clyde): former oil rig site, one of the deepest sea entrances in Northern Europe (water depth at LAT: 20m); available for redevelopment; maybe suitable for large caissons construction (operational dry dock)
- Swansea and Port Talbot: located in the vicinity of the project; as depth is limited, maybe suitable for smaller caissons construction
- Nigg Yard (Cromarty Firth): offshore platform yard, floating caisson opening; maybe suitable for large caissons construction (water depth at LAT: 9.14m)
- Harland & Wolff in Belfast: could be suitable for smaller caissons in the dry dock (water depth at LAT: 8.6m)
- Milford Haven (Wales); one of the deepest port.



Nevertheless, these ports would probably not have sufficiently large areas for the caissons to be mass produced in. The need for large working space, might mean that the only viable casting yards would be the sites of former oil field fabrication yards.

The suitability of European ports (e.g. Cherbourg, Le Havre, Rotterdam...) depends on transport conditions and possibilities of towing the caissons through the Channel. East European ports on the Baltic may not be suitable as water depths are very limited.

Former yards used for oil and gas platform construction are still existing and could be re-used:

- Ardyne Point at the mouth of the Clyde (owned by Sir Robert McAlpine): 3 docks used for constructing North Sea oil platform in the 1970s, each big enough for the largest caissons. Investments for upgrading and refurbishment should be required so as to re-use it (provision of docks gates...)
- Kishhorn Yard (West coast of Scotland): also developed for oil platform construction in the 1970s

Also, sites in Western Europe could be considered, in particular some which have been used for offshore structures in Norway, Holland, France and Spain.

Conclusion – Caisson construction yards

The possibility of implementing caisson construction yards (location, consent...) is considered as a major issue for each STP scheme and more particularly for the Cardiff-Weston one which would require several sites.

More detailed studies have to be undertaken later in order to confirm the availability of the potential sites, taking into account environmental impacts, consent process, caisson transport (tug) cost, sites characteristics (e.g. water depth, transport network for material and equipment delivery...) and carbon footprint.

Innovation in caisson construction and transport could also be envisaged so as to optimise the size and number of yards. More yards could reduce construction risk (by reducing the effect of a delay at one yard) and would also result in lower total yard costs, provided more existing yards could be used without much modification.

C – Concrete

Introduction

Concrete is also a major concern due to the large volume required and their impact on the UK market. Each component of the concrete must be taken into account so as to anticipate any bottleneck in the supply chain. For large projects, materials required for concrete fabrication and works (rebar, formwork, cement...) are procured through national and international markets (rather than regional markets). It is difficult to predict availability in 5 to 10 years time, however pre-ordering well in advance would be the key to availability.

Aggregates for concrete

See section A-5 “Aggregates & armour stone for a STP scheme”.

Cement

Finished cement production in Great Britain was 10mt in 2008 (11.9mt in 2007). This is a notable drop as cement production has remained above 11mt for the last 5 years. Increasing competition in overseas markets has led to a decline in cement exports in recent years, with UK exports of cement falling to 487,000t in 2007, compared with 613,000t in 2006 and 826,000t in 2000. The UK has become a net importer of cement due to insufficient domestic production capacity, importing more than 2,370,000t of cement in 2007.

Year	Cement clinker		Portland cement	
	Exports	Imports	Exports	Imports
2000	256	351	570	1,420
2001	169	387	327	1,182
2002	161	290	306	1,143
2003	61	506	216	1,715
2004	83	377	214	2,034
2005	135	406	321	1,645
2006	91	517	522	1,397
2007	28	836	459	1,534

UK imports and exports of cement clinker and Portland cement
Source: HR Revenue & Customs

The 5 largest cement manufacturers in the UK are Hanson (Heidelberg Cement Group; 3 plants), CEMEX UK Cement (3 plants), Lafarge Cement UK (7 plants), Tarmac Buxton Lime and Cement (1 plant) and Quinn Group (1 plant) operating 15 cement plants. Due to high energy prices and deteriorating market conditions, Lafarge has suspended operations at its Westbury cement production facility (Wiltshire) and CEMEX has closed Barrington plant (Cambridgeshire).

Cement plants have cement capacity of between 0.3mt/year to 1.4mt/year. Cement is transported mainly by road and sometimes by rail.

Company	Cement Plant	Cement capacity (thousand tonnes/year)	Transport
Lafarge Cement UK	1. Dunbar	1000	Road/Rail
	2. Hope	1300	Road/Rail
	3. Cauldon	1000	Road
	4. Aberthaw	500	Road
	5. Westbury	700	Road/Rail
	6. Northfleet	1000	Road
	7. Cookstown	500	Road
CEMEX UK	8. South Ferriby	800	Road
	9. Rugby	1250	Road
	10. Barrington	300	Road
Hanson Cement	11. Ketton	1400	Road/Rail
	12. Padeswood	800	Road
	13. Ribblesdale	1400	Road
Tarmac Buxton Lime & Cement	14. Tunstead	800	Road/Rail



Assuming that 13mt/year of cement could be produced in the UK by the time a STP scheme is likely to be constructed, the impact of the total demand for cement (civil structures, concrete ballast and precast armouring) on the national market is as follows:

Demand for cement (structures, ballast & precast armour units)	Total demand for cement	Duration of civil engineering construction	Annual demand for cement	% of annual average production & imports of cement in the UK (forecast - 2020)
Scheme	mt	Year	mt/year	13mt/y
Cardiff-Weston barrage	2.98	6	0.50	3.8%
Shoots barrage	0.33	4	0.08	0.6%
Beachley barrage	0.16	4	0.04	0.3%
Welsh Grounds lagoon	0.51	5	0.10	0.8%
Bridgwater Bay lagoon	1.49	5	0.30	2.3%

Impact of the total demand for cement on the national market

Source: Parsons Brinckerhoff & DECC

If only civil structures (caissons, crest walls...) and concrete ballast are taken into account, the impact becomes:

Demand for cement (structures & ballast)	Total demand for cement	Duration of civil engineering construction	Annual demand for cement	% of annual average production & imports of cement in the UK (forecast - 2020)
Scheme	mt	Year	mt/year	13mt/y
Cardiff-Weston barrage	2.90	6	0.48	3.7%
Shoots barrage	0.33	4	0.08	0.6%
Beachley barrage	0.16	4	0.04	0.3%
Welsh Grounds lagoon	0.51	5	0.10	0.8%
Bridgwater Bay lagoon	0.89	5	0.18	1.4%

Impact of the demand for cement (structures & ballast) on the national market

Source: Parsons Brinckerhoff & DECC

Only the Cardiff-Weston barrage would have a relative impact on the UK demand for cement production. There are two Lafarge cement plants in the vicinity of the Severn Estuary: Aberthaw (0.5mt/year) and Westbury (0.7mt/year; provided this facility would be re-opened after the economic recession), and the other plants located in the UK are likely to be able to meet this demand.

In case of shortage of cement supply in the UK, cement importation from overseas plants (Europe) might be envisaged from cement plants located close to European ports so as to optimize transportation. Pre-ordering well in advance would be the key to availability.

Concrete production

The average UK production of ready-mixed concrete is about 11mt per year. The location and limited capacity of existing concrete plants is unsuitable for the largest STP schemes (from 3mt/year to 2.2mt/year). The existing UK cement plants typically supply less than 300m³ each per day; there are about 1,300 ready-mixed concrete plants in the UK (a number of concrete production plants closed during 2008).

Moreover, there will be insufficient plants within range of the construction yards to be able to supply these sites. The quantities of concrete required will justify the setting up of concrete batching plants at most of the caisson construction sites. This is a normal practice for projects requiring large quantities of concrete. These will probably have a quay besides the plant to accept cement, sand and aggregates brought in by sea directly to the site. This would greatly cut the burden on the local transport infrastructure, and would enable bulk deliveries by water which would be cheaper than by rail or road.

The overall impact of concrete demand for civil structures, ballast and precast armouring on the UK market is as follows (assuming that in the future, 12mt/year of concrete could be produced):

Total demand for concrete (structures, ballast & precast armour units)	Demand for concrete			Total demand for concrete	Duration of civil engineering construction	Annual demand for concrete	% of annual average production of concrete in the UK (forecast - 2020)
	Structures	Ballast	Precast armour units				
Scheme	mt	mt	mt	mt	Year	mt/year	12mt/y
Cardiff-Weston barrage	18.32	2.36	0.61	21.29	6	3.55	29.6%
Shoots barrage	2.09	0.24	0	2.33	4	0.58	4.9%
Beachley barrage	1.05	0.11	0	1.16	4	0.29	2.4%
Welsh Grounds lagoon	3.57	0.11	0	3.68	5	0.74	6.1%
Bridgwater Bay lagoon	5.79	0.54	4.69	11.03	5	2.21	18.4%

Impact of the demand for concrete (structure, ballast & precast armouring) on the national market

Source: Parsons Brinckerhoff & DECC

Without taking into account the concrete for precast armour units, the result is as follows:

Demand for concrete (structures & ballast)	Total demand for concrete	Duration of civil engineering construction	Annual demand for concrete	% of annual average production of concrete in the UK (forecast - 2020)
Scheme	mt	Year	mt/year	12mt/y
Cardiff-Weston barrage	20.68	6	3.45	28.7%
Shoots barrage	2.33	4	0.58	4.9%
Beachley barrage	1.16	4	0.29	2.4%
Welsh Grounds lagoon	3.68	5	0.74	6.1%
Bridgwater Bay lagoon	6.34	5	1.27	10.6%

Impact of the demand for concrete (structures & ballast) on the national market

Source: Parsons Brinckerhoff & DECC

Mainly the largest schemes (Cardiff-Weston barrage and Bridgwater Bay lagoon) would have a significant impact on the national concrete production.

Steel reinforcing bars

Most of the manufactured steel reinforcing bars are currently made from recycled scrap metal. In 2007, the production of rods and bars for reinforcement in the UK was 0.785mt for home delivery + 0.327mt for exports (total output capacity: 1.112mt); 0.575mt were imported.

The overall impact of rebar demand for civil structures and precast armouring on the UK market is as follows (assuming that in the future, 1.5mt/year of rebar could be manufactured):

Demand for rebar (structures & precast armour units)	Total demand for rebar	Duration of civil engineering construction	Annual demand for rebar	% of annual average production & imports of rebar in the UK (forecast - 2020)
Scheme	mt	Year	mt/year	1.5mt/y
Cardiff-Weston barrage	1.55	6	0.26	17.3%
Shoots barrage	0.17	4	0.04	2.8%
Beachley barrage	0.08	4	0.02	1.4%
Welsh Grounds lagoon	0.29	5	0.06	3.9%
Bridgwater Bay lagoon	0.87	5	0.17	11.5%

Impact of the demand for rebar (structures & precast armouring) on the national market

Source: Parsons Brinckerhoff & DECC

The UK steel making facilities (in particular Celsa Steel Ltd in Cardiff which produces about 0.89mt/year of reinforcing and wire rod products and recycles 1.3mt of the 3.3mt of steel scrap used by UK steelworks) are likely to be able to meet all the demand for rebar for the smaller schemes (annual demand: 0.02 to 0.06mt).

As for the Cardiff-Weston barrage (total demand: 1.55mt) and the Bridgwater Bay lagoon (total demand: 0.87mt), overseas importations could be required; this is a classical practice for large construction projects.

Precast concrete units manufacturing

The main demand of precast concrete (PC) units includes PC protection armour units for embankment or breakwater (Dolosse for the base case). The UK precast concrete industry has a capacity of around 40mt/year.

The organisations that hold the patents for precast armour units such as Accropodes or Dolosse fulfil a design function but do not manufacture the units. They allow the units to be produced under license for given projects. The fabrication of moulds and the production of the units are the responsibility of the project.

Existing precast concrete facilities are generally capable of satisfying usual demand and have the capacity to deal with small fluctuations but they are almost all located inland. The need for a substantial increase in production can be addressed in a number of ways and these can be managed with sufficient time and resource. Production alternatives might include: the use of various existing plants in Europe (or further afield) and transport by sea to the site; expansion of existing plants (and associated transport links); or the provision of a new dedicated but temporary facility to produce the units specifically for the STP scheme.

It is likely that the preferred solution would be the construction of purpose built casting yards set up at a coastal location in the Severn Estuary for manufacture of precast concrete armour units or wall, both because of the quantities required and for ease of transport to the embankment. The construction of these precast armouring units could also be envisaged within existing port facilities (e.g. Port Talbot or Avonmouth), using sea or rail transportation.

Precast concrete armour units are only proposed for the Cardiff-Weston and Bridgwater bay schemes, based on 5t Dolosse units. The impact on the UK precast units manufacturing market is rather low.

Demand for precast armour units (Dolosse – 5t/unit)	Total number of units (Dolosse)	Total weight	Duration of civil engineering construction	Annual demand for Precast armour units	% of annual average production of precast units in the UK (forecast - 2020)
Scheme		mt	year	mt/year	40mt/y
Cardiff-Weston barrage	60,501	0.303	6	0.040	0.13%
Bridgwater Bay lagoon	468,667	2.343	5	0.468	1.17%

Impact of the demand for precast armouring on the national market

Source: Parsons Brinckerhoff & DECC

There is limited equipment to handle precast units but the construction industry should respond to new demands and thus adequate fore-warning of the needs for plant would enable new requirements to be addressed. Trucks and cranes to move and handle such units are widely used in the construction industry and would not be a problem.

Conclusion - Concrete

The main constraint for concrete supply is the availability of aggregates already mentioned in chapter A. The other concrete components (cement, steel...) can be sourced from the national market or even from overseas and the key to success is anticipation.

Like other large projects, on-site concrete batching plants have to be installed.

D – General points

Competition from other concurrent large construction projects in the UK or in Europe

Competition from concurrent large construction projects would increase costs as demand for the resources of plant, labour and materials surpasses supply. Nevertheless the global resources required to meet the project objectives do exist. Major civil engineering projects comparable with a STP scheme (e.g. Channel Tunnel) have been successfully constructed despite other opportunities being available for the labour plant and materials required. Early involvement of the contractors and suppliers would contribute to the project's success by engaging those parties in the development process and providing, at the relevant stage, certainty.

In terms of aggregates and concrete supply, the possibility of other major projects is not a significant constraint on supply to Severn Tidal Power schemes. The UK markets would take a number of years (from 5 to 10 according to the MPA) to recover from the current recession and individual projects such as Crossrail and Nuclear power stations account for only small proportions of total demand (for example the Olympics project is accounting for no more than 1% per year of national aggregates and concrete demand).

Nevertheless, aggregates, cement, and ready-mixed concrete volumes fell sharply during the second quarter of 2009 as the construction recession intensified, according to the latest quarterly survey of construction material trends by the Mineral Products Association (MPA). Compared with the same period of 2008, sales volume of crushed rock and sand and gravel aggregates fell by 29% and 27% respectively, cement and ready-mixed concrete by 32% and 37% respectively, and asphalt by 24%. The MPA says these rates of decline are broadly similar to the first quarter, and are likely to moderate slightly in the second half of the year, as industry demand dropped dramatically in the third and fourth quarter of 2008, so the comparative base is reduced. By the time a STP is scheduled to be constructed, the economic situation is likely to be more favourable for construction projects.

Impact on existing transport infrastructure

The location of all the five STP proposals that are currently under consideration would require improvements to the local transport infrastructure to link the proposed works with the existing network. The demands on the road network could be reduced by maximising the potential use of rail and sea delivery of materials. For the larger schemes the improvements would be more substantial and extensive and have a significant, albeit possibly temporary, impact upon the environment. Given the limitations on the existing road network it is inevitable that some upgrading and strengthening work would be required. The location of the sites for preparatory works would be a key issue and the opportunity to use seaborne transport would have a significant impact upon the extent of landside infrastructure that needs to be provided and improved. The location of the quarries for aggregates supply, far from the construction sites, could lead to transport constraints as well as the location of precast facilities or other materials suppliers.

In any case, the closeness to the sea offers a far better solution to moving most materials than would be possible by land; it makes more sense to install temporary quays, and jetties and to take the transport burden off the existing infrastructure. Within the responses, it is also mentioned that the creation of a new or the enhancement of an existing port in the Severn estuary that would be used as a base for sea-borne transport, would be a suitable solution to minimize long-haul road transport.

Moreover, rail transportation would be prioritized when possible. For example, when the second Severn crossing was built most of the aggregates and fill material requirements for the embankments and approach roads were sourced from large quarries in Somerset and delivered by rail to the project.

E - Conclusion

The proposed civil engineering works for all the selected STP projects are not particularly innovative and would generally involve proven techniques (e.g. port and marina construction or extension, storm surge barrier construction...). Only the scale of the largest schemes is considered a technical challenge. The civil engineering issues that might delay completion are all predictable and, subject to appropriate management and assessment, can be accommodated.

The main issues would be the location of caissons construction yards, the supply chain for sand and gravel and armour stone and... the weather. Innovative design and construction process could be one of the keys to success.

IV - MAIN MECHANICAL AND ELECTRICAL EQUIPMENTS

A – Turbines and Generators

Introduction - Background

Turbine units are the main mechanical concern; only two existing horizontal axis turbine designs are suitable for a tidal power plant: bulb turbine (the name "bulb" comes from the shape of the upstream casing which contains a generator located on a horizontal axis) and Straflo turbine ("Straight Flow"; the concept is based upon a rim driven generator of the former Escher Wyss company – now Andritz Hydro; the patent has already expired). The turbines envisaged for each shortlisted STP scheme are set out as follows (base case from Phase 2 Optimisation study):

Barrage: Turbines + Generators	Units	Cardiff-Weston	Shoots	Beachley
Bulb-Turbines rated 40MW (base case)	No	216		
Straflo-Turbines rated 35MW (base case) <i>or variant Bulb-Turbines</i>	No		30	
Straflo-Turbines rated 12.5MW (base case)	No			50

Lagoon: Turbines + Generators	Units	Welsh Grounds	Bridgwater Bay
Bulb-Turbines rated 25MW (new base case)	No	40	144
<i>Bulb-Turbines rated 12.5MW (previous base case)</i>	No	108	108

Bulb turbines for tidal barrages were developed specifically in the 1960s for the La Rance barrage built and operated by EDF (24 units rated 10MW; 5.3m diameter; 93 rpm). Bulb turbines are able to generate electricity in two directions of flow and can also be used as pumps. Bulb turbines have been installed in many low head hydro power plants worldwide but after La Rance, only in smaller tidal power plants: Jiangxia (China - 5 bulb units rated 0.5, 0.6 and 0.7MW - total 3.2MW - 1980) and Kislaya Guba (Russia - 1 bulb unit rated 0.4MW - 1968). The Sihwa barrage in South Korea is the latest large tidal barrage project in the world and the 10 bulb turbines rated 25.6MW are scheduled to be commissioned in mid-2010.

Bulb units are manufactured by the following main turbine manufacturers:

- Alstom Hydro (France)
- Voith Hydro (Germany)
- Andritz Hydro (Austria/Germany)
- Hitachi (Japan)
- Dongfang Electrical Machinery Company Ltd (Dongfang Electric Corporation - DEC - China)
- Harbin Electric Machinery Company Ltd (Harbin Electric Inc. - HEC - China)
- Bharat Heavy Electrical Ltd (India)

Only Alstom, Andritz and Voith have the expertise and know-how to handle large projects, are able to meet the technical requirements for a STP scheme (size, output capacity...) and can deliver large numbers of units. For the other turbine manufacturers, bulb units are not considered as their core activity.

The main bulb and Straflo turbines manufactured by the 3 major turbine suppliers are set out in the following tables:

Country	Scheme	Power (MW)	Head (m)	Runner Diameter (m)	Number of Units	Year of completion	Manufacturer
USA	Vidalia	25	5	8.2	8	1987	Markham UK & Hunger Hydraulic UK
China	Chang Zhou	42.9	9.5	7.5	3	2007	Alstom Hydro
China	Qiao Gong	48.5	13.8	7.45	4	2007	Alstom Hydro
China	Tong Wan	46.2	11	7.1	4	2007	Alstom Hydro
China	Wu Jin Xia	36.1	9.2	7	4	2007	Alstom Hydro
USA	Greenup	25	9	6.1	3	1982	Alstom Hydro
USA	Rock Island	58	12	7.4	8	1978	Alstom Hydro
France	Saut Brenaz	23	8	6.25	2	1986	Alstom Hydro
France	Chautagne/Belley	46	14.7	6.4	4	1980	Alstom Hydro
Portugal	Crestuma	43	11.3	6.8	3	1987	Alstom Hydro
USA	Racine	24.6	7	7.7	2	1983	Andritz Hydro
Austria	Melk	21.7	8.2	6.3	9	1985	Andritz Hydro
Austria	Greifenstein	35	10.9	6.5	6	1985	Andritz Hydro
Austria	Freudenau	30.3	10.8	7.5	6	1998	Andritz Hydro
Austria	Ybbs Persenbeug	48.5	12.1	7.5	1	1993	Andritz Hydro
Thailand	Pak Mun	35.4	13.5	6	4	1994	Andritz Hydro
USA	Belleville	25.9	5.5	7.5	2	1999	Andritz Hydro
USA	Arkansas 2	35	12.6	7	3	1999	Andritz Hydro
China	Da Yuan Du	31.3	11.2	7.5	4	1999	Andritz Hydro
China	Fei Lai Xia	39	14	7	4	1997	Andritz Hydro
Turkey	Karkamis*	34.8	?	7.5	6	2000	Andritz Hydro
South Korea	Sihwa (tidal)	25.4	5.8	7.5	10	2009	Andritz Hydro
Ontario-Canada	St Mary	18	?	7.1	?	1978	Voith Hydro
China	Ma Ji Tang	18	?	6.3	?	1978	Voith Hydro
China	Jing Nan	35.4	11.0	6.3	2	1992	Voith Hydro
China	Bailongtan	33	18.0	6.4	6	1994	Voith Hydro
Austria	Melk	22.3	8.2	6.3	3	1979	Voith Hydro
Austria	Greifenstein	34.7	10.9	6.5	3	1981	Voith Hydro
Austria	Oberaudorf - Ebbs	30.9	11.6	6.1	2	1988	Voith Hydro
Austria	Freudenau	30.3	6.8	7.5	2	1992	Voith Hydro
Austria	Ybbs Persenbeug	48.5	12.1	7.5	1	1993	Voith Hydro
Pakistan	Chashma	23.7	13.8	6.3	8	1994	Voith Hydro
USA	New Martinsville	20	6.4	7.3	2	1986	Voith Hydro
USA	Cannelton	29.6	6.1	7.7	3	2008	Voith Hydro
USA	Smithland	25.7	5.5	7.7	3	2008	Voith Hydro
USA	Willow Island	21.3	4.9	7.7	2	2008	Voith Hydro
USA	Meldahl	37.2	7.6	7.7	3	2009	Voith Hydro
Germany	Rheinfelden	21.3	4.8	7.7	2	2006	Voith Hydro
Brazil	San Antonio	71.0	13.9	7.5	10	2008	Voith Hydro
Brazil	Jirau	76.6	15.2	7.5	10	2009	Voith Hydro
Turkey	Karkamis*	35.5	14.5	6.3	6	1999	Voith Hydro

Main large bulb-turbines (diameter > 6m) installed in the world

*Karkamis: consortium led by Andritz hydro with Voith Hydro

Straflo turbines were designed mainly for low head run of river hydro plant and around 100 units have been installed in the world. Only one Straflo turbine (Rated 20MW – 7.6m diameter – 50 rpm) was installed in 1984 for the Annapolis demonstration tidal power plant (Nova Scotia – Canada). To date, due to the previous patent, the Straflo turbines were only manufactured by Andritz Hydro. As the patent has expired, other turbine manufacturers can now use this technology but they are likely to be reluctant to manufacture Straflo turbines for fear of encountering higher costs and technical shortcomings.

Country	Scheme	Power (MW)	Head (m)	Runner Diameter (m)	Number of Units	Year of completion	Manufacturer
Switzerland	Augst-Whylen	6	7	3.8	13	1994	Andritz Hydro
Switzerland	Laufenburg	11.6	10	4.25	10	1993	Andritz Hydro
Manitoba-Canada	Pointe du Bois	8.5	14	?	1	1999	Andritz Hydro
Nova Scotia-Canada	Annapolis (tidal)	20	7	7.6	1	1984	Andritz Hydro

Examples of Straflo turbines installed in the world

It is important to bear in mind that Alstom, Andritz and Voith are also able to design and manufacture generators, governors, protection system, excitation, control and monitoring system as well as gates, stoplogs and valves (Alstom and Andritz).

In the following presentations of the 3 major turbine manufacturers, a summary of the technical discussions on the Severn project and recommendations are also set out (meetings held in DECC office and also in their headquarters offices).

Alstom Hydro

Alstom Hydro (5500 staff in 19 countries) is a 50/50 joint venture (set up in 2006) between Alstom (Alstom Power and Alstom Transport) and the Bouygues Group (2 main sectors: construction and media/telecoms). Alstom Hydro is now one of the major suppliers of hydroelectric equipments and services, having installed turbines and generators capable of providing more than 400GW of electricity (25% of global hydroelectric generating capacity; 310 GVA generators and 155GW turbines). Alstom Hydro operates in more than 70 countries worldwide.

With more than 250 bulb turbines (runner diameter varies from 3m to 7.5m) installed worldwide (total output: 5,000MW; including more than 35 large units commissioned in China alone during the last ten years), Alstom Hydro has gained wide knowledge and experience in design, manufacturing, installation, commissioning and management of complex bulb projects, whatever the environmental conditions. The former Neyrpic and Alsthom companies (now Alstom Hydro) were involved in the design of La Rance bulb turbines and they supplied 12 units (the other units were manufactured by Jeumont-Schneider and the Société des Forges et Ateliers du Creusot). Alstom Hydro (former GEC Alsthom Turbine Generators Ltd), as a member of the STPG consortium, was also involved in the Severn studies carried out in the 1980s. Therefore, Alstom Hydro has perhaps the best expertise in bulb turbine design for tidal barrages.

Alstom Hydro is committed to developing a more “fish-friendly” turbine (fewer but longer blades for Kaplan and Bulb turbines so as to reduce fish mortality + spherical design of the hub) and to mitigate environmental impacts (e.g. oil-free operation thanks to runner bearings lubricated by water for Kaplan turbine).

Alstom Hydro has 2 development and test facilities:

- Turbine Technology Centre in Grenoble (France – 140 staff) including 7 test rigs for all type of turbines (Francis, Kaplan, Bulb...). Modelling (Computational Flow Dynamics - CFD) is used to improve turbine efficiency and performance as well as model tests. Two recent test rigs, one of which has been in operation since 2003, are used for bulb turbines.
- Generator technology Centre in Birr (Switzerland)

Alstom Hydro has several turbine/generator manufacturing facilities in the world: Taubaté (Brazil), Tracy (Canada), Tianjin (China), Baroda (India) and Grenoble (France). Large turbines are mainly manufactured in China, India and Brazil; bulb turbines and Kaplan are currently built in the Taubaté, Tianjin and Tracy facilities. Other generator manufacturing facilities are: Bilbao (Spain), Birr (Switzerland).

Alstom Hydro estimates that 65,000 hours are reported to be needed to produce a large bulb turbine (>50MW) and around 35,000 hours for smaller units. For instance, in the Taubaté facility where bulb turbines are manufactured for the San Antonio and Jirau hydro power plant in Brazil (see below), the annual working hour capacity is 1.25 million (780 staff); currently 2 bulb turbines per month are delivered in this facility. It would be possible to increase the bulb turbine delivery rate by a further 2 units per month provided there is no higher demand in Brazil and South America for other types of turbine. Nevertheless, there are point constraints in the manufacturing cycles, particularly the use of limited boring machines, blade sourcing and manufacturing. A delivery rate of 44 turbines per year, as proposed in the original STPG studies, could not be achieved without an improvement in the existing international facilities (expansion of existing facilities or even a possible construction of a dedicated facility in the UK so as to meet not only the Severn demand but also the other future tidal schemes in the North West Region). For example, for the Three Gorges scheme, runners were constructed at site due to their large size and transport issues.

According to Alstom, the main constraints from the turbine supplier point of view is the pace of civil work and the final client processes on design/drawings approval, that have to be in line with what will be requested as the pace for manufacturing and engineering. As a precondition, Alstom Hydro recommends a very early kick-off meeting clearly defining interfaces and critical path of components with payment events and deliverables in a logical sequence to avoid non added value work being done in different phases of the project. In its experience, issues on time schedules are mostly due to interfaces and decision-making processes.

Alstom Hydro has developed a Plant Integrator™ concept so as to provide complete and optimised power solutions to customers. Improvements in manufacturing process have been achieved and up to 25% lead time savings are possible.

All the key components of a turbine unit are designed and manufactured by Alstom itself so as to control the quality and manufacturing process. Alstom uses a Primavera planning tool which can take into account existing orders plus 3-year workload and 5-year marketing forecast.

In terms of size of the bulb turbines, nowadays an 8m runner diameter is considered as the upper limit due to existing machine size (in particular boring machine). A 9m diameter bulb turbine could be envisaged but it would be a technical challenge and it would require further investments for the machine tools. Alstom Hydro is also constrained by lack of large boring machines and machining centres where turbines are made.

Alstom Hydro also points out possible constraints in terms of steel and nickel supply. Steel availability depends on the world-wide steel consumption, among other things, in competing projects. The situation in a few years depends on the economic situation, local and global policies, and can vary considerably in terms of costs and delay for material procurement.

Alstom Hydro optimizes the material procurement process depending on the market situation, taking into account all suitable materials for turbine construction. The Alstom global supplier panel, based on framework agreements for key commodities such as carbon and stainless steel plates, castings, forgings, copper and silicon steel plates among others, forecast through a very strong load analysis process, makes it possible to anticipate its load and also the load of its suppliers through a very close scanning process undertaken by its Key Commodity Managers for each strategic commodity.

In Alstom's experience of working on projects such as Rio Madeira and large Chinese projects, they have never been in a situation of material shortage. This is largely due to having in place a strong material procurement process and ensuring that material specifications are in line with supplier capacities and technology needs.

Andritz Hydro

Andritz Hydro (formerly VA Tech Hydro) has been part of the Andritz Group (Pulp & Paper, Hydro, Metals, Environment & Process and Feed and Biofuel) since 2006.

Andritz Hydro is a leading global supplier of turnkey electromechanical systems and services to hydropower plants and offers new hydroelectric power stations as well as services, rehabilitation and upgrading of existing plants.

Thanks to several acquisitions of European turbine manufacturers (Escher Wyss, ELIN, Vevey, Bouvier, Charmilles...) and recently General Electric Hydro (2008), Andritz Hydro has more than 160 years of expertise in hydropower.

Before the acquisition of GE Hydro, VA Tech (4,500 staff) had large turbine manufacturing workshops in Ravensburg (Germany), Linz (Austria), Kriens (Switzerland), Schio (Italy), Madrid (Spain), Morelia (Mexico) and Faridabad (India). Three large generator and electrical manufacturing workshops are located in Weiz and Vienna (Austria) and in Bhopal (India). Three R&D laboratories are located in Linz (Austria) and Vevey and Zurich (Switzerland). There are several sales and services offices in the world (25 countries).

The acquisition of GE Hydro (400 staff, 9 very large facilities in Canada, China, Brazil, Sweden, three Hydraulic laboratories in Brazil, Canada and Finland) is a key milestone in Andritz Hydro development and this company is becoming one of the key global hydro turbine manufacturers. There are now several Andritz hydro facilities all around the world and in particular in countries where the hydro demand is high (China, South America, India...).

VA Tech Hydro has installed around 26,000 turbines (245GW) and 51GVA generators; GE Hydro has installed a total of 152GW turbines and 107GVA generators.

More than 300 bulb units have been supplied by Andritz Hydro for heads up to 27m, a maximum runner diameter of 8.2m and outputs up to 55 MW (77MW for the current Rio Madeira project). The total installed capacity amounts to 4,500 MW approximately. Andritz Hydro is one of the leaders in Bulb turbine/Generator units with more than 50% market share in the last decade.

Andritz Hydro has been involved in 2 tidal schemes:

- Annapolis (Nova Scotia-Canada): 1 Straflo turbine (Sulzer Escher-Wyss; 7.6m runner diameter) rated 20MW (1984)

- Sihwa (South Korea): 10 Bulb turbines (7.5 runner diameter) rated 25.4MW (order in 2005 – completion originally due by the end of 2009 but power plant commissioning delayed to mid-2010)

Andritz Hydro has no specific experience of reversible bulb turbines as proposed as a variant for Cardiff-Weston barrage or the lagoon schemes which may require some development work.

For the Sihwa project, the owner Korean Water Resource Corporation (K-Water) selected Daewoo Engineering and Construction Co. as a prime contractor. Andritz Hydro was a Daewoo subcontractor and the scope of work comprised: detailed design of the bulb turbines/generators and their ancillaries, supply of all major electromechanical equipments (turbine runners, turbine shaft seals and bearings, oil heads, guide vanes, governors, stator cores and windings, rotor poles and combined bearings). Key components (e.g. turbine runners, bearings, generators) were manufactured mainly in Germany and Austria at Andritz workshops and shipped to site, while the bulk of steelwork and Balance of Plant were made in Korea. Due to the scheme configuration, the turbines operate only on flood generation mode, and during ebb they operate on sluicing mode. Andritz Hydro carried out many hydraulic studies so as to optimise the efficiency of these bulb turbines and to adapt them to the unusual context for a tidal scheme (flood generation). As a matter of fact the available basin volume has to be filled within a given time so as to assure maximal energy production and therefore the start of the turbines has to be well estimated for each cycle. Thanks to this project, Andritz Hydro has acquired updated expertise in tidal generation and bulb turbine design.

Andritz Hydro can manufacture bulb turbines of around 7.5 to 8m diameter, but above that size, they say they are not economic to produce nor very stable in operation. As for Straflo turbines, they can also manufacture large fixed blades machines; despite this they do not have many orders. For large hydro projects it can take 12 months to do the design and model testing of a single turbine, a further 22 months to manufacture and then 10 months to ship, install and commission, i.e. a total of 40 months. However, it is possible to shorten this time with a large order, and of course a number of turbines can be processed in parallel.

Shipping and transporting the turbines to the construction sites is also considered as a challenge. For example, from the Ravensburg manufacturing facility, Andritz Hydro transports the turbines on specified heavy load/width roads to the Neckar river, where they are transported by barge to the coastal ports on the Baltic.

Andritz Hydro offers a warranty of 2 years with their hydro turbines, and they have a design lifetime of 40 years with a recommended major overhaul after 20 years. For tidal turbines they thought these periods would be considerably longer as they are not in such continuous use. They do not offer any ongoing maintenance contract but offer to train the engineers of the operating company to handle any normal faults. If anything more serious goes wrong they would agree a separate contract for that.

In conclusion, Andritz Hydro thought they would be able to supply turbines for the lagoon and smaller barrage options, provided they were given an order a couple of years ahead, and they would probably do it as part of a European consortium in order to spread the risk and make the delivery time more acceptable. They did not think the turbines for a Cardiff –Weston barrage could be delivered on the expected timetable without a major expansion in manufacturing capacity, and they would need some confidence that the project would go ahead before taking this investment risk.

Voith Hydro

Voith Hydro (formerly Voith Siemens Hydro Power Generation – joint venture with Siemens in 2000) is a division of the Voith Group (Voith Paper, Voith Hydro, Voith Turbo and Voith Industrial Services). Voith Hydro core activity is turbine and generator manufacturing; they have design capabilities but are less involved in the manufacturing of other mechanical equipment (e.g. gates...) but they work closely with other mechanical manufacturers in hydro mechanical equipment.

Voith Hydro has installed about 40,000 turbines and generators in the world (total capacity around 300GW) and has more than 135 years of hydro expertise.

Voith Hydro (4000 staff) has 5 main facilities (there are also worldwide service and sales offices):

- Heidenheim (Germany): headquarters, R&D laboratory and facility mainly devoted to turbines rehabilitation
- York (USA): North America headquarters and large engineering, manufacturing and servicing facility and also R&D laboratory for mechanical equipment

- Sao Paulo (Brazil): manufacturing facility, capable of handling the largest turbine runners in the world (crane capacity of up to 300t); R&D laboratory for generators and electrical equipments
- Shanghai (China): manufacturing facility focusing on high-performance turbines and generators (China and East Asia market)
- Kawasaki (Japan): facility dedicated for new and modernization projects (turbines, generators, auxiliaries, control & automation equipment, transformers and high-voltage switchgear)

Since 1955, Voith Hydro has installed over 180 bulb turbines in the world with outputs to nearly 50MW and diameters up to 8m.

Voith Hydro has no experience in tidal turbines but its know-how in bulb design would allow the company to undertake design studies and to manufacture such turbines. Voith Hydro is also used to working closely with Andritz Hydro (they share a facility in Ravensburg) and Alstom.

Voith Hydro can currently deliver 6-15 bulb turbines per year with a maximum delivery rate of 1 unit/month. The average manufacturing lead time for one large bulb unit (from manufacturing to site delivery) would be 19 – 20 months (without preliminary design study and modelling test); it would be 15-16 months for smaller bulb units.

Voith Hydro have a long experience of handling supply chain constraints; they are used to manufacturing the bulb components in various places in the world (China, Brazil...) with the right manufacturers and then they assemble them in one place, sometimes in a new purpose-built facility close to the construction site. For instance, a new assembly facility has been built in China (Shanghai) for a large hydro scheme (Francis turbines) where welding, heat treatment and final assembly are undertaken by local workforce. The facility and equipment cost €10m. Voith Hydro suggests that for the Severn, a new specific assembly facility could be built (instead of a full manufacturing facility)

A 9m bulb diameter is not considered as a technical challenge; Voith has already manufactured 8.5m bulb for the USA.

Voith Hydro also confirms that delivering between 100 and 220 turbines is a challenge which can be overcome thanks to a consortium set up between the 3 major European suppliers; the Madeira experience shows that such cooperation works well. A delivery rate of up to 3-4 bulb/month could be achievable for the larger Severn schemes.

Voith Hydro seems to be reluctant to work with Chinese turbine manufacturers (subcontractors) for bulb turbines because of the lack of Chinese experience in bulb and also due to problems of quality.

Voith Hydro suggests that as soon as the decision of the Severn scheme is taken, a pre-design contract would be set up between the 3 turbine leaders so as to start the design study of the turbines (3-6 month preliminary studies); an independent hydro consultancy could be asked to supervise the design study, particularly for the interface with civil-works (e.g. Coyne & Bellier, Lahmeyer International, Stucky...)

Case study: the Brazilian Madeira Hydro project. Example of a turbine manufacturers consortium

In Brazil, 2 large run of river hydro dam projects on the Madeira river were launched in 2008. In order to meet the demand for the numerous bulb turbines & manufacture), a consortium between Alstom Hydro (leader), Andritz Hydro and Voith Hydro was set up.

- San Antonio (3,200MW): 20 bulb-units rated 71MW and 24 bulb-units rated 75.5MW - 7.5 runner diameter (to be commissioned in 2012)
 - Alstom will provide 19 bulb turbines + 22 generators + 50% of the project's hydro-mechanical and lifting equipments
 - Andritz will provide 12 bulb turbines + 12 generators + 24 voltage regulating systems
 - Voith will provide 13 bulb turbines + 10 generators
- Jirau (3,300MW): 28 bulb-units rated 75MW - 7.5 runner diameter (to be commissioned in 2015)
 - Alstom will provide 10 bulb turbines + 17 generators + 28 speed governors, monitoring systems, bus bars and surge/neutral devices
 - Andritz will provide 8 bulb turbines + 8 generators + 28 voltage regulating systems
 - Voith will provide 10 bulb turbines + 3 generators
 - The remaining 16 bulb turbines are not included in this contract and they will be manufactured by DEC (China)



The magnitude of these projects and the turbine manufacturer consortium will provide an interesting example for the STP schemes.

The Alstom-led consortium has set up a manufacturing process as follows:

- Study, design and delivering of the first bulb unit: around 32 months
- Total timescale for the supply of the turbines for each scheme: 88 months after main order to proceed
- San Antonio will be the first scheme to be constructed; construction of the Jirau scheme will be launched 36 months later (52 months of common works on both schemes)
- Average delivery rate: Alstom 1.5 turbine/month; Andritz and Voith: 1 turbine/month

The design of the bulb units is based on shared design, in particular combined hydraulics and mechanical design for the turbine and shared generator design. San Antonio is to use 4 to 5 bladed turbines and Jirau will use 4 bladed turbines.

Chinese turbine manufacturers

Harbin Electric Machinery Company Ltd - HEC, established in 1951, manufactures generating equipment for hydro and thermal power plants. HEC has manufactured more than 500 turbines units for about 200 hydropower plants in China (40% of large hydropower units in China have been supplied by HEC), in particular 700MW turbines for the Three-Gorges scheme. To date, HEC has already exported 138 turbines (total capacity: 12GW; 138 units) to 24 foreign countries (USA, Canada, Pakistan, India, Brazil, Iran...).

Dongfang Electrical Machinery Company Ltd - DEC, established in 1984, is involved in nuclear, thermal and hydropower. DEC is the 2nd hydro turbines supplier in China (40% of the national market, including also 14 x 700MW turbines for the Three-Gorges left bank power plant) and the company has already manufactured 60 large and medium generating units in China and abroad (USA, Peru, Philippines, Turkey, Indonesia, Canada, Pakistan, Iran...). DEC will also deliver the remaining 16 bulb turbines (75MW) for the Jirau hydropower scheme.

These two Chinese turbine suppliers only manufacture Francis and Kaplan turbines but they are already involved in large bulb units projects (7.5m diameter) in China. They are likely to have the necessary manufacturing capacity to deliver large bulb turbines for tidal schemes. Under the supervision of one of the 3 major European turbine manufacturers (consortium or subcontractor), in particular to improve the quality of their products which remains an issue, they could offer additional manufacturing capacity for bulb turbines (mainly non reversible units). HEC have far larger machining centres available in China (up to 16m diameter boring machines, compares to 8m limit at Alstom for example). HEC has also 2 coastal manufacturing bases for large size manufacturing and assembling.

Main issues

Due to the high and steady worldwide demand for hydro turbines (average 50GW/year), most of the turbine manufacturers have a reasonably full order book with around two years of firm production and are running at near capacity. Moreover, the size of the turbines is growing (>700MW; 1000MW turbine projects in China) and requires further investment, in particular for machine tools. The bulb-turbine market is also soaring because run of river schemes seem to be easier to build.

Tidal turbines for barrages are still considered as a niche market and turbine manufacturers are waiting for further projects before modifying their organisation. Due to the economic recession, even the large tidal projects in South Korea were delayed in 2009 by the owners and investors (Garolim...). But the situation has already evolved due to the country's commitments to developing renewable energy and South Korea has just confirmed the launching of the 1.32GW Incheon tidal barrage which is scheduled to be completed in June 2017. In the UK, the development of tidal projects like the Mersey or the Solway, scheduled to be commissioned by 2020, would also change the turbine manufacturers' strategy.

It is difficult for the three main turbine manufacturers to provide relevant information on their ability to meet the demand for hundreds of bulb turbines... It is likely that a consortium would need to be set up in order to share the financial and technical risks and to be able to deliver in time the high number of units for a Cardiff-Weston scheme, and even for the smaller schemes.

The overall turbine unit delivery rate for these three turbine manufacturers could reach between 3 and 6 units/month but this increase in capacity would also depend on the short and long term demand for conventional hydro turbines. If

China (and also another country like India or Brazil) confirms its commitment to building more very large hydro schemes, the market will be very strained and all the turbine manufacturers will have to make strategic choices.

It is too early at this stage to compare the two following manufacturing strategies:

- Using existing worldwide facilities and transporting the bulb units by sea to the construction site
- Developing a new facility (or more) in the vicinity of the construction site so as to mitigate cost of transportation and to meet the delivery rate

Shipping the turbines from the facilities to the construction site is also challenging due to the size and weight (a 7.5m turbine weighs around 200t) and requires vessels or barges, and perhaps heavy load/width roads. A specific study could be undertaken so as to compare the transportation solutions.

The decision to invest in one or maybe two new manufacturing facilities in the Severn area would require a high degree of certainty for the turbine manufacturers (probably signed contract for the number of turbines required). Some possible locations would be possible either close to the future caisson construction yards or within existing ports facilities (e.g. Port Talbot or Avonmouth).

The Madeira Hydro project highlights the fact that the STPG assessment for the Cardiff-Weston turbines delivery rate (44 turbines/year – 5 years) is very challenging; the current situation among the 3 major turbine manufacturers (delivery rate: 2-3 turbines/month) means that it would take between 6 and 9 years to supply the 216 Cardiff-Weston turbines. Therefore, additional facilities for manufacturing or assembling are essential for the improvement of the delivery rate.

Turbines and caissons

The use of caissons for river and sea civil works construction is now a standard practice (barrier, embankment, bridge, marina, port, lock...). During the Delta Plan projects in the Netherlands, many embankments and dams were built with caissons (e.g. Volkerak dam, Veerse Gat dam, Zandkreek dam...) and construction and installation processes were improved. The replacement of the Braddock Dam (Pennsylvania – USA) in 2002 by a new gated dam (4 radial gates) was a technical breakthrough (largest float-in navigation structure built in the USA): the 190m long dam was divided into 2 caissons built in a construction yard (27 miles downstream from the dam site) and towed to the site after foundation preparation.

There are very few examples of caissons used for hydro power plant housing turbines. Generally turbines and generators are assembled when the caissons are on site and perfectly positioned. The first example of turbines and generators assembled in the construction yard and floated into position was the 400kW experimental Kislaya Guba tidal power plant in the early 1960s. Later, Alsthom Atlantique and Neyrpic built three 25MW bulb turbines and installed them in two steel caissons which were transported across the Atlantic in a submersible load-carrying ship, off-loaded and towed up to the Mississippi and Ohio rivers into an existing dam (Greenup project). Then the caissons were sunk in their final position within a temporary cofferdam which was dewatered and the caissons were concreted in. In 1980, Boving & Co. were awarded a contract for a single steel caisson housing height 8.2m diameter bulb turbines (Vidalia scheme – USA).

The STPG report mentioned that the turbines should not be installed in their caisson in the construction yard so as not to delay the installation rate of caissons on the site. During the discussion with the turbine manufacturers, the suppliers did not make many suggestions on the turbine installation process, and conventional methods on the final site had been assumed.

The installation of the turbines inside the turbine-caissons is also considered to be a very delicate task using heavy-lift crane barges and previous experiences (in particular installation of large sluice-gates for storm surge barriers) has shown that a good installation and management process is the key to success.

Conclusion - Turbines

The turbine delivery for the smaller schemes can be achieved by the three leading turbine manufacturers using a consortium so as to mitigate risk and to tackle manufacturing issues. Lessons learnt from the Madeira project should provide interesting feedback. Only the 30 turbines for the Shoots barrage scheme and to a certain extent the 40 bulb turbines for the Welsh Grounds lagoon could be sourced from only one turbine manufacturer in the timescale envisaged.

As for the Cardiff-Weston barrage (and to a certain extent for the Bridgwater Bay lagoon), delivering such a large number of turbines is considered as very challenging by the manufacturers, if they were to use only the existing manufacturing facilities. A consortium between them is not the only key to success. In order to increase the delivery rate and the manufacturing capacity, a development and procurement strategy is likely to be set up by these manufacturers and investment in a new plant could be envisaged, provided contracts can be signed in advance.

B – Gates-Cranes-Bascule bridge

The overall demand (in thousand tonnes of steel) for steelwork for sluice gates, lock gates, stoplogs, gantry cranes, stoplog handling cranes and temporary bulkheads is as follows:

Scheme	Total demand for fabricated steelwork
	Thousand tonnes
Cardiff-Weston barrage	200
Shoots barrage	65
Beachley barrage	47
Welsh Grounds lagoon	45
Bridgwater Bay lagoon	50

Demand for fabricated steelwork

Source: Parsons Brinckerhoff

It is very unlikely that these items of mechanical equipment will be supplied from the UK, but the UK could provide a significant amount of steel components manufactured in its facilities (e.g. Corus). The specialist nature of the design, manufacture and installation of gates, bascule bridges and similar equipment limits the number of providers. Such equipment is often sourced from suppliers based in the Netherlands who have the experience and capacity to produce and install these facilities.

Regarding the gates, they could be provided either by turbine manufacturers or by international suppliers (in particular from the Far East). Cranes can be sourced from worldwide manufacturers, in particular in Asia. Bascule bridges are more specific equipment and the demand is low.

Sufficient time should exist to identify suppliers, procure the materials and design, manufacture and install all the equipment. These should not be critical path items.

Transportation of these pieces of equipment would be the main issue due to their size. The installation process would have to be optimised so as to avoid too large land area for stockpiling these equipments (which means ports infrastructure availability) and to install them directly on the construction site.

In terms of raw material, as all this equipment is made of steel, variation in prices on the market is likely to be one of the major issues.

C – Other technical equipment

With the possible exception of the large transformers and switch gear equipments (and cables to a certain extent), there are few other electrical items that would cause undue concern. With a project of this nature with long lead-in times, securing the necessary equipment should not be a particular problem, provided the process is adequately managed.

Some electrical components can also be provided by turbine manufacturers (e.g. control systems...).

Given the current and ongoing need to overhaul the UK's electricity grid network, and parts of the associated infrastructure, to meet increased demand and changes in connection requirements (wind energy, biofuel power stations, etc) there are many competing schemes for suppliers and contractors. There is a similar requirement in parts of Europe. These demands are likely to increase costs.

Aside from the competing schemes, other concerns are the availability of sufficient suppliers to provide the electrical equipment, a sufficient work force of skilled designers and contractors and the dependency upon the supply chain from the designers to the provision of base materials to the installation. Given the extent of the demand for electrical equipment, international resources would be required to address the supply requirement. Appropriate management of the supply chain would be necessary to ensure sufficient time for design, manufacture and installation of the equipment.

D – General points

Competition from other concurrent large construction projects in the UK or in Europe

Competition from concurrent large construction projects may increase costs as demand for the resources of plant, labour and materials surpasses supply. Nevertheless the global resources required to meet the project objectives do exist. Major engineering projects comparable with the STP have been successfully constructed despite other opportunities being available for the labour plant and materials required. Early involvement of the contractor(s) and suppliers would contribute to the project's success by engaging those parties in the development process and providing certainty at the relevant stage.

For the mechanical equipment, the main competition is the demand for large hydro schemes (mainly turbines + generators, gates...) and for the electrical components, the ambitious European target on renewables could result in possible bottlenecks in the delivery rate of suppliers.

Impact on existing transport infrastructure

The abnormal load routes on the national and local road network are of limited extent and it is likely that each of the five STP options under consideration would require some upgrading and/or strengthening to accommodate heavy loads and dense road traffic.

The opportunity to transport equipment by sea directly to the point of installation would reduce the need for road improvements and as most of the heavy equipments (transformer, bulb-unit...) are likely to be sourced outside the UK, sea transportation is likely to be the preferred solution. For example, for the future Hinkley Point nuclear station, EDF Energy favours sea transportation so as to mitigate the impact on the road and bridge network.

The need to deal with maintenance and replacement of heavy and large components (e.g. generator or transformer) needs to be considered in overall project/life costs.

E – Conclusion

The magnitude of a STP Scheme would pose constraints in terms of the supply chain for mechanical and electrical equipment, especially a Cardiff-Weston barrage and to a lesser extent Bridgwater Bay lagoon due to the number of turbines and electromechanical equipment associated.

There are a number of concerns that could delay the completion of a scheme. These are the availability of sufficient suppliers to provide all the mechanical and electrical equipments required and the dependency upon the supply chain from the designers, to the suppliers of base materials to the final installation.

Therefore early involvement of potential suppliers is essential to determine a feasible construction programme for these pieces of equipment.

Most of the supply chain issues could be addressed via a procurement strategy and firm orders.

V – LABOUR AND SKILLS

A Severn Tidal Scheme will support temporary employment in the industry during the development and construction period. The core phases of development for each scheme require a range of skill sets and construction tasks, in particular for the following areas:

- site investigation, design, supervision and site overheads...
- marine engineering: dredging, marine heavy lifting operation...
- civil engineering and construction: caissons, embankments, navigation lock, surface building...
- mechanical engineering and manufacturing: turbines, gates, cranes...
- electrical engineering and manufacturing: generators, transformer, control system...

During the operational phase, various skills will be required, in particular for the maintenance.

Previous estimates have been made of employment creation and skills required to construct a Severn scheme (STPG 1989 report). The DTZ Regional Economic Impact Study also provides some estimates based on engineering data generated during the first phase of the STP feasibility study and was used as the basis for the questionnaire (http://severntidalpowerconsultation.decc.gov.uk/supporting_documents). However, it should be noted that updated data on construction cost and labour requirements have been provided by Parsons Brinckerhoff during Phase 2. These are provided below.

Many respondents found questions posed relating to labour and skills difficult to answer given the strategic nature of the study. However some respondents usefully provided additional information from existing surveys from various Sector Skills Councils (e.g. Sector Skills Council for Science, Engineering and Manufacturing Technologies and the Engineering Construction Industry Training Board).

The following information is a summary of responses received and data from existing reports and surveys (see Appendix 3 – Sources of Information).

Parsons Brinckerhoff updated data on construction employment estimate (Phase 2)

During its optimisation study (Phase 2), Parsons Brinckerhoff (PB) has updated the construction cost of each scheme (results provided after the questionnaire responses). DTZ estimated that the value earned per employee ranged between £139,000 and £144,000. Using this as a basis, the overall construction employment estimates are given in the table below. It should be noted that these figures may change as scheme costs are further refined and methodologies are reviewed.

As operating and maintaining a Severn Tidal Scheme will require various specific skills, a first assessment of local labour share and capacity to deliver these future jobs has also been made.. The composition of operating employees by discipline is as follows (Parsons Brinckerhoff assessment):

- 10% manager
- 35%-45% skilled technicians
- the remainder would consist variably of unskilled workers, trainees and administrators.

Schemes	Total Cost (incl. Contingency excl. compensatory habitat) £bn	Overall no FTE jobs
Cardiff-Weston Barrage	20.832	140,000 to 150,000
Shoots Barrage	3.931	25,000 to 30,000
Beachley Barrage	2.659	Around 20,000
Welsh Grounds Lagoon	5.501	35,000 to 40,000
Bridgwater Bay Lagoon	10.643	70,000 to 80,000

STP schemes – Total cost and overall number of FTE jobs

Source: Parsons Brinckerhoff (phase 2)

How many of the above jobs would be realised in South West England and Wales, or even the UK, will be dependent on a number of factors previously discussed by DTZ. The full range of assumptions underpinning regional

employment estimates are under review at the time of writing but phase 2 studies by PB suggest that the following should be considered:

Assumptions:

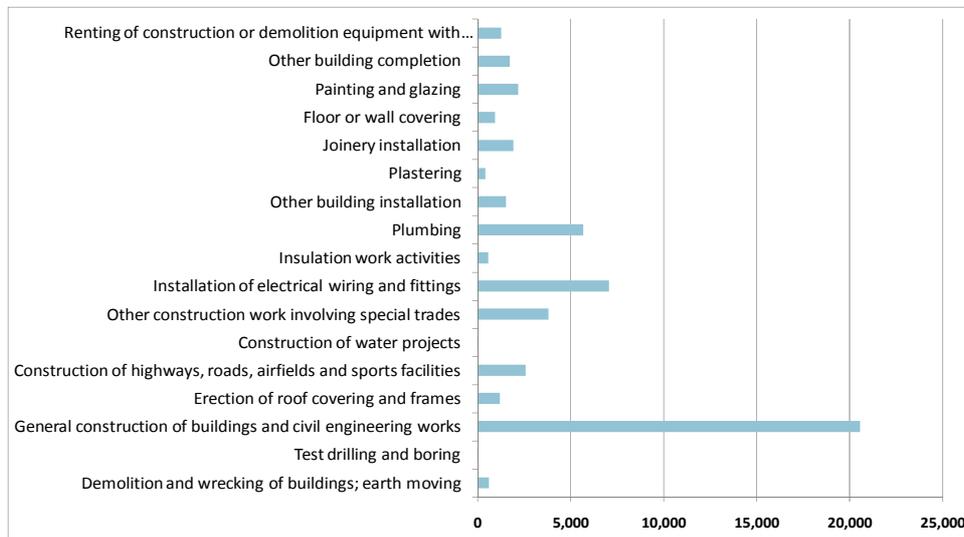
- Cardiff-Weston barrage caisson yard employment in the region would represent one third of total UK caisson yard employment.
- For Shoots and Beachley barrage and for the lagoons, all caissons could be built in the region, with concrete aggregates sourced within the region.
- For Shoots and Beachley barrage and for the lagoons, labour employment in material manufacture is assumed to be related only to transmission equipment and cranes, not turbines equipment and gates
- For Shoots barrage, civils employment should be split 50:50 between shores; 90% of M&E employment assumed on English shore.
- For Shoots and Beachley barrage and for the lagoons, the regional employment required for material supply is assumed to be the same as Cardiff-Weston barrage. There is considerable uncertainty over this estimate due to uncertainty in material sources.

These assumptions in addition to the points raised below and those made in the peer review of the DTZ study will be fed in to work to revise the regional employment estimates.

Local Area and Regional construction labour capacity

The NOMIS employment data for 2006 suggests that Construction Broad Sector (SIC F) employed 51,300 people in the Local Area as defined by DTZ in 2006, and 52,200 in 2007. However 2008 and 2009 data are expected to show decreases in new entrants to the Construction industry due to the economic recession.

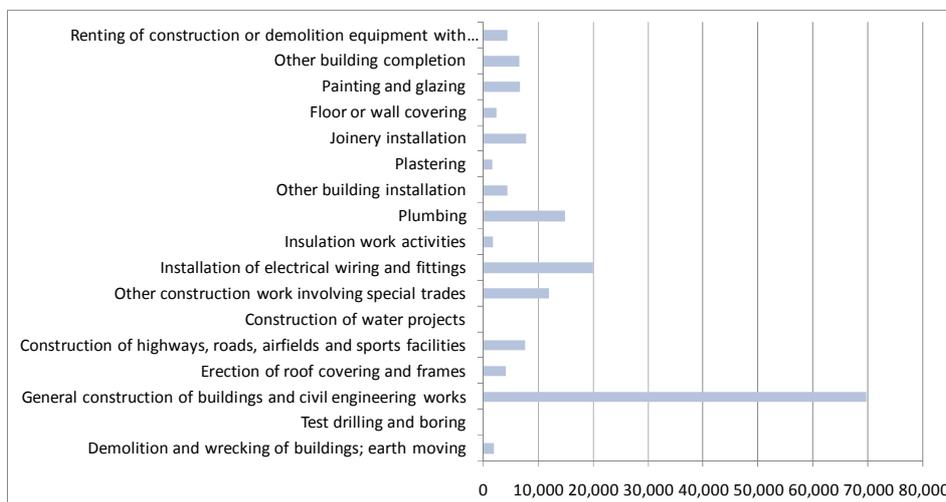
The profile of construction workforce in the Local Area is shown below in the following Figure. As shown in this Figure, not all of the 52,200 employees in Construction in the Local Area will be available or will have skills to work at both Hinkley Point Nuclear Plant and Severn Tidal Project sites.



Total employment in Construction (SIC 45) and Architectural and Engineering and Related Activities (SIC 74.2) by Occupation type in the Local Area in 2007

In fact, between 25,000 and 36,000 employees will have relevant sector skills for the majority of works excluding those in occupations related to residential construction and repair works.

Within the South West and Wales there have been 167,113 employees in the construction industry in 2007. The breakdown by occupation types is shown in the Figure below.



Total employment in Construction (SIC 45) and Architectural and Engineering and Related Activities (SIC 74.2) by Occupation type in the South West and Wales in 2007

In a similar way as analysed for the Local Area, we can assume that the number of employees with relevant sector skills in the South West and Wales was between 118,000 and 134,000. This is a large pool of construction workforce; however it reflects the current level of demand from construction projects and doesn't take into account future requirements. Obviously lesser number of employees will be available from outside the Local Area the longer it takes to travel to the construction site.

The current recession has seen major redundancies in many sectors of the economy including the Construction sector. The South West has the second lowest unemployment rate among all UK territories at 5.7% in 2009, whereas unemployment has reached 7.7% in Wales – higher than England, GB, and UK averages. The number of jobs in the construction industry in the South West has decreased by 1.4%, and in Wales by 0.8% by December 2008 compared to 2007. These figures will increase as the situation has worsened in 2009. Whilst the pool of unemployed may be good news for current construction projects as this drives the cost of labour down and means that skills are easier to find, the situation will be changing in the medium to long-term as these unemployed workers will be absorbed into other industries and their skills will not be up-to-date anymore.

The Construction Skills Network (CSN) reports acknowledge that Major Infrastructure Projects (MIP) led and financed/part-financed by the government will serve as a cushion in the difficult times for the industry.

The CSN outlook (2009-2013) for construction in Wales and in the South West Region is summarized as follows:

Wales Total employment and annual recruitment requirement (ARR) by occupation: 2009-2013				South West Total employment and annual recruitment requirement (ARR) by occupation: 2009-2013			
	Employment		ARR		Employment		ARR
	2009	2013	2009-2013		2009	2013	2009-2013
Senior, executive, and business process managers	3,450	3,730	<50	Senior, executive, and business process managers	6,360	6,740	<50
Construction managers	7,250	7,940	170	Construction managers	16,650	17,820	<50
Non-construction professional, technical, IT, and other office-based staff	9,840	10,500	160	Non-construction professional, technical, IT, and other office-based staff	24,080	23,930	100
Wood trades and interior fit-out	14,060	14,540	390	Wood trades and interior fit-out	24,190	23,750	90
Bricklayers	2,860	2,890	<50	Bricklayers	9,330	9,700	50
Building envelope specialists	4,660	4,960	<50	Building envelope specialists	11,100	11,000	<50
Painters and decorators	5,770	5,870	140	Painters and decorators	13,830	13,110	<50
Plasterers and dry liners	3,320	3,550	170	Plasterers and dry liners	2,960	3,190	<50
Roofers	900	880	<50	Roofers	4,570	4,470	100
Floorers	1,220	1,260	60	Floorers	3,460	3,510	<50
Glaziers	2,610	2,680	120	Glaziers	3,950	3,930	<50
Specialist building operatives nec*	4,110	4,260	110	Specialist building operatives nec*	6,190	6,230	50
Scaffolders	1,490	1,540	<50	Scaffolders	1,680	1,790	<50
Plant operatives	3,180	3,160	120	Plant operatives	4,440	4,080	<50
Plant mechanics/fitters	950	1,010	<50	Plant mechanics/fitters	1,860	1,840	90
Steel erectors/structural	2,330	2,460	50	Steel erectors/structural	1,810	1,870	100
Labourers nec*	6,950	7,710	220	Labourers nec*	13,480	14,110	90
Electrical trades and installation	5,310	5,350	50	Electrical trades and installation	11,060	10,820	160
Plumbing and HVAC Trades	6,300	6,580	130	Plumbing and HVAC Trades	15,530	15,160	<50
Logistics	1,650	1,730	<50	Logistics	1,860	1,860	<50
Civil engineering operatives nec*	4,080	4,100	<50	Civil engineering operatives nec*	4,790	4,470	<50
Non-construction operatives	5,150	5,390		Non-construction operatives	13,180	12,930	
Total (SIC 45)	97,440	102,090	2,120	Total (SIC 45)	196,360	196,310	1,130
Civil engineers	2,420	2,330	<50	Civil engineers	4,710	4,490	100
Other construction professionals and technical staff	4,960	5,060	130	Other construction professionals and technical staff	12,330	12,370	170
Architects	580	560	<50	Architects	3,750	3,650	<50
Surveyors	2,520	2,820	<50	Surveyors	4,680	4,990	<50
Total (SIC 45 and 74.2)	107,920	112,860	2,330	Total (SIC 45 and 74.2)	221,830	221,810	1,450

Source: Construction Skills Network (CSN) outlook (2009-2013)

* nec - not elsewhere classified

In Wales, during the period 2009-2013, total new infrastructure construction output is forecast to grow at an annual average rate of 5.2%, driven in particular by transport and energy projects (£84m Port Talbot Peripheral Distributor Road, £320m Private Finance Initiative scheme to expand the M4 and a new bridge across the Menai Strait, £400m wood-chip fuelled electricity station at Port Talbot...). Total construction employment of 113,510 in 2007 is forecast to fall to 107,920 by 2009, and then rise by 4.6% to 112,860 in 2013. In order to meet this demand, and after taking into account those entering the construction industry other than from training and those leaving, 2,330 new workers will be required to join the construction field each year.

In the South West, during the period 2009-2013, the prospects for growth in new infrastructure construction are poor. Total construction employment is projected to remain static between 2009 (221,830), and 2013 (221,810), after falls between 2007 and 2009. After taking into account those entering the construction industry other than from training and those leaving, 1,450 new workers will be required to join the construction field each year.

It is interesting to note that the Severn tidal scheme is only mentioned in the CSN Wales report. The possible Hinkley Point Nuclear Plant is not mentioned in the South West report.

If approved, construction of a new nuclear power plant at Hinkley Point will start, according to the current plans sometime in 2013-2014. nPower has been acquiring rights for sites, which are suitable for nuclear power stations in Wales, and plans to build at around the same time as planned by EDF Energy for Hinkley Point. The new Oldbury nuclear plant could also be launched by E.ON later.

The 2005 Wales and South West Workforce Mobility reports by IFF Research (*Workforce Mobility and Skills in the UK Construction Sector prepared for Construction Skills, DTI and ECITB*) found that only 41% of Construction industry workers in Wales worked on projects in more than two types of Construction sub-sectors (out of five total). In the South West 65% of workers worked on projects in more than two types of sub-sectors. However this does not represent great changes in skills or qualifications. The report further shows that 65% of workers in the Construction sector in the South West had always worked in the same occupational area as their current job. Overall, just over a third (35%) had ever switched roles – this would amount to 48,000 workers in the South West region in 2007 across all occupations. In Wales only 25% of workers in the Construction sector had ever switched roles, which would represent 18,000 of workers across all occupations in the country in 2007. Propensity to gain new skills and qualifications required to switch roles is therefore quite low in Wales.

Where from originally...	Where currently working...											
	London	South East	East	NE	NW	Y&H	East Mids	West Mids	SW	Wales	Scot.	N. Ire
%	%	%	%	%	%	%	%	%	%	%	%	%
London & South East	40	66	16	2	1	*	4	3	10	2	*	-
East	7	3	55	1	*	1	1	*	1	1	*	-
North East	5	2	3	91	2	3	1	1	1	1	1	*
North West	5	2	4	1	75	3	2	4	3	3	1	1
Yorkshire & Humberside	1	2	2	2	9	81	8	2	1	2	1	-
East Midlands	3	3	5	*	*	5	65	5	1	1	-	-
West Midlands	2	2	2	1	3	*	8	76	3	3	-	*
South West	1	4	*	1	*	1	1	*	67	3	*	*
Wales	3	1	1	-	2	*	1	1	5	81	1	-
Scotland	4	2	*	1	2	1	2	1	2	1	91	2
Northern Ireland	-	*	1	1	1	*	*	*	1	-	1	90
Outside the UK	30	12	11	*	5	5	7	7	5	2	4	7

Construction workers mobility (IFF Research)

The above table shows that 67% of construction workers in the South West are originally from that region whereas the ratio is 81% in Wales. A relatively high proportion of the South West construction workforce comes from other region.

The South West and Wales are likely to be unprepared to supply labour for a nuclear power station and a Severn Tidal scheme (especially the largest barrage option) together because the industry will be adjusting after the economic recession in the years leading to the start of the construction work of the new nuclear plant (Hinkley Point?) and the Severn Estuary.

Labour supply in the UK

Since July 2008, 128,000 people were made redundant in the Construction sector across the UK according to ONS. The number of redundancies in the 1st quarter of 2009 increased by 195% compared to the 1st quarter in 2007 and even in 2008. At the same time the number of vacancies nationally has been steadily decreasing since March-May 2008.

The Construction Skills Network (CSN) report predicts that the workforce expansion in construction industry in the UK will re-start in 2011 (in 2.5-3 years from now), and that the employment will increase by about 74,000 starting from 2010, which will see 18,500 employees a year on average. The annual recruitment requirement for this level of growth is about 37,000 excluding new entrant trainees in the UK. Overall 37,000 people have entered into construction employment in 2007. A slowdown was felt in Wales and Scotland and the total expansion of the workforce in Great Britain stood at 32,800 employees. CSN and other Sector Skills Councils recognise the difficulty of training and delivering new recruits and upgrading the skills of the current workforce.

The economic recession will have a profound impact on the availability of labour for projects starting after 2011. In the short-term, i.e. for any projects starting in 2009-2010, the construction workforce will be available and cheaper due to redundancies. In the long-term this outflow of workers will mean losses of skills and experience and the actual losses of labour, which will transfer into other industries. At present skills shortages are some of the highest in the Construction Industry according to the Learning and Skills Council (LSC). The workforce made redundant from the industry will be harder to reach for any training programmes run by LSC and Skills Councils, which will exacerbate the problem.

The Severn Tidal Project is one of the many new plants required to both replace the ageing energy infrastructure in the UK and meet the renewable energy targets. Some 30-40GW of generating capacity in the UK has to be replaced by 2030, of which around 15GW is needed by 2016 and much of the transmission and distribution network will need to be renewed or upgraded.

The UK has committed to sourcing 15% of its energy from renewable sources by 2020 which means delivering around 30% renewable electricity (5.5% today) so as to reach a total output of 38.5GW.

The Government's ambition is to deploy 25GW of offshore wind on top of the already planned 8GW. However a BERR paper on supply chain constraints (*BERR Supply Chain Constraints on the Deployment of Renewable Electricity Technology – Douglas Westwood 2008*) analyses only 18GW planned capacity as, given the timescales, it is a more realistic target. Offshore wind farms are considered as the most viable option due to several factors including planning constraints. However, they are facing some of the supply chain obstacles: for example, increasing skills shortages due to “experience and desire to work offshore becoming increasingly scarce”.

The BERR report also found that if the 2020 target of 35.8GW for all types of renewable energy projects is met, this is expected to require 122-133,000 jobs from current levels of 16-26,000 to manufacture, construct, and operate. The report further indicates that construction of biomass power stations is experiencing “growing lead-times due to levels of power plant construction both inside and outside the UK”.

Other infrastructure projects include Crossrail, which requires 8,700 FTE jobs during construction phase. Crossrail services will start in 2017 as currently planned, and therefore this project will also compete for resources with other construction projects nationally during the next decade.

Across the UK there are 11 sites (3 of them in the South West and Wales), which have been proposed for possible nuclear power station development. It is anticipated that only one nuclear station will be built before 2020. Even if a nuclear power station is built outside the South West and Wales it will still have an impact on the availability of construction and civil engineering workforce for the Severn Tidal Power Project.

United Kingdom Total employment and annual recruitment requirement (ARR) by occupation: 2009-2013			
	Employment		ARR
	2009	2013	2009-2013
Senior, executive, and business process managers	98,010	105,160	1,600
Construction managers	219,080	235,520	3,550
Non-construction professional, technical, IT, and other office-based staff	282,340	292,630	1,460
Wood trades and interior fit-out	281,150	285,750	4,370
Bricklayers	88,160	90,920	2,420
Building envelope specialists	92,590	95,870	1,050
Painters and decorators	135,660	133,090	2,820
Plasterers and dry liners	48,300	51,930	1,460
Roofers	46,520	46,740	480
Floorers	38,050	38,900	570
Glaziers	41,740	43,300	1,220
Specialist building operatives nec*	56,170	57,780	950
Scaffolders	24,260	25,780	880
Plant operatives	46,750	45,400	1,300
Plant mechanics/fitters	27,060	27,820	880
Steel erectors/structural	28,330	29,070	900
Labourers nec*	116,590	125,070	1,950
Electrical trades and installation	177,880	181,100	2,740
Plumbing and HVAC Trades	176,920	180,110	1,290
Logistics	32,280	34,300	660
Civil engineering operatives nec*	59,660	58,150	710
Non-construction operatives	123,930	125,540	
Total (SIC 45)	2,241,430	2,309,930	33,260
Civil engineers	52,300	52,620	1,170
Other construction professionals and technical staff	143,930	144,820	1,670
Architects	40,550	40,490	400
Surveyors	57,280	61,700	530
Total (SIC 45 and 74.2)	2,535,490	2,609,560	37,030

Source: Construction Skills Network (CSN) outlook (2009-2013)

Among competing barrage schemes equivalent to a small STP scheme, two tidal barrages over the Solway Firth and the Mersey are currently being studied, and are initially planned to be completed within similar time scales (The Mersey Tidal Power scheme is scheduled to be commissioned in 2020 and construction should start in 2014). If these projects are confirmed and launched, they could add supply chain constraints, in particular for the turbines delivery (unless, turbine manufacturers take the opportunity to invest in a shared facility for all these schemes).

The BPC therefore concludes that the UK capacity for MIP construction will be under high pressure from 2013 and onwards, which will definitely have major implications for labour availability and cost. This may cause delays, and not only for Severn Tidal Project but for other MIPs.

International labour capacity

Internationally, many countries are facing similar problems in terms of depleting energy production facilities, and many have significant plans to build more power stations and renewable energy generating projects.

Nuclear power plants require a lengthy construction process due to complexities of technology and safety requirements that need to be met. The latest average construction time for nuclear plants is 6-7 years according to International Atomic Energy Agency (IAEA) statistics for projects initiated between 2001 and 2007 (based on 25 reactors). During 1996-2000 the average construction time was 12 years (based on 23 reactors).

Therefore, if construction of the first new nuclear power plant will start in 2-3 years, it will run through 2011/2012 to 2017/2018. However many commentators consider the start of a project/s in 2-3 years as being overly optimistic and many others point to new case studies of nuclear power plant construction available from France and Finland where Areva supplied plants are currently being built (EPR). Both construction projects have suffered delays: Finnish power plant in Olkiluoto is three years behind the schedule to be completed in 2012; and EDF French plant in Flamanville in Normandy has been reported to be nine months behind schedule.

The main competition for international skills is coming from neighbouring EU countries where more than 29 nuclear projects are planned to be completed before 2020. Not only does this put high pressure on the availability of engineering, mechanical, and electrical components of nuclear projects but also on the availability of experienced international experts in nuclear engineering, as well as in construction of major projects.

Internationally there are skills to build large scale projects but the world has embarked upon a simultaneous nuclear power build programme, which will put the strain on both supply chain and human resources available and thus will put even more strain on availability of project management and skilled construction labour for the UK MIPs. Tidal engineering skills are also in a nascent stage in terms of availability as they are being built up by a handful of companies across the world through the ongoing research and demonstration projects.

Possibility of transferable skills from other industries

Project management skills are available outside the construction and engineering industry and potentially many consulting companies have people with project/programme management skills, who could be re-trained for construction and engineering projects to be able to deal with technical issues. They would however, lack relevant experience and will need specific support. Re-training may potentially be less than one year. Very often consulting firms suffer skills shortages themselves, and therefore availability of the workforce willing to transfer to another industry may be limited.

Manufacturing is experiencing overall decline in the UK and is likely to continue to do so in the future. This may provide a good source of labour especially for lower and medium skilled jobs. Retraining may take up to 1-2 years depending on qualifications.

In particular, it is likely that industries such as mining and shipbuilding could provide a labour force with both transferable skills and the potential to be re-trained. The main areas for re-training are: caisson construction, marine heavy lift operation and turbine manufacture. The re-training periods could range from 3-18 months, depending upon the level of skill in the initial workforce and the required level of competence (i.e. a training in a skill combined with experience of applying that skill).

Assessment of the % of works which could be directly done within Wales and South West region (% of construction cost)

The questionnaire asked respondents to fill in a table setting out the main construction cost for each scheme (based on Phase 1 construction cost data) and to estimate the % of works directly done in the two Regions, in the UK and abroad. The Bristol Port Company (BPC) and the Severn Tidal Power Group (STPG) both carried out this assessment (see the tables below). As the construction cost data have been revised in Phase 2 study, these tables only give a first assessment of possible workforce breakdown. They should be interpreted and applied to the updated scheme cost and employment estimates.

Construction stage	Cardiff-Weston Barrage	% of work done in the Regions or in UK or Abroad				Shoots Barrage	% of work done in the Regions or in UK or Abroad				Beachley Barrage	% of work done in the Regions or in UK or Abroad				Welsh Grounds Lagoon	% of work done in the Regions or in UK or Abroad				Bridgwater Bay Lagoon	% of work done in the Regions or in UK or Abroad			
		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad
Pre-construction	209					30					21					41					38				
<i>Preliminaries and site overheads</i>	<i>1,035</i>	<i>15</i>	<i>15</i>	<i>30+</i>	<i>40-</i>	<i>129</i>	<i>25</i>	<i>25</i>	<i>50-</i>	<i>0-5+</i>	<i>104</i>	<i>25</i>	<i>25</i>	<i>50-</i>	<i>0-5+</i>	<i>161</i>	<i>25</i>	<i>25</i>	<i>50-</i>	<i>0-5+</i>	<i>161</i>	<i>25</i>	<i>25</i>	<i>50-</i>	<i>0-5+</i>
<i>Embankments</i>	<i>505</i>	<i>25</i>	<i>25</i>	<i>40</i>	<i>10</i>	<i>159</i>	<i>35</i>	<i>35</i>	<i>25</i>	<i>5</i>	<i>19</i>	<i>40</i>	<i>40</i>	<i>20</i>		<i>795</i>	<i>25</i>	<i>25</i>	<i>40</i>	<i>10</i>	<i>637</i>	<i>25</i>	<i>25</i>	<i>40</i>	<i>10</i>
<i>Navigation Locks</i>	<i>1,001</i>	<i>15</i>	<i>15</i>	<i>15</i>	<i>55</i>	<i>52</i>	<i>25</i>	<i>25</i>	<i>5-</i>	<i>55</i>	<i>52</i>	<i>25</i>	<i>25</i>	<i>5-</i>	<i>55</i>						<i>20</i>	<i>25</i>	<i>25</i>	<i>5-</i>	<i>55</i>
<i>Surface Buildings</i>	<i>83</i>	<i>25</i>	<i>25</i>	<i>50</i>		<i>42</i>	<i>25</i>	<i>25</i>	<i>50</i>		<i>25</i>	<i>25</i>	<i>25</i>	<i>50</i>		<i>42</i>	<i>25</i>	<i>25</i>	<i>50</i>		<i>42</i>	<i>25</i>	<i>25</i>	<i>50</i>	
<i>Caissons</i>	<i>5,314</i>	<i>18-</i>	<i>18-</i>	<i>54-</i>	<i>15+</i>	<i>608</i>	<i>50-</i>	<i>50-</i>	<i>10+</i>		<i>600</i>	<i>36-</i>	<i>73-</i>	<i>10+</i>		<i>319</i>	<i>25-</i>	<i>25-</i>	<i>50-</i>		<i>377</i>	<i>25-</i>	<i>25-</i>	<i>50-</i>	
Total general civils	7,938					990					800					1,317					1,237				
<i>Generating plant</i>	<i>5,841</i>	<i>2.5-</i>	<i>2.5-</i>	<i>5-</i>	<i>90+</i>	<i>642</i>	<i>5-</i>	<i>5-</i>	<i>10-</i>	<i>80+</i>	<i>382</i>	<i>5-</i>	<i>5-</i>	<i>10-</i>	<i>80+</i>	<i>919</i>	<i>5-</i>	<i>5-</i>	<i>10-</i>	<i>80+</i>	<i>919</i>	<i>5-</i>	<i>5-</i>	<i>10-</i>	<i>80+</i>
<i>Grid connection</i>	<i>500</i>	<i>5</i>	<i>5</i>	<i>90-</i>	<i>5+</i>	<i>96</i>	<i>5</i>	<i>5</i>	<i>90-</i>	<i>5+</i>	<i>47</i>	<i>5</i>	<i>5</i>	<i>90-</i>	<i>5+</i>	<i>113</i>	<i>5</i>	<i>5</i>	<i>90-</i>	<i>5+</i>	<i>90</i>	<i>5</i>	<i>5</i>	<i>90-</i>	<i>5+</i>
<i>Gates</i>	<i>1,160</i>	<i>15</i>	<i>15</i>	<i>15</i>	<i>55</i>	<i>356</i>	<i>25</i>	<i>25</i>	<i>5-</i>	<i>55</i>	<i>242</i>	<i>25</i>	<i>25</i>	<i>5-</i>	<i>55</i>	<i>315</i>	<i>25</i>	<i>25</i>	<i>5-</i>	<i>55</i>	<i>321</i>	<i>25</i>	<i>25</i>	<i>5-</i>	<i>55</i>
Total Mechanical and Electrical	7,501					1,094					671					1,347					1,330				
Design and Supervision	271	17	17	50	16	38	25	25	50-	10+	31	25	25	50-	10+	42	25	25	50-	10+	41	25	25	50-	10+
Site Investigation	4	25	25	50-	10	0.6	25	25	50-	10	0.2	25	25	50-	10	2	25	25	50-	10	1.7	25	25	50-	10
Ancillary Works	300	25	25	50		100	25	25	50		80	25	25	50		10	25	25	50		50	25	25	50	
Contingencies	1,209					182					141					220					209				
Contractors on costs and profits	746					112					87					136					129				
Total construction costs	17,969					2,546					1,831					3,115					3,035				

% of work done in the Regions or in the UK or abroad for each scheme – The Bristol Port Company assessment (Phase 1 data)

Construction stage	Cardiff-Weston Barrage	% people employed, by location of normal residence				Shoots Barrage	% people employed, by location of normal residence				Beachley Barrage	% people employed, by location of normal residence				Welsh Grounds Lagoon	% people employed, by location of normal residence				Bridgwater Bay Lagoon	% people employed, by location of normal residence			
		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad		South West	Wales	UK	Abroad
Pre-construction	209	5	10	85		30	5	10	85		21	5	10	85		41	0	15	85		38	15	0	85	
<i>Preliminaries and site overheads</i>	<i>1,035</i>	<i>11</i>	<i>22</i>	<i>67</i>		<i>129</i>	<i>11</i>	<i>22</i>	<i>67</i>		<i>104</i>	<i>11</i>	<i>22</i>	<i>67</i>		<i>161</i>	<i>0</i>	<i>33</i>	<i>67</i>		<i>161</i>	<i>33</i>	<i>0</i>	<i>67</i>	
<i>Embankments</i>	<i>505</i>	<i>11</i>	<i>22</i>	<i>67</i>		<i>159</i>	<i>11</i>	<i>22</i>	<i>67</i>		<i>19</i>	<i>11</i>	<i>22</i>	<i>67</i>		<i>795</i>	<i>11</i>	<i>22</i>	<i>67</i>		<i>637</i>	<i>11</i>	<i>22</i>	<i>67</i>	
<i>Navigation Locks</i>	<i>1,001</i>	<i>8</i>	<i>17</i>	<i>50</i>	<i>25</i>	<i>52</i>	<i>8</i>	<i>17</i>	<i>50</i>	<i>25</i>	<i>52</i>	<i>8</i>	<i>17</i>	<i>50</i>	<i>25</i>				<i>25</i>	<i>20</i>	<i>25</i>	<i>0</i>	<i>50</i>	<i>25</i>	
<i>Surface Buildings</i>	<i>83</i>	<i>13</i>	<i>12</i>	<i>75</i>		<i>42</i>	<i>13</i>	<i>12</i>	<i>75</i>		<i>25</i>	<i>13</i>	<i>12</i>	<i>75</i>		<i>42</i>	<i>25</i>	<i>0</i>	<i>75</i>		<i>42</i>	<i>25</i>	<i>0</i>	<i>75</i>	
<i>Caissons</i>	<i>5,314</i>	<i>13</i>	<i>12</i>	<i>75</i>		<i>608</i>	<i>13</i>	<i>12</i>	<i>75</i>		<i>600</i>	<i>13</i>	<i>12</i>	<i>75</i>		<i>319</i>	<i>25</i>	<i>0</i>	<i>75</i>		<i>377</i>	<i>25</i>	<i>0</i>	<i>75</i>	
Total general civils	7,938					990					800					1,317					1,237				
<i>Generating plant</i>	<i>5,841</i>	<i>5</i>	<i>5</i>	<i>50</i>	<i>40</i>	<i>642</i>	<i>5</i>	<i>5</i>	<i>50</i>	<i>40</i>	<i>382</i>	<i>5</i>	<i>5</i>	<i>50</i>	<i>40</i>	<i>919</i>	<i>0</i>	<i>10</i>	<i>50</i>	<i>40</i>	<i>919</i>	<i>10</i>	<i>0</i>	<i>50</i>	<i>40</i>
<i>Grid connection</i>	<i>500</i>	<i>5</i>	<i>5</i>	<i>80</i>	<i>10</i>	<i>96</i>	<i>5</i>	<i>5</i>	<i>80</i>	<i>10</i>	<i>47</i>	<i>5</i>	<i>5</i>	<i>80</i>	<i>10</i>	<i>113</i>	<i>0</i>	<i>10</i>	<i>80</i>	<i>10</i>	<i>90</i>	<i>10</i>	<i>0</i>	<i>80</i>	<i>10</i>
<i>Gates</i>	<i>1,160</i>	<i>5</i>	<i>5</i>	<i>70</i>	<i>20</i>	<i>356</i>	<i>5</i>	<i>5</i>	<i>70</i>	<i>20</i>	<i>242</i>	<i>5</i>	<i>5</i>	<i>70</i>	<i>20</i>	<i>315</i>	<i>0</i>	<i>10</i>	<i>70</i>	<i>20</i>	<i>321</i>	<i>10</i>	<i>0</i>	<i>70</i>	<i>20</i>
Total Mechanical and Electrical	7,501					1,094					671					1,347					1,330				
Design and Supervision	271	10	10	70	10	38	10	10	70	10	31	10	10	70	10	42	0	20	70	10	41	20	0	70	10
Site Investigation	4	10	10	80		0.6	10	10	80		0.2	10	10	80		2	0	20	80		1.7	20	0	80	
Ancillary Works	300	5	5	90		100	5	5	90		80	5	5	90		10	0	10	90		50	10	0	90	
Contingencies	1,209					182					141					220					209				
Contractors oncosts and profits	746					112					87					136					129				
Total construction costs	17,969					2,546					1,831					3,115					3,035				

% of work done in the Regions or in the UK or abroad for each scheme – The STPG assessment (Phase 1 data)

Possible skills shortages

STPG has identified three primary areas of skills shortage for the construction stage activities. They do not believe that there will be a significant shortage of skills in the design/development stage activities, principally due to the globalisation of the design supply chain. The three construction stage activities with skills shortages are:

- Caisson construction, whether this is undertaken in a dry dock or in-situ, slip-formed or otherwise, there is very little local capacity. Probably the nearest and most recent slip-forming works were at the LNG storage facility, constructed by Taylor Woodrow, for CB & I, at Milford Haven., these were on-shore, fixed facilities.
- Marine heavy lifting operations – most marine heavy lifting operations in the UK are undertaken using suppliers from mainland Europe. Developments in off-shore wind farms could result in an increase in the capacity of this market within Europe.
- Turbine manufacture due to the reduced number of companies able to supply these specific turbines

The consequences of other concurrent works will largely be determined by their location. STPG does not believe that projects such as Crossrail will have an adverse impact on any of the schemes in this study, as it is too far away geographically, and the skill sets are somewhat different (Crossrail is almost all below ground construction and tunnelling).

However, if the proposed new nuclear power stations at Hinkley Point and Oldbury run concurrently with any of these schemes they could generate significant risks to:

- Locally available labour
- Accommodation for the migrant workforce
- Availability of high quality concrete
- Availability of raw materials

The scale of the risk will vary, depending on the scheme, but even the smallest scheme, Beachley Barrage, if under construction at the same time as a nuclear power station at Oldbury, could effectively double the demand for local labour and accommodation.

Off-shore wind projects may limit the availability of marine heavy lifting resources (people and plant).

Skilled labour for operation and maintenance

During the operational phase, according to respondents, the key skills required in a tidal power plant are as follows:

- Management skills:
 - HR and people management
 - Leadership, team management, coaching and mentoring
 - Project and Contract management (e.g. maintenance works)
 - Quality management
 - Risk management
 - Collaboration and operating across businesses
- Engineering skills: a wide range of technical skills at varying levels from semi-skilled, through craft and technician, to skilled engineer
 - Electrical and electronic engineering
 - Mechanical engineering
 - Control and instrumentation engineering
 - Telecommunications engineering
 - Civil engineering
 - Software/Systems engineering
- Commercial skills:
 - Budgeting
 - Customer care and service

- Trading awareness

These skills are applied across key engineering activities such as:

- Plant operation
- Plant maintenance
- Specialist areas such as power system protection

However, the Electricity Industry is experiencing significant recruitment difficulties and skills gaps in the workforce (in particular in technical and craft jobs). The main reasons of recruitment difficulties identified as being the most important by Electricity Industry employers are:

- Shortage of appropriately skilled/qualified people in the marketplace
- Competition for skills from other employers
- The poor image of engineering industries
- Low number of applicants

Conclusion

Based on the analysis of research published by different Sector Skills Councils (Construction Skills, ECITB, SEMTA) and the BPC and STPG responses, some skills shortages are likely to occur in engineering (design, construction and supervision), in particularly in civil, marine and electrical engineering.

Nevertheless, most of the supply data mentioned in this survey do not take account of students coming out of college or university or transfers of workforce from other industries. Therefore, the net requirement is likely to be lower than shown in the figures.

The various scheduled MIPs schemes (nuclear plant, infrastructure works, wind farm...) will all be competing for similarly skilled employees, however, with the general down turn in work in the construction sector, and the impact of the Credit Crunch, it is likely that several of these schemes will be shelved or delayed, so that the peaks in resource demands predicted a year or so ahead may be much less severe than might have otherwise have been the case. However, demand may peak again in 5-10 years.

For the barrage schemes, most of the labour demand will be used for the construction of the caissons. If this work was done at existing shipyard or port sites there is unlikely to be a shortage of suitable labour. On the other hand, if the construction was located in a purpose built caisson yard, the amount of labour required and available would be an important factor in the choice of location of the yard.

For the lagoon schemes, not only will there be a need for caissons but there will also be a greater labour demand for the embankment, including marine expertise to handle the construction vessels (barges...). Such operations will use relatively little labour, and companies tend to use their own carry teams of specialists who travel from project to project. They would act as a cadre to which locally trained labour could be added.

There will be a further discussion of employment issues in the revised regional economic impacts study, the options definition report and the SEA Communities topic paper.

VI – POSSIBLE FURTHER STUDIES

The report highlights the need for further study or analysis in the following main areas (for each scheme):

Vessels

- Need for purpose-built vessels due to innovative construction or installation process.
- Assessment of the various vessels required (number, size, type...) and location of ports able to accommodate them (including possible improvement and refurbishment).

Aggregates

- Location of potential additional dredged areas required for marine aggregates supply (lagoon schemes): Bristol channel or other UK coast.
- Assessment of the volume of recycled and/or secondary aggregates required and location of the corresponding sources.
- Analysis of Government plans for aggregates extraction forecast and proposal for changes.

Concrete

- According to the demand of cement, location of the cement plants, including overseas imports (the result is also linked to the choice of the caisson construction yards).
- Precise assessment of the volume/tonnage of concrete aggregates required for each component: sand, gravel and crushed rock. These figures would enable choice of the most suitable quarries (delivery, location, transport...) including overseas imports (the result is also linked to the choice of the caisson construction yards).
- Accurate volume of precast concrete units (protection armour...) required and location of the plant including imports.

Caisson construction yards

- Confirmation of the availability of the sites mentioned, including existing ports according to the technical requirements.
- For each scheme, optimization of the location of the caisson construction yards.

As for the other mechanical and electrical equipments, at this stage it is too difficult to know where these components could be sourced because most of them are likely to be delivered from overseas manufacturers. However, the impact on existing transport infrastructure will be better assessed by these additional studies on civil works which represent the largest potential transport burden.

The scope of further studies would also address the potential environmental impacts of each technical choice in terms of location of sources of materials and equipment, transportation, temporary storage, disposal of materials (e.g. dredged materials unsuitable for construction use), road/bridge improvement, harbour upgrading...

APPENDIX 1

SEVERN TIDAL POWER QUESTIONNAIRE

A - VESSELS

For the construction of each scheme, various vessels should be required for the following tasks:

- dredgers (trailer suction hopper dredgers, large cutter suction dredgers, grab dredgers...),
- jack-up barges (for rock dredging pre-treatment by drilling and blasting),
- tugs (for caissons towing),
- vessels for caissons ballast filling,
- floating cranes (equipments installation, bulkheads removal...)
- heavy load crane barges (e.g. heavy derrick barge) for turbine, transformer, gates installation,
- side dumping barges/split hopper barges for embankments construction,
- rock transport (pontoons, barges...) for embankments and armouring construction,
- ...

Q1: what is the availability of these types of vessels in the national and international market? What are the most critical type of vessels in terms of availability

Q2: how do you envisage this availability changing over the next ten years?

Q3: where can these vessels be sourced (country, main owner-charterer...)?

Q4: will some additional specific vessels have to be built or retro-fitted? If yes, where (country...) and what are the likely timeframes for doing so?

Q5: what are the consequences of competition from other concurrent large offshore construction projects in UK or in EU (e.g. offshore wind farms...) in terms of vessels availability?

Q6: could the harsh site conditions (tidal stream velocity, waves) be incompatible with conventional vessels, in particular for the caissons installation?

Q7: is the capacity of the existing port facilities in the Severn estuary appropriate for these vessels? Do these ports need to be upgraded so as to accept these vessels (berth size, crane capacity, mooring...)?

SEVERN TIDAL POWER QUESTIONNAIRE

B – CIVIL WORKS

Dredging

Q1: according to the existing policies and legislation on marine dredging in the Severn Estuary, what are the main constraints?

Q2: what are the main constraints for getting additional licences for dredging in the estuary?

Q3: where can the dredged materials be stored before being re-used for civil works (ballast, construction...)?

Q4: what are the main constraints for getting licences for spoil disposal in the estuary? Are there already areas suitable for this spoil disposal?

Caissons yards

Q5: what is the up to date list of potential coastal sites in UK/EU suitable for the construction of caisson yards facilities?

Q6: is there any existing port (in UK or EU) suitable for the implementation of a caisson yard facility?

Q7: what are the main constraints for manufacturing, building and installing equipments/assembly facilities required for each caisson yard (cranes, quays...)?

Concrete

Q8: are the existing national and regional policies that prescribe volume and location of aggregate extraction compatible with the aggregates demand (gravel, sand...)?

Q9: are the existing national and regional policies that identify, or have the secondary outcome of production of, suitable secondary aggregates (e.g. bottom ash from waste incinerators) compatible with the recycled aggregates demand?

Q10: what is the availability in the regional, national or international market of:

- steel bar reinforcement
- cement (Portland)
- additive compounds (fly ash...)
- formwork/shuttering?

Q11: pozzolanic cements and cements using more than 60% of slag as aggregate are more resistant to sea water. If these were used instead of pure Portland cement, are there likely to be significant constraint in their supply?

Q12: are the existing UK concrete plants suitable and appropriate?

Q13: what is the availability of dumper trucks, cranes for precast concrete armour units installation...?

Q14: what is the compatibility of precast concrete armour units manufacturing (0.78 million tonnes for Cardiff-Weston scheme) with existing precast production and facilities in UK or EU?

Materials for embankments & breakwaters

Q15: are the existing national and regional policies that prescribe volume and location of aggregate extraction compatible with the materials demand for embankments/locks breakwaters (rock, sand...)?

Q16: what are the main constraints in terms of sources of rocks in UK and EU?

Q17: where are the most suitable sites for materials sourcing (quarries...)?

Q18: how to cope with the shortage of rock sources?

General points

Q19: in civil works, what is the major concern which could delay the completion of the scheme?

Q20: what are the consequences of competition from other concurrent large construction projects in UK or in EU (e.g. nuclear plant, Crossrail...) in terms of civil engineering and works?

Q21: what is your assessment on the capability of existing transport infrastructure to cope with increased construction traffic? Does the transportation of materials from regional and national sources require upgrading or strengthening the existing roads or bridges?

SEVERN TIDAL POWER QUESTIONNAIRE

C – MAIN MECHANICAL EQUIPMENTS

Total weight of fabricated steel components: about 200,000 tonnes for Cardiff-Weston scheme.

Turbines

The following questions are also appropriate to the supply of generating equipment.

Q1: what are the main constraints in terms of manufacturing/design? Can the demand of large number of units be easily met within the timeframe available?

Q2: in particular, for Straflo turbines, as there is only one European manufacturer (due to patents), what are the main specific constraints (ability to provide the number of turbines, risks of time delays to completion...)?

Q3: what are the best locations for turbine assembly facilities? New facility built close to the turbine caissons yard or existing facility?

Q4: is the installation solution suggested in the STPG report still appropriate?

Q5: is there a risk of shortage of specific materials (e.g. stainless steel...) required for the construction of the turbines? If yes, are there any alternative solutions?

Q6: what are the main constraints in terms of turbines supply?

Gates (dam, turbines and locks) and bascule bridges

Q7: can the regional or national manufacturers meet the demand of gates and bascule-bridges supply?

Q8: what are the main constraints in terms of gates/bridges supply?

General points

Q9: in mechanical engineering, what is the major concern which could delay the completion of the scheme?

Q10: what are the consequences of competition from other concurrent large construction projects in UK or in EU (e.g. nuclear plant, Crossrail, hydro power plants...) in terms of mechanical engineering and procurement?

Q11: what is your assessment on the capability of existing transport infrastructure to cope with increased construction traffic? Does the transportation of heavy or large components from regional or national facilities require upgrading or strengthening the existing roads or bridges?

**SEVERN TIDAL POWER
QUESTIONNAIRE**

D – MAIN ELECTRICAL EQUIPMENTS

Electrical equipments

Q1: what are the key electrical components whose supply could be challenging?

Q2: can the regional or national suppliers meet this electrical equipment demand?

General points

Q3: in electrical engineering, what is the major concern which could delay the completion of the scheme?

Q4: what are the consequences of competition from other concurrent large construction projects in UK or in EU (e.g. nuclear plant, Crossrail, hydro power plants, wind farms...) in terms of electrical engineering and procurement?

Q5: what is your assessment on the capability of existing transport infrastructure to cope with increased construction traffic? Does the transportation of heavy or large components from regional or national facilities require upgrading or strengthening the existing roads or bridges?

**SEVERN TIDAL POWER
QUESTIONNAIRE**

**E – LABOUR & SKILLS
(MARINE, CIVIL WORKS, MECHANICAL AND ELECTRICAL)**

Q1: indication of the number of jobs (for each field) that might be directly created in Wales and South West region during the construction works.

Q2: in case of regional (Wales and South West) job creation, assessment of the % of resident and new resident labour force (level of employment displaced in the region).

Q3: assessment of the particular skills required for the studies (site investigation, design studies...) and the construction works in each field. In what study and construction fields is there a risk of shortage of skills and/or workforce?

Q4: given the likely work force demands outlined in Part 1, to what extent do you think there is likely to be spare capacity in the following markets to meet this labour demand:

- Regional (South West and Wales)
- National
- International

Q5: in case of shortage of particular labour supply, are you aware of industries with transferable skills that may be able to fill these gaps? If so, give estimates of likely period to re-train.

Q6: assessment of the % of works which could be directly done within Wales and South West region (% of construction cost).

Q7: what are the consequences of competition from other concurrent large construction projects in UK or in EU (e.g. nuclear plant, Crossrail, hydro power plants, wind farms...) in terms of labour and skills?

Q8: indication of the number of jobs (for each field) that might be directly created in Wales and South West region for the operation and maintenance of each scheme.

Q9: in what operation and maintenance fields is there a risk of shortage of skills and/or workforce?

Q10: do you have any comment on DTZ data and figures presented in Part 1?

APPENDIX 2

LIST OF CONTACTS (QUESTIONNAIRE)

In italics, response received.

Civil Works

- *Institution of Civil Engineers (ICE)*
- Civil Engineering Contractors Association

Aggregates

- *MPA Mineral Products Association (MPA)*
- Aggregates Industry UK Ltd
- Institute of Quarrying
- British Aggregates Association:
- *British Marine Aggregate Producers Association (BMAPA)*
- South West Region Aggregates Working Party

Vessels - Ports :

- *Association of British Ports*
- British Ports Association:
- UK Major Ports Group
- *Bristol Port*
- United Kingdom Harbour Masters Association
- Bristol Docks
- Cardiff Harbour Authority
- Newport Harbour Commissioner
- Porthcawl Harbour
- Burry Port
- Penarth Harbour
- *Milford Haven Port Authority* (response from *Ledwood Mechanical Eng*)
- Tenby Harbour
- *Bridgewater Harbour*

- Society for Underwater Technology
- Marine and Coastal Construction Services

- *International Marine Contractors Association*
 - ACERGY (UK)
 - Technip (F)
 - Heerema Group (NL)
 - HELIX Energy Solution Group (USA)
 - SAIPEM (IT)
 - *Van Oord (NL)*
 - Tideway (NL)
 - Royal Boskalis Westminster (NL)
 - *SMIT (UK)*
 - Global Marine Systems
 - Bourbon (F)

Dredging

- Central Dredging Association
- *UK Dredging* (response with ABP)
- *Dredging, Environmental & Marine Engineering (DEME – B)*

- Land and Water

Reinforced Concrete

- British Cement Association
- British Association of Reinforcement

Formwork...

- National Access Scaffolding Confederation

Precast concrete

- National Precast Concrete Association:

Service road + surface buildings

- Chartered Institute of Building (CIOB)
- Chartered Institution of Building Services Engineers

Mechanical & Electrical

- Electrical Contractors Association
- Institution of Engineering and Technology
- Institution of Mechanical Engineers
- *British Construction Steelwork Association*
- UK Steel
- Association of Electrical and Mechanical Trades (AEMT)
- British Electrotechnical & Allied Manufacturers Association (BEAMA)
- Forwarded to Electrical Companies: *Areva T&D Ltd* response

Manufacturers - Contractors

Civil contractors

- Eiffage TP (F)
- Bouygues Construction (F)
- *Vinci Construction (UK)*
- Bam Nuttall
- Dean & Dyball
- *Morgan East*
- Volker Wessels
- Volker Stevin
- C Spencer
- Raymond Brown
- Balfour Beatty
- Murphy Group
- Galliford Try
- DCT Civil Engineering
- Gerwick (USA)

Marine contractors

- Delta Marine Consultants (NL)
- *Deltares (NL)*
- Land & Marine Ltd
- Briggs Marine
- *Dredging, Environmental & Marine Engineering (DEME – B)*

Turbines

- *Alstom Hydro (F)*
- *Andritz Hydro (AU)*
- *Voith Hydro (G)*
- Hitachi (J)

Mechanical

- *Sheffield Forgemasters Engineering Ltd*
- Cleveland Bridge
- Severfield Reeve Structures (Watson Steel)
- William Hare

Electrical

- ABB
- Pauwels (Be)
- *Siemens UK*
- Clemessy (F)
- Wilson Power Solutions
- Balfour Kilpatrick
- Hitachi-Power (D)

Cranes

- Demag cranes
- *Kone cranes*
- Alatas
- Pegasus Mechanical Lifting

STPG

- *Sir Robert McAlpine*

Miscellaneous

- *Crown Estate*
- Hydro - Dam
- British Dam Society
- British Wind Energy Association (BWEA)
- Rijkswaterstaat (RWS; NL)
- International Business Wales
- Confederation of Business Industry
- UK Contractors Group
- Engineering Construction Industry Association (ECIA)
- HMG Government
- Department for Business Enterprise & Regulatory Reform (BERR)/ Department for Innovation, Universities & Skills (DIUS): review of productivity and skills in the engineering construction sector
- Department for Energy & Climate Change (DECC) - Trade promotion from UK Renewables
- Department for Energy & Climate Change (DECC) - Renewable Energy & Innovation Unit (REIU)
- *Department for Business, Innovation & Skills (BIS)*
- Department for Business Enterprise & Regulatory Reform (BERR) - Office of Nuclear Development
- *Members of the STP Regional Workstream (South West Regional Development Agency, Environment Agency, Welsh Assembly Government...)*

APPENDIX 3

SOURCES OF INFORMATION

Previous studies

- Department of Energy – Severn Barrage Project (STPG) – Detailed Reports 1989 (Volumes I – V)
- Department of Trade and Industry – The Severn Barrage (STPG) – Definition Study for a New Appraisal of the Project – Final report 2002

Vessels/Ports

- Construction of Marine and Offshore Structure by Ben C. Gerwick Jr (CRC Press – 2007)
- Eastern Schield storm surge barrier: Delta project brochures
- UK Ports for the Offshore Wind Industry: Time to Act (DECC – BVG associates – 2009)

Turbines

- Bulb/pit/S-turbines and generators – Voith Siemens brochure
- Bulb turbines and generators – VA Tech Hydro brochure
- Bulb Units – The complete solution for low head – Alstom Hydro brochure

Aggregates

- The role of imports to UK aggregates supply (British Geological Survey – 2005)
- Aggregates supply in England – Issues for planning (British Geological Survey – 2008)
- Collation of the results of the 2005 Aggregates Minerals survey for England and Wales (British Geological Survey – 2007)
- National and regional guidelines for aggregates provision in England 2005-2020 (Communities and Local Government)
- Construction aggregates – Mineral Planning Factsheet (British Geological Survey – Communities and Local Government – 2007)
- Managing aggregates supply in England – A review of the current system and future options (British Geological Survey – 2008)
- Primary Aggregate Reserves in England 1990-2004 (British Geological Survey – Communities and Local Government – 2006)
- The need for indigenous aggregates production in England (British Geological Survey – 2008)
- Aggregates resource alternatives: options for future aggregate minerals supply in England (British Geological Survey – 2008)
- Wales: Minerals Planning Policy-Minerals Technical Advice Note – 1: Aggregates (2004)
- Scottish Aggregates Survey (One Scotland – Scottish Government – 2007)
- Technical and Strategic Assessment of Aggregate Supply Options in the South West Region (South West Regional Assembly – Capita Symonds Ltd – 2005)
- South West Regional Aggregates Working Party – Annual Report 2006
- Marine Aggregate Dredging – The Area Involved – 10th Annual Report (BMAPA – The Crown Estate – 2007)
- Aggregates from the sea (BMAPA brochure)
- UK Minerals Yearbook – 2008 (British Geological Survey)

Concrete

- Cement – Mineral Planning Factsheet (British Geological Survey – Communities and Local Government – 2008)
- UK Steel - Key Statistics 2008 – EEF (*data for rods and bars for reinforcement*)

Labour & Skills

- Construction Skills Network: Labour Market Intelligence 2009-2013
 - Wales
 - South West
 - UK
- Energy Skills – Opportunity and Challenge. A report to Government by the Sector Skills Organisations responsible for Energy. A response to the Energy White Paper 2007 (2008)
- Sector Skills Council for Science, Engineering and Manufacturing Technologies (SEMTEA): Engineering Skills Balance Sheet – An analysis of Supply and Demand issues (2008)
 - England
 - Wales
 - South West
- Skills Shortages in the UK Construction industry (Chartered Institute of Building – 2008)
- Today's investment – tomorrow's asset: skills and employment in the Wind, Wave and Tidal sectors (SQWenergy - report to the BWEA – 2008)
- Energy & Utility Skills – Sector Skills Agreement – Stage 1 and 2 – Report on the electricity industry (2006)
- Energy & Utility Skills – Employment and Skills Study of the UK Electricity Industry (2004)

Miscellaneous

- Supply Chain Constraints on the Deployment of Renewable Electricity Technologies (BERR – Douglas-Westwood – 2008)
- 2016 Future Supply Chain – Cap Gemini – The Global Commerce Initiative (May 2008)



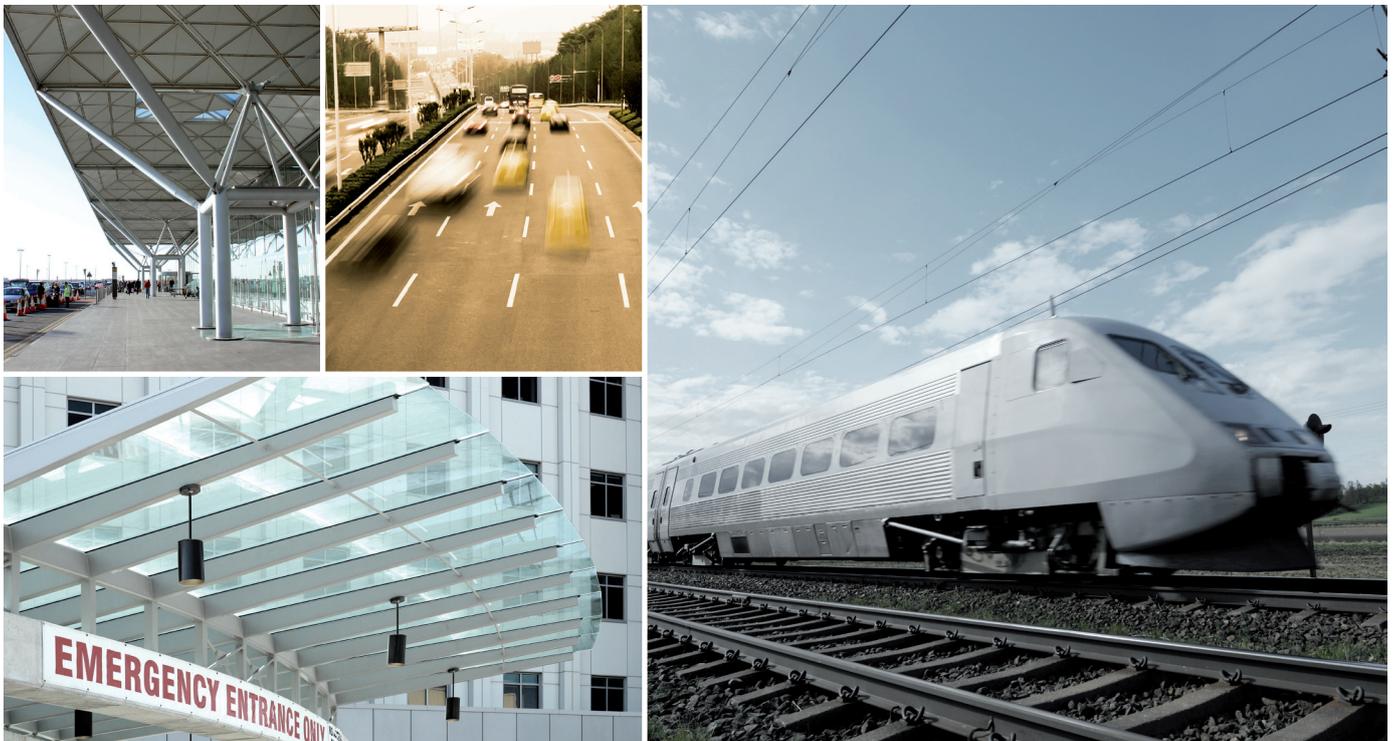
Llewellyn Consulting
Independent Economic Advisers



**PENSION INSURANCE
CORPORATION**

UK Infrastructure: The challenges for investors and policymakers

White paper 2013





About Pension Insurance Corporation

Pension Insurance Corporation ("PIC") provides tailored pension insurance buyouts and buy-ins to the trustees and sponsors of UK defined benefit pension funds. A market leader, PIC brings safety and security to scheme members' benefits through innovative, bespoke insurance solutions, which include deferred premiums and the use of company assets as part payment. Clients include FTSE 100 companies, multinationals and the public sector.

PIC has almost £9bn in assets primarily invested in investment grade corporate bonds, UK government debt and cash. Within this, housing association and infrastructure debt is expected to play an increased role in helping the company diversify its asset portfolio. In 2012 PIC completed the first ever UK publically-listed solar finance bond, investing £40 million as the sole buyer in a Solar Power Generation Ltd bond, as well as directly funding Raglan Housing Association as the sole buyer of a £50 million bond issue.

PIC is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and Prudential Regulation Authority (FRN 454345). For further information please visit www.pensioncorporation.com



About Llewellyn Consulting

Llewellyn Consulting is a niche 'macro-plus' economics advisory, based in the City of London. We provide high-level bespoke services to a strictly-limited number of clients. We look at macroeconomics from the top down, with a particular emphasis on policy, so as to determine the economic and market implications that flow from contemporary events, as well as from longer-term drivers.

For further information, please see www.llewellyn-consulting.com

Executive Summary

- The UK economy is experiencing a chronic shortage of aggregate demand
- Meanwhile the share of both public and private investment in UK GDP is low, at a time when its infrastructure is widely recognised as poor
- More infrastructure investment would make economic sense, both for cyclical and for structural reasons
- Greater private sector involvement could address the shortfall that is due to Government hesitancy to engage in public sector investment
- Pension funds are already significantly invested in infrastructure, including importantly through the listed bond markets
- However, they continue to have a large and growing need for secure, stable, and predictable long-term cash flows better to match liabilities
- Infrastructure could offer pension funds and insurance companies further investment opportunities through new debt or ungeared equity investment structures
- Such investment would mobilise previously unused funding, helping to expand the economy both near – and longer-term
- This requires a constructive institutional environment that, inter alia, tempers upfront financial risks, particularly for large projects
- Regulations inhibiting institutional investors require particular attention
- New legal/financial frameworks would be particularly beneficial for smaller projects
- Shaping the institutional environment and creating new legal/financial frameworks represents an important role for Government
- It is desirable to find ways to pool the resources of smaller pension funds
- Enhancing private sector infrastructure investment in aggregate requires a more stable, long-term, national strategy for the UK's infrastructure
- Additional expenditure on infrastructure of 1% of GDP could expand GDP by as much as 1.4% – over £20bn
 - The £310bn Infrastructure Plan if fully implemented could, over a run of years, end up contributing over £400bn to UK GDP (currently £1.6tr)
- The national accounts should make a clear distinction between public debt that is backed by saleable assets, and general public debt that is not
- The situation could be addressed piecemeal; but it would be better to take a more coherent approach
- It is recommended that this be done by a combination of:
 - 'Invest and sell' asset transfers
 - Reanimation of the Private Finance Initiative
 - Creation of a National Investment Bank or Fund



Table of Contents

I.	Introduction.....	6
II.	Infrastructure's role in the economy.....	7
III.	The legacy of the Global Financial Crisis.....	8
IV.	The United Kingdom: a serial under-investor.....	11
V.	Financial characteristics of infrastructure projects.....	13
VI.	Macro constraints on private financing.....	15
	Box: Macroeconomic effects of infrastructure spending.....	16
VII.	Pension funds and alternative sources of funding.....	17
	Box: Some specific problems faced by small pension funds.....	19
VIII.	Overcoming the barriers to infrastructure investment.....	20
IX.	The way ahead – three ideas.....	23
	Box: The National Infrastructure Plan.....	27
	Endnotes.....	29
	References.....	29

Authors: Russell Jones and John Llewellyn



I. Introduction

The UK's infrastructure is under duress

In the wake of the Global Financial Crisis (GFC), most of the advanced economies are recovering only slowly, and public sector balance sheets are under duress. This has led governments to cut back on public spending, and not least on infrastructure investment.

Notwithstanding a slight shift of emphasis in favour of public investment outlays, and in particular the prominence of a few high-profile projects in its latest public spending plans, the United Kingdom is no exception; and nor are its macroeconomic conditions likely to normalise any time soon. The recovery seems set to remain hesitant, fragile, and uneven.

Increased investment in infrastructure can contribute positively: not just to the recovery process, through the boost that it provides to aggregate spending, but also to the economy's longer term performance and competitiveness. Moreover, the UK has for some time tended to spend comparatively little on this key component of GDP and catalyst for development.

The UK's global competitiveness ranking for 'quality of overall infrastructure' was 24th in 2012-13, equal to the US, and below all the other G7 economies except Italy.¹ In 2007 the UK ranked 19th (Figure 1). In a 2012 survey by the Confederation of British Industry, nearly two thirds of companies judged the UK's infrastructure unfavourably relative to that of other EU countries; only a minority of companies were confident that the UK's transport, energy, and water networks will improve in the near future; and nearly half rated the UK's transport networks as well below average international standards.² And, notwithstanding the government's recent claims about transformational plans for road building and the railways, and talk of lengthening the government's policy horizon in this area,³ its latest initiatives are in significant part a repackaging of previous ideas.

Pension funds could help to address the shortfall

One increasingly talked-about way to achieve a higher level of infrastructure investment has been to encourage greater private sector financing. This is consistent with the objective of institutional investors, such as pension and insurance funds, to increase the diversification of their portfolios, and enhance their long-term asset-liability management. There is a lead role for Government here in setting the necessary framework.

In short, there are huge infrastructure demands, and increasingly interested and cash-rich institutional funds. A key challenge therefore is to bring the two together. This paper considers some of the problems involved, and the options available to overcome them.

II. Infrastructure's role in the economy

Infrastructure is important for economic success

A country's infrastructure is central to the functioning of its economy and to the welfare and development of its population.

A broad definition of infrastructure includes both physical (tangible) and non-physical (non-tangible) assets. Infrastructure can be thought of as the economic arteries and veins that enable people, capital, manufactured goods, commodities, water, energy, information, and more to move efficiently both within, and into and out of, the country. It includes the assets that underpin the economy's networks for transport; energy generation, distribution and storage; communications; waste management; and water distribution and treatment.

Arguably, the most important elements extend to major roads, railways, airports, seaports, power lines, pipes and wires; electricity and gas; electronic communications, including broadband; water, sewerage and waste; flood defences; and intellectual capital.

Most economists would also include 'social infrastructure' in the list, namely housing; hospitals; schools; universities; the legal system; government research institutions, and more.

From the institutional investor's point of view, there is little doubt that 'social infrastructure' should indeed be included in the definition. For such investors, it is the associated long-dated cash flows that matter most, and 'social infrastructure' is just as capable of delivering these.

Thus infrastructure facilitates the delivery of goods and services that promote prosperity and contribute to quality of life; and it adds to the productive capacity of the economy. But empirical analysis suggests that it can also have effects on economic growth over and above those arising from simply adding to the capital stock. It also facilitates:

- Trade and the division of labour;
- Competition in markets;
- More efficient allocation of activity across regions;
- The diffusion of technology;
- Better organisational practices; and
- Access to new resources, both physical and human.

Infrastructure can also help to address the burgeoning global challenges of climate change, and encourage the 'greening' of the economy.

(For more, see Box: *Macroeconomic effects of infrastructure spending*).

Infrastructure boosts aggregate demand and aggregate supply

Figure 1: World Economic Forum Global Competitiveness Report, UK global ranking, selected infrastructure measures

Quality measure	UK ranking in 2013	Best performer	UK ranking in 2007	Best performer
Overall infrastructure	24th	Switzerland	19th	Switzerland
Roads	24th	France	14th	Singapore
Railroad infrastructure	16th	Switzerland	N/A	N/A
Port infrastructure	12th	Netherlands	19th	Singapore
Air transport infrastructure	22nd	Singapore	9th	Singapore
Electricity supply	8th	Netherlands	10th	Iceland

Source: *World Economic Forum*

III. The legacy of the Global Financial Crisis

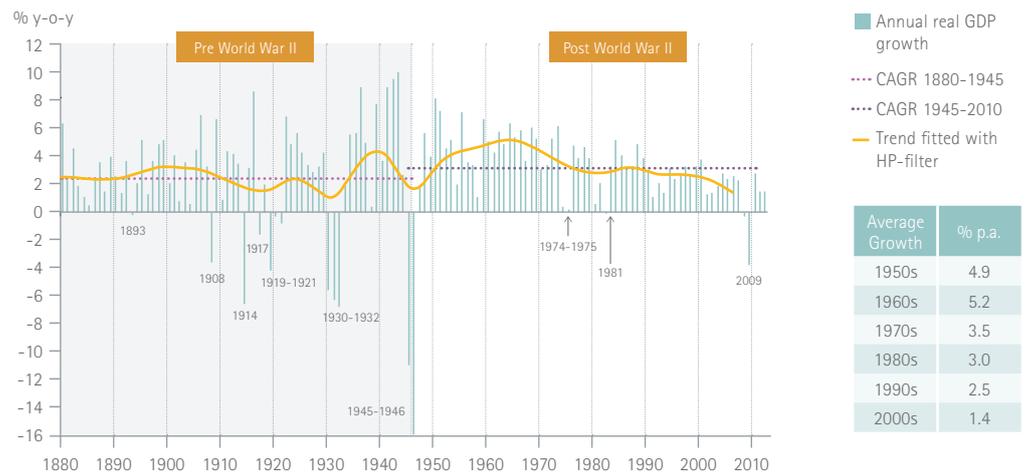
The global crisis sparked the worst downturn since WWII

In the aftermath of World War II, economic growth, even if it began to trend downwards from the 1960s, was markedly less volatile, and subject to fewer major setbacks, than it had been in the pre-war period. Indeed, the major economies went more than 60 years without experiencing a major decline in real GDP (Figure 2).

All this changed, however, with the Global Financial Crisis (GFC) in 2009, which saw a major decline in output right across the advanced world – in the case of the UK a fall in GDP of 7.2%, peak-to-trough. The subsequent recovery has been slow in coming, hesitant, and uneven.

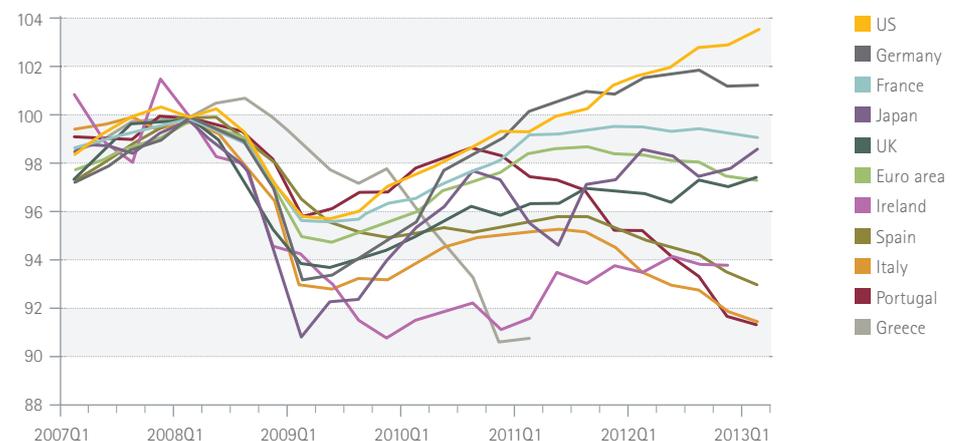
The United Kingdom's cyclical upswing has, if anything, been less impressive than most of its major competitors: output (GDP) is still some 4% below its previous high, particularly disappointing when compared with the US. Indeed, only those economies at the periphery of the euro area that have suffered extended sovereign debt crises have fared worse (Figure 3).

Figure 2: G7 GDP growth has been trending down post World War II



Source: Angus Maddison database and IMF WEO database, April 2013
Notes: HP filter series is shown up to 2006 to avoid 'endpoint' problem

Figure 3: The recovery in GDP after the crisis has disappointed



Source: Eurostat
Notes: 2008q1=100

III. The legacy of the Global Financial Crisis

Demand has slumped and the supply-side is at risk of damage

Major financial crises are always expensive, and exact an enduring cost on economic activity. The experience of developed economies of such episodes is that the loss of output, relative to the previous extrapolated trend, can run ultimately to between 50% and 100% of one year's GDP.

Seven years after a financial crisis, GDP is typically 10% below trend, most of the 'lost' output reflecting the fact that investment spending is on average around 30%-odd below where it would normally have been expected to be in normal times. There can be other longer term effects on productive potential too, if the weakness in investment spending persists, and labour skills atrophy in an environment of extended unemployment. Financial crises can even depress an economy's underlying growth rate (Figure 4).

Perhaps the best way to describe the prevailing conjuncture in the UK and the other major economies is that there is a chronic deficiency of intended (so-called *ex ante*) investment relative to intended savings. Normally, during such periods of very weak aggregate demand, the public sector is able, in conjunction with other efforts to stimulate the economy such as monetary policy easing, to at least partially fill the gap with additional government spending, not least on infrastructure investment.

Fiscal incontinence...

Since the Global Financial Crisis, however, public debt burdens, which were already historically elevated, have risen to peacetime highs (Figure 5). The average advanced-economy general government gross debt-GDP ratio now stands substantially above 100%, and is still rising. The IMF's forecast for the UK this year is 108.1%, and it is generally reckoned that this figure is unlikely to decline much over the coming five years.⁴ Moreover, the advanced economies, including the UK, are confronted by ageing population structures that will require increasingly large outlays on pensions and healthcare.

Following the short burst of discretionary fiscal stimulus in 2009, Western governments have proved reluctant directly to boost demand through sustained budgetary activism, for fear of eliciting a negative response from markets and the rating agencies. Rather, the emphasis has been on fiscal restraint, and it is public investment that has often been the prime casualty. In the UK, public investment fell 6% in quarter-on-quarter terms in the January-March period of this year.

... and political philosophy ...

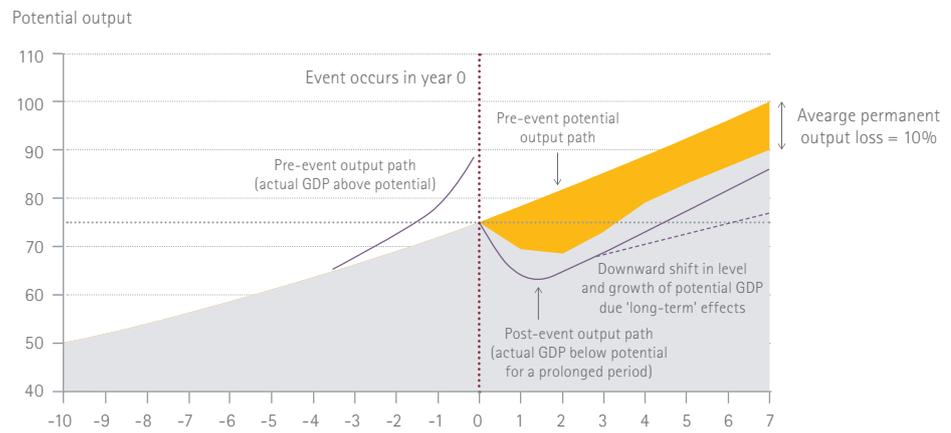
There has also been an ideological element to this restrictive fiscal policy stance, and not least in the UK. A widely-articulated view in Government has been that budgetary stimulus produces more costs than benefits, and that on previous occasions the public provision of infrastructure has failed to deliver efficient investment, with misallocations across sectors or regions. This conviction has led in turn to the twin conclusions that it is the private sector that should be responsible for the bulk of investment expenditure; and that, when government investment expenditure is reduced, private sector investment will 'crowd in' to fill the vacuum.

However, any hope that the private sector would rapidly fill the hole in aggregate spending has proved wide of the mark. Contractions in government expenditure have not in general led to a hoped-for rapid 'crowding in' of private expenditure, whether for infrastructure or otherwise. Confidence has been at too low an ebb, and too many market failures and other constraints have intervened. The private sector is the more likely to 'fill in the hole' the greater the extent to which it has clarity about the infrastructure in which it can invest pursuant to government's long-term strategy.

... have prevented a major effort to boost public investment

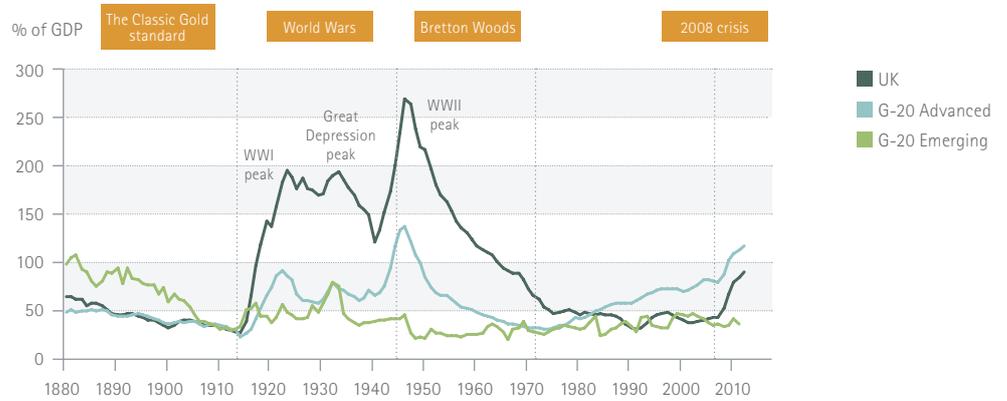
Hence, the UK has benefited neither from the ability of infrastructure investment to stimulate demand in the near term, nor from its capacity to raise potential over the longer term.

Figure 4: Financial crises are expensive



Source: Llewellyn Consulting

Figure 5: Government debt to GDP 1880-2012



Source: IMF Historical Public Debt Database and IMF WEO April 2013

IV. The United Kingdom: a serial under-investor

The UK's share of total investment in GDP is low...

The Organisation for Economic Cooperation and Development (OECD), variously in its *Going for Growth* series and its regular *Economic Surveys*, has consistently identified investment in infrastructure, and especially in transport, as one of the main priorities for the UK.⁵

... as is its share of public investment in GDP...

The UK's shortcomings are perhaps most succinctly captured in the economy's low share of both total investment and public sector investment in GDP. Since the 2008 global financial and economic crisis, total investment-to-GDP ratios have fallen in all the major economies, to well below historical norms: the UK is thus not alone in this regard. However, in 2012 the UK's total investment ratio was a mere 14% of GDP, compared with 16% in the US, close to 20% in the euro area, and slightly above 20% in Japan. Moreover, the UK has had a relatively low investment share for many years (Figure 6).

Much the same is true of investment by the UK government (Figure 7). Over the past twenty years, the share of gross public investment in GDP has been lower than in most of the UK's major advanced-economy trading partners. While the ratio did increase significantly in 2008-09, in response to the emergency policy action by the then government, public investment has since fallen back to its pre-crisis level.

Moreover, according to the Office of Budgetary Responsibility, the share of public sector *net* investment in GDP (i.e. excluding depreciation) is set, on announced plans, to fall further, from 2.6% in 2010-11 to just 1.1% in 2016/17, the lowest level since 2001/02 and a mere one-sixth of the figures recorded in the late 1960s.⁶

... resulting in a major 'infrastructure gap'

Thus the UK is clearly suffering from a major 'infrastructure gap'. Resolving this requires a sophisticated interplay between Government and the private sector.

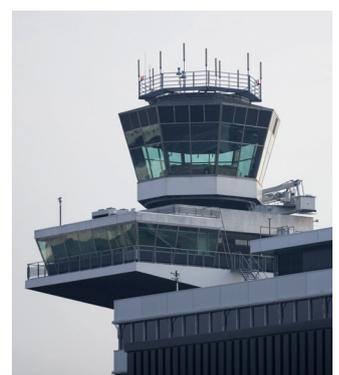
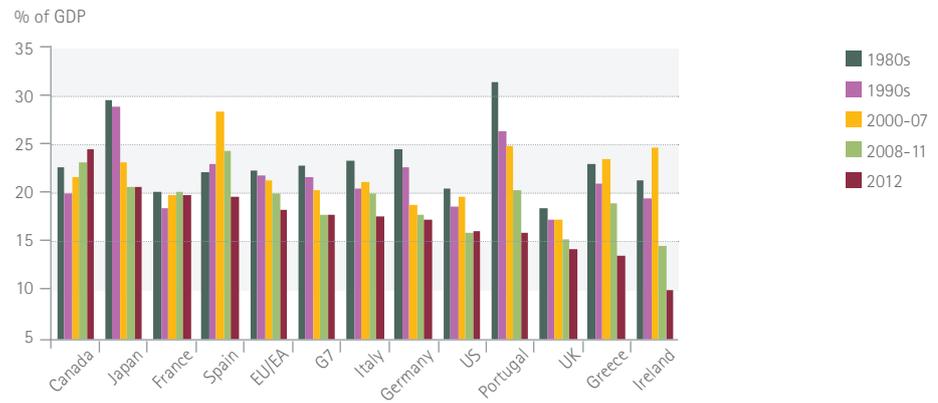
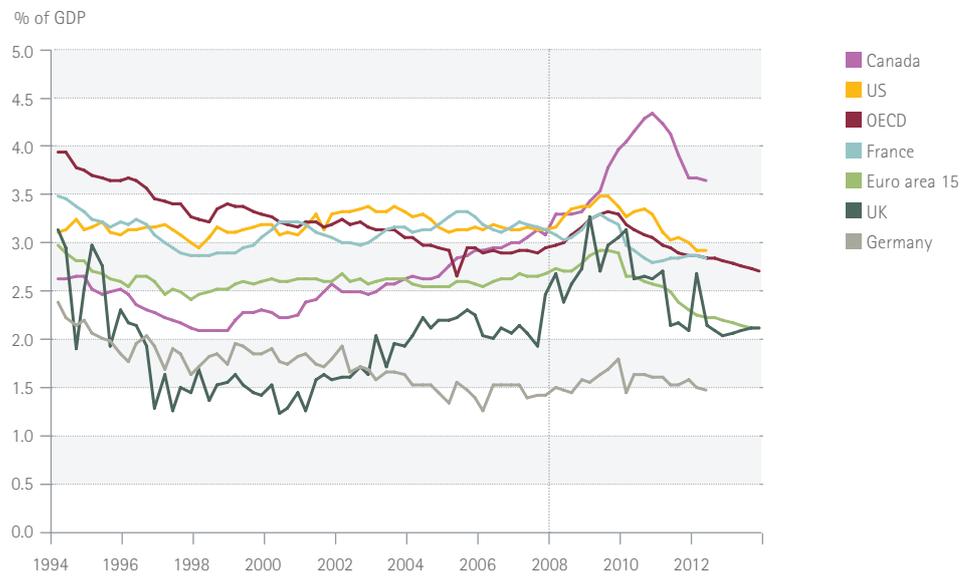


Figure 6: Total investment, share of GDP, 1980-2012



Source: IMF World Economic Outlook, April 2013
Notes: Average over periods indicated

Figure 7: Public investment, share of GDP, 1994-2013e



Source: OECD Economic Survey of the UK 2013

V. Financial characteristics of infrastructure projects

Infrastructure projects have a number of distinct characteristics (Figures 8, 9 and 10). In particular, such projects:

- Produce cash flows that are determined by a regulatory regime set by government, or sponsored by a government or quasi-government body
- Frequently are monopolistic or quasi-monopolistic;
- Require a large initial capital outlay;
- Have to satisfy the double imperative of ensuring financial sustainability and meeting user needs and social objectives;
- Involve contracts that are complex and of long duration;
- Offer extended duration, stretching to 25 or 30 years and in some cases even longer;
- May provide inflation protection, in that the associated revenues are often combined with an inflation adjustment mechanism, whether via regulated income clauses, guaranteed yields, or other contractual guarantees;
- Yield stable and predictable long term cash flows that can support significant leverage; and
- Yield a return that is predictable, inelastic, and relatively uncorrelated with the business cycle.

... not least because of the structure of cash flows

'Greenfield' investments – defined as first time usage at a site – involve considerable planning, development financing, a procurement phase, and extended construction stages during which investors rarely make a profit. The cash flows associated with 'Greenfield' sites demonstrate a distinct 'J' curve pattern. By contrast, however, the later, revenue-generating, stages can offer high and stable cash flows similar to standard fixed income investments or real estate.

'Brownfield' sites – those already operational in some sense or other, or that have a predecessor – involve reconstruction, renovation, or expansion but are generally less expensive in the early stages. Hence, there is less of a 'J' curve effect.

Various financing structures are available

Given these characteristics, two broad options are available to investors: equity (which in turn can be subdivided into geared pooled investor funds and non-geared direct investor funds); and debt (bonds).

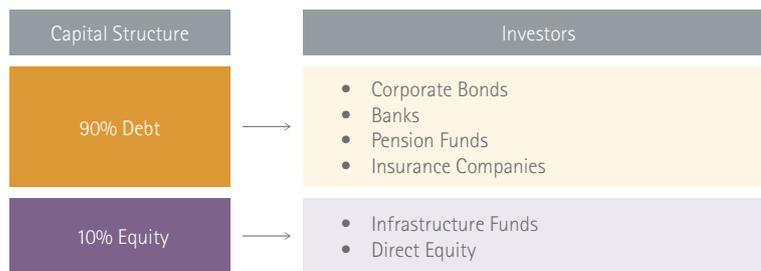
- **Equity.** Listed shares can be bought in large companies, and in particular those in the larger utility, energy, and transport sectors. Investor funds can be bought from managers with in-house expertise who can finance individual projects and who may hold the equity of smaller infrastructure projects which are not listed.
 - Geared pooled direct investor funds are typically based on the private equity model. Prior to the GFC, they were often highly geared and promised exits after seven years, though there is little evident economic rationale for that particular time frame. There are therefore question marks over the appropriateness of these funds for the infrastructure sector.
 - Non-geared direct investor funds often follow the model developed in Canada, not least by Borealis, the investment arm of the Ontario Municipal Employees Retirement System (OMERS) that boasts C\$55.7bn in total assets, uses specialist teams of managerial and operational expertise to manage C\$8.5bn of infrastructure investments, and not just in Canada – some of their interests are in the UK. It embraces a long-term 'buy and hold' strategy; takes direct control of the assets of the project; and seeks to avoid any agency issues with fund managers.
- **Debt.** Most infrastructure projects can be highly geared and sub-divided into 85-90% debt and 10-15% equity financing, depending on the project. The debt financing is generally:
 - Investment grade;
 - Secured on physical assets or contracts;

- Issued by states, municipalities, utility companies, other large corporates, or Special Purpose Vehicles (SPVs); and
- Offers returns that may be linked to inflation and/or to project revenue.

Where individual projects are of sufficient scale to warrant public-debt financing – typically £200 million or more – a public listed bond can be issued. Often this will be the cheapest form of debt financing, because investors put a value on the liquidity of a public bond that can be traded in the secondary market. Often the bonds are issued only once the initial construction stages have been completed and the associated risks have declined.

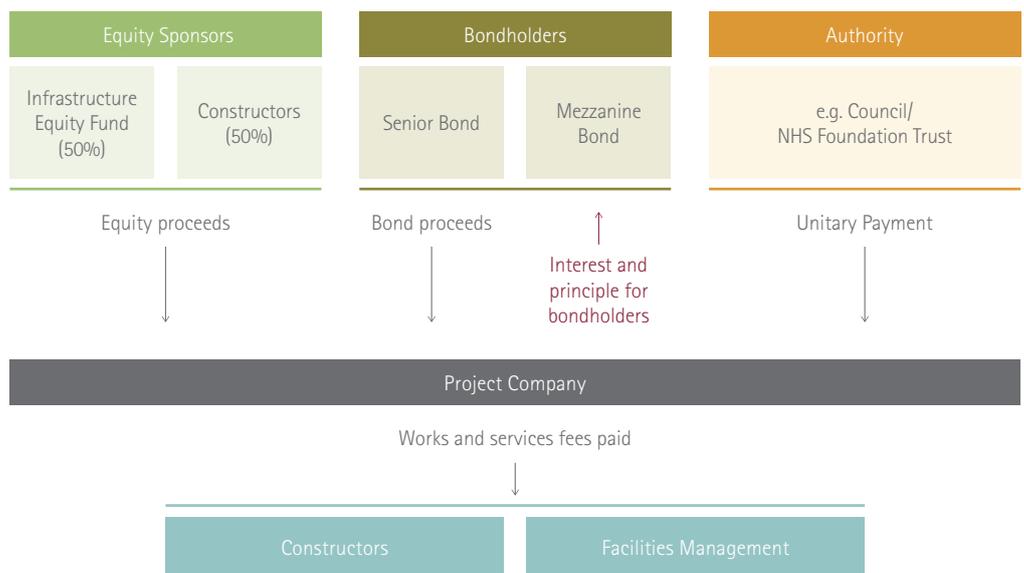
For smaller projects, private debt deals can be arranged. These can take the form of loans, and be sold to individual debt investors or clubs of debt investors.

Figure 8: Typical project capital and investor structure



Source: Pension Insurance Corporation

Figure 9: Roles of key participants in a typical infrastructure/PFI deal



Source: Pension Insurance Corporation

VI. Macro constraints on private financing

The travails of the banks have hurt private financing

In the run-up to the GFC, fierce competition and abundant cheap credit encouraged infrastructure asset values to rise sharply in an environment where there was a widespread 'stretch for yield'. The credit quality of many infrastructure deals declined. There were also issues with increased gearing. Some investors, and not least the banks, which had been seeking stable incomes by investing in infrastructure, found themselves owning over-priced and over-leveraged assets with very different risk profiles from those initially hoped for and expected.

Since the GFC, the options available for the private financing of infrastructure have been severely curtailed, in large part the result of the pressures exerted on the banks. In principal, banks remain the most flexible source of funding. Such flexible funding is particularly useful in the construction phase, when the exact timing of the various financial requirements is unknown. But latterly they have faced serious capital and liquidity issues, if not of outright solvency. Banks have become risk averse, and focused on shedding assets and restraining credit growth, especially over longer maturities. It has also become more difficult for them to shift credit risk from their balance sheets. There is every likelihood that regulation, in the form of Basel III, will only add to this conservatism in the near term.

Some banks have withdrawn from the sector altogether

Some of the banks which were most active in UK infrastructure financing, including Depfa, Espirito Santo, Commerzbank, and Mizuho, have either substantially cut back their activities in these areas or have withdrawn altogether. Meanwhile, considerable infrastructure project expertise has been lost elsewhere in the sector.

The banks' difficulties have also affected Public Private Partnerships (PPPs), whereby project risks are shared across the private and public sectors. The government (often local or municipal) typically specifies the quantity and quality of the service it requires from the private partners, which are coalesced into a consortium, and which capitalises a Special Purpose vehicle (SPV) with varying recourse to debt and equity. The consortium is tasked with the design, construction, financing, operation, and management of the infrastructure asset, as well as delivery of the resulting service, whether to the government or the public. The group may benefit from some equity contribution from the public sector sponsor, but it will also receive either a stream of payments from the government or user charges levied on end users, or a combination of both.

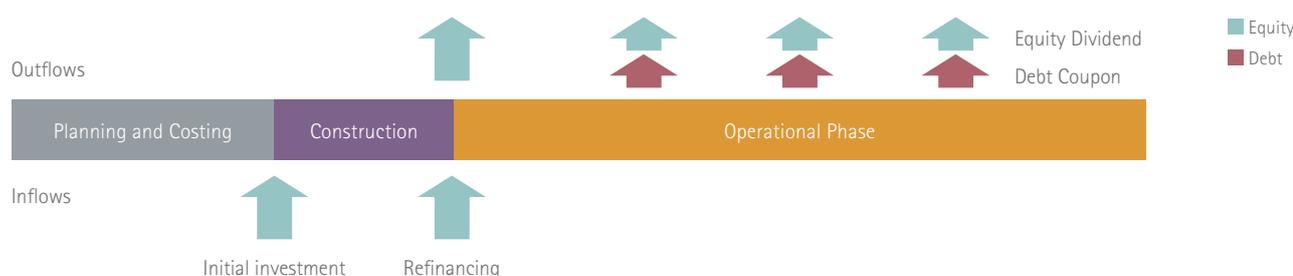
In the UK, which was something of a global pioneer in this area, these schemes have been bracketed under the term Private Finance Initiative (PFI). The PFI contributed considerably to infrastructure spending over the 15 years leading up to the GFC. More than 700 such partnerships were assembled, with a capital value of more than £50bn. This included almost 100 hospital schemes, more than 100 education projects, and around 40 transportation projects and initiatives in areas as diverse as defence and culture. Overall, they were associated with some 12% of total annual capital expenditure over the latter part of that period.⁷

Bank and insurance troubles have hit the UK's PFI hard

However, the PFI has been a major casualty of changing political priorities, as well as the banks' more conservative attitudes to lending, an attitude that has been further encouraged by the losses some banks have made on these projects. Smaller PFI projects in particular were highly dependent on bank finance. The PFI was dealt a further blow by the collapse of the involved insurers that had hitherto conducted much of the project risk evaluation spadework and lent their stamp of approval to the bonds issued to finance larger projects.

Moreover, the more cost-conscious, post-GFC, period saw a growing focus on whether these initiatives were offering sufficient value for money for taxpayers. The net result is that PFI activities have tapered off decidedly since 2008. The current government has tried to address some of these issues with its PF2 programme, but this effort has yet to reach critical mass.

Figure 10: Infrastructure financing timeline and cashflows



Source: Pension Insurance Corporation

Box: Macroeconomic effects of infrastructure spending

The evidence points to relatively large effects, particularly in conditions similar to the present conjuncture.

The relationship between infrastructure and output is difficult to estimate precisely and causality can be hard to determine empirically. Important influences on the observed relationship, both in the near term and over the longer term, include:

- The precise nature of the spending;
- Its longevity;
- The stance of monetary policy;
- The state of the business cycle;
- The health of the financial sector and prevalence of credit constraints on the household and business sectors; and
- Externalities and spill-over effects.

Such caveats aside, there is suggestive evidence that infrastructure enhances growth in ways that go beyond the direct effect on the capital stock. These include economies of scale, network externalities, and the potential for increased competition. The construction of a new airport for example, could be expected to generate benefits to the economy that go way beyond the initial capital outlay.

The results of empirical studies suggest that effects differ both across countries and sectors, and that they vary over time, with episodes of under- and over-provision, and efficient and inefficient use of investment. But, as is to be expected, infrastructure appears to exert a stronger long-term impact on growth at lower levels of provision. (See: Egert, B., Kozluk, T. and Sutherland, D, 2009. *Infrastructure and growth: empirical evidence*. OECD Economic Department Working Paper No. 685.)

In practice, achieving a value for the multiplier – defined as the increase in GDP following a 1% increase in infrastructure spending – of much above 1 will depend on the nature and quality of the investment, and in particular on the potential for long term impacts on productive potential and productivity.

It is, however, likely that multipliers are larger for public investment than for other fiscal policy measures, and that they are also likely to be larger when, as in current circumstances, the stance of monetary policy is easy, the private sector is unable or unwilling to borrow, unemployment is high, and the economy is working below full capacity.

A survey of a broad range of the pre-crisis literature on infrastructure suggests a multiplier range of between 0.5 and 1.5. However, more recent, post-crisis, estimates have put the value as high as 2.0 or more, the suggestion being that the particular circumstances characterising the current conjuncture have if anything enhanced the impact of infrastructure-related fiscal stimulus. (See: IMF, 2010b. *Effects of Fiscal Stimulus in Structural Models*. IMF Working Paper 10(73)).

Simulations for the UK economy conducted by the UK's National Institute of Economic and Social Research (NIESR) concluded that, in the wake of the crisis, a 1% of GDP increase in infrastructure investment not only increases GDP by close to 1% in the near term, but also increases potential GDP by a further 0.2 and 0.4% over the longer term. (See: Fic, T. and Portes, J. 2013. *Macroeconomic impacts of infrastructure spending*. National Institute of Economic and Social Research).

(For more on the UK government's National Infrastructure Plan, see Box: *The National Infrastructure Plan*).

VII. Pension funds and alternative sources of funding

Pension funds offer an alternative source of funding

So far they have little direct exposure to these investments...

With the banks under duress and much more cautious in their approach, there is a need for new and alternative sources of funding for infrastructure. Fortunately, the diversity of the non-bank financial sector is such that there are numerous other sources, including insurance companies, family offices, sovereign wealth funds and, in particular, pension funds.

UK pension fund assets are particularly large, equivalent to around 112% of GDP in 2012 (Figure 11). Only the Netherlands and Switzerland have larger pools of pension assets relative to the size of their economies, while for most other advanced economies the figure is much lower.

UK pension funds are heavily skewed towards defined benefit (DB) schemes, which account for almost three quarters of the total (Figure 12). This is changing, but DB schemes will retain the largest pool of assets for some time, although a significant portion is expected to pass across to insurance companies via buyouts. An issue for Defined Contribution (DC) pension fund investment in illiquid assets such as unlisted infrastructure is that people have the option to switch funds easily.

The asset allocation split of UK pension funds has historically been dominated by equities, although the proportion allocated to bonds, now 37%, has been increasing, both in an effort to reduce the volatility of returns and because of investor conservatism following the GFC.

Currently, in most countries and including in the UK, most pension funds carry some exposure to the infrastructure sector. This is predominantly indirect, via equity and corporate debt issued by the infrastructure project or company and traded in listed markets. Some investments are made through financing vehicles such as SPVs or private equity funds but, in the main, and certainly beyond the largest pension funds, direct investment asset allocations to infrastructure remain limited.

Most UK pension funds will hold listed utility equities. And the typical non-Gilt fixed income portfolio will include 10-15% in utilities and perhaps a further 20% in broader exposure to infrastructure of one sort or another, including in particular bonds issued by the major airports, or PFI consortia. A key requirement of all such investments is that the infrastructure projects be of sufficient scale to merit the financial instruments being listed.

The 'other investments' category, which is designed to encourage the diversification of portfolios, and which captures direct exposure to infrastructure equity, accounts for only 17% of total assets, and the direct infrastructure allocation itself is estimated at less than 5%. It is the larger pension funds that tend to dominate this category: many, perhaps most, UK pension funds have little direct investment in infrastructure equity.

The large pension fund holdings of infrastructure cover a range of project types, with different investment characteristics. Based on risk/return profiles, these portfolios often divide into two segments:

- A core holding, where cash yield is dominant; and
- A value added/opportunistic holding, where capital appreciation is the dominant focus.

Large pension funds can also focus more on 'Greenfield' sites and relatively untested technologies, though such investments generally represent only a tiny proportion of the total infrastructure holding.

The clear inference is that there is considerable scope in principal for UK pension funds, and in particular smaller pension funds, to increase their exposure to infrastructure. The long-term alternative sources of funding represented by pension funds may also be preferable for infrastructure project managers in search of patient, stable, long-term funding.

... but the prospect of predictable real returns is attractive...

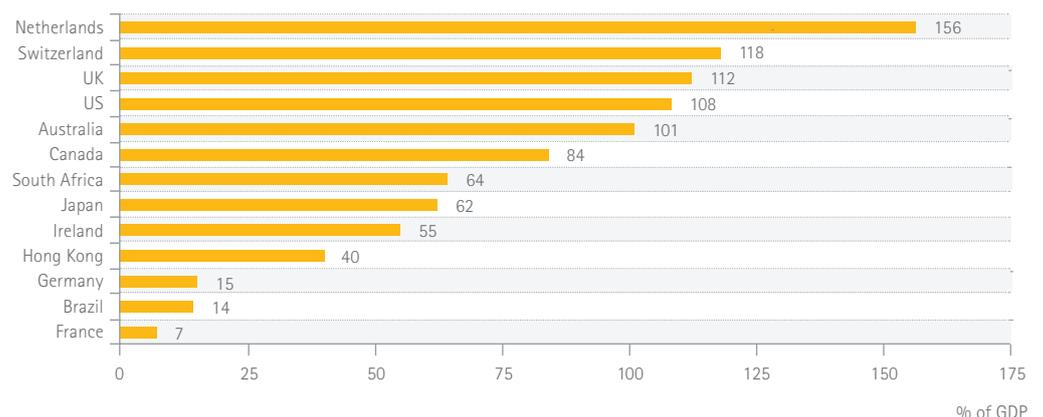
... especially while index-linked Gilt yields are negative

The risks associated with the illiquidity of the equity-financed portion of infrastructure projects are one of the major constraints on the pension fund involvement, especially for the smaller entities (see Box: *Some specific problems faced by small pension funds*). But on the other hand, the more secure and predictable stream of income flows that infrastructure assets can provide, via fixed income instruments and other conduits, is attractive in terms of liability matching. And this is particularly so given the consequences of the Bank of England’s persistent resort over recent years to unconventional monetary policy (Quantitative Easing), which has depressed Gilt yields and thereby widened pension fund deficits. Data from the Pension Protection Fund (PPF) indicate that the collective deficit of the 6,316 schemes it covers stood at £186bn in May 2013.⁸ It has also been estimated by Pension Insurance Corporation that the initial round of UK Quantitative Easing increased pension fund deficits by some £74bn.

Long-term interest rates in the UK, as in many advanced economies, have declined sharply since the GFC, falling to historical lows in nominal terms, and into negative territory in real terms (Figure 13). With normalisation of monetary policy likely to prove slow, and governments, because of their onerous debt burdens, increasingly resorting to variations on the theme of financial repression to contain borrowing costs, this situation is unlikely to change dramatically any time soon. Real returns on sovereign bonds, both in the UK and more broadly, seem set to remain paltry at best for a number of years.

Moreover, these difficulties are exacerbated by the fact that pension liabilities are generally only partly hedged, and so are highly sensitive to falling interest rates and the particular structure of UK pension liabilities. Obligations in excess of 25 years account for about 30% of the total, and some 60% of the overall interest rate sensitivity of liabilities (Figure 14).

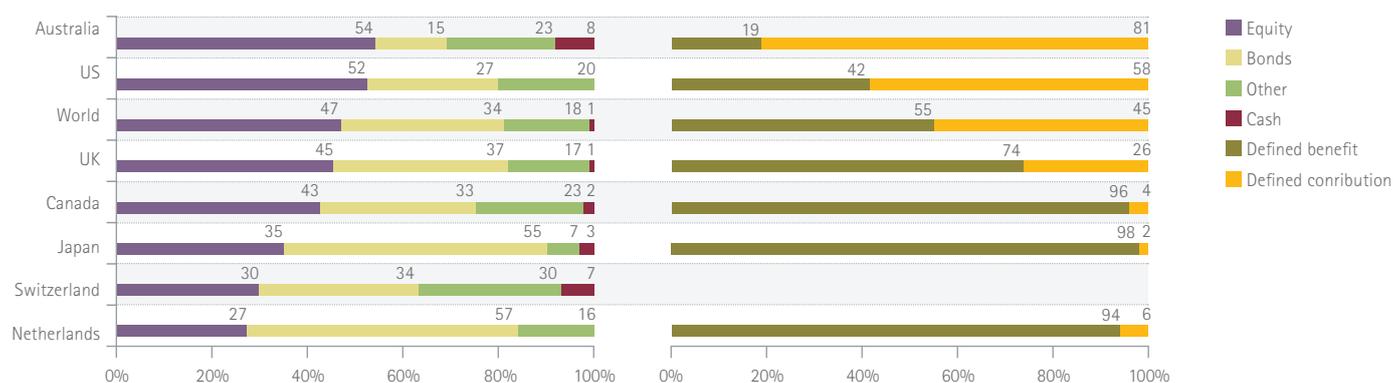
Figure 11: UK pension fund assets relative to other countries, 2012



Source: *Global Pension Assets Study 2013*, Towers Watson

VII. Pension funds and alternative sources of funding

Figure 12: UK pension fund assets allocation and defined benefit and defined contribution split



Source: *Global Pension Assets Study 2013*, Towers Watson
 Notes: DC assets in Switzerland are cash balances and are excluded

Box: Some specific problems faced by small pension funds

Helping smaller pension funds pool their resources stands to increase direct investment in infrastructure projects.

By international standards, the UK pension fund industry is quite fragmented. Smaller pension funds face some especially-thorny issues in investing in infrastructure:

- They lack the necessary expertise, and often depend on third-party advice;
- They are reluctant to invest in illiquid assets, especially when they can be confronted by short-termism and the possibility of buy-out, with all its uncertainties over price, within a few years;
- The focus of private equity funds on a 7-year investment horizon and the growth- or return-seeking parts of investment portfolios are ill-suited to smaller pension funds seeking secure long-dated credit-like assets; while
- Private equity governance and fee structures such as the 2+20 model are a further disincentive. However, fees have fallen since the GFC.

The recently-created UK Pensions Investment Platform (PIP) is intended to overcome at least some of these issues. Established by the National Association of Pension Funds (NAPF), which represents some 1,200 entities, with assets of £800bn, and the Pension Protection Fund (PPF), it is designed to be an aggregated infrastructure fund "for pension funds, managed by pension funds".

The UK PIP was modelled on Australia's Industry Funds Management (IFM). It aims to pool pension assets and invest them directly in infrastructure projects, with a view to generating long-dated, low-risk, inflation-linked returns of the order of RPI inflation plus 2-5% on relatively low leverage. The complexities of coordinating the views of such a large number of players with limited experience and resources, however, should not be underestimated, especially when decision times can be a key factor. A target size of £20bn in ten years has been set, and can already boast ten pension funds as founding members. However, thus far, it has raised just £2bn.

Investment in water, for example, could be particularly attractive to smaller pension companies. Given that population sizes and structures typically evolve only slowly, and that trends in water demand are strong, confidence in future cash flows would seem warranted.

VIII. Overcoming the barriers to infrastructure investment

The barriers to private infrastructure are many and various

A number of important hurdles need to be overcome before a significant number of UK pension funds and insurance companies can consider taking a significant direct exposure to infrastructure investment.

These hurdles fall into three categories which, in order of importance, are: investment opportunities; investor capability; and the conditions for investment.

Investment opportunities

Limitations on opportunities at present include:

- The small number, and sporadic nature, of projects – including a lack of privatisation programmes;
- A shortage of political commitment to particular projects over the long term;
- Regulatory instability;
- Fragmentation of the market across different and uncoordinated levels of government;
- High initial bidding costs – partly the result of the absence of a clear, consistent, simple bidding process; and
- Other risks – constructional, operational, business, gearing, legal, and environmental.

Investor capability

A number of other limitations also inhibit investors. These include:

- Lack of investor expertise in infrastructure; and consequent dependency on the due diligence of third parties, such as private equity funds, that may prove difficult to oversee;
- Size of investment fund – smaller pension funds face particular issues (see Box: *Some specific problems faced by small pension funds*);
- Regulatory barriers – e.g. moves to risk-based solvency standards; and
- A culture of investor short-termism.

Conditions for investment

Furthermore a lack of understanding of infrastructure investment is also a limitation. These include:

- Negative perceptions of the value of infrastructure – deriving from novelty and general unfamiliarity;
- A lack of transparency in the sector and/or a scarcity of data needed to assess risk and return profiles of projects, or separate project tranches; and
- Financial processes that are run by banks and geared to banks' products.

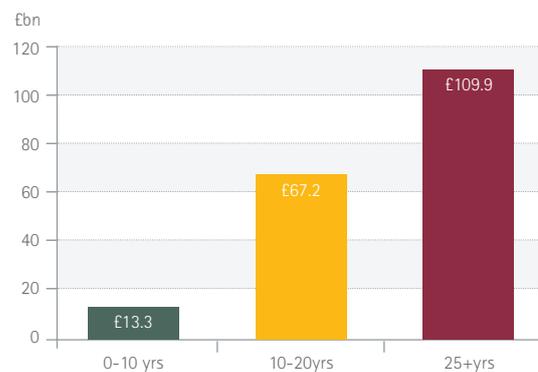
Figure 13: UK benchmark index-linked Gilt yields



Source: Macrobond

VIII. Overcoming the barriers to infrastructure investment

Figure 14: Pension fund sensitivity to changes in bond yields



Source: Pension Insurance Corporation

Government's role is central, both for large and small projects

A range of policy responses is warranted...

Policy responses

Enhancing investment in UK infrastructure will require a range of integrated policy responses. Government has to be involved.

As regards the largest, most complex, projects, the experience, both in the UK and other advanced economies, is that many of these, such as airports and major railway routes, need a (government) sponsor, even though the bulk of the financing may come ultimately from existing public markets. Government cannot avoid planning, delivering and, to some extent, partially financing projects, at least in their early stages.

For smaller projects too, such as individual hospitals, schools, or renewable energy plants the government is also important, albeit for somewhat different reasons. Historically, equity for a small infrastructure project, such as a PFI deal came from the sponsor and potentially the constructor, with the debt component supplied largely by the banks. But with the banks now deleveraging, this financing component is in short supply, even though the potential equity providers are still present.

Hence to encourage equity funds and capital market conduits in general there is a burgeoning need for Government to involve itself in:

- Developing appropriate new legal frameworks for such projects;
- Managing the procurement process so as to ensure that the debt is delivered to (non-bank) investors in a suitable form, and with feasible timelines in respect of pricing and delivery of funds;
- Developing risk transfer systems, such as guarantees and stand-by lines of credit; and
- Incorporating into the overall financing assessment the setting of tariffs and user charges for which it is responsible, whether directly or indirectly.

In terms of governance, a stable and accessible long term programme of infrastructure investment will need to be:

- Co-ordinated across different departments and levels of government;
- Devoid of frequent policy reversal and prevarication over key decisions;
- Supported by regulatory stability (especially in relatively regulation heavy sectors such as energy and utilities); and
- Dovetailed with the ability of construction firms to supply the necessary resources to do the job.

... as is a major change in attitude and approach...

Clearly, a vibrant and revived PFI could help in the latter regard.

To facilitate all this, infrastructure will need to be elevated in the political debate, and there is a need for cross-party buy-in. There has been some evidence of this lately in the UK, in that both the government and the opposition have expressed support for an increased emphasis on capital spending at the expense of current spending.

However there has, as yet, been little attempt to build a formal political consensus on a list of priority projects. Agreed national infrastructure priorities could with advantage be championed more aggressively, perhaps using the 2012 London Olympics as a model for successful delivery. That was a large, complex, and diverse project, that involved numerous layers of planning and the engagement of all levels of government, and which at its completion generated numerous saleable assets.

Infrastructure investment needs to be disengaged from the electoral cycle, and with greater acceptance of an unavoidable, and sometimes large, role for government, especially in the initial stages of projects when risks are highest.

Investor responses

... among investors as well as within government

In addition to the direct requirements for government, the capability of investors needs to increase too. But even here, there is a role for government in creating the necessary preconditions for the development of the institutional sector's capabilities. In practice this includes:

- Developing a regulatory, supervisory, and tax framework that allows or encourages private sector entities to develop necessary expertise and professionalism;
- Improving pension fund governance through better pension trustee composition; and
- Fostering resource-pooling and collaborative strategies through the consolidation of smaller pension funds and the merging of fund resources to create entities of sufficient scale to be able to offer more effective risk management systems and implement a broader investment strategy.

Further broader initiatives that would bolster investor capability include:

- Developing the regulatory framework to reduce the focus on short-term performance;
- Encouraging transparency in business models; and
- Reforming funding regulations for defined benefit schemes.

Such measures would in total help to improve the alignment of interests between the pension funds and the infrastructure industry, particularly through the provision of a prudential framework more attuned to long term investment.

Data and performance metrics are also a priority

Conditions for investment could also be enhanced by:

- Specifying common definitions for types of infrastructure project;
- Encouraging the independent and objective collection of data that hitherto has been scarce and largely proprietary; and
- Implementing common performance measures for risk and return, including specified industry benchmarks.

Universities and research bodies, including the OECD, could be tapped for expertise on infrastructure. And the creation of an independent association of infrastructure investors to bring forward institutional investors' interests, together with a formal platform for dialogue between them, the finance industry, and Government would also be beneficial.

IX. The way ahead – three ideas

A comprehensive, overlapping, strategy is thus required

The manifest importance of infrastructure spending to the UK economy, both as regards its immediate prospects and its long-term development, together with the equally obvious shortcomings in the way that this core aspect of investment is planned, funded, and regulated, lead to the question of what is the best way forward to address these issues.

Arguably, even a piecemeal approach, embracing some of the suggestions outlined in the previous section, would be better than doing nothing. But much better would be a comprehensive long term strategy that put in place an improved institutional framework for the future delivery of infrastructure, and which helped to create a stable and more sympathetic investment environment.

Accordingly, three proposals are offered below. Each differs in degree of breadth and concentration. None is mutually exclusive. All could in principle be capable of delivering a greater degree of coherence to the solution of the UK's infrastructure investment conundrum.

'Invest and sell' asset transfers

'Asset transfers' could address the immediate shortfall...

This is a demand-side proposal, designed to provide a public-expenditure-related stimulus at a time, such as the present, when there is significant excess capacity in the economy, the monetary policy stance is easy, yet the public finances are under duress and there is sensitivity about any such initiative that might frighten the markets or the rating agencies. It also offers up new opportunities for investment by the private sector in the latter stages of infrastructure projects, when the related cash flows are more stable and dependable.

The proposal is that the government should borrow an additional sum, say in the region of £15-30bn (some 1 to 2% of GDP) to directly finance investment expenditure in projects that stand to produce marketable output, with the stated intention of subsequently selling these assets, either partially or wholly, when times are better. Potential examples include railway lines; sea ports; airports; bridges; toll roads; perhaps even social housing. The expectation, based on evidence from abroad, such as France's network of high speed trains (TGV) such schemes would, in due course, induce the private sector to spend more.

... need not upset the markets or rating agencies ...

To deal with potential market and/or rating agency concern at near-term increases in public borrowing, it is suggested that the national accounts be re-presented such that they make clear the fundamental distinction between public debt that is backed by saleable assets, and general public debt that is not. This makes explicit the idea that not all debt is created equal; not all debt is quite the dead weight on the economy that it is sometimes presented as being.

This idea was suggested to the UK government by John Llewellyn and Gerry Holtham from 2009. It was rejected at the time, on a number of grounds: one was that there were few available, 'shovel-ready' projects; another was that, if there really were demand for such investments, the private sector would already be advancing them.

Given that it takes considerable time for a major infrastructure project to reach its high-expenditure phase, it is necessary that planning – including public enquiries, the design of contracts, land procurement, and so on – be undertaken well in advance. This would mean that one or more projects could, when necessary, be launched at relatively short notice, and even subsequently be switched on and off in accordance with the balance of aggregate supply and demand, both regionally and across the economy as a whole.

The Llewellyn/Holtham argument at the time was buttressed by the evidence, from many other economies, that recovery from financial crises was always likely to be shallow, so that there would still be time enough for this preparatory work to be done and for projects still to be worthwhile.

Furthermore, given the generally-low level of business and consumer confidence and the travails and conservatism of the banking sector, expecting the private sector to show much initiative in regard to infrastructure, or indeed any investment, was considered to be wishful thinking? Hence the public sector had to look to catalyse the recovery: and, if it did so, the private sector would be 'crowded in', rather than 'crowded out'.

Given that the cyclical upswing has indeed failed to gather much momentum over the intervening period, the persistence of historically-low interest rates because of QE, and that monetary policy remains to some extent hamstrung by balance sheet adjustments in the financial and non-financial private sectors, recent periods have seen government attitudes to fiscal stimulus, and in particular public-investment-related stimulus, ease somewhat. For example, the government has recently announced increases in its infrastructure spending plans amounting to about 0.2% of GDP per year for each of the next five years.

However, the fear remains in Whitehall that too much fiscal largesse might produce a negative reaction on long term interest rates or Sterling. Hence the logic for the original Llewellyn/Holtham proposal, and its ability to deliver a more substantive kick to the economy while addressing the issue of market nervousness. What is more, there is no reason why it should not be combined with some of the other potentially positive long term stimuli to infrastructure investment and the increased resort to private sector financing outlined above.

The Private Finance Initiative

The PFI method of infrastructure funding ran into the sand in the face of financing difficulties and, in particular, a shortage of bank lending, although there are tentative signs this is changing.⁹ After reaching a rate of some £8bn per year prior to the GFC, PFI investment has subsequently slowed sharply.

The vexed issue of bank financing is unlikely to disappear anytime soon unless a more adventurous approach is taken to banking sector recapitalisation and reform. The economic case for this is strong, but the potential cost to an already overburdened Treasury is clearly a major constraint.

Beyond fixing the banks, however, more could be done to reanimate the PFI, not least by recalibrating it away from service infrastructure towards investments in energy, broadband, and transportation.

Government has already responded to National Audit Office (NAO) evaluations of the sector, and has taken steps to address its shortcomings, not least through an active process of information exchange and consultation with the industry. Moreover, its December 2012 PFI2 initiative, whereby it is proposed to take a minority stakeholding in project firms and then siphon off some of the profits, goes some way towards the simplifying funding in the most risky phases of projects. This should make the financial instruments easier for non-bank capital to invest in. However, with the results so far disappointing, there is a case for pursuing this more forcefully.

Efforts have also been made to accelerate PFI delivery by setting a limit on the tendering phase for projects, and moving towards centralised departmental funding. The government has further sought to bring greater transparency and accountability to the PFI financing through the release of a project approval 'tracker', and the publication of private sector equity returns. All of these improvements warrant being sustained.

... and could be dovetailed with other initiatives

Reanimating the PFI would pay dividends...

... via a switch in focus...

... and greater efforts by government to shoulder equity risk

Perhaps the key consideration with the PFI, however, is the need for Government to be willing to shoulder more equity risk in the early phase of a project's lifespan. The UK Guarantees scheme was announced in July 2012 with a view to providing backing for around £40bn of infrastructure projects that have struggled to access private finance because of adverse credit conditions. However, thus far the tangible results have been few, with just two contracts signed.¹⁰ Industry players consider that this initiative needs to go further in order to overcome market risk, with perhaps less stringent conditions attached to the structure of the guarantees, and a willingness to extend it to projects that are not entirely dependent on a guarantee.

Other potentially useful initiatives include additional co-lending, and a real effort to inject life into the embryonic Green Investment Bank.

Were PF2 ultimately to match the achievements of the original PFI, it would represent around £300bn of additional capital spending.

A National Investment Bank

A NIB would offer an all-bracing approach

By far the most comprehensive, as well as potentially controversial, option would be the creation of a National Investment Bank (NIB) or fund. This would in essence represent the creation of a single vehicle to address the majority of the government policy and other issues raised in previous sections.

A NIB is an idea with a long and impressive lineage, stretching back to the writings of John Maynard Keynes in the 1930s and '40s.¹¹ His concern at the time was of an extended period of underemployment, if not quasi-secular stagnation, when monetary policy was compromised and private sector (mainly household) spending was hamstrung by balance-sheet adjustments of one form or another.

Keynes' solution was a stable, long term, investment programme, both private and public in origin that would sustain aggregate demand and boost confidence.

Keynes' analysis and policy conclusions have echoes in the current environment of extended demand deficiency; structural shortage of infrastructure and investment spending more generally; and insufficient recognition of various market failures in the private capital markets, not least in the area of financing.

Moreover, a NIB could in principal be used to offset some of the short-termism of industry and politicians, encourage the rebalancing of the economy via a focus on competitiveness, help to foster green investment (perhaps by taking over the existing Green Investment Bank, created last year), help SMEs, and be an important mechanism to tap pension and insurance funding. What it would not do is swell the public sector deficit unsustainably.

It would provide guarantees and issue bonds...

A NIB would in essence operate in two ways, but it would not directly distribute public money:

- **First**, it would provide a partial or full guarantee to support the initial equity cost of project finance where the private sector is reluctant to invest, or a partial or full guarantee on the repayment of bonds issued directly by investment projects themselves. In this way it would assume some or all of the risks of projects, especially in their early stages, and reduce funding costs.
- **For the most part**, however, it would lend to finance investment projects and raise funds for lending from the capital markets by issuing 'national investment bonds' which could be expected to carry a modest premium over the interest rate on government securities. These would be attractive fixed income investment instruments for pension schemes, both large and small, and offer a set of benchmark interest rates for infrastructure.

... while providing a long-term vision for infrastructure

It is not without risks, not least of political capture

Its governance would have to be carefully configured

However, a NIB would also set out to deliver long-term policy stability, and ensure that the supply of credit would dovetail with the pipeline of projects. It would build confidence in individual projects, and it would act as a focal point for project preparation and management. It could help to develop financial (e.g. risk management) and other expertise pertinent to the sector; provide a repository of objective information and quality data; work closely with the PIP and PFI; and aim at simplifying planning procedures.

Naturally the establishment of a NIB, like any policy initiative, would not be without risks, and its interventionist ethos could prove politically concerning. There would clearly be a chance of its becoming merely an unwieldy and inefficient quango, at risk of being captured by narrow political interests, or indeed ending up crowding out private sector financing, if not cannibalising the entire market for infrastructure. Safeguards would have to be put in place.

A NIB would need to be operationally independent of government, perhaps in the manner of the Bank of England, yet have a strategic link to government set in published mandates in order to perform something of a countercyclical macro stabilisation policy role.

It would need a high credit rating, and therefore a quality loan portfolio, and be run on the basis of sound banking principles. This in turn means that the Chief Executive or other senior officials would need to be government-appointed, accountable to Parliament, and audited by the NAO.

There would need to be a conservative ratio of lending to funding, and no explicit government guarantee on loans. The NIB would also have to be prohibited from undertaking any form of current spending.

In short, the NIB's activities would need to be confined to the financing of investment in productive assets that generate a long term return. Its initial capital could be raised either by government bonds to be bought by the market or the Bank of England, or perhaps from the proceeds of sales of semi-nationalised financial institutions such as RBS or Lloyds. It could also usefully aim at making a small profit that could be used to accumulate reserves.



IX. The way ahead – three ideas

Box: The National Infrastructure Plan

The UK's infrastructure plan relies on private sector involvement, and lacks detail and credibility.

In an effort better to meet the nation's infrastructure requirements, and to encourage new private sector investment in infrastructure (not least from pension funds), the UK government has, since 2010, set out a National Infrastructure Plan (NIP), which it has updated annually as part of the regular budget process. The 2012 plan outlined a pipeline of 550 projects, worth some £310bn, an increase of £45bn on 2011, with energy and transport accounting for nearly 90% of that total. The intention is to deliver one third of the total amount over the 2015-20 Parliament.

Across the board, the private sector is assumed to finance some 60% of the total, although there is considerable variation across sectors, and little is said about how this is to be achieved, beyond reference to the potential offered by pension funds, sovereign wealth funds, and insurance companies. Energy, water, and communications investments are assumed to be almost entirely privately funded. For transport, waste, flood protection, and intellectual capital, however, the public sector is expected to be the overwhelmingly dominant source of funds.

Reactions to the NIP have been mixed. The Institute of Civil Engineers was broadly positive, commenting that it:

"... lays the foundations for a more structured approach to our infrastructure delivery"

by setting out what the UK needs, and praising the efforts to attract pension fund investment. Others have been more critical. The New Economics Foundation said it fell some way short of what was required, and described it as:

"... [a] cobbled together compendium of every scheme that the Treasury had on the stocks."

Professor Dieter Helm, the Oxford University economist and author of a 2009 Policy Exchange report on infrastructure, wrote in the Financial Times that, although the plan was in essence a good idea, it did not reveal much "system planning", and that it was in many ways merely akin to "a wish list of individual projects". Finally, Terry Morgan, the chairman of Crossrail has recently bemoaned the lack of "continuity" in UK infrastructure programmes, and contrasted the UK's "extremes of demand" with the much "smoother" profiles seen in Europe.

The overall conclusion appears to be that, while embracing a plan is something of a step forward, as currently configured it is more indicative than operational. There remains considerable uncertainty about the consistency and durability of the pipeline, and how the blueprint can become reality, given the current macro conjuncture and without major changes in the way that infrastructure investment is viewed and acted upon by government. Soundings of firms actively involved in the construction sector highlight these issues, and continue to bemoan the lack of "shovel-ready" projects. Indeed, such are the present day imponderables about UK infrastructure that construction skills are already in short supply, existing expertise is being denuded, and some specialist investment and engineering teams are apparently moving employees abroad:

"We will be demobilising our tunnelling capacity next year...It would be a crying shame if we weren't able to pass on what we have learnt". (Terry Morgan, CEO of Crossrail)

Clearly, the NIP could be improved and rendered more sympathetic to the attraction of private sector funding by moving from aspiration to greater certainty and a more acute focus on delivery. This requires, *inter alia*, detailed analysis of the barriers to infrastructure funding.

Figure 15: National Infrastructure Plan

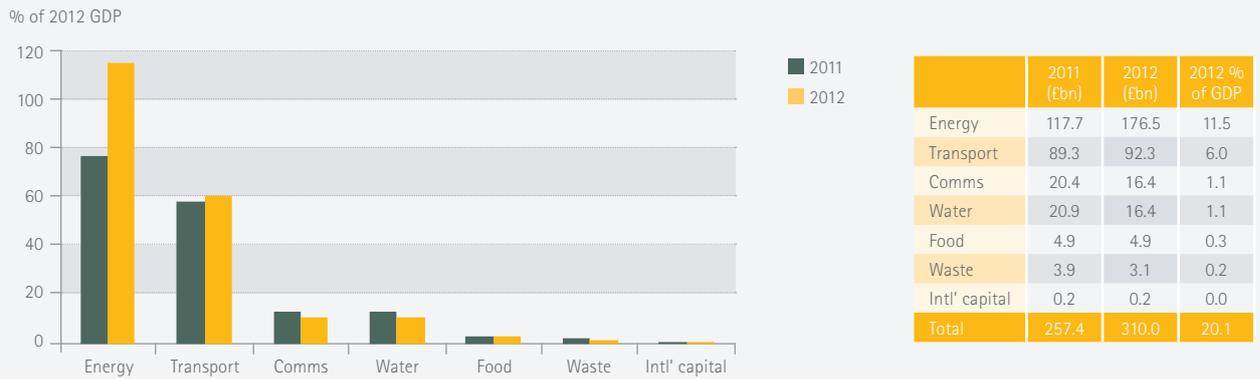
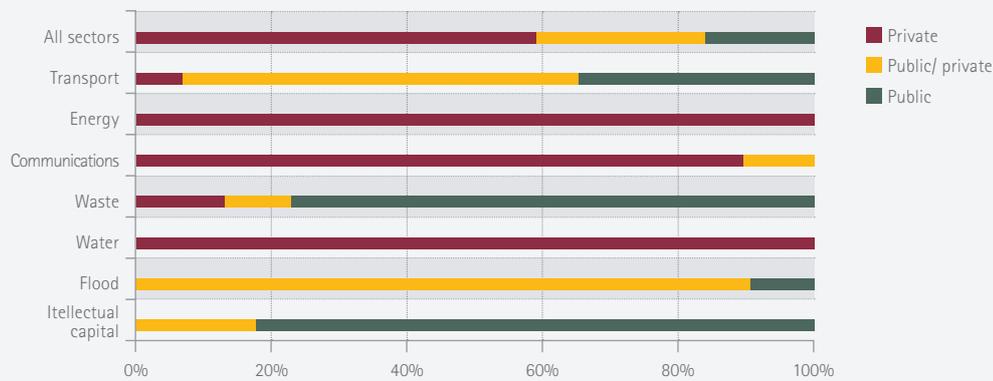


Figure 16: National Infrastructure Plan proposed funding sources



Source: HM Treasury National Infrastructure Plan 2012

Endnotes

1. **World Economic Forum**, *Global Competitiveness Report 2012-2013*
2. www.cbi.org.uk/business-issues/infrastructure/infrastructure/survey/infrastructure-survey-2012/
3. **Financial Times**, 27 and 28 June 2013
4. **IMF**, *IMF Fiscal Monitor: Fiscal Adjustment in an Uncertain World*, April 2013
5. **OECD**, *Economic Reforms: Going for Growth 2013*.
6. **Office for Budget Responsibility**, *Economic and Fiscal Outlook*, March 2013
7. http://www.hm-treasury.gov.uk/d/summary_document_pfi_data_march_2012.pdf
8. **Pension Protection Fund**, PPF 7800 Index, 31 May 2013
http://www.pensionprotectionfund.org.uk/DocumentLibrary/Documents/PPF_7800_June_13.pdf
9. **R. Della Croce**, *Pension funds investment in infrastructure – policy actions*, OECD Working Paper on Finance, Insurance and Private Pensions No. 13, September 2011
10. **Financial Times**, 24 June 2013
11. **John Maynard Keynes**, *The General Theory of Employment Interest and Money*, 1936, and *Collected Writings*, Volume xxxvii, *Shaping the post-war world: employment and commodities*.
(The cut-off date for information in this publication is 1 July 2013)

References

- Bardens, J.** (2013) *Infrastructure policy*, House of Commons Library, 28 March
- Bagaria, N., Holland, D. and Van Reenen, J.** (2012) *Fiscal consolidation during a depression*. National Institute Economic Review vo. 221
- Barrell, R., Fic, T. and Liadze, I.** (2012) *Fiscal Policy Effectiveness in the Banking Crisis*. National Institute Economic Review, No. 207
- Canning, D. and Pedroni, P.** (2008) *Infrastructure, Long-run Economic Growth and Causality Tests for Cointegrated Panels*. Manchester School, vol. 76(5)
- Della Croce, R.** (2011) *Pension funds investment in infrastructure – policy actions*, OECD Working Papers on Finance, Insurance and Private Pensions No.13, September
- Demetriades, P. and Mamuneas, T.** (2000) *Intertemporal Output and Employment Effects of Public Infrastructure Capital: Evidence from 12 OECD Economies*. Economic Journal, 110(465), 2000
- Egert, B., Kozluk, T. and Sutherland, D.** (2009) *Infrastructure and growth: empirical evidence*. OECD Economic Department Working Paper No. 685
- Eldrup, A. and Schutze, P.** (2013) *Organisation and financing of public infrastructure projects main report*. May
- Fic, T. and Portes, J.** (2013) *Macroeconomic impacts of infrastructure spending*. National Institute of Economic and Social Research
- HM Treasury**, *National Infrastructures Plan 2011*
- HM Treasury**, *Infrastructure delivery update 2012*
- HM Treasury**, *Infrastructure delivery update 2013*
- Holland, D. and Portes, J.** (2012) *Self-defeating austerity?* National Institute Economic Review 222
- IMF**, 2010a. *Will it hurt? Macroeconomic Effects of Fiscal Consolidation*. Chapter three, World Economic Outlook
- IMF**, 2010b. *Effects of Fiscal Stimulus in Structural Models*. IMF Working Paper 10(73)
- Inderst, G. and Della Croce, R.** (2013) *Pension fund investment: a comparison between Australia and Canada* (Draft), OECD, May
- Keynes, J. M.** (1936) *The General Theory of Employment Interest and Money*
- Keynes, J. M.** (2012) *Collected Writings, Volume xxxvii, Shaping the post-war world: employment and commodities*
- Ottesen, F.** (2011) *Infrastructure and pension investments – creating the perfect match*, OECD Journal: Financial Market Trends. volume 2011/1
- Skidelsky, R., Martin, F. and Wigstrom, C. W.** (2011) *Blueprint for a British investment bank*, Centre for Global Studies, November

Disclaimers

The information, tools and material presented herein are provided for informational purposes only and are not to be used or considered as an offer or a solicitation to sell or an offer or solicitation to buy or subscribe for securities, investment products or other financial instruments. All express or implied warranties or representations are excluded to the fullest extent permissible by law.

Whilst reasonable efforts have been made to ensure the accuracy of the content of this publication we make no warranties or representations as to its accuracy, currency or comprehensiveness and assume no liability or responsibility for any error or omission and/or for any loss arising in connection with or attributable to any action or decision taken as a result of using or relying on the content of this publication. This publication may contain references to material(s) from third parties whose copyright must be acknowledged by obtaining necessary authorisation from the copyright owner(s). Llewellyn Consulting will not be liable or responsible for any unauthorised use of third party material(s).

Nothing in this report shall be deemed to constitute financial or other professional advice in any way, and under no circumstances shall we be liable for any direct or indirect losses, costs or expenses nor for any loss of profit that results from the content of this report or any material in it or website links or references embedded within it. This report is produced by us in the United Kingdom and we make no representation that any material contained in this report is appropriate for any other jurisdiction. These terms are governed by the laws of England and Wales and you agree that the English courts shall have exclusive jurisdiction in any dispute.

©Copyright Llewellyn Consulting LLP 2013. All rights reserved. The content of this report, either in whole or in part, may not be reproduced, or transmitted in any form or by any means, electronic, photocopying, digitalisation or otherwise without the prior written permission of the publisher.

This publication has been prepared for general guidance on matters of interest only, and does not constitute professional advice. You should not act upon the information contained in this publication without obtaining specific professional advice. No representation or warranty (express or implied) is given as to the accuracy or completeness of the information contained in this publication, and, to the extent permitted by law, Pension Corporation, its members, employees and agents do not accept or assume any liability, responsibility or duty of care for any consequences of you or anyone else acting, or refraining to act, in reliance on the information contained in this publication or for any decision based on it.

'Pension Corporation' refers to Pension Insurance Corporation Limited and its affiliated entities. Pension Insurance Corporation is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and Prudential Regulation Authority FRN 454345.

Investment in Social Housing:

How institutional investors are investing in local communities



PENSION INSURANCE
CORPORATION



About Pension Insurance Corporation

Pension Insurance Corporation ("PIC") provides tailored pension insurance buyouts and buy-ins to the trustees and sponsors of UK defined benefit pension funds. PIC brings safety and security to scheme members' benefits through innovative, bespoke insurance solutions, which include deferred premiums and the use of company assets as part payment.

At 30 June 2016, PIC had £18.4 billion in assets backing the pensions of more than 130,000 policyholders. These assets are primarily invested in investment grade corporate bonds, UK government debt and cash. However, as a specialist pension insurer with liabilities analogous to those of a defined benefit pension scheme, PIC also invests in other forms of secure, long-term cash flows.

To date we have invested more than £500 million in debt issued by Housing Associations through direct deals, backing affordable housing up and down the country. With asset growth of around £5 billion in the past 18 months, PIC is a growing business with the expertise, desire and capacity to partner with Housing Associations on future deals.

PIC is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and Prudential Regulation Authority (FRN 454345). For further information please visit www.pensioncorporation.com

Table of Contents

Introduction.....	04
Partnering with institutional investors.....	06
• Case study – Pendleton Together.....	08
Policy/ regulatory drivers	09
• Case study – Grŵp Gwalia Cyf.....	11
Working with prospective lenders.....	12
• What should a Housing Association expect from a lender?.....	13
• Case study – mhs homes.....	14
• Case study – Investment in Church of England's Housing Assistance for the Retired Ministry.....	15

Introduction

Housing Associations ("HAs") are independent, not for profit bodies that provide rented homes, some at sub-market rates, within a strong regulatory framework with implicit government support.

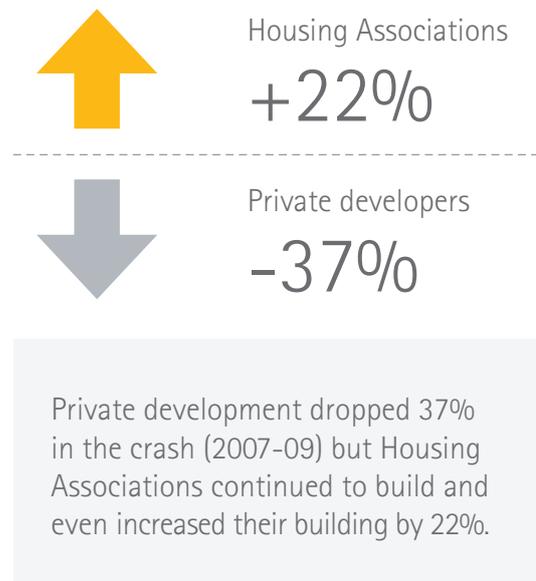
They can have a hugely positive role on the lives of residents and in the development of local communities, as well as the wider economy (see Figures 1 & 2). They can also be important partners for institutional investors, helping to support the pensions of millions of people around the country.

Figure 1.



Source: National Housing Federation 'Housing Association Facts and figures'

Figure 2.



Source: National Housing Federation 'Housing Association Facts and figures'

In order to gather background and data for this document, PIC sent a survey to our HA partners in the summer of 2016. We asked them about their outlook for the sector, their pipeline of projects, as well as their views on planning processes. The responses we received were surprising in the extent and breadth of the activities they provide for residents beyond providing subsidised places of residence. We were also heartened by the levels of economic and social benefit they strive to bring to local communities. There are many examples of best practice in this area contained in this document.

From the responses we received, it's clear that all this doesn't happen by accident. At their very best, HAs really do design their projects around the needs of the community. This might include for example,

providing, at no cost, community buildings for use by charities involved in training, skills development, provision of childcare and bereavement counselling for local residents. It might also include the provision of leisure facilities such as allotments, urban farms or arts theatres.

The best HAs are developing crucial links to local businesses at the early stages of their development projects, helping to create local jobs and apprenticeships. Even once the development phase has finished, they are providing ongoing benefit to the local economy. Indeed, in 2015 one third of all houses developed in the UK were built by HAs, so they have a crucial role to play. One HA that responded to our survey provided opportunities for more than 50 residents to find employment in 2015. Others have specific measures for the overall success of their development projects in part on the jobs created and the businesses supported.

This document is, in part, designed to highlight the best practice we at PIC see in our work with HAs in order that this can be shared and developed more widely.

This document is also designed to highlight the perhaps surprising perspective of those who work in HAs about the importance of their relationships with long-term investors, especially as banks are no longer able to lend at the same pre-crisis levels. These organisations have been clear to us that without the long-term relationships and security of financing that can be offered by institutional investors, development plans would need to be cancelled or scaled back. This can have a significant impact on the local community. Links with the City and with institutional investors are therefore very important to HAs. These links feed directly into the wider social benefits that HAs bring to local communities.

What is clear from our conversations with the people who work for HAs is that they do not feel that story is well enough understood by important audiences, including politicians and indeed by their own residents.

Ultimately, this document is designed to provoke discussion and debate about this relationship and how institutional investors can best work with HAs, and vice-versa.

Figure 3.



1/3

of all houses built in the UK in 2015
were built by Housing Associations

Source: *National Housing Federation 'Housing Association Facts and figures'*

Partnering with institutional investors

From an investment perspective, HAs have become an increasingly important partner for institutional investors, such as pension funds and insurance companies. This is because institutional investors with long-term liabilities need to match their pension payments with secure long-term cash-flows. The long-term nature of HAs means that they are able to offer investment opportunities, in the form of high quality, secure debt, at rates attractive to these investors in a world of low returns.

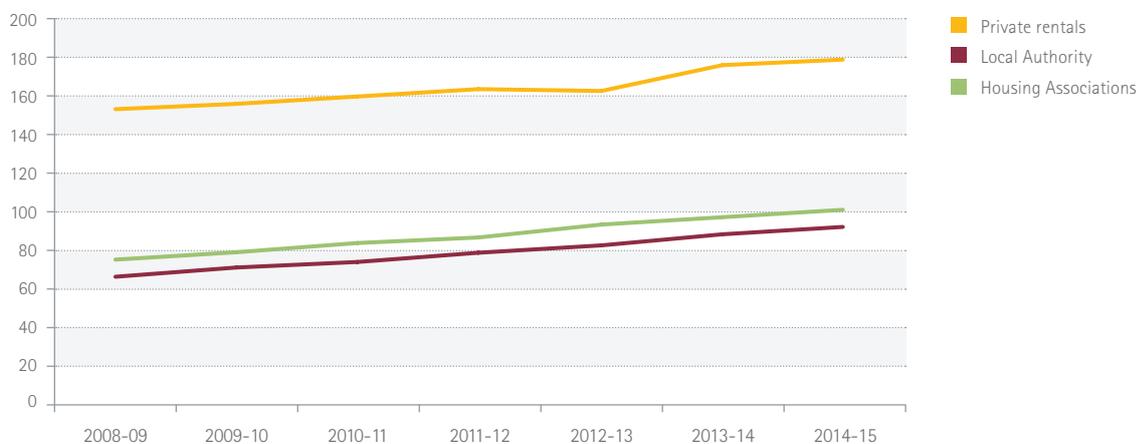
From the HA perspective, however, this is not a one way street: they need long-term relationships with stable lenders who are able to work with them to meet their funding needs with secure financing. This might include reducing the overall cost of borrowing, reducing the cost of carry and fully funding development aspirations.

There are certain steps that need to be considered on both sides if the relationship is to be a success.

Investors need to be clear why they are investing in HAs, and, as with other illiquid investments, need to put in time and effort to understand what they are investing in and the risks that are the counterpoint to the reward. Investors need to remember that just because a sector is regulated, there is no substitute for proper due diligence. To the contrary, regulations can be changed and, as we have seen over the past few years, this can change the investment case. For example, in his Summer Budget 2015, the then Chancellor, George Osborne MP, reversed a previously agreed policy of CPI plus 1% as the basis of rent increases for the subsequent decade. Instead, he announced that HA rents would decline on average by 12% over the four years to 2020-2021, forecast to benefit tenants by about £700 a year. Regulatory uncertainty has the potential to make some HAs appear a higher-risk investment.

Figure 4 shows how HA rent levels compare with other sectors, even in spite of the rent increases.

Figure 4: Rental incomes 2008-2015

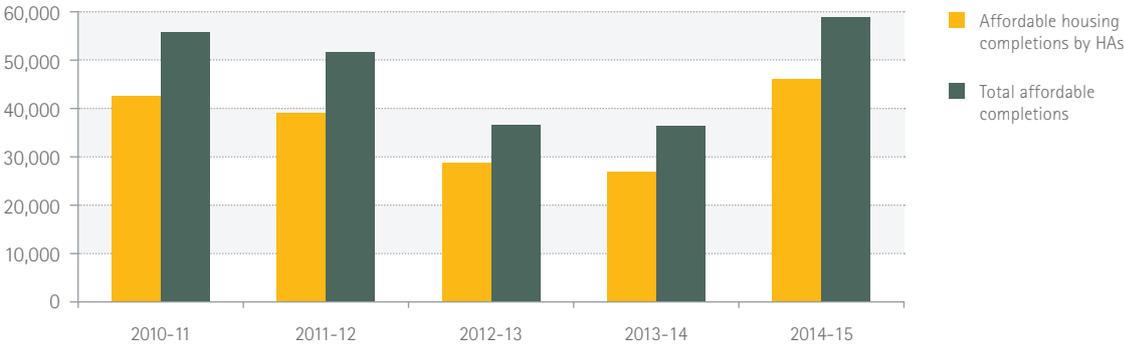


Source: DCLG English housing survey 2014 to 2015

Likewise, changes in the macro-economic environment can also impact, for better or for worse, the case for investing in HAs. For example, following the (Brexit) referendum result, the UK was downgraded by rating agencies. As HAs are supported by the overall UK rating for their own ratings, this means that they were also impacted. If a particular investor is only able to invest in debt with a certain rating, this could rule out investing in HAs.

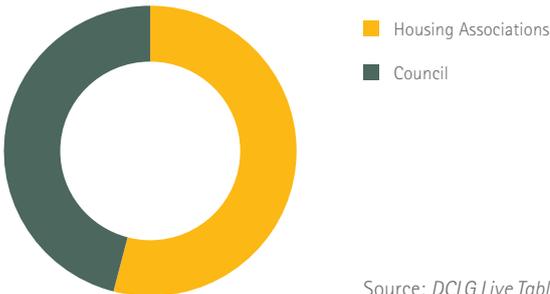
However, the fundamental investment case remains strong: the structural demand for housing (affordable or otherwise) in the UK. Indeed, in 2015 there were more than 1.2 million households on waiting lists for social housing in England, although this list is shorter than it might otherwise have been due to the effect of the Localism Act 2012. Ultimately, however, the sheer demand for housing helps to support the cash-flows generated by the underlying assets and HAs are a critical provider of housing in the UK (see Figures 5 & 6).

Figure 5: Affordable housing completions by HAs vs Total affordable completions



Source: DCLG Live Table 209

Figure 6: Social housing providers in the UK



Source: DCLG Live Table 209



Case study – Pendleton Together

In 2013, PIC was the sole investor in £72 million of bonds backed by a project agreement with Salford City Council, to fund the New Pendleton Social Housing PFI project.

The funding is being used for the refurbishment of existing dwellings and associated infrastructure. The dwellings are a mix of high-rise blocks and low-rise terrace properties. The funds are being used by the project to refurbish about 1,250 existing dwellings in Salford, and to finance their maintenance over 30 years.

This project was delayed in the early days due to uncertainty of funding availability both of PFI credits and long-term bank financing, so having the funding from PIC in place at the start of the contract provided the certainty and security that the project needed. On the back of this, other private funding has been levered, allowing for significant additional investment, improving the local geographic area in terms of appearance, economic activity, health and wellbeing improvements and job creation schemes.

In choosing to work with any potential client/ borrower, the ability to build long-term relationships is critical to PIC.



Policy/ regulatory drivers

Institutional investors have to understand that the direction of policy and regulation can change quite suddenly, undercutting business models and affecting stakeholders in quite dramatic ways. A recent example of this is the Pension Freedoms introduced by the Government in 2015. This radically altered the way that savers were able to use their pension pot and completely removed the obligation to purchase an annuity, dramatically altering the business models of some insurance companies.

We have not seen anything this radical in the social housing sector. However, the general tone of government policy has been to encourage a shift from social housing renting to more home ownership. They have also been keen to encourage HAs to streamline their cost base and increase merger activity across the sector.

These changes, including the 1% rent reduction for the next four years on the majority of social housing units, present both challenges and opportunities for investors.

Perhaps the most important point is that fundamentally, the rent reduction and squeeze on benefit levels will put financial pressure on HAs. On the face of it this should make their debt less attractive to investors. However, this isn't necessarily the case as the sector responds in a variety of ways.

Those HAs with robust financials, good governance and sensible risk appetites should be able to successfully weather the changes, and indeed the sector is already showing signs of responding to the challenges. A strong case can be presented to potential financial partners by those HAs who can demonstrate they are well-prepared for the challenges ahead.

Others will be harder hit and the expectation is that we will see greater credit differentiation between HAs, as some will be better placed to respond to the changes than others. This may well lead to some HAs introducing more risk into their business model (e.g. through substantial development and sales exposure) to boost revenues. This means they will likely have to offer a higher yield on their debt. Whilst the increased yield versus government bonds on offer may be tempting to investors, especially in a world of negative sovereign bond yields, it is likely to be less attractive to institutional investors with a need to match assets and liabilities and strict regulatory frameworks with which they have to comply. Debt default is the greatest threat in this circumstance and whilst security structures can be negotiated (see section on *Working with prospective lenders*, pg.12), the balance of risk and reward will be carefully scrutinized on a case-by-case basis.

As a result of the policy changes, we would expect to see some further consolidation in the sector and an increased focus on higher levels of operational efficiency. Along with Right to Buy, which is generally considered credit positive as this may generate large cash windfalls for HAs, consolidation should be good for the sector as it will create larger, more stable HAs, and hopefully continue the trend of greater efficiencies being achieved by management across the sector.

Ultimately, whether consolidation happens or not, institutional investors will continue to work with HAs on their financing needs, despite the risk of further policy/ regulatory changes. They will try to manage some of this risk, however, by focusing on high quality credits which are well placed to withstand potential changes.

"Without doubt, these recent changes in policy have been factored into future strategies, risk appetites and financial appraisals. What is not in doubt is the demand for new homes. In view of this, ways will be found to procure new dwellings but the mix/ tenure might have to be altered to fit new political aims. When this is achieved, further debt funding will be needed."

Pendleton Together

Summary of policy/ regulatory change in the sector:

- 1% rent reduction for the next four years on the majority of social housing units
- Right to Buy – allows housing association tenants the right to buy their homes, albeit initial proposals have been watered down and it is now voluntary for HAs to sign up to this
- Pay to stay – requires higher income social housing tenants to pay increased levels of rent (HA participation is now voluntary)
- Benefit Cap – reduction in the benefit cap (the maximum amount of benefits that can be claimed) from £26k p.a. to £20k p.a. (£23k in London)
- Local Housing Allowance (LHA) caps – housing benefit will be capped for new entrants at the relevant LHA rate set for each area
- Deregulatory measures for the social housing regulator (the Homes and Communities Agency), to overturn the recent classification of HA debt on the government's balance sheet



Case study – Grŵp Gwalia Cyf

Grŵp Gwalia Cyf (now part of the Pobl Group) is a leading provider of social housing in south and mid Wales, managing over 10,000 high quality affordable homes and meeting the needs of a broad and diverse range of people in the community. Following a recent merger (with Seren), The Pobl Group has responsibility for 16,000 properties. Gwalia agreed a £35 million loan with PIC in 2012, through private placement, to invest in affordable and social housing projects across south Wales, building approximately 250 new homes.

For Gwalia, certainty of funding was critical at outset to allow them to put their plans in place. However, having certainty of funding was a risk management strategy to cushion them as far as possible from regulatory and policy changes. In particular, they were concerned about the risk of an extension of rent controls to Wales, following the 1% rent reduction seen in England, which does not currently apply in the Principality.

"When choosing a provider we are obviously focused on price. But of real importance is the ability to develop a long-term relationship with the funder, as well as their ability to be flexible in terms of structuring the finance package."

Gwalia



Working with prospective lenders

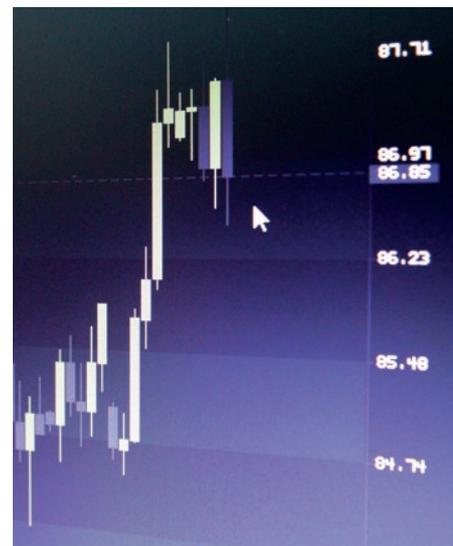
From a practical perspective, how should an HA work with a prospective lender to ensure that they complete the deal on the best possible terms for both parties?

HAs should ideally have the ability to:

- Be flexible in the types of debt structures that can be accommodated – the final structure should work well for both parties
- Secure the debt to social housing assets
- Accommodate inflation-linked structures as well as more traditional fixed rate debt
- Maintain a strong investment grade equivalent rating
- Offer flexibility on maturity of debt to allow lenders to better match their liability profiles

Preparation is also key to ensuring that HAs get the very best deal they can. In particular they should:

- Have a strong management presentation
- Offer transparency
- Have clear but flexible timescales
- Have a willingness to build a long-term relationship
- Be prepared to include prepayment protection for the lender



Likewise, what should an HA expect from a lender?

Lenders can often accommodate investing in a range of structures. For example, lending directly to HAs or funding social housing development and regeneration schemes through a PFI model. This will of course depend on the expertise and risk tolerance of the lender in question, but ideally there should be opportunity to at least explore both options.

In assessing the level of expertise that a lender has, and hence how beneficial the relationship might be, HAs should check whether the lender has the flexibility to apply their own internal rating. This is important from a borrower's perspective because it allows them to issue debt without having an external credit rating. This facility gives them flexibility around timelines for deal completion and indicates their level of sophistication and therefore the likelihood of them seeing the deal through to completion.

It is also worth seeing whether the lender can accommodate quite specific requirements, such as deferred draw down profiles. These offer flexibility to borrowers and provide certainty of funding whilst reducing the cost of carry. They are not, however, facilities which every lender will be able to accommodate.

When engaging on the direct side, lenders should be flexible on structure, to accommodate the needs of the HA. This might mean participating in public bonds, private placements, and loan structures. It should be noted that in most cases negotiation directly with an individual or club investor significantly reduces any potential execution risk from a transaction.

Institutional investors may also need the investment to be secured on social housing assets. This means that borrowers will be able to lend at a lower yield as there is ultimately less risk to the lender. For insurance companies this is particularly important.



Case study – mhs homes

In 2016, PIC invested £40 million in secured debt issued by mhs homes, a social housing provider based in Kent. Mhs homes are one of the largest independent landlords in Kent, owning and managing more than 8,500 homes in Medway, Maidstone and Dartford.

Key aspects of the transaction:

- £40m private placement, drawn in two stages over the next two years, giving mhs homes certainty of funding costs, whilst reducing the cost of carry
- Funding to help provide more than 400 new properties
- 34 year maturity (April 2050), to match PIC's liabilities
- Secured on social housing properties

"This funding will help provide over 400 new properties in the Medway and surrounding areas. The flexible arrangements agreed with PIC meet the requirements of our business plan and provides the long-term funding to match our aspirations."

Bruce Shelmerdine, Finance Director at mhs homes

Figure 7.

Building long-term relationships



Source: MHS Homes Data (2016)



Case study – Investment in Church of England's Housing Assistance for the Retired Ministry

In 2015, PIC invested £70 million in secured debt issued by CHARM Finance Plc, to fund retirement housing in the CHARM (Church's Housing Assistance for the Retired Ministry) scheme.

This scheme, provided by the Church of England Pensions Board ("CEPB"), offers subsidized retirement housing for clergy in the Church of England. The investment is linked to CPI and secured against a portfolio of residential assets. PIC was the sole investor.

For CHARM, the long-term certainty of funding allowed them to move from a rate reviewed three monthly on the rolling credit facility. They were also happy with the inflation linkage, which is a good match for inflation linked rents. The funds also allowed them to buy out the Church Commissioners' financial interest in properties that the Pensions Board considers to be long-term holds and means they will enjoy the rewards and risks of ownership.



Best practice highlighted by our partners



“ Ongoing estate management is contributing to lower anti-social behaviour, an increase in demand for dwellings. ”

“ The investment is resulting in new jobs and apprenticeships for local people. ”

“ New parks and allotments are bringing health and leisure benefits. ”

“ New jobs/apprenticeships in construction have been created but also in associated support areas such as catering and cleaning. Jobs have also been created in estate/management services. ”

“ When designing the overall project, the wider needs of the community are integral and the masterplan was subject to significant resident consultation. Input from local people help forge the long term plans. ”



“ Factors such as ease of access to services such as public transport, retail and healthcare are important. ”

“ Our environmental aims include energy efficiency as part of planned reinvestment. ”

“ 320 properties have been insulated over the past 2 years and 160 double-glazed windows and doors installed. ”

“ Aim to meet Decent Home Standards in newly acquired and re-let properties. ”



“ Our work plan over the next two years that link to our social and environmental activities will mainly fall into the following areas:

- To deliver great services
- To provide quality homes
- To help our customers achieve their potential
- To be financially fit and lean
- To have exceptional and diverse talent.

”

“ Our primary purpose is to alleviate the levels of homelessness and to provide a safe, affordable home to those most in need. Our added value activities often include personal support to help people with:

- Personal financial management
- Access to skills, training and employment
- Train people to engage with the digital world.

”

“ We are also corporate partners with Medway UTC (a new technical school for 14-19 year olds specialising in Engineering, Construction and Design) and for 2016/17 we will be hosting 20 students for work experience and working with Mid Kent College on an academy for apprentices for our own in house maintenance team.

”

“ For all our maintenance and development contracts we seek one apprentice for every £1m of contract value. These are local apprentices. We also have our own programme of work experience, apprentices and interns across different teams. For the year 2015/16 we provided opportunities for:

- 48 work experience placements
- 15 apprentices
- 56 residents into employment.

”

“ With any new homes development we research the likely demand, overall costs of construction vs the market value once completed. Certain locations are better suited to certain tenures (market rent/ and sale if e.g. close to commuter hubs, and older persons accommodation if close to shops and medical facilities). All refurbishment and new build opportunities are fully appraised before being proposed and approved to ensure that the business and our communities are well served.

”

Contact



Allen Twyning

Head of Debt Origination

twyning@pensioncorporation.com

+44 20 7105 2232



Elizabeth Cain

Debt Origination Analyst

cain@pensioncorporation.com

+44 20 7105 2080



Jeremy Apfel

Head of Corporate Affairs

apfel@pensioncorporation.com

+44 20 7105 2140

This publication has been prepared for general guidance on matters of interest only, and does not constitute professional advice. You should not act upon the information contained in this publication without obtaining specific professional advice. No representation or warranty (express or implied) is given as to the accuracy or completeness of the information contained in this publication, and, to the extent permitted by law, Pension Corporation, its members, employees and agents do not accept or assume any liability, responsibility or duty of care for any consequences of you or anyone else acting, or refraining to act, in reliance on the information contained in this publication or for any decision based on it.

'Pension Corporation' refers to Pension Insurance Corporation plc and its affiliated entities. Pension Insurance Corporation plc is a public limited company registered in England and Wales under company number 05706720. It is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and Prudential Regulation Authority. FRN 454345. Pension Services Corporation Limited is a limited company registered in England and Wales under company number 8019046 and provides services to PIC. Both Registered offices are at 14 Cornhill, London EC3V 3ND.



PENSION INSURANCE
CORPORATION

Appendix 1

West of England Response to the National Infrastructure Assessment: Call for Evidence

Rail

What is the proposed remedy?

For the background context see our response to 'What is the Issue?'

Our proposed remedy is as follows. A mechanism needs to be put in place by Network Rail and approved by the Office of Rail and Road, for sharing the costs and risks of third party rail schemes between the third party and Network Rail, on the following basis.

Joint Third Party/Network Rail Investment Mechanism (CP6)

Requirement	Details
Strategic & policy objectives	Schemes must demonstrate its contribution to rail industry strategic objectives and set out the strategic case for the scheme.
Value for money	Schemes must be WebTag compliant for their economic appraisal. The scheme economic case to be reviewed and approved by Network Rail.
Governance and Programme Control	Requirement for entry into the Joint Programme would be on the basis of completing GRIP2 and review and approval of the economic case at GRIP stages 3, 4 and 5.
Commercial and Contractual Model	The contractual model for the scheme to be determined on a scheme by scheme basis. The board options being: i) all GRIP stages procured via Network Rail through Development Services/Implementation Agreement, ii) all GRIP stages procured via external consultants and then validated by Network Rail, with construction and implementation delivered by a third party contractor iii) a hybrid of i) and ii) iv) A bespoke delivery mechanism, such as a special purpose vehicle.
Pre-construction phase	GRIP1 – 2 is funded 100% by the third party. GRIP3 & 4 is funded jointly by the third party and Network Rail, split 80% third party and 20% Network Rail. GRIP5 is funded jointly by the third party and Network Rail, split 67% third party and 33% Network Rail. All non GRIP costs ie, planning consent costs, land agent, highway design, etc are funded 100% by the third party.
Construction & implementation phase incl land acquisition, highway construction, environmental mitigation etc	GRIP6-8 and all other construction and implementation costs funded jointly by the third party and Network Rail, split 67% third party and 33% Network Rail.

Risks	<p>GRIP1 to 2 all risks are owned by the third party funder.</p> <p>GRIP3 & 4 risks are shared jointly by third party and Network Rail, split 80% third party and 20% Network Rail.</p> <p>GRIP5 risks are shared jointly by third party and Network Rail, split 67% third party and 33% Network Rail.</p> <p>GRIP6 to 8 all risks are owned by Network Rail. The GRIP5 cost estimate will fix the contribution of the third party to the construction and implementation of the scheme.</p>
-------	--

Worked example

Line re-opening scheme with a total delivery estimated cost of £100m (out-turn).

Cost Element	Total	Third Party contribution		Network Rail contribution	
	£m	£m	%	£m	%
GRIP 1-2 Feasibility including 7% Ind Fee & Risk Fund	£0.25	£0.25	100%	£0.00	0%
GRIP 3 & 4 Option Selection & Development including 7% Ind Fee & Risk Fund	£2.25	£1.80	80%	£0.45	20%
GRIP5 Detailed Design including 7% Ind Fee & Risk Fund	£4.50	£3.02	67%	£1.49	33%
Other pre-construction costs ie planning and other consents, land agent, highway design	£4.00	£4.00	100%	£0.00	0%
GRIP6-8 all Construction and Implementation costs including, land acquisition, highway construction, environmental mitigation etc including 7% Ind Fee & Risk Fund	£89.00	£59.63	67%	£29.37	33%
Totals	£100.00	£68.70	69%	£31.31	31%

The total contribution by the third party in this worked example is capped at £68.70m, based on the GRIP5 cost estimate.

The entry bar for the third parties would still be high as it would have to meeting all costs up to GRIP2 and most of the GRIP 3, GRIP4 & 5 costs. This would act to sift out highly 'aspirational' third party schemes, given the burden of cost to get to GRIP5 would remain very significant.

On the basis that the net contribution by Network Rail would broadly work out at around 30% depending on the scheme, an allocation by Network (via Control Period 6) of £300m would lever in third party investment of £700m, with a total investment in the network of £1bn.

Input to National Infrastructure Committee Call for Evidence, February 2017

To: NIAEvidence@nic.gsi.gov.uk

From the Linear Infrastructure Network – LINet

We would like to submit this response to the National Infrastructure Committee Call for Evidence on behalf of the Linear Infrastructure Network (LINet). This is an informal group of linear asset owning/managing sectors, with a shared aim to promote, embed and mainstream the use of green infrastructure (GI) as a tool for enhancing the resilience and reducing the whole life costs of national and local linear infrastructure assets.

Our input focuses on the strategic importance of green infrastructure being part of traditional or 'grey' infrastructure. Although this has relevance to question 11, 'How should infrastructure most effectively contribute to protecting and enhancing the natural environment, we see it is an over-arching strategic importance and a current gap, or missed opportunity in the approach and plan.

The value of increasing and incorporating green infrastructure is significant. We recommend that highest value should take into account the multiple benefits derived from incorporating well maintained and designed green infrastructure as an important part of infrastructure investment, such as quality of place, flood risk and air quality management, enhanced physical and mental health, energy and pollination.

The assessment and national infrastructure plan should promote the inclusion of green infrastructure such as trees and other planting, living roofs, walls and sustainable drainage such as swales and raingardens. This includes the incorporation of green infrastructure into new-build linear infrastructure assets, retrofitting it into existing linear infrastructure assets and its appropriate management and maintenance.

Green infrastructure is important in keeping the UK resilient to extreme weather by reducing rainfall run off rates and overall temperature. It contributes to tackling air quality, regenerative, resilient, green city. LINet members recognise the value of green infrastructure in enhancing the resilience of 'grey' infrastructure networks and improving reliability and reducing risk.

Benefits of including green infrastructure with linear infrastructure include

- storm and flood prevention by attenuating water flow
- bank stabilisation, as low water using vegetation stabilises soil
- perceived noise attenuation and visual barriers
- reduced leaf fall and tree and deer collision risk shading and cooling, which prevents track buckling

For evidence of demonstrating the above see:

<http://publications.naturalengland.org.uk/publication/5752930789490688>

<http://publications.naturalengland.org.uk/publication/6692039286587392>

http://www.plantlife.org.uk/publications/road_verge_management_guide

<http://www.susdrain.org/resources/ciria-guidance.html>

http://www.ciria.org/Research/Project_proposals2/Delivering_green_infrastructure_along_linear_assets.aspx?WebsiteKey=3f18c87a-d62b-4eca-8ef4-9b09309c1c91

The assessment and plan should promote the early inclusion of green infrastructure as when introduced early into the design they are often cheaper to install and maintain than traditional solutions. For example, installation of green roofs versus bitumen roofs and the associated (grey) positive drainage systems they need to cope with runoff, especially when valuing the other benefits they deliver such as drainage.

Many infrastructure companies, including LINet members, have adopted (such as Network Rail and Highways England) policies for securing 'net gain' from development (or are considering adopting this, such as Transport for London). Net gain projects deliver quantifiable and measurable benefits for biodiversity as well as providing a range of wider environmental enhancements, such as flood risk mitigation, enhanced air quality and opportunities for public engagement with the natural environment.

Examples of the role of infrastructure in delivering net positivity for biodiversity can be found here:

<http://www.wsp-pb.com/Global/UK/WSPPB%20Biodiversity%20whitepaper.pdf>
http://bbop.forest-trends.org/documents/files/network_rail_webinar_presentation.pdf

If the national Plan were to build on the pioneering work of LINet members by advocating the adoption of 'net gain' outcomes as business as usual across all infrastructure projects would secure significant environmental benefits.

It is important that the UK embraces this proactively and with a cross-sectoral engagement.

LINet would be very happy to give a presentation or further detail to the Commission if this would be helpful.

Yours sincerely

[name redacted]

[position redacted]

Maximising linear infrastructure resilience, environmental performance and return on investment.

Incorporating **well designed, managed and maintained green infrastructure** into linear infrastructure can enhance **asset resilience**, increase **asset efficiency and performance** and deliver an **improved return on investment**.

Well managed green infrastructure as an integral part of the UK's linear assets is the exception not the rule, causing costly disruption and with significant lost value from missed opportunities.

Whole life costs must be considered in soft estate performance and management assessments to secure more resilient, efficient and cost effective hard infrastructure.

400,000km of public roads

+

16,000km of Network Rail route

+

15,000km of energy networks

=

A UK opportunity of at least

420,000ha of road and rail estate

LINet

Linear Infrastructure Network

Poorly maintained = liability

Failure to provide and maintain green infrastructure along linear infrastructure networks leads to significant liabilities including:

- **increased operational** and **safety risks;**
- **greater** performance costs and **increased disruption;**
- **poorer customer** and **community relations** and **increased complaints;**
- **increased capital** and **management costs.**



60,000

average deer and vehicle collisions resulting in

450

human injuries per year in the UK



£100m

annual cost of vegetation impacts on train performance to the UK economy

25, ☹️☹️☹️

complaints per annum to Network Rail related to vegetation management

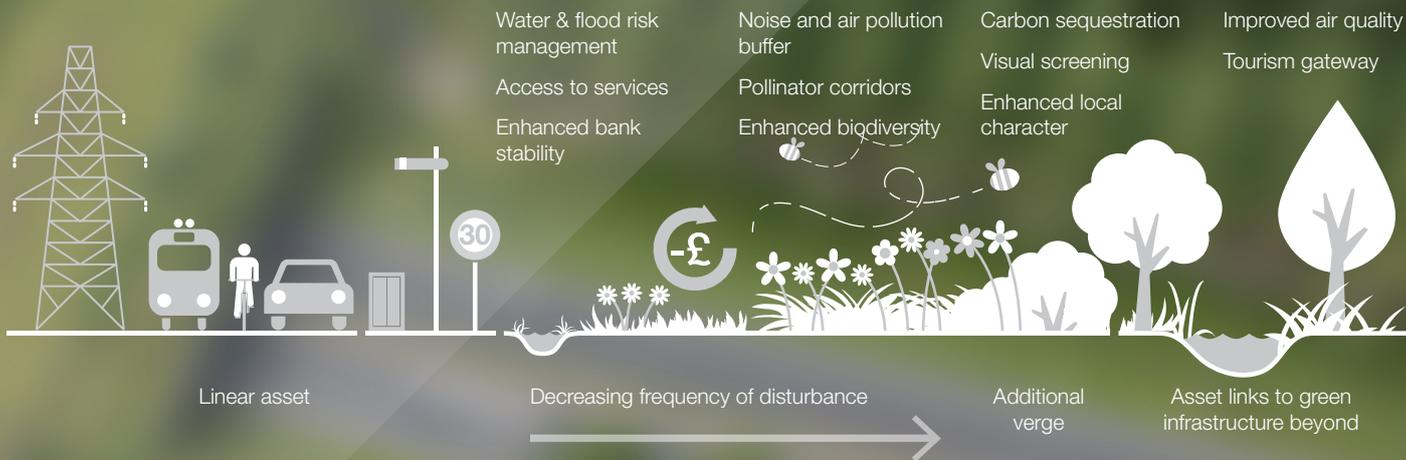
£200%

Traditional drainage solutions cost twice the capital costs of Sustainable Drainage Systems (SuDS)

Well maintained = asset

The right green infrastructure in the right place along linear infrastructure networks could bring significant benefits including:

- **enhanced local character** and **user experience**;
- **revenue generation** opportunities and **reduced waste** from verge harvesting for biomass energy;
- **uplifted property values** through green space provision;
- **improved air quality**, **drainage** management and **carbon** capture, and
- **enhanced biodiversity** corridors, recreation opportunities and **quality of life**.



**£6
£1**
National Grid has found of natural capital benefit for every spent enhancing natural resources

£90m
biomass harvesting revenue potential over
25 years

95%
↑
of developers expect an uplift in commercial property value from greenspace provision

300,000
trees along roads in Devon and Cornwall store over
22,000 tonnes
of carbon and prevent
76,000m³
of run-off per year

850,000ha
of UK crops pollinated by insects providing £1,057m market value per year. Linear networks provide extensive pollinator habitat

The logo for ARUP, featuring the word "ARUP" in a bold, black, serif font.The logo for Birmingham City Council, featuring a stylized red and blue shield with a white cross, followed by the text "Birmingham City Council" in a red sans-serif font.The logo for ciria, featuring the word "ciria" in a white, lowercase, sans-serif font on a solid green square background.The logo for the Department for Transport, featuring the Royal Coat of Arms crest above the text "Department for Transport" in a black sans-serif font.

For more information contact
LINet@naturalengland.org.uk

or visit Green Infrastructure
Partnership at www.gip-uk.org

For further information on the business
benefits of green infrastructure and
tools available to measure these
please see:

**Microeconomic Evidence for the
Benefits of Investment in the
Environment**

**Toolkits on ecosystem services
and natural capital**

The Natural Capital Protocol

Natural Infrastructure for Business

LINet members include linear
infrastructure asset owners
and managers, consultancies,
Government and its agencies, NGOs
and academics.

Front image: © Shutterstock
Inner image: © Joop van Houdt
Graphics: © Arup

The logo for the Environment Agency, featuring a stylized green tree icon to the left of the text "Environment Agency" in a green sans-serif font.The logo for the Green Infrastructure Partnership, featuring the word "GREEN" in large green letters above "INFRASTRUCTURE PARTNERSHIP" in smaller green letters, with a row of green icons representing various infrastructure types.The logo for highways england, featuring a stylized blue and green road icon to the left of the text "highways england" in a blue sans-serif font, with "driving forward" in smaller blue text below.The logo for LDĀ DESIGN, featuring the text "LDĀ DESIGN" in a black, uppercase, sans-serif font.The logo for nationalgrid, featuring the text "nationalgrid" in a blue, lowercase, sans-serif font.The logo for Natural England, featuring the words "NATURAL ENGLAND" in white, uppercase, sans-serif font on a solid green square background.The logo for NetworkRail, featuring the text "NetworkRail" in a blue sans-serif font above a stylized red and orange graphic representing train tracks.The logo for Peakhill Associates, featuring a stylized green and white icon to the left of the text "Peakhill Associates" in a black sans-serif font, with "Delivering Sustainability" in smaller black text below.The logo for Plantlife, featuring the word "Plantlife" in a green, lowercase, sans-serif font.The logo for RSPB, featuring a stylized blue bird in flight above the letters "RSPB" in a white, uppercase, sans-serif font on a blue square background.The logo for Transport for London, featuring a blue circular icon with a white bar to the left of the text "TRANSPORT FOR LONDON" in a black sans-serif font.The logo for The Wildlife Trusts, featuring a stylized white animal silhouette above the text "THE WILDLIFE TRUSTS" in a white, uppercase, sans-serif font on a black square background.

10th February 2017

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Dear Sir/Madam

Re: National Infrastructure Assessment Call for Evidence

Liverpool John Lennon Airport (LJLA) welcomes the opportunity to contribute information as part of the National Infrastructure Assessment Call for Evidence.

LJLA handled over 4.8 million passengers in 2016 with flights to over 60 destinations in the UK and across Europe and has seen passenger throughput grow by almost 10 times since the mid 1990's, firmly establishing the Airport not only as a gateway for Merseyside but for the North West and North Wales and the wider Northern Powerhouse.

Economic importance of regional airports

At LJLA, over £130m has been invested at the airport in recent years helping to grow passenger numbers and this on-going investment in Airport facilities will allow LJLA to continue to provide an efficient operation and high levels of customer service.

Successful regional airports bring clear economic and strategic benefits and a competitive advantage for the regions that they serve, which should not be underestimated. For example, LJLA is one of Merseyside's major employers, attracting inward investment and bringing significant tourism benefits, helping to boost the region's economy. A study undertaken in 2016 by York Aviation showed that LJLA is a significant driver of prosperity in the Liverpool City Region, currently supporting an estimated £250 million per annum in GVA and supporting 6,000 jobs in the City Region. Across the Northern Powerhouse, the GVA impact of the Airport increases to £440m with 11,900 jobs supported.

The York Aviation report also highlighted the long term potential of the airport, with future GVA predicted to be over £1bn across the Northern Powerhouse, supporting almost 23,000 jobs. Key to achieving these figures is the growth in air connectivity coupled with an efficient and seamless journey to and from the airport via road and rail.

Importance of efficient Surface Access

In responding to the call for evidence, it is important to highlight the fundamental economic role that regional airports play for the catchment areas that they serve; and key to maximising this benefit is the importance of investing in quality road and rail infrastructure that enables seamless journeys to the airport and makes LJA yet more attractive to new routes, and drive upwards its economic contribution to the area.

Maximising improvements to surface access is important for both inbound and outbound travelers and this will increase the UK's competitiveness globally through the following:

- Increasing the airport's catchment area and providing choice and competition not only to the travelling public, but also to airlines looking to establish routes into the UK – with a direct benefit in the ability of inbound visitors to fly closer to their end destination in the UK
- Enhancing air connectivity is a key factor in attracting inward international investment to the UK. Improving connectivity to Regional Airports such as Liverpool will provide a step change in the economic benefits for these areas
- Improved surface access impacts directly the inbound visitor economy, making the journey between the airport and the visitor's destination as seamless as possible.
- Allowing the Airport to maximise the benefits of the entire airport site and the adjacent land. An important part of the Airport's long term plan will be the future development of land to the south of Airport which will allow the airport to grow and to attract a broader range of aviation activities to support the growing freight market, supporting business aviation, and attracting support services such as maintenance and aviation training facilities that enhance the attractiveness of LJA as an airline base.

The recent independent report commissioned by Transport for the North on international connectivity highlighted the importance of surface access to the region's airports, and specifically stated improvements in road and rail access to LJA through the Eastern Access Road to the Airport, and the provision of direct rail links.

Importantly, such improvements to surface access not only benefit an airport but can also help to improve access to surrounding areas unlocking wider economic opportunities.

The Eastern Access Road scheme to LJLA has the potential to do just this, delivering multiple economic benefits. However, a lack of sufficient public sector funding has meant that bid submissions to both the Department for Transport's Large Local Major Schemes Fund and the Liverpool City Region Combined Authority Single Investment Fund, to progress this scheme have been unsuccessful.

Increased public sector funding support at a local and national level is needed in order to promote the pipeline of projects that can unlock a number of potential economic opportunities that will support post-Brexit international trade, drive inward investment and maximise the potential of the Northern Powerhouse.

Liverpool John Lennon Airport shares the Government's vision to build an industrial strategy that addresses long-term challenges to the UK economy. The success of this strategy would rely on investment in infrastructure projects that help to deliver economic growth.

In responding to this call for evidence, we have set out our thoughts relating to the economic importance of regional airports such as Liverpool, and the need for investment in improving the surface access infrastructure in order to realise the significant economic and social potential of the Airport. We would welcome further discussion with the Commission on issues specific to Liverpool but also regional airports, and would be happy to discuss this in more detail.

Yours sincerely

National Infrastructure Assessment – Call for Evidence

10th February 2017



1. About the Local Government Association (LGA)

The Local Government Association (LGA) is the national voice of local government. We work with councils to support, promote and improve local government.

We are a politically-led, cross party organisation which works on behalf of councils to ensure local government has a strong, credible voice with national government. We aim to influence and set the political agenda on the issues that matter to councils so they are able to deliver local solutions to national problems.

2. Summary

The LGA supports the work of the NIC and welcomes the production of the NIA. We believe that the document should take a holistic view of the UK's infrastructure and examine what is needed, what needs to be maintained and where responsibility should lie for this.

Whilst we have contributed specific evidence across a number of sectors where councils have an interest our comments across all sectors are characterised by the need for greater devolution of decision making and funding and less nationalised decision making.

Councils are strongly placed to make local decisions on how infrastructure is best provided and maintained. There are also areas in our submission where we believe capacity constraints could be alleviated with more powers for local authorities. This would be cheaper and simpler than building extra capacity. We strongly urge the commission to examine areas where this could be the case and include them in their report to Government.

3. Cross Cutting

What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

These will vary around the country depending on local circumstances. For many they will be connectivity infrastructure – such as transport and ultra-fast broadband. For other areas, flood prevention infrastructure to protect businesses and the workforce or more natural assets to promote tourism will be most important. As well as new infrastructure, maintenance and better use of existing infrastructure will provide better tax-payer value.

How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Submission

Good and well-maintained infrastructure will allow businesses to interact at lower cost with each other and their markets. For example, more manufacturers depend on just-in-time delivery, meaning that free-flowing roads and lower congestion will help them to be more globally competitive.

With regards to UK roads, it is one big network made up of the local roads network, managed by local authorities, and the strategic roads network, managed by Highways England. It is important that investment in one part of the network does not have an adverse impact on the capacity of another part.

How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Government must view housing investment in the same way that local government does: as a fundamental part of infrastructure that adds to the asset base and expands the economy. Housing provides a safe investment with rapid returns for local economies with every additional £1 of investment in construction generating an extra £2.84 of economic output and 56p of tax revenues. Housing construction can be 'shovel ready' more rapidly than other forms of infrastructure investment, it adds to gross domestic product (GDP) more rapidly, and is less reliant on imported materials. The LGA's Housing Commission report¹ sets out more than 30 recommendations for how local and national government can work together to build more homes, and to build homes that meet the diverse needs of people, partners and places.

The Housing Commission's key recommendations include:

Sustainable models for financing infrastructure long term

- Taking opportunities for joining up and devolving infrastructure and growth funding linked to local objectives to deliver homes.
- Exploring routes for capturing greater proportions of land value uplifts resulting from planning permission in order to finance infrastructure for homes.
- Increasing the contribution of Community Infrastructure Levy (CIL) - for instance making it simpler for councils to establish and by enabling them to borrow against future receipts.

Investment in infrastructure is critical to supporting the ambition for increasing housing supply by building community support for new development, as well as ensuring sites are commercially viable and do not constrain existing facilities. An OECD report in 2015² reported that UK infrastructure has suffered from under-investment compared with competitor countries, since the 1980s. Councils have found that local communities were on balance more supportive of housing development when it is accompanied with associated investment in new infrastructure³.

Infrastructure funding is an increasingly important concern for councils seeking to build homes.

¹ [LGA Housing Commission final report \(December 2016\)](#)

² OECD, UK economic survey 2015: Improving Infrastructure, February 2015

³ LGA: New housing developments survey 2012

Councils are increasingly working collaboratively to consider how new infrastructure could best deliver housing, however this can be held up due to lack of investment. The establishment of a Housing Infrastructure Fund of £2.3 billion⁴ to deliver infrastructure that enables housing growth is a welcome acknowledgement of the role of infrastructure finance in unlocking housing growth. Councils will work with the Government on the detail of the scheme to ensure it delivers maximum homes, and helps build prosperous places.

Looking ahead, devolution offers an opportunity to increasingly devolve infrastructure spending to places in ways that can link to commitments to deliver housing growth. Government departments and agencies investing in infrastructure – including the Homes and Communities Agency – should be required to work with local authorities to consider how it might be best targeted to deliver housing.

Local and national government should also take opportunities to test and develop models for forward funding infrastructure by capturing greater proportions of land value increases resulting from planning permissions. There might be a range of ways in which land value capture can be enabled. For instance the Land Compensation Act could be amended in ways that enable councils to acquire land through compulsory purchase order (CPO) at close to existing use value for sites that have been designated for infrastructure, including housing through the local plan process. This would then enable borrowing against the future uplift in land values to fund the necessary infrastructure investment. The current legislation guarantees that the landowner is entitled to the uplift in land value even when planning permission has not been granted, but would likely be granted if a planning application was submitted.

There is also scope to simplify and expand the use of existing infrastructure financing tools. The Community Infrastructure Levy (CIL) is one tool available to councils to raise funds to help deliver infrastructure, and should play a greater role into the future. Councils should be enabled to borrow against future CIL receipts which would allow, for example, councils to forward fund a developers' contribution element of major infrastructure schemes. Regulations should also clarify that the permission to pass CIL receipts to another body also applies where this is to reimburse expenditure already incurred by that other body; for example, when they have acted as a forward funder, in cases where a developer is unable to fund the required investment at an early stage of a development.

Furthermore, the proposals for full local retention of business rates include the power for elected city-wide metro mayors to be able to add a 2p premium⁵ to business rates to pay for new infrastructure, provided they have the support of a majority of the business members of the local enterprise partnership (LEP). This power should be extended to all councils.

Viability negotiations that provide infrastructure and affordable housing

- Establish a clear, robust and transparent viability procedure to help manage down the escalation of land values and ensure the delivery of affordable housing and infrastructure communities need to back development.

⁴ Autumn Statement 2016

⁵ <https://www.gov.uk/government/news/chancellor-unveils-devolution-revolution>

The assessment of economic viability of development is an important planning consideration for assisting with the development of Local Plans and plan policies and when determining individual planning applications. Councils have raised concerns about the viability process.

Councils raised concerns that the plan-led system is being undermined by the use of viability arguments from developers to avoid the need to meet local plan policy requirements including the provision of affordable housing and providing infrastructure contributions. Uncertainty in the viability process impacts on the price that developers pay for land, which can in turn impact on viability negotiations around affordable housing and infrastructure contributions. The Government, councils and the development industry should therefore work together to establish an agreed approach to viability assessment that reduces the incentives for developers to pay over the odds for land, and so supports subsequent viability negotiations to deliver the objectives agreed with communities in the Local Plan.

What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Councils play an important role in managing demand for infrastructure. The country's roads are facing a projected rise in congestion of up to 85% by 2040 and the answer is not to simply build more roads but to manage existing capacity better and to also manage demand. This could mean more people shifting modes of travel – such as from private cars to buses, or for shorter car journeys to be made by cycling or on foot. Much more can be achieved by local authorities if they had the right levels of funding, funding certainty and comprehensive decision-making powers over all national funding for local transport.

What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Much more can be achieved by local authorities if they had the right levels of funding, funding certainty and comprehensive decision-making powers over all national funding for local transport. LGA commissioned independent research found that there 8 different sources of funding for local transport in 2016-17. Greater certainty of funding enables councils to plan ahead, placing them in a better position to lever in private sector and third party investments, coordinate investment with national infrastructure, gain through economies of scale, and invest in innovation.

How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Through better coordination and planning across different network providers, such as rail, strategic and local roads and by placing local authorities at the heart of infrastructure investment decisions. Memorandums of Understandings (MoUs) between Highways England and combined authorities are a step in the right direction.

"How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?"

As well as the balance of maintenance spend as opposed to spending on new

infrastructure spend the commission should also consider the balance of maintenance spend within existing systems. For example, in particular the LGA has highlighted the huge disparity between the resources available in this parliament for the strategic road network (£1.1m per mile) compared to the local road network (£27k per mile). In an interconnected system like our road network a failure to adequately maintain any part of the system can result in delays across the network.

"Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?"

The Government should commit to long term funding certainty for local authorities in order for them to commit to financing infrastructure projects. Currently many viable infrastructure projects are affected by a council's ability to commit revenue resources in order to bid for capital funds made available by government departments. Infrastructure projects can often need to bid to multiple funding streams from a variety of providers each with different funding criteria. This can add significant and unnecessary cost to infrastructure projects that councils often struggle to afford. We would prefer a system of funding certainty for major projects like those given to Highways England and Network Rail who are able to plan long-term projects in advance.

"What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?"

We are concerned that the current system of cost benefit analysis is not as useful a tool for decision makers as it could be. The Government acknowledges these difficulties in its guidance on WebTAG

"There are some impacts – such as noise, air quality, landscape, social and distributional impacts – where the transport model is unable to directly measure the impact."⁶

When it comes to transport infrastructure, we believe that it would be best if decisions were devolved to highways authorities as far as it is possible. Local authorities will have a better ability to plan strategic decisions around funding that are both cost effective and fit alongside wider policy goals.

4. Transport

"How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?"

It is difficult to anticipate changes in travel patterns. The Chartered Institute of Highways and Transportation looked at the impact of two assumptions for the impact of technology on transport through their report Uncertainty Ahead: Which way forward for transport? They examined how the future cost of energy and the future preference for accessibility might influence transport preferences. Their four scenarios look at how these variables could influence

⁶

⁶https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427073/webtag-tag-overview.pdf

transport but more importantly how they could influence spatial planning and urban design.

Anticipated changes in these variables could have profound impacts on local councils who have to plan for long term changes in travel behaviour. For instance if more people chose to work remotely it could hasten the demise of traditional high streets with the need for local authorities to make drastic changes to spatial strategy.

There has been much speculation on what impact automated vehicles could have on travel patterns. It seems clear that their impact is difficult to fully predict however there is much work emerging on the questions that would arise from the large scale take up of autonomous vehicles.

According to research conducted by WSP Parsons Brickerhoff more than 50% of land used for parking could be released by a move away from private motoring towards on demand autonomous vehicles. Many suburban streets could release on street parking spaces for greater road capacity or urban realm improvements. Whilst many of the assumptions in their work are highly speculative this gives an indication of the amount of land that could be released by changes in travel patterns in particular away from individual car ownership and the huge changes this could mean for urban planning.

Currently the government have hypothecated Vehicle Excise Duty to pay for road investment. 'Mobility as a service' and autonomous vehicles have the potential to greatly reduce the amount of private motor vehicles. Although the impacts of the technology are unclear, it would seem likely that if this service was widely adopted fewer cars would be used but each car would be used far more. This would significantly reduce VED revenues that are levied on individual vehicles and do not account for the distance a vehicle is driven.

"What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?"

The highest value transport investments are often smaller projects with relatively low costs. However given the cost associated with bidding competitively for funding many small projects can go unfunded as the amount of bureaucracy associated with bidding for them can outweigh their benefits. More devolution of funding for councils to take their own decisions around prioritising smaller schemes as opposed to large national schemes whose cost benefit ratios are much smaller would offer better value-for-money for taxpayers.

Councils currently do not have the power to tackle urban congestion as effectively as they would like. There are a number of immediate measures that could be taken that would allow councils to decrease congestion delivering increased capacity on our infrastructure with no large financial investment. There simply needs to be willingness for central government to get on with giving councils the tools to do the job.

There is a clear case for greater powers to be given to local authorities to tackle urban congestion. We would like the following to be available for all local authorities who wish to make use of them:

- * Stronger powers to manage street works including lane rental
- * The discretion to introduce workplace parking levy
- * Full implementation of Part 6 of the Traffic Management Act 2004

We also believe that the funding streams available for tackling congestion and investing in infrastructure are too complex and involve too much bureaucracy. Currently funding is provided on a competitive basis by a number of different funders in a variety of different funding regimes, causing duplication and waste.

If we were to give councils these powers they could be set at levels that were self-funding meaning that we could better tackle congestion. They could also be targeted at peak times for congestion and have the effect of equalising traffic flow throughout the day. This would mean that existing infrastructure was used more efficiently boosting road capacity without having to resort to large scale capital expenditure.

"What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?"

Many of the observations above apply equally to urban/non-urban environments.

However it is worth considering the role local networks play in facilitating inter urban travel. The Rees Jeffery identified 3,800 miles of local authority-controlled roads providing essential connectivity by filling the gaps in the SRN. These roads account for almost the same amount of traffic as the SRN however their maintenance is delivered by local authorities who have to combine maintenance of these roads with the remaining 96% of the network. More flexibility in the money allocated for the strategic network, allowing it to be used on projects that could improve the SRN even if those projects are not on the SRN, could increase its flexibility and capacity.

"What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?"

Mobility as a service has the ability to make road usage more efficient and a number of areas, such as Transport for the West Midlands, are exploring the potential benefits. Identifying which transport option will be quickest and/or cheapest will incentivise more efficient use of existing transport systems and should release greater capacity out of existing networks.

It could also be used to create a demand management approach with providers potentially adjusting their prices in close to real time in order to encourage passengers to use spare capacity on one mode or route and divert them away from parts of the network that are overcrowded.

It could also increase overall network resilience with the ability for real time adjustments to be made to journeys.

All of these developments would suggest an approach that could lead to an increase in journeys without impacting journey times as more latent capacity is used and overall the network is used more efficiently. If mobility as a service can be effectively introduced and is genuinely multi modal it somewhat undermines the need for road pricing as road pricing is often suggested as means to reflect the impact that peak time car use has on the road network and local communities. To some extent mobility as a service can be considered a carrot compared to the stick of road pricing.

5. Digital Communications

What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

Fixed line connectivity

Over the long term it is widely accepted that only the extension of fibre networks, to the premises where possible, will provide future-proofed digital connectivity. Whilst ubiquitous FTTP coverage is some way off, in the short to medium term, it is important that investment and national policy aims to catalyse its spread, including to rural and remotely rural areas, where fibre backhaul can support hybrid solutions of fibre and wireless to premises too difficult to connect directly.

Encouragingly, the increase in “alt nets” in the market has given local authorities a wider choice when procuring solutions to extending provision to the hardest to reach residents. Solutions must continue to focus on creating a competitive, fair and transparent marketplace that continues to innovate in order to improve the availability of excellent connectivity to UK residents.

Mobile connectivity

Despite reported progress in the extension of national mobile connectivity, country-wide coverage figures have a tendency to mask the deep disparity between coverage in urban and rural areas.

Inevitably better coverage requires the expansion of mobile infrastructure, especially in rural areas. Owing to the sparsity of population and challenges with local topography, such areas are often unviable for suppliers. In these cases, national policy must encourage the sharing of infrastructure between suppliers to decrease cost and seriously consider solutions to how achieve ubiquitous landmass voice and data coverage.

Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

At present significant areas of the country are not serviced with adequate digital connectivity coverage. Public interventions have played their part correcting failures of the market. However, there is still a role for the commercial sector, obligated through regulation, to provide appropriate levels of coverage for residents in both urban and non-metropolitan settings.

Fixed line connectivity

Councils have played a significant role in the extension of digital connectivity to households through the Superfast Broadband Programme. Latest Government figures show that over 90 per cent of UK premises were covered by these speeds or faster with the programme passing over 4.1 million premises.

However, despite the progress of the Superfast Broadband Programme, there are still 1.4 million premises that currently cannot receive a download speed of 10Mbps with 70 per cent of them in rural areas. This increases to 2.6 million if you include those premises that cannot achieve upload speeds of 1Mbps. It is not yet clear the extent to which new roll-out of superfast broadband will provide the remaining sub-10Mbps premises with faster broadband. Inevitably, a portion will be covered by further commercial and publicly-funded roll-out but

some, particularly the most geographically isolated, will not. Ofcom estimates that even taking account of existing public intervention and future commercial roll out plans combined, 600,000 premises will not be able to access speeds of 10Mbps or higher by 2020.

The LGA has consistently made clear that the Universal Service Obligation (USO) will only tackle the country's digital divide by providing a minimum download speed, rising in line with national averages, and guaranteeing a consistent performance of other elements which make for a good quality internet connection, such as upload speed.⁷

As a minimum, the LGA has made clear its support for a highly specified USO which would obligate suppliers to provide the consistent performance of a range of indicators that make for a good connection.

Ofcom has revealed that only BT (and KCOM in the City of Hull), have so far expressed interest in the delivering the USO. This is potentially concerning as a national programme, delivered by a single provider, will not benefit from competitive tenders or be able to provide bespoke technological solutions to local topography and sparsity of premises issues. Ideally, a range of providers would supply connections under the USO. However, if smaller providers show little interest, this preference may prove unviable.

Mobile connectivity

Following councils' deep involvement in the provision of superfast broadband, many are exploring the role they can play in catalysing improvements in local mobile provision. To date, whilst some councils have developed and maintain their own strategic relationships with MNOs, the majority of interactions are via council planning departments regarding the placement of mobile infrastructure.⁸ Such interactions are likely to decrease following Government plans to extend permitted development rights for taller mobile phone masts of up to 50ft to be built or upgraded without planning permission. MNOs need to work with councils and communities rather than bypass them in order to identify and address coverage blackspots together. There is also further work to be done ensuring councils across the country are better placed to have more strategic level conversations with MNOs to fully understand their roll out plans and, where appropriate, help the extension of provision through the use of public infrastructure.

Finally, Ofcom must utilise all the levers at its disposal to encourage mobile operators to provide ubiquitous coverage that equates to improved user experience

6. Flood risk management

What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

⁷ [LGA submission to Ofcom's Call for inputs on the design of the broadband Universal Service Obligation, June 2016](#)

⁸ In an LGA survey conducted last year, less than 50 per cent of councils surveyed had relationships with MNOs, locally. Of the 40 per cent that did not, 75 per cent were keen to develop.

Around 5.4 million properties (about one in six) in England and Wales are at risk from flooding from one or more water sources (rivers, seas and surface water)⁹. Flooding in 2013/14 cost the economy up to £1.5 billion¹⁰ and initial estimates suggests that the economic impact of the December 2015 floods will exceed £5 billion¹¹.

In addition, whilst there are many uncertainties in climate predictions, the Intergovernmental Panel on Climate Change found in its most recent report¹² that over the 21st Century it is very likely that extreme precipitation events will become more intense and frequent in many regions.

On that basis the Government should assess the impact of the current partnership funding approach to flood defences across the country, and specifically how this has impacted on the resilience of communities and businesses to recent extreme weather and future flood events.

What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Capital investment, and subsequent revenue funding, should be devolved to councils working in partnership with Local Enterprise Partnerships to decide on the best direction for this vital programme of investment. This could be trialled through the devolution deal process. The Department for Environment, Food and Rural Affairs (DEFRA) should work with the LGA, councils and other central government departments to develop this.

Councils are ready to take more control of the work that prevents flooding or mitigates damage at a local level, working with local partners, including the Environment Agency. This would enable them to work to make sure future disasters are prevented. Devolution bids calling for additional powers over funding for flood risk management include:

- Cornwall: The agreed deal includes proposals to join together funding for flood defences from a range of partners to provide a joint investment programme to improve coastal defences.
- Greater Lincolnshire: The agreed deal proposes reprioritisation of capital water management investment, to better utilise current levels of national funding, maximise local benefit and attract increased investment. In addition, it proposes developing opportunities to take on more local responsibility for delivering projects in the investment programme, where this would generate efficiencies and private and commercial contributions. Bid offers to use delegated powers and funding to deliver a 30 per cent efficiency in developing projects currently subject to DEFRA's funding controls and approval processes.

⁹https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/381939/F_CRM_Long_term_investment_scenarios.pdf

¹⁰ [The costs and impacts of the winter 2013 to 2014 floods](#)

¹¹ <https://home.kpmg.com/uk/en/home/media/press-releases/2015/12/flooding-economic-impact-will-breach-5bn.html>

¹² IPCC United Nations Intergovernmental Panel on Climate Change 2014 Climate Change 2014 Synthesis Report Summary for policy makers

Proposals to enable affordable, accessible insurance for high flood risk households through Flood Re¹³ are welcome. However, we would also like to see the Government introduce a mechanism to ensure a proportion of the levy (for example any surplus levy at the end of each year) is reinvested on prevention in future flooding.

The Government gave the Somerset Rivers Authority the power to raise a Shadow Precept from April 2016 which will enable the Authority to raise additional funding for flood risk. We would like the Government to allow other areas to use a similar mechanism where there is local agreement to do so.

We would like to see availability of additional resources for catchment wide projects that, for example, could investigate the effects of holding water upstream, catchment sensitive farming techniques and flow diversions, and how this could help mitigate flooding downstream.

7. Solid Waste

Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Councils have indicated that there isn't a clear enough long term strategic commitment from the government to treatment capacity. They therefore find themselves developing localised solutions which don't really benefit from any national plan. For any council the commitment to developing their own treatment capacity is one which is a major financial undertaking which can take years to deliver. Derbyshire County Council developed its own in-vessel composting (IVC) plant which took 10 years to build and millions were spent on the planning process. By the time it was completed the then government announced its backing for the development of anaerobic digestion plants, which meant Derbyshire had invested in technology the government would be moving away from in the future.

In order for the recycling market to grow and be able to process increased tonnages of recyclate, new facilities need to be planned and financed on the basis of a commercial proposition and one that delivers value for the taxpayer. It was on this basis that the Treasury announced Waste Infrastructure Credits back in 2009. Subsequently, DEFRA projections indicated that there would be sufficient residual waste treatment capacity online by 2020 to enable the UK to meet its EU landfill targets. This was the basis for the Government then withdrawing the Waste Infrastructure Credits (formerly PFI credits) from the final three projects it had committed to.

The decision to withdraw this subsidy, which appeared to increase costs, may in the future be seen as having enabled the market to develop infrastructure on a commercial basis creating a more sustainable industry. For the time being the change has left big waste infrastructure, including energy from waste plants, in planning and funding limbo which will see either a hiatus or an end to the delivery of these types of large residual waste treatment facilities beyond those in the pipeline.

English local authorities will continue to drive improvement in collection of waste and recycling, not least because English householders so value the service they

¹³ <http://www.floodre.co.uk/>

receive, on which they report consistently high satisfaction levels. This will continue to involve further evolution of service that reduces landfill and collects more material for reuse and recycling as efficiently as possible. However, increased levels of ambition in recycling performance will become progressively more expensive to achieve above the existing target level, and will be increasingly difficult for tax payers to bear.

There are also practical limitations on what can be realistically achieved. English local authorities have committed many hundreds of millions of pounds to underpin the delivery of waste treatment infrastructure to radically reduce landfill by 2020. This treatment capacity will process a volume of waste that will make meeting a suggested 70 per cent recycling target unachievable.

Local authorities paid approximately £570 million in landfill tax to the Treasury in 2013/14, which will rise to over £600 million in 2015/16, despite reducing landfill by over three quarters per household in a decade. These receipts could provide investment capital that would contribute towards increased recycling levels and help councils to deliver infrastructure that would not otherwise be affordable. This could include the costs of new receptacles, collection vehicles, sorting facilities, reuse storage capacity and organic treatment facilities.

To achieve this we suggest a return to the original principles of redistribution of landfill tax via the Revenue Support Grant. This would allow councils to decide locally how to invest in infrastructure that could be delivered quickly to improve recycling performance by 2020.

Councils in England have doubled their spend on waste and recycling services since 2000 to £3.28 billion. This makes collection and disposal of waste and recycling the third highest cost service for English local authorities. Our estimates show that current spending on waste by English authorities would need to increase significantly to include additional collection services (in particular organic waste) just to meet the existing 50 per cent target. This will be unachievable since councils are under extreme pressures to reduce spending in response to a 40 per cent reduction in government grant to English local authorities since 2010, a level of reduction that is projected to be repeated over the next parliamentary period to 2020.

What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

A circular economy makes best use of waste and resources, which is a high priority for English local authorities as key delivery agents for municipal waste collection, reuse, recycling and disposal services. There are clear benefits from achieving a more circular economy, including greater competitiveness from increasing the value obtained from the existing resources in the economy. A more circular economy would also offer increased employment potential with estimates suggesting that it could help create more than 200,000 additional jobs in the UK by 2030. But this will only be achievable if there is a more equitable contribution by those at the top of the supply chain to supplement the current reliance on those collecting and disposing of material at tax payer expense once it enters the waste stream.

The UK raises the lowest level of contribution from producers amongst all EU member states at less than 20 Euro per tonne of material compared to 200 Euro in Austria and over 150 Euro in France and Spain. To further illustrate this the UK's limited packaging producer compliance scheme generated £111 million of compliance revenue in 2013, only £37 million of which went towards collection.

This compares to the £550 million cost to local authorities for collection and sorting of packaging material. There should be a minimum level of producer contribution based on the costs of collection and subsequent reuse, recycling or disposal of their products. The LGA would welcome further discussion of the implementation of extended producer responsibility schemes with government and industry representatives.

At present a large proportion of material that finds its way into the waste stream cannot be cost effectively reused or recycled. While innovative techniques continue to be developed to disassemble, refurbish, repair and recycle different products it can be challenging to create financially viable markets for secondary resources across all materials and product types. To drive demand for secondary materials and improve the financial viability of recycling collection the Government should consider further product and material specific requirements to use recycled content in product manufacture.

There also needs to be a self-sustaining market for secondary material streams. The current targets require the recycling of particular materials, but make no requirements for the use of recycled material in product manufacture. This gap means, as is currently seen across the EU, that secondary material reprocessors have to compete in a volatile market that is often undermined by lower cost virgin materials.

Compliance with the obligation to set up separate collection systems for paper, metal, plastic and glass is seen as an essential part of the circular economy. However, separate collections come with a direct cost and challenges around the market for secondary material streams. Currently some councils do have contracts where they separate out waste. However, these contracts have an additional cost within them for this service. Expecting all councils to be compliant with this requirement will have a direct financial impact for many councils.



The Local Government Technical Advisers Group

Contact details:

[name redacted]
[position redacted]
Technical Advisers Group (TAG)
Suite 104 Blyth CEC
Ridley Street
Blyth NE24 3AG
[telephone number redacted]
[telephone number redacted]
[email address redacted]

Commission Secretariat
NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London EC3M 8UD

9th Feb 2017

1. Introduction and background to TAG

1.1 Thank you for the opportunity to submit evidence to the National Infrastructure Commission. As a background, we have submitted responses to Government and given evidence to the House of Commons Transport Select Committee (HOCTC) and other House of Commons Select Committees and indeed many other august bodies and inquiries on various Transport, Planning and other Infrastructure issues over many years. This includes giving evidence to the Institution of Civil Engineers on National Infrastructure about this time last year. We attach our statement to the ICE as Appendix 1 and some other supporting Appendices linked to our submission text below.

1.2 TAG as a professional/technical organisation represents a large number of local authorities in the country, these include those with highway and transport responsibilities such as Transport for London, most London boroughs, Metropolitan authorities, Unitary authorities, consultants providing highway and transport services for major local authorities and many of the districts and towns in two tier authorities. While 'second tier' authorities do not have direct responsibility for transport, they do have the major role in looking after significant towns trying to ensure adequate housing is provided and the sensible overall planning of them including providing a reasonable environment protecting them from flooding, through and with other authorities most other infrastructure to support the population and businesses and trying to ensure, through the Highways and Transport Authorities, that the transport system is fit for purpose.

1.3 TAG was first created as a joint officer body to coordinate across the various areas of Local Government and was formed by an amalgamation of the Associations of London Borough Engineers and Surveyors (ALBES), Metropolitan District Engineers (AMDE) and Chief Technical Officers (ACTO) of the districts in two tier areas. One of the major reasons for this combination was so that advice could come from one body. TAG still has a major role in advising the LGA and recent submissions from the LGA on transport issues usually reflect TAG advice.

1.4 Overall we represent over 100 different authorities and for the National Infrastructure Assessment we believe as a body we have much to offer as local authorities have over the years probably had more responsibility and experience than any other organisation in the provision of supporting infrastructure for society as a whole.



The Local Government Technical Advisers Group

1.5 We can confirm that we have consulted our key membership on the content of this submission and it represents the overall views but not necessarily the views of individual members or authorities

2. General and summary.

2.1 In our submission we predominantly consider transport related issues. Nevertheless, we hope that we can adequately address the key issues covering flood risk management and outline views on energy, water etc. For waste TAG does have a waste topic group but our strength in this area is mainly from Northern Ireland. Regarding transport, TAG has and continues to advocate that the Department for Transport (DfT) and Government should formulate a national transport strategy and ensure that decisions are taken on the basis of the best potential national outcome rather than isolated views in relation specific modes of transport or specific parts of the networks. TAG has also raised on a number of occasions concerns regarding the transport scheme appraisal process and the different approach taken on expenditure and value depending on whether such public expenditure could be considered as 'revenue' or 'capital'.

2.2 As mentioned we did submit evidence to the Institution of Civil Engineers and took part in subsequent discussions at Great George St. We do in general support the findings of the Institution in its report – 'National Needs Assessment – a vision for national infrastructure' - in particular we believe that housing and in addition schools, industry, government and local government premises etc. are all part of the National Infrastructure.

2.3 We agree that demand management is essential for much of the infrastructure and particularly national and urban roads. We are concerned that the ICE submission still seems to support adding significant capacity where demand exceeds supply. There is little factual evidence that such a strategy, certainly for the road network, will help our real economy, reduce congestion, help the environment, reduce pollution let alone reduce CO2.

2.4 According to the Eddington study (a link to the documents produced by Eddington can be found on <http://collections.europarchive.org/tna/20100408160254/http://www.dft.gov.uk/about/strategy/transportstrategy/eddingonstudy/>) 89% of congestion is in Urban areas. Unfortunately vast sums are being spent on the interurban network which will tend to exacerbate the problems in the larger urban areas with very little attention being paid to manage the interface. Without effective linking, this 'investment' by Central Government will not help our national competitiveness. It is of note that the House of Commons Transport Select Committee is presently having an Inquiry into Urban congestion. Written (see Appendix 2) and verbal evidence given by TAG on 9th January 2017 may be helpful for the National Infrastructure Commission's work.

2.5 Finally as part of the general issues in TAG's submission to the ICE we also stressed the need to rebalance the economy and reduce the pressure on the south east of England and the importance of ensuring we can (and can afford to) properly maintain our existing infrastructure before adding to the maintenance burden by adding more infrastructure.

3. Answers to the questions raised

3.1 While our overall views on National Infrastructure needs are explained briefly above and in more detail in Appendices 1 and 2 we have endeavoured to answer the Commission's specific questions below:



Cross-cutting issues:

Question 1 - *What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?*

TAG is a national organisation with strengths in different infrastructure needs for different areas. Nevertheless the best returns and most needed infrastructure investments are probably in order:

- rebalancing the economy to bring more employment (and hence people) to the north of England and regions (this should also reduce the need for some infrastructure for water power etc)
- affordable homes
- maintenance and energy conservation in homes constructed before about 1975
- proper maintenance and ensuring the best use of all existing infrastructure
- densification of our cities (including better use of surface car parking and single floor retail stores etc.)
- protection and resilience from hazards of nature (eg coastal or river flooding)
- managing traffic volumes in urban areas and strategic roads
- provision of sustainable transport systems – pedestrian and cycle facilities, comprehensive and affordable bus services and rapid transport systems for our major towns
- integration between strategic roads and urban areas by traffic limitation measures, park and ride, bus lanes etc.
- infrastructure provision specifically targeted at regeneration of our cities and towns to support economic development.
- infrastructure to ensure that waste and resources are appropriately treated and/or disposed of as close to their point of origin as possible. This is particularly pertinent going forward given the importance in the Industrial Strategy on resource efficiency, and the promise that could be realised through better management of resources to stimulate local economic development.

Following Brexit and noting our present severely adverse balance of payments, local infrastructure to serve farming and local industry will become much more important.

Question 2 *How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?*

As the Standing Advisory Committee on Trunk Road assessment (SACTRA) 1999 study showed, care needs to be taken to understand if better infrastructure can help or hinder an area or country's competitiveness. Bridport in the 1850s with a rail connection and Ramsgate this century with improved roads have shown that infrastructure access to ports doesn't necessarily help. In some cases transport may be too easy and cheap for domestic or international competitiveness – an example being potatoes grown in Kent going to Somerset to be packed in brown paper sacks! That said reducing costs for UK located industries should increase our competitiveness but, as we import far more than we export, improving connections to ports could logically reduce our competitiveness.

Helping final access to UK based businesses for staff and inbound and outbound goods should help. For where we have a concentration of exporting industries access to ports and airports would undoubtedly be helpful, this needs to/ could be by both road and rail but is likely to be more local than strategic in nature (e.g. access from Nissan in Sunderland to the port).



The Local Government Technical Advisers Group

We believe greater evidence is needed and probably local needs identified before an automatic assumption is made that port and airport accesses by any mode are desirable.

Agglomeration and sharing of skills should increase Britain's productivity and reduce business overhead. Agglomeration is likely to be best delivered in our big cities and by improving local public transport and improved pedestrian links and environment, or between cities by reduction in vehicle movement and improved electronic communication. However we need to ensure that in delivering agglomeration that the economy becomes increasingly diversified and not focussed on a single aspect.

Question 3 How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

As mentioned above we agree with ICE that housing is an essential and important part of infrastructure. With a rebalancing of the economy there should be less need for housing in south east England. Nevertheless wherever housing is provided a reasonably quiet unpolluted environment is needed with access to all normal facilities including social interactions with people in other housing nearby, by as short a journey as possible and by sustainable means of foot, bus, cycle or even poolcars/car clubs, car share and taxi. We do not believe significant further strategic infrastructure is required now or in the period up to 2050, so hopefully poor environments caused by strategic roads will not cause further damage to places people need to live and work.

Fundamentally, development needs to be properly planned and a more balanced approach needs to be adopted, whereby the government, developers and local planning authorities can be confident that where development takes place infrastructure provision will be adequate. The current approach is resulting in planning consents which are not implemented because of inadequate local infrastructure including provision of bus routes. Similarly, the current approach to housing provision which confuses the issues of ownership and supply is and will continue to be largely ineffective in addressing the shortages. History shows that significant supply can be provided, however housing authorities and associations need to be allowed and resourced to deliver new housing with appropriate infrastructure. Development should be targeted to existing urban areas in order not to exacerbate transport needs and other associated environmental impacts.

Another issue which is frequently overlooked is the necessity to ensure that appropriate waste collection and storage arrangements are in place to ensure that housing is pleasant and easily maintained. Too often, these issues are addressed after the fact. Many European countries ensure that development considers waste collection and storage from the outset so that appropriate, and minimally intrusive, systems are installed to service housing. In most instances, this pre-development stage also ensures that other environmental issues, such as carbon impact, can be mitigated from the outset. Rather than relying on labour and capital intensive approaches such as bins and/or boxes, several European cities and Countries now underground their waste services (for example, Hammarby – see www.envacgroup.com/.../HammarbySjostad_Brochure_ENG.pdf?...)

Question 4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects? Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this

www.lgtag.com



The Local Government Technical Advisers Group

could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

If any product or service becomes 'cheaper' to individuals there will be a tendency to use more of that product or service.

For us in TAG we have experienced increase in refuse volume after wheelie bins became commonplace and have noticed that recycling rates and tonnages in some quarters tend to increase if householders know they intend to recycle the items purchased (see <https://hbr.org/2016/10/the-behavioral-economics-of-recycling>). We are also aware when parking controls or congestion restraint are introduced in an area it will reduce terminating traffic and in the centre of big cities but it will result in some growth of 'through' traffic to fill the available space. It is therefore important that a significant part of the benefits, say from a traffic limitation scheme, is used to improve alternative modes such as pedestrians, cycles or buses or improve the general environment.

We are not experts in behaviour change as a result of energy or water conservation measures.

On flooding we do not think change in behaviour is a big issue but property values are likely to increase if areas become less likely to flooding.

For transport schemes we believe there is considerable scope for demand management. London and Nottingham, Oxford St exclusion of general traffic and successful travel plans at various companies and organisations demonstrate effective demand management works. However, as we have highlighted to government on several occasions, in most instances to be successful demand management strategies need to be supported with adequate revenue funding. Generally such revenue funding is not necessarily very large but in the current funding regime imposed on the public sector it is extremely problematic.

Question 5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

If a piece of infrastructure is genuinely redundant or being replaced with a real alternative then maintenance of the previous asset is not required, but any scheme costs for the new infrastructure should include full removal of the old infrastructure and restoring the land to the most appropriate state. Otherwise TAG considers the maintenance of existing assets should take priority over the provision of new infrastructure. Unfortunately new capital funding seems to take too much priority over maintenance (largely revenue spending) at government level.

Recent developments in waste management show that many of the PFI contracts arranged under previous administrations are increasingly under pressure due to the ongoing austerity squeeze being felt by local authorities (for example, GMWDA is seeking to renegotiate their multi-billion pound contract <http://www.letsrecycle.com/news/latest-news/greater-manchester-waste-contract-under-financial-pressure/>). These developments, at a national level, risk causing disruption to the provision and maintenance of appropriate waste treatment and disposal facilities in the UK at a time when alternatives are notably thin on the ground (see Q1 above).

Question 6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Local authorities have been required to seek best value in all construction services of maintenance and provision of new Infrastructure by competitive tendering; unfortunately we www.lgtag.com



The Local Government Technical Advisers Group

have not been able to ensure proper competition and best prices for relocation of statutory undertakers works (please see our submission to the ICE Appendix 1). Local authorities have also considerable recent experience in collaboration between authorities for construction services.

Government has widely promoted competition for funding and the Department of Transport has applied competition to both major scheme and maintenance funding. However, TAG has and remains highly critical of this approach. For maintenance there are both winners and losers; the losers invariably are left under-resourced and the winners often merely receive the funding they initially required. Additionally, there are costs associated with bidding, which can be of the order of £30,000 for a basic competition; so for example the recent DfT competition for sustainable transport funding of £64m attracted 62 bids with a likely cost in excess of £1.8m in total; the sums awarded varied from £680,000 to £7.5m and 37 bids were unsuccessful receiving no funding. This is clearly not an efficient use of scarce revenue resources for public bodies. We fully support the devolution of decision making regarding major transport investment to the regions and wish to see this extended and that the regions are adequately funded.

We do not consider that competition per se has delivered significant benefits to users in the delivery of transport services. We have welcomed the Government's Bus Services Bill, although see no logic in restricting the powers to areas with an elected Mayor. This Bill will allow bus services to be subject to better control where needed, whilst allowing those areas where competition and collaboration are working to remain unaltered. Indeed we believe that the prospect of direct intervention alone may be sufficient to encourage better joint working, overcoming shortfalls in what is a poor regulatory system. We have grave concerns regarding the potential expansion of competition in the operation of rail services as suggested by the Competition Commission fearing that this will ultimately lead to "operator centric" service delivery rather than passenger centric and fail to deliver strategic benefits of a national rail network.

Specifically relating to waste, there are pressures brought to bear in maintaining collaborative working in long-term partnerships arising from planning decisions, delays and changes in the political make-up of local authorities. These are increasingly acute when overlain with the length of time taken to secure appropriate facilities due to, for example, changes in technology, bidding partnership, procurement challenge or dynamic waste streams (a decade is not uncommon). Going forward, it is increasingly apparent that new approaches will be needed to both pay for and deliver waste and resources management in the UK (several reports indicate that policies such as extended producer responsibility will need to be refreshed to provide a greater proportion of the capital and revenue necessary to fund waste and resource management infrastructure, see <https://www.ciwm.co.uk/ciwm/news/2016/ciwm-presidential-report-explores-different-eu-approaches-to-packaging-waste.aspx>).

Many local authorities are working together and collaborating in the delivery of services, however there will clearly be limits to extent to which this will be appropriate, whether it be for reasons of geography or for that matter political differences.

Question 7 What changes in funding policy could improve the efficiency with which infrastructure services are delivered? Note: by "funding", the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

It has been generally accepted that there has been a need for at least 50 years to encourage sustainable transport use over excessive car use. In order to encourage such behaviour we have to work on:



The Local Government Technical Advisers Group

- achieving a culture change,
- providing benefits for those who do change and
- ensuring policies are joined up.

Parking or road user charges, where any net revenue is diverted to improving sustainable transport, obviously provides 'a doubling up' of incentives.

It is notable that an extra driver on the road network does not pay for the extra congestion 'he' causes other road users, let alone the environmental damage 'he' causes. The situation with air travel is not dissimilar. This situation probably also applies to over consumption of energy, water etc.

We mentioned above our support for the devolution of infrastructure decisions and for transport we believe this should extend to all modes of travel and that the regions should be adequately resourced. However, the key issue remains that of revenue funding and in our recent submission to the House of Commons Transport Committee we highlighted how inadequate revenue funding is contributing to increasing road traffic congestion. These restrictions on revenue are also adversely affecting the maintenance of transport infrastructure and particularly highway assets. Generally we have reservations regarding the hypothecation of taxes; however the current arrangements for the distribution of revenue funding to local authorities can only result in the problems being exacerbated.

In terms of waste, policy measures such as extended producer responsibility (see Q6) provide a mechanism whereby waste and resources management costs can be better aligned with producers. This would have the added benefit of affecting the design and products and could be a useful contributor to the development of resource efficiency and the Circular Economy in the UK.

Question 8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets? Note: projects that "can be funded" but "will not be financed" refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

TAG members are generally construction, property or planning professionals in Local Government and we have limited knowledge of all funding and banking mechanisms. We are however very sceptical that there are well functioning markets that properly respond to supply and demand in transport generally and particularly in road transport, the internet, water supply, waste or indeed flood protection.

In order for us to proceed with a project we usually have to go through a complex and costly bidding process for moneys or approval from Central Government. The rules and incentives (please also see our comments on question 12 on cost benefit analysis) set down by government often mean we bid for schemes that we in local government believe are far from the best schemes for our individual areas, but often we consider that something for our individual area is better than nothing.

The process means that we often can't afford to bid for the most desirable schemes for our areas. The failure so far to fund a proper rapid transit system for Leeds is a very pertinent example as described in Appendix 2. We are aware that the government has recently also favoured 'shovel ready schemes' rather than a scheme to try and solve a current problem - we consider that this has further increased the number of less desirable schemes for an area.

More delegation of funding to local areas rather than funding at National level would probably increase the likelihood that worthwhile schemes would be built and our infrastructure be



The Local Government Technical Advisers Group

properly maintained. However it is also recognised that very large scale projects will likely require financial support at a national level.

Question 9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

As stated above we believe a priority for government is to rebalance the economy between north and south this would substantially increase the resilience of the housing infrastructure market and reduce the demand to move quantities of water, electricity etc. around the country. We also believe that it is essential to rebalance the economy in terms of its' component sectors and that this is interrelated to geographical rebalancing.

Resilience in Transport within the system can best be fostered by using finer networks with less reliance on high capacity strategic roads. Additionally, the extra costs associated with resilience need to be recognised as a benefit rather than elements which can omitted to reduce cost often erroneously labelled as "value engineering". Appendix 3 was a joint response with our County based colleagues ADEPT on a previous inquiry by government into resilience (please note that some compromises were made in this response, for example TAG, on the basis of past evidence (see link references in Appendix 1), do not believe significant large road building programmes would help meet most objectives for the UK)

Question 10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The Local Plan and Local Transport Plan process probably can properly identify housing and transport infrastructure requirements in individual areas especially if the administrative areas were given a greater level of freedom from central government to properly identify the issues and come up with the best local solutions. The process can also identify power, water, waste, flood and energy requirements. What is sadly lacking are national plans based on agreed evidence and objectives for Transport etc. We would stress the importance of doing the right things rather than necessarily speeding up the process.

We believe public involvement with proper information is a major contributor to identifying the right strategies – the Swiss referenda systems seem to work rather better.

It is notable that TAG has previously submitted views on the new 'inquiry' process and classification of schemes of 'National Importance' – please also see Appendix 2.

Question 11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Almost by definition all of us involved in the construction industry cannot be 'protecting and enhancing the natural environment' but we can help reduce the impact of the damage past infrastructure has done on the natural environment and minimise the impact future necessary infrastructure, to support life, does in future. (TAG does recognise the world may be a poorer place for us humans without some of our exceptional pieces of infrastructure.) Our basic themes of rebalancing the economy (including maximum use of brownfield sites), energy conservation, densification of our cities and sustainable transport investment and revenue spending are critical, as is good design, in maintaining and improving the overall environment.



The Local Government Technical Advisers Group

Infrastructure has a critical role to play in providing appropriate services and facilities for society today. A critical element in this is to ensure the principle of systems design from the outset to ensure that these services/facilities are not only fit-for-purpose but are also designed in such a manner as to add positively to the environment. This attitude may be counter to many previous developments which failed to adequately consider the full-life costs and long-term impact of the development, or how it could be maintained, repurposed or dismantled at the end of its life. This emphasis is crucial going forward as, in an increasingly resource-constrained world, more thought is needed at the preliminary/front-end to consider exactly what the value-added benefits are and how these can be maximised.

Question 12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent? Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

TAG and many other professional organisations and individuals are very critical of the present system of Cost Benefit Analysis (CBA) when applied to Transport and particularly roads. Appendices 2.1 and 2.2 (as submitted to House of Commons Committees DfT etc) cover TAG’s position on this subject for Transport.

It needs to be remembered that the guiding principle of socio cost benefit analysis is the value society as a whole would ascribe to perceived or calculated benefits whether these are time savings to travellers, improvements to life expectancy from medical treatments, road safety, clean water, flooding etc. Some benefits ascribed to Transport schemes are not benefits that society would value - the best obvious example is the popularity of reducing speed limits to 20 mph in towns which on the basis of CBA calculations according to government advice would be likely to be negative.

The best summary description of TAG’s position on modelling and CBA can be found in a recent peer reviewed technical paper (see page 37-42 of <http://worldtransportjournal.com/wp-content/uploads/2016/02/9th-Feb-final-opt>.

where it is stated:-

‘---there is also substantial evidence that extra road space and higher speeds do not necessarily provide economic benefits. Reference can also be made to the 1999 SACTRA report on roads and the economy which included doubts that the economic benefits could be as high as the calculated time savings. We also know that the ‘economic benefits’ calculated largely on basis of predicted time savings are highly artificial --- in the following terms:

“ --- However linking models (which have been highly calibrated or ‘adjusted’ to try and match a base year situation) to predict behaviour change with an economic assessment introduces potential for a highly distorted view of the potential benefits to real travellers or the economy.

Within the ‘economic assessment process there are the following major issues: -

- The evaluation is largely based on the difference between two enormous sums of time spent on the network with and without a scheme; each of these sums is based on a large number of assumptions, the process is therefore mathematically very unsound.
- For major road schemes most of the ‘benefits’ appear for the peak traffic times (i.e. largely for car commuting – a mode and time that most highway and planning authorities do not want to encourage – it is noted that the very recent increase in the value of time for commuting is likely to further exacerbate this problem) and for the period 30-60 years in the future (where the assumptions taken are even less real).
- The impact of ‘generated’ traffic compared with the so called ‘natural traffic growth’ and its impact outside the proposed scheme is never adequately considered (seldom do the models predict the level of generated traffic caused by the new road fully;also



The Local Government Technical Advisers Group

the extra generated traffic causes minor extra widespread congestion and delays outside the immediate study area, this is usually modelled without the junctions and without other traffic that passes through that area but not through the study area – delays at junctions in urban areas increase very rapidly with small increases in traffic.”

We would wish to clarify that we do consider that modelling travel behaviour is an essential part in the development of most infrastructure but the cost benefit analysis presently carried out gives decision makers a totally flawed value of the likely benefits to society.

We believe greater delegation of funding and decision making to local or regional administrations, proper real information, public involvement, proper planning (see answer to question 10 above) and objective based assessment is likely to improve decision making on infrastructure enormously.

We should add that if the output benefit / cost ratios of schemes were to be taken at face value then road safety schemes, parking management and enforcement, travel planning, traffic signal maintenance, spare drivers for trains, bus lanes etc. would receive much greater funding and most national transport schemes would not pass the tests to obtain funding.

CBA does not align particularly well with Life-Cycle Analysis (LCA) which is better at capturing some of the environmental considerations of projects. CBA tries to ascribe a quantified economic “cost” to every item in the equation, which then limits how this is portrayed and valued. Albeit simplistic, in terms of waste there is a handy guide which can assist (see <http://cri.dk/files/dokumenter/artikler/filea951.pdf>).

Transport:

Question 13 How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

The DfT base most of their strategies on an immutable traffic growth largely assumed on past trends rather than where society may want to be. It is noted that despite large increases in population (and widening of the M25 and other motorways outside London potentially generating traffic increases) traffic levels have been reducing.

It is quite possible and deliverable that traffic reductions could be achieved in the next 30 years for every significant urban area if appropriate policies and strategies were followed. Reductions in traffic in urban areas would probably be reflected in reductions in traffic on the interurban networks.

If such strategies were put in place we would expect an increase in all sustainable travel modes, more needs to be met by providing better access to local shops, jobs, schools, hospitals, recreational facilities etc.; more demand for electronic communications, more home working, and at least a levelling off of air travel demand. Here we also recognise the need for good spatial planning and the appropriate co-location of land uses.

Local van or light goods traffic is presently increasing rapidly for servicing and from home delivery of internet organised goods. Costs of sending a van with very limited ‘payload’ need careful consideration and probably further research before all the appropriate strategies can be put in place for dealing with this issue.



The Local Government Technical Advisers Group

At present we believe it is too early to tell whether self driving vehicles will have any significant effect on the structural elements of road infrastructure provision but we are confident that we should not be relying on such technology alone to solve many of our transport problems.

Question 14. *What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas? Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.*

Our answer to question 1 covers this point best i.e. relatively small schemes improving communication by foot, public transport, bicycle and other means and in urban areas. Reducing traffic volumes and particularly car traffic in and around urban areas will help people travel by sustainable means more reliably and quickly and necessary freight to be able to move on the road network without the need for significant capacity increases. That is not to say that additional junctions and transfer points are needed between the Strategic Road network and local towns. Two examples in Kent are access points urgently needed between the M2 and east Sittingbourne and west Faversham. At a different scale Park and Ride where rail lines cross the M25 and a congestion charge inside the M25 could be very helpful.

We believe that continued electrification of the rail network is an essential element of transport investment which can both improve efficiency and simultaneously contribute to reducing the environmental impacts of travel, furthermore electrification needs to be simultaneously implemented on local and regional networks to ensure greatest efficiency particularly in terms of rolling stock utilisation.

Question 15. *What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area? Note: this includes travel in and between rural areas, as well as between urban areas and international travel.*

Unequivocally demand management to make better use of all existing investment - it is interesting to note that Eddington (see above) stated that road pricing/congestion charging was 'a no brainer'. Also as stated above demand management and better integration of policies between urban and national networks is likely to be very helpful. For freight transshipment from road to rail and sea/coastal freight is probably very helpful nationally and internationally. Loading gauges and the ability of rail to carry more freight needs further investigation. As mentioned above our international competitiveness also depends on final access and this includes links to farms in rural areas.

Nevertheless we also believe that the rail network continues to offer opportunities for further growth with targeted investment. Here the current methodology, largely based upon predict and provide, often understates opportunities for locations either not currently served or not well served.

Question 16. *What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?*

Mobility as a service, for example by taxis, is used by many people to complete journeys to final destinations. Londoners are probably furthest advanced with credit/debit card bus and tube 'tickets' being carried around in pockets and available for use at any time; the taxi, car club and Uber services are also readily available and all have probably been instrumental in reducing car traffic in London. However it is not necessarily the case as more 'empty'



The Local Government Technical Advisers Group

circulating vehicles are not helpful to the environment or traffic. It is probably desirable that no low occupancy vehicles, even if taxis, are given advantages over other vehicles.

We do not see mobility as a service being particularly relevant for the introduction of road user charging – political courage and support combined with an integrated holistic approach to transport and a need to replace present petroleum and vehicle taxation (with an alternative affecting electric vehicles), as the strongest drivers.

Digital communications:

TAG do not consider we are best to comment on the group of questions below except to say home working, conference conversations - instead of long distance national and international travel, management information on network conditions and services and personal advice on services by electronic means are all helpful.

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this? Note: the existing “regime” refers to the current market, competition and planning frameworks. “Digital communications” includes both fixed and mobile connectivity.

Energy:

Again TAG have only limited knowledge of this sector but we do make some observations as below.

Question 19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Rebalancing the economy between the north and south, densification of our cities, energy conservation/insulation, use of roofs for photovoltaic generation, better storage of energy, combined heat and power, microgeneration and more electric vehicles with more available charging facilities could all be beneficial

Question 20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

No comment from TAG

Question 21 What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

We understand that transport is responsible for about 25% of the CO₂ produced in the country and therefore a similar proportion of the energy. We do not believe that air travel can be electrified in the near future however small drones can stay airborne for up to about half an hour – unthinkable with electric motors and batteries 15 years ago; Electric cars now have quite respectable ranges and this is improving rapidly. The result would appear to indicate we will need a significant increase in generation capacity to provide for road transport.-please see our answer to question 19 for where this generation may come from.



Water and wastewater (drainage and sewerage):

Question 22. *What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute? Note: “demand” includes domestic, commercial, power generation and other major sources of demand.*

Question 23. *What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand? Note: this can include, but is not necessarily limited to, governance frameworks across the country.*

Alternatives to traditionally engineered sewerage solutions need to be investigated. These should include real time control, storm water retrofit techniques, education to enable communities to change behaviour, enhancing incentives for communities to reduce surface water flowing to sewers and innovative permitting arrangements across drainage networks and sewerage treatment works. Water and sewerage companies should continue to review and develop other innovative solutions.

For example, where a company may historically have preferred to tackle sewer flooding or combined sewer overflow pollution by increasing its underground drainage to store more rainfall during storms, it might consider other options in future – such as working with customers to manage the rainfall close to source, preventing it from entering the sewer.

Question 24. *How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?*

Flood risk management:

Question 25. *What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?*

Flood and coastal erosion is expected to increase due to climate change and development in areas at risk. It is not possible to prevent all flooding or coastal erosion, but there are actions that can be taken to manage these risks and reduce the impacts on communities.

There are a wide range of approaches available to manage flood and coastal risk. Risks should be managed in a co-ordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment.

Risks of flooding and coastal erosion should be clearly understood, to enable investment in risk management to be prioritised.

Clear consistent risk management plans should be set out so communities and businesses can make informed decisions about the management of the remaining risk.

Emergency plans and responses to flood incidents should be effective and communities should be able to respond effectively to flood forecasts, warnings and advice.

Communities should also be able to recover quickly and effectively after incidents.

Question 26. *What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk? Note: “innovative technologies and practices” can include, but is not necessarily limited to, property level resistance and*



The Local Government Technical Advisers Group

resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

Natural flood management (NFM) schemes can provide many benefits such as; reducing flood risk to smaller more prevalent events; multiple environmental benefits, such as improved soil and water quality by managing surface water runoff; schemes are relatively cheap to implement; maintenance can form part of land management practices. NFM schemes are limited by their ability to remain effective during major flood events.

Property level resistance and resilience measures have had a significant effect on allowing property owners the ability to take control of their own flood risk, allowing communities to recover more quickly and effectively after incidents. These measures should however be treated as the last line of defence as they do not address wider community and environmental issues.

Temporary defences can be an effective means in reducing flood risk with the ability to deploy at different locations when required. It is important to consider the amount of setup time and labour needed to prepare the defences in addition to factors like cost and protection. Depending on flood frequency and site conditions, it may be more cost effective in the long-term to install a permanent, in-situ flood barrier.

The above technologies or practices should not be considered as standalone options for reducing flood risk to communities, but instead should be considered alongside more 'traditional' management techniques in order to take a more holistic approach to the management of flood risk.

Solid waste:

Question 27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

The simple answer at this stage is “no”. Currently, local authorities are under considerable pressure to deliver ongoing improvements in terms of their waste collection arrangements, while also delivering improvements and better efficiency regarding waste and resources treatment and disposal. Pressures are coming to bear in terms of the supply chain (increased costs), increases in residual waste arisings, increasing emphasis on health & safety (rightly so) and dynamic waste streams (i.e. newspapers, which used to generate a revenue for local authorities is declining in correlation to the rise of social media). These developments have tended to mean that budgets are squeezed and “*more from less*” becomes the order of the day. This means that publicity and communications budgets have been amongst the first to suffer and has meant that engagement with residents has reduced.

In order to turn the curve and reduce the generation of residual waste, there needs to be a complete recast of the narrative around waste. Several of the answers above (see Q1, Q6) have highlighted that there is a risk of an infrastructural deficit arising in light of Brexit and a lack of funding to develop or maintain the existing facilities. Given the many millions of tonnes of waste generated in the UK each year, this needs to be addressed with urgency as already concerns about increases in waste crime are crystallising (see <http://www.endsreport.com/article/55331/concerns-over-post-eu-illegal-waste-trade-mount>) and without appropriate facilities and an increasing emphasis on the inherent value in the materials being discarded or recycled, the sector will underperform.

This will need specific Government policy to establish the direction of travel and provide certainty for investment and clarity as to expected outcomes.



Question 28. *What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be? Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.*

At present, a lack of clear Government policy and direction and confusion around the CE Package being discussed in Europe, confounded by the Brexit timetable, is hampering support for and investment in the Circular Economy. Much of industry is looking for certainty and simplicity in order to be able to develop appropriate business models (generally on a pan-European basis to streamline production and manufacture and minimise costs) and the UK is failing to provide that at a national level.

This is creating confusion and tension also between the regions where both Scotland and Wales have adopted more ambitious approaches and would seek to be world-leaders in this area. Despite many positive stories in UK manufacturing, the UK is missing out on what is increasingly being called the fourth industrial revolution and a global trade valued in the trillions (see <http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/europes-circular-economy-opportunity>).

4. Concluding comments

4.1 TAG can only advise that in order to tackle the problems associated with existing infrastructure and deliver the required new infrastructure and services over the next 30 years the most appropriate authorities need to be adequately resourced, given, or allowed to use, adequate powers and that revenue funding is fundamental part in providing the right infrastructure. TAG is confident that within local authorities there is adequate understanding and expertise to adequately deal with appropriate planning of our towns and cities, transport, flooding and waste issues.

4.2 Please do not hesitate to contact me through Andy Morris the TAG Secretary or other TAG colleagues if you require further detail information or wish any further discussions on a face to face basis.

Yours sincerely,

[signature redacted]

[name redacted]

[position redacted] Local Government Technical Advisers Group

Attachments / Appendices as part of this submission:

1. Tag's Submission to the ICE on National Needs Assessment Feb 2016
2. Tag's Submission to the House of Commons Transport Select Committee 6th Dec 2016
- 2.1. Response to Government on Transport Investment and Economic Performance



The Local Government Technical Advisers Group

March 2014

- 2.2. TAG submission on NATA refresh Feb 2008
3. Joint TAG ADEPT response on resilience

Appendices to TAG evidence to the National Infrastructure Assessment consultation

Appendix 1 Tag's Submission to the ICE on National Needs Assessment Feb 2016

The Local Government Technical Advisers Group Evidence to the

Institution of Civil Engineers

National Needs Assessment

1.0 Introduction

1.1 The Local Government Technical Advisers Group (TAG) is a professional association, incorporated in 1995, serving all levels of local government covering the whole range of technical services. Our membership includes authorities with highway and transport responsibilities, including Transport for London, London Boroughs, Metropolitan, Unitary and District Authorities and many with responsibilities for economic development and land use planning. Many of our individual members are Chartered Civil Engineers.

1.2 TAG is particularly active in the areas of transport, flood and coastal management and waste management.

2.0 Summary

2.1 TAG welcomes the opportunity to present its views to the Institution of Civil Engineers and broadly supports the vision and outcomes.

2.2 Regarding transport, TAG has and continues to advocate that the Department for Transport and Government should formulate a national transport strategy and ensure that decisions are taken on the basis of the best potential national outcome rather than isolated views in relation specific modes of transport or specific parts of the networks. TAG has also raised on a number of occasions concerns regarding the transport scheme appraisal process and the different approach taken on expenditure and value depending on whether such public expenditure could be considered as 'revenue' or 'capital'.

2.3 TAG considers that a key issue relating to any decision regarding capacity is the extent to which productivity is enhanced. We also suggest that rebalancing the economy and health impacts are major factors. Additionally, we believe greater clarity is required regarding the meaning of the term "national significance".

2.4 We acknowledge the comprehensive nature of your consultation, however competing demands upon local authority resources has limited our ability to respond to each individual issue and here we will predominantly consider transport related issues. Nevertheless, we hope that we can adequately address the key issues covering flood risk management and outline views on energy water etc. For waste TAG does have a waste topic group but our strength in this area is mainly from Northern Ireland. Relatively recently ICE Northern

Ireland did an infrastructure report to which our colleagues in waste in Northern Ireland contributed. Please see

<https://www.ice.org.uk/getattachment/media-and-policy/policy/state-of-the-nation-2014-northern-ireland/SoN-Infrastructure-2014-Northern-Ireland.pdf.aspx>

3.0 Call for Evidence Questions

3.1 Do you agree with our proposed vision and outcomes? What amendments would you propose?

3.1.2 Broadly yes and we particularly appreciate that any additional investment in infrastructure needs to be done, 'efficiently, affordably and sustainably' and improving 'services' are equally important and may avoid the need in many locations to provide new infrastructure. However we believe that there are two factors that should be added to the considerations: improving productivity and rebalancing of the economy.

3.1.3 Improving productivity is implicit; however it should be an explicit objective. TAG considers that, whereas improving capacity for transport can sometimes contribute to improved efficiency, the current road programme for Strategic Roads is flawed and the appraisal methodology applied to road investment often overstates the benefits. Just over a year ago TAG submitted a document and five appendices to the House of Commons Scrutiny Committee on the Infrastructure Bill – this submission might be particularly helpful in your deliberations - <http://www.lgtag.com/index.php/news/566-tag-evidence-to-hoc-scrutiny-committee-on-infrastructure-bill>

3.1.4 The construction of new or improvement of existing routes contributes to increased travel demand and consequentially the time saving efficiency gain measured in the appraisal process is eroded or fails to materialise. The recent reports regarding the widening of the M25 having resulted in significant increased levels of traffic again illustrates the point and consequentially anticipated time saving benefits will have been reduced on the route. Additionally, the consequential impact of the additional traffic contributes to area wide congestion and further increased delays on the wider network. There is significant evidence to support this view (please also see <http://worldtransportjournal.com/wp-content/uploads/2016/02/9th-Feb-final-opt.pdf> and the listed references).

3.1.5 This issue is exacerbated by the absence of a clear national strategy for transport investment. Consequentially decisions are made on the basis of single mode or sector investments whereas alternative or a combination of investments could deliver greater and better outcomes. Investment in measures that reduce the need for private vehicle travel should be prioritised and we caution against indiscriminate increases in road capacity.

3.1.6 Rebalancing of the economy or at least a contribution to rebalancing the economy should be an objective. Although decisions relating to infrastructure investment will not necessary in themselves rebalance the economy, it is an essential element of any strategy.

3.1.7 Currently the economy is dominated by the financial services (FS) sector, which is also highly concentrated in specific geographical areas, and mainly within the City of London. Invariably, investment decisions based on GDP will therefore favour those projects

that support the FS sector; this is not necessarily wrong. Additionally, the delivery cost of projects increases exponentially with the density of the location, albeit that such costs can be offset by the scale of potential benefits. Consequentially, where the scale of infrastructure investment, and particularly transport investment, has been historically highly constrained an increasing proportion of the national budget has been directed into one specific area and to the detriment of others. Accordingly, a more balanced approach is required if the necessary beneficial change to the economy, including making the British economy more resilient, is to be achieved.

3.1.8 TAG also considers that health impacts should be identified more specifically, rather than as, say, a potential subset of “wider environmental impacts”. Perhaps most prevalent at this time, associated with transport, is the issue of air pollution, which is directly related to traffic volume and therefore capacity and is a particular problem in or near urban areas. The health impact of noise is also increasingly being recognised and is an issue where transport capacity is to be considered. Decisions regarding investment in transport mode also have health implications; broadly, investment in private vehicle transport will have a negative health outcome whereas non-motorised and public transport investment will be broadly positive.

3.1.9 In any case we agree strongly that effective demand management strategies are essential, and if they are not to include road charging on a national scale in the short term, every effort needs to be given to other appropriate measures, such as:

- parking control, limiting available parking; changing the business rating system so that it reflects costs imposed by certain businesses that have many parking spaces and generate much traffic;
- workplace (and shopping) parking charges;
- congestion charging and
- other positive methods such as improving public transport and effective travel planning.

3.2 What will be the main drivers of demand for UK national economic infrastructure over the next 35 years that we should consider in our assessment?

3.2.1 In the transport field Britain and many other countries have spent a lot of effort in an often vain attempt to reduce congestion by adding to road capacity. Unless we educate some of the members of our Institution (ICE), the decision makers and advisers, the pursuit of congestion reduction by road building will unfortunately continue to be a driver. We consider health, pollution, climate change, access to jobs by disadvantaged members of society should be far more significant drivers for capital and revenue investment in Transport.

3.2.2 Security will remain a key issue and the implications for the transport sector will be a major consideration particularly for mass transport systems and international travel. The resulting challenge will relate to the deployment of technologies and adapting our infrastructure to accommodate new and emerging technologies.

3.2.3 Climate change and weather extremes will continue to be a driver together with the need to protect society against severe weather events and the need to cater for an expanded population. Indeed rising ground water levels and tides are also key issues relating to climate change that not only need infrastructure to try and handle but also put up the costs of infrastructure.

3.2.4 This winter has again brought home the need for expanded investment in coastal and river protection, but, like transport investment, proper maintenance and revenue expenditure is essential. However, the lessons relating to previous winters, when snowfall was the major concern, should not be forgotten.

3.2.5 Investment in energy conservation is likely to provide one of the best investments; this will help the UK reduce its contribution to global warming, minimise the need for extra power generation and reduce the need for more capacity in the power networks. However, there is also recognition that investment is essential for the replacement of our increasingly outdated energy generation and distribution systems

3.2.6 Rebalancing the economy and ensuring there is not a continuing southwards drift of population will help reduce the need for extra investment in national water provision or more power networks.

3.3 What will be the main constraints on the UK's ability to provide sufficient UK national economic infrastructure assets and services over the period and what solutions or mitigations of those constraints should the UK adopt?

3.3.1 The main constraints are:

- Political support and commitment, cross party, and the need to take decisions in the longer term and in the wider interests of the country
- Overall economic performance of the UK economy, including the long-term losses on balance of payments
- Public understanding of the issues
- Press and influencers on politicians for short term visible fixes
- Availability of revenue funding, and to a lesser extent capital, and the financial rules favouring certain types or arrangements of funding
- Skills shortages

3.3.2 It is agreed that the diversity of the nature of the potential constraints is such that detailed mitigation strategies need to be developed for each.

3.4 What nationally significant investments in capacity or changes in policy & regulation should we prioritise to deliver these outcomes and deal with these drivers of demand?

3.4.1 A clearer understanding of what constitutes “nationally significant” is required. Many investments required relating to capital or revenue are not of a scale of national significance,

although some are being labelled as such - for example adding extra capacity to Blackwall crossing of the Thames. This is clearly a London scheme and is of similar importance for transport users and delays/congestion as the diagonal pedestrian crossings at Oxford Circus (which is not labelled as a scheme of national importance). However, it is also accepted that local and regional scale projects can make contributions to national productivity.

3.4.2 We strongly believe that, for transport and the economy, the required investments are likely to be local – light rail and tram systems, bus services and priorities, more facilities for pedestrians etc. Nevertheless, where national and local interests coincide there is scope for capital and revenue investments in demand management, park and ride etc.

3.4.3 The situation is broadly similar for the necessary works on flood prevention, power networks etc.

3.5 In what areas can demand management or other forms of behavioural change make a significant impact? What are the blockers and enablers for realising these opportunities?

3.5.1 Traditional economics suggest that all goods and services are price elastic for demand, but there is a lag and probably some hysteresis. However, public opinion, the press and politics are likely to be very strong influencers on what can and can't be used in demand management.

3.5.2 We believe that water metering has not been as effective as expected in reducing demand.

3.5.3 Congestion charging, tolling and parking charges have proved fairly effective over the years in managing traffic volumes, especially if accompanied by carrots of improved public transport. It is interesting to note that cheap (or free to 'pensioners') public transport has similarly increased demand and higher peak rail fares do have some impact on trying to limit peak passenger demand and move some of that demand to other periods. Integrated travel planning was shown to be very effective, however central government does not seem to be giving such measures the priority they deserve commensurate with their potential effectiveness in dealing with excess traffic.

3.5.4 Energy charging again does encourage some reduction in use, but is helped by the carrots of grants for microgeneration, insulation etc.

3.5.6 The scope, on fluvial and coastal protection for demand management to be effective, seems very limited.

3.5.7 For changes to take place in the demand for goods and services, culture is also critical. In the late 1990s there was a bipartisan line on the importance of traffic reductions; some interesting campaigns, effective leadership from politicians and real progress was made, at least on energy and traffic demand management. It seems that much of this has been lost in many areas around the country and by central government.

3.5.8 Effective behavioural change must have leadership, a strong effort at culture change, sticks and carrots and an integrated holistic approach - with no, or as few as possible, mixed messages.

3.6 How can greater cross-sectoral decision making be encouraged?

3.6.1 In large organisations there is a very strong tendency to work in silos, budgets are provided or agreed for specific areas, decisions often made from a narrow point of view. Better multidisciplinary or cross sectoral organisation is necessary. This tends to be achieved with smaller governmental units but it is essential that such units have the necessary understanding or technical support so they are able to make decisions on facts and evidence.

3.6.2 Powerful lobbying or vested interest at local or national level also results in less than optimal decision making on priorities.

3.6.2 Fully open government, with each decision justified and open to scrutiny, will help. Similarly very local responsibility and democratic decisions on infrastructure where the whole range of considerations for such infrastructure can be considered rather than more single discipline organisation that is inevitable with larger bodies.

3.7 What opportunities and challenges are presented by devolution of infrastructure decision making?

3.7.1 If devolved decisions, on the basis of understanding and knowledge, are made (across area boundaries when necessary) and sufficient budgets are delegated to provide a reasonable service, there could be great improvements. Unfortunately recent history shows the reverse has happened; one of the best examples is that about 50% of the roads budget is being spent on 2% of the network and a large part of that on fruitless widening of the strategic road network (see section 3.1 above and other submitted evidence)

3.8 What new and emerging technologies and disruptive trends should we consider in producing this assessment?

3.8.1 Invariably, within the lifetime of the projects identified, technology will impact, however it is difficult to determine the extents of such impacts for future requirements. Often the introduction of such technologies have their own challenges or barriers, which may inhibit or negate any benefits. Care needs to be exercised, therefore, when considering the potential for such impacts.

3.8.2 Current and evolving telecommunication technologies can and will be likely to play a part in reducing travel demand, however the impact to date has been less than initially anticipated. However such developments will likely have a significant impact upon productivity and increase opportunities for social and economic diversity.

3.8.3 The electrification of transport fleets is a further factor that may have only a modest impact in relation to travel demand, but will likely impact upon energy requirements and pollution levels!. Further advances in storage and distribution are essential to improve the

viability of wider-scale delivery, these will no doubt occur, but the timescale is less certain. Additionally, central government's approach and degree of support will have influence. In the case of rail, the financing of the electrification programme and for road, the incentives provided by grants and taxation.

3.8.4 Driverless technology will also be a factor for road transport, however the precise timescale and nature of the impact are more uncertain.

3.9 How can we improve public engagement in infrastructure decision-making?

3.9.1 Fundamentally, good communication will be key. The messages need to be clear, concise and relevant and processes well managed, and where possible early engagement is to be preferred.

3.9.1 The Swiss model of local referenda seems to have some appeal; a piece of research carried out by an Australian academic has compared decision making in the UK, Australia and Switzerland, which may be useful for ICE deliberations –

<http://worldtransportjournal.com/wp-content/uploads/2015/02/wtpp17.3.pdf>

If you require any further information or wish to discuss any issue directly please do not hesitate to contact Martin Sachs the Secretary to TAG Transport Committee or indeed other representatives in TAG who you will find on our contacts page of our website:

<http://www.lgtag.com/index.php/contact-us>

v29-2-16

Appendix 2 Tag's Submission to the House of Commons Transport Select Committee 6th Dec 2016

Contact details:

[name redacted]

[position redacted]

The Local Government

6th December 2016

Technical Advisers Group (TAG)

13 Carrick Drive

Barkingside

Ilford

Essex IG6 2LX

[telephone number redacted]

Mrs Louise Ellman MP

Chair House of Commons Transport Select Committee

Dear Chair and Members of The House of Commons Transport Select Committee

INQUIRY INTO URBAN CONGESTION

1. Introduction and background to TAG

1.1 Thank you for the opportunity to submit evidence to the Committee on this most important subject. As a background, we have submitted responses to Government and given evidence to the House of Commons Transport Select Committee (HOCTC) and other House of Commons Select Committees and indeed many other august bodies and inquiries on various Transport Policy Issues over many years. We attach some relevant documents previously submitted to Government and HOCTC as appendices to this submission.

1.2 TAG as a professional/technical organisation represents a large number of local authorities in the country, these include those with highway and transport responsibilities such as Transport for London, most London boroughs, Metropolitan authorities, Unitary authorities, consultants providing highway and transport services for major local authorities and many of the districts and towns in two tier authorities. While 'second tier' authorities do not have direct responsibility for transport, they do have the major role in looking after significant towns and the sensible overall planning of them including providing a reasonable environment and trying to ensure, through the Highways and Transport Authorities, that the transport system is fit for purpose.

1.3 TAG was first created as a joint officer body to coordinate across the various areas of Local Government and was formed by an amalgamation of the Associations of London Borough Engineers and Surveyors (ALBES), Metropolitan District Engineers (AMDE) and Chief Technical Officers (ACTO) of the districts in two tier areas. One of the major reasons for this combination was so that advice could come from one body. TAG still has a major role in advising the LGA and recent submissions from the LGA on transport issues usually reflect TAG advice.

1.4 Overall we represent over 100 different authorities and for this inquiry we believe as a body we have more responsibility and experience than any other organisation to support the Select Committee in its work.

1.5 We can confirm that we have consulted our membership on the content of this submission and it represents the overall views but not necessarily the views of individual members or authorities.

2. Summary

2.1 We note the headings included in the invitation to submit evidence are broadly headed as **Integrated Strategies** including strategies to limit car traffic by road pricing, congestion charging and parking control, improvements to sustainable transport, and technological innovations and **Wider Considerations** including managing construction activities, construction and operating costs, cost benefit analysis, the bus market and safety. TAG members and all Technical officers in Local authorities have to grapple with all these issues. For a detailed understanding of some of the issues, individual local authorities have particular experience and expertise which we have not been able to fully tap into in the time available or do justice to the subject matter in a reasonably concise submission eg Nottingham, Manchester and Sheffield on Tram systems, TfL on congestion charging.

2.2 Nevertheless we will endeavour to provide an overview of most of these issues and their linking. In addition we have also prefaced the consideration of these issues with our

own 'General Issues' section discussing overall urban strategies and interfacing between interurban and urban areas and the nature of congestion.

3. General Issues

3.1 TAG agrees that traffic congestion, including for buses and pedestrians, is wasteful and we support any reasonable measures that can be shown to alleviate congestion. The Eddington Report (a link to the documents produced by Eddington can be found on - <http://collections.europarchive.org/tna/20100408160254/http://www.dft.gov.uk/about/strategy/transportstrategy/eddingtonstudy/>)

) identified that the worst congestion was in urban areas, indeed he identified that 89% of traffic congestion is in urban areas. Furthermore he stated that road pricing/ congestion charging was 'a no brainer' as part of the solution to congestion.

3.2 TAG recognises the political difficulties of road pricing and indeed most traffic limitation strategies but, realistically for any major urban area, efforts have to be directed at measures to reduce the dependence and use of private motor vehicles; this is for congestion, environment and economic reasons.

3.3 TAG believes, with evidence, that enlarging the road network anywhere near major cities will in the relatively short term increase traffic levels, congestion, CO2 and pollution levels and can make all travel worse. (The Committee may want to refer to a recent peer reviewed technical paper on the subject of generated traffic as a result of road enlargements (<http://worldtransportjournal.com/wp-content/uploads/2016/02/9th-Feb-final-opt.pdf> please see pages 37-42); while this particular paper was written as a review of the government policy and strategy on the strategic road network, the analysis applies even more to proper urban, road capacity or design speed, highway 'improvements'. However TAG understands fully that getting this message across is very difficult and indeed it appears that at least some of the people submitting evidence to this inquiry certainly believe the answer to congestion is more road space.

3.4 Much has been written over the years on how to manage the transport system in towns, probably the most useful and perceptive are the 1963 Buchanan report Traffic in Towns and J.M.Thompson's 1977 book Great Cities and their Traffic. Particularly relevant and still very pertinent are some quotes from the Buchanan report:-

"We think it will be necessary for transportation plans to be based on a conscious decision regarding the extent to which demand for the optional use of cars can be met. The plans should contain measures to influence the demand so that it matches the provision that can be made.there appear to be four possibilities:

- (i) A system of permits or licences.....*
- (ii)pricing for the use of road space.*
- (iii) Parking policy.*
- (iv) Subsidising public transport so that it offers considerable financial advantages over the use of cars"*

(Traffic in towns paragraph 451)

"The question of how much parking space should be provided in new buildings needs to be considered.... Developers or owners of a new building should provide sufficient space within

the site to accommodate all the essential traffic generated by the building.... Doubt attaches to the provision of space especially for car-commuters To put it shortly: why should an employer be obliged to provide parking space for all and sundry on his staff who may choose to drive to work primarily for their own convenience?" (T in T Para 454)

"the application of arbitrary parking standards to new buildings may produce an accumulation of parking space which the network cannot deal with..."

"....parking policies need re-examination to ensure that traffic difficulties are not being 'built in' by the provision of too much parking space..." (T in T Para 456)

3.5 Great Cities and Their Traffic complements Buchanan's findings with analyses of the environment, success and liveability of a number of world cities of different sizes. Broadly the main findings are that any city over about 250,000 population will suffer considerable congestion and indeed social disadvantage if it does not promote sustainable transport. It is also worth considering two very different examples of cities for the present day. Central London has a car commuting share of typically about 1 in 20 people driving, yet even in Central London approximately ¼ of all land is used for road transport (and servicing); increasing road space for private motor cars would obviously be fruitless. Austin the capital city of Texas and possibly one of the more pleasant American Cities has a population of about 1 million and occupies the land area of the whole of Greater London yet still suffers considerable congestion.

3.6 TAG has on a number of occasions expressed its concern to your committee and others about the disparity between the policies and strategies being followed on the National Road Network and those required in urban areas - where the vast majority of trips begin and end and which are the main drivers of the economy. If very different strategies are to continue to be employed, much stronger consideration and funding has to be given to appropriate interfaces between the very different policies and strategies.

4. Integrated strategies

4.1 TAG agree wholeheartedly that managing competing demands for urban road space; shifting people from private vehicles to public and active transport modes in urban areas is absolutely essential if there is any desire to reduce urban road traffic congestion, pollution, and environmental damage and to provide healthy cities that are pleasant to live in or economically prosperous. However to deliver such policies requires culture change, leadership, effective design and implementation of 'sticks and carrots' and an integrated holistic approach across the whole planning and funding for urban areas. It is notable on this that recent policies are going against providing the right incentives - rail fares are to rise by 1.9% (above the general inflation rate) while motoring fuel costs have come down over recent years and a further budget freeze on fuel duty doesn't help deliver positive advantages to those willing to use sustainable transport

4.2 If the government has set its sights against national road pricing for the foreseeable future (for understandable political reasons) it needs to provide support and help for all strategies at local and national level to encourage individuals to use sustainable modes -

(e.g. by effective management of public and private parking, park and ride, workplace parking levies, congestion charging, rating changes for premises with plentiful parking, travel planning, planning standards, bus and high occupancy vehicle lanes, cycle provision, wider footpaths etc.).

4.3 TAG firmly believes that to be successful, measures need to be introduced as part of an integrated strategy. Whereas individual elements can be introduced any success is likely to be very localised and limited. Public transport and parking control are considered to be the key elements and the provisions of the Bus Services Bill are particularly welcome and will allow better opportunities for the coordination of public transport and more efficient use of the limited finances currently used for subsidies.

4.4 For our larger urban areas rail commuter services are also an important factor however there is currently only limited opportunity for coordination. Evolving devolution agreements and new franchising arrangements can afford better opportunities for coordination particularly when coupled with the provisions of the Bus Services Bill and are welcomed.

Positive traffic limitation strategies

4.5 Parking control and management have been recognised for nearly 60 years as powerful tools in managing transport and traffic in towns. The policies have been deployed by: development standards for parking provision in new buildings, provision of public car parks, charging for the use of the valuable commodity of a parking space and enforcement to ensure roads are kept clear and spaces are rationed to help essential users and functions. More recently Nottingham has introduced control on workplace parking and some other authorities are exploring possibilities of such controls.

4.6 For Central London positive methods of traffic reduction by parking control precede even Buchanan and his suggestions (see para 3.4 above). A little later In the mid-1970s research by the Greater London Council and Central London Boroughs identified that a 1/3 reduction in traffic volumes was necessary to provide an improved residential environment, facilities for pedestrians or an enhanced bus service. Measures investigated included Supplementary Licensing and Area Control (basically precursors to the present Congestion Charge), Private Non Residential (PNR) parking control – a precursor to workplace parking levies (but which also included privately owned shopping centre car parks) and effective management and enforcement of street parking controls and their extension throughout much larger parts of London (It should be noted that in the late 1970s parking enforcement was so poor that about ½ of all trips ended in an illegal parking act). (Some papers from these studies are still available and one of the authors of this submission can provide copies, if required by the Committee).

4.7 While TfL can provide a great level of detail about the Congestion Charge - in particular it is notable from their studies that there was a very substantial reduction in car commuting and indeed the use of workplace parking after implementation. Many cities have substantial numbers of office car parks in the city centre many dating from before planning standards were changed (1969 in central London and following Planning Policy Guidance note 13 in most other cities – unfortunately PPG13 was removed as part of the NPPF). If there are a lot of terminating as opposed to through movements in a city, workplace parking controls, especially if the charges are passed to employees, can be very effective especially if the revenues can be used to improve public transport at the same time - as happens in Nottingham. While many people involved with urban transport including a previous Minister of Transport (Stephen Norris) may have seen workplace parking charges as a theoretically

better way of limiting traffic in London, the political and practical difficulties of recycling revenues to public transport from several different Central London local authorities would have been very difficult within a political cycle.

4.8 While parking control in all its guises helped hold traffic growth down in London the integrated approach of:

- stopping major new road construction,
- effective parking enforcement,
- extension of controlled parking zones,
- a steady programme of bus lane implementation,
- travel planning type initiatives at workplaces and other land uses,
- improvements to public transport services
- the central London congestion charge
- removal of excess road capacity
- awareness of the effects of CO₂ and a cultural change away from car ownership

all occurring from the mid-1990s have resulted in a fairly dramatic change in traffic levels from a steady growth to a clear traffic reduction throughout London; this is despite the large population increase. This peak car phenomenon has been well researched by David Metz and Phil Goodwin (a quick reference to this change in London can be found on the graphs in this presentation: <http://www.carplus.org.uk/wp-content/uploads/2014/12/D-Metz-University-College-London.pdf>). Incidentally this presentation illustrates another worthwhile contribution to reducing but still allowing car use with 'pool cars'.

4.9 Experiences from Nottingham, which despite having a less benevolent operational framework for bus services than London, indicates significant success in integrating parking management and public transport. Nottingham remains the only city to have introduced a workplace parking levy, which despite some concerns raised by local businesses was introduced and has operated successfully since 2012. Car journeys in Nottingham reduced by 7.9% between 2000 and 2015 whereas other large cities have seen increases and the levy raised £9.3m in 2015/16. The funding raised by the levy has secured improvements to public transport including extension of the city's tram network and appears to represent a more palatable method of traffic constraint than that of road pricing.

Low emission zones

4.10 Low emission zones (LEZ's) represent a valuable tool to control the harmful environmental effects of road transport. A number of LEZ's have been introduced in the UK specifically to address concerns regarding local buses, which is perhaps more of a stinging indictment of the state of public transport. London is the main exception where goods vehicles are also restricted and in common with other major cities, that have introduced such schemes, air quality has improved. However traffic levels are unlikely to reduce following the introduction of an LEZ and therefore it is unlikely to have a significant direct impact on congestion.

Bus priority measures

4.11 Bus priority measures have worked but have not always been popular and for example were removed in Liverpool. London has now had an effective bus lane implementation programme for over 40 years and by and large bus lanes have been accepted and indeed welcomed in many areas. Bus priority can have the effect of reducing the overall capacity of routes for all vehicles and it is therefore essential that where

considered to be introduced the impact on the wider network should be carefully assessed. Nevertheless, relatively low cost bus priority schemes can generate significant benefits, particularly in terms of journey time savings and have the potential to improve journey time reliability. However these benefits are not necessarily readily apparent for users and therefore a commitment to enhancing bus services or least maintaining service levels is essential for on-going public support. Parking management will also be necessary to constrain car trip demand and ensure that benefits are not eroded.

Street running tram and trolley bus systems

4.12 Britain lags substantially behind its neighbours in Europe and the 1985 Transport Act certainly hindered our larger cities except for London in providing effective Public Transport. Nevertheless there is now considerable experience and knowledge from London, Nottingham, Manchester and Sheffield for street running trams. Leeds is still trying to get a workable modern public transport system - recently via trolley buses. The comparison of Leeds not being able to get on with its provision in a city of 800,000 people with a substantial hinterland population, with say Luzern in Switzerland with a population of 50,000 with its own trams, is stark.

4.13 It is certainly clear that the travelling public prefer tram systems over conventional bus services. However the cost of retrofitting the heavy apparatus into existing urban streetscapes is often significant (issues regarding utility costs and cost-benefit calculation are made below). Urban development patterns also present challenges for some cities and the trend towards decentralisation which has weakened many city centres results in a greater geographical distribution of journeys. Nevertheless trams can play a key role in reducing congestion and when coupled with appropriate land use policies can contribute significantly towards the strengthening of city centres as key locations.

Technological innovations

4.14 While TAG is keeping abreast of potential intelligence within cars to avoid collisions and increase capacity on the strategic road system however we do not believe such technological advances will reduce urban traffic congestion markedly in the next 20 years and for our largest cities such technological advance could extract public transport users and cause an increase in congestion.

4.15 Tag is concerned that revenue restrictions and skills shortages are not only reducing the deployment of current technology but also impacting adversely on its' maintenance. Consequently, even a humble set of traffic signals will be maintained such as to operate safely, however replacement of failed detection equipment for example is not prioritised thereby adversely effecting optional efficiency, contributing to congestion and the consequential health and environmental impacts. This we believe has contributed to an increasing tendency to "switch off" or remove installations with the suggested objective of easing traffic flow. Similarly, despite the significant benefits for the management of congestion by the deployment of area wide Urban Traffic Management and Control Systems, revenue funding in particular is challenging and many authorities are unable to commit to further expansion and even retraction to reduce revenue costs. Skills shortages in this area can result in the wrong selection of an appropriate control strategy for junctions or

deployment of the wrong technology in addition to limiting availability of sufficiently qualified maintenance staff.

4.16 Bluetooth and mobile telephone data technologies offer opportunities for real time traffic monitoring which when combined with the control afforded by an Urban Traffic Management and Control System can provide for significantly improved congestion management. However for many authorities the revenue implications are likely to be prohibitive even if the capital can be found for the deployment of the necessary equipment.

4.17 Information technology offers significant benefits for public transport users but uptake and deployment has been slow, particularly in the bus industry. Real time information systems can be readily deployed, however bus operators have not in all areas embraced it and in some areas only partially adopted it, causing a mixture of real and timetable information to be displayed, wholly undermining its' integrity when delays occur. Similarly, wider and more particularly multi-operator network ticketing is not necessarily available. It is to be hoped that the proposals contained in the Bus Services Bill will enable the better and wider deployment of these technologies.

Cycling and walking infrastructure

4.18 Almost all trips for all purposes involve a walking stage and in the centre of our largest cities, and indeed smaller historic cities, walking is fundamental to general travel, the economy and environment. Reducing delays to and improving the environment for pedestrians, even at the expense of slightly increased delay to vehicles, is well worthwhile and particularly space efficient. Such measures will also reduce car traffic volumes - the best example of such an effect was the removal of general traffic from Oxford Street in the 1970s.

4.19 Cycling undoubtedly has significant health benefits, is often the fastest way of travelling in our big cities and is also very space efficient. An holistic approach to cycle facilities and use can be effective to make cycling a significant mode of travel and encourage some people who might have previously used a private motor car. Cambridge, Oxford, York and London provide probably the best examples in the UK, but Holland, Paris and Switzerland (where apparently 14% use cycles for the journey to work in a wet cold hilly country!) can provide useful lessons in improving cycle travel.

4.20 It is notable that the increase in light van use must be contributing to urban congestion. It is likely that many vans are often carrying very little and efforts made to encourage more use of walking (also combined with Public Transport use) and cycles and even mopeds for small loads could have an impact. The recent growth of Deliveroo services is an interesting example

5. Wider Considerations

Managing disruption to local communities and businesses during construction and operation

5.1 Local Authorities feel most acutely the pressure to minimise disruption during construction and other operations of their works, as local council members quickly react to any concerns raised. However this is not the case for other agencies and the majority of complaints arise from utility works. Some improvement in utility company performance has occurred resulting from statutory and regulatory changes, however several authorities have considered it necessary to resort to the introduction of charging schemes whereas others remain reluctant to do so due to the bureaucratic overhead costs associated with the operation of such lane rental schemes.

5.2 The greatest consternation regarding the execution of local authority schemes, particularly major works, remains the performance of the utility of companies and their contractors. Largely, performance is based upon their goodwill with no contractual requirements to perform either to any specific timeline or costs. In many cases where project overruns are encountered, utility companies or their contractor's performance is cited to the major factor.

Construction and operating costs –

5.3 Again one of the likely highest cost elements in a transport project in the urban area will be that of utility diversions. However, it is the uncertainty of performance which raises most concern during the lifetime of a project from its very inception until final completion. Uncertainty of performance brings high risks both directly associated with their costs and also potential indirect costs arising from delays over which neither authorities nor contractors have any control. The utility companies need to be made more accountable; it is worth noting that not all countries fund utility diversion costs resulting from major infrastructure works, which no doubt incentivises better performance.

5.4 For Local Authorities the management of operating costs is a primary concern, however in reality given revenue constraints the relationship between proper management/ maintenance of assets and available funding are diverging. Consequently, in the longer-term overall operating costs will invariably increase or more likely the need for capital replacement. The majority of authorities have adopted or are in the process of adopting best practice in the management of their highway assets, which is to be welcomed, however this process highlights the scale of the value of highway assets and the limited and wholly inadequate funding currently available. An alternative funding mechanism needs to be considered if government wishes to both maintain the asset and stringent financial controls.

5.5 The revenue funding issue mentioned above extends beyond highway maintenance into all aspects of services. Relatively low cost beneficial transport services such as sustainable transport projects including Workplace Travel Planning can demonstrate significant returns but require relatively modest revenue funding which for many authorities is not an option. Limited funding is being made available to some authorities for sustainable transport however this can only be obtained through competition which invariably results in many authorities not receiving any assistance despite very high cost benefit ratios calculated for such schemes.

5.6 Revenue funding for public transport has reduced significantly and consequently many bus services deemed by authorities to be a social necessity are being removed. Additional pressure on public transport budgets arises due to the cost of the operation of the National Concessionary Travel Scheme which is not being met by central government. Consequently many transport authorities are faced with need to reduce concessions for younger people. The current arrangements for Bus Service Operators Service Grant and reimbursement of concessionary fares, outside London, do not make best use of this limited but significant funding.

5.7 Overall the disparity between the treatment and funding for revenue and capital costs, as we have said many times before, is inappropriate and limits the ability to operate our transport assets safely and efficiently. The maintenance of existing infrastructure should be our first priority.

Approaches to cost-benefit calculations

5.8 TAG has at each opportunity voiced concern regarding the way Cost Benefit Analysis (CBA) is being used at present. We have welcomed the devolution by the Department for Transport (DfT) of transport investment decisions but note that the frameworks within which authorities are required to work have been strongly influenced by DfT with significant emphasis placed upon a project's CBA. If it were used rigorously, smaller schemes and even some larger schemes including congestion charging and many smaller public transport projects would likely dominate, not road schemes or grand projects.

5.9 Rather than reiterate previous papers here, a brief summary of issues and concerns relating to CBA and the implications in its use is set out below (Reference can also be made to two appendices attached):- –

- Large Commuter Flows Dominate – for road traffic the result is the potential for continuous road widening,
- Lower Cost Options Dominate – inter-urban construction costs are generally lower than urban resulting in greater values for investment in the Highways England Network,
- Accordingly, we question whether the true costs of projects are being measured and similarly whether benefits are being accurately represented.
- It is appreciated that DfT has sought to improve the approach, however in doing so the models become more complicated and the relationships to real outcomes ever more obtuse.
- Similarly, we question whether the current approach adequately addresses the desired policy outcomes.

Implications for the sustainability of the market for provision of bus services

5.10 TAG has noted the continuing decline of bus services and passenger numbers particularly in large urban areas except London as what must now be considered a long-term trend. This is not necessarily initiated by the 1985 Transport Act but in our view certainly hastened by it. Notwithstanding the introduction of the Act, outside London bus service operations appear to have been overly dependent upon subsidy and with the

major contractions in funding in recent years the levels of service have reduced significantly, together with passenger numbers. The implications on continuing reductions in subsidy appear inevitable under the current model. TAG believes that the Bus Services Bill when enacted will afford authorities an opportunity to intervene where necessary although invariably stability in the funding regime will be necessary to avoid continuing reductions.

5.11 Nevertheless, TAG strongly believes that bus services are an essential element of the public transport system and can contribute greatly to the reduction in congestion in urban areas particularly when operated as part of an integrated transport system.

The safety of road users, particularly cyclists and pedestrians

5.12 TAG contends that the area of road safety has suffered in recent years from complacency due in part to previous success. Consequently insufficient effort or resources are being invested in reducing the occurrence of road traffic accidents in this country. We have benefited in recent years from a trend of reducing accident rates driven by great efforts by road designers, road safety practitioners and significant improvements in vehicle technology. However reductions in revenue funding have resulted in many local authorities dispensing with or at least significantly reducing road safety teams and loss of key staff resources in design teams. Indeed a number of authorities are discontinuing or significantly curtailing their school crossing patrol services due to the limitations of revenue funding.

5.13 TAG strongly recommends that local authorities are provided with adequate financial resources to enable them continue and where necessary reinstate essential road safety services.

The Traffic Management Act – Part 6

5.14 TAG has consistently argued for local authorities to be provided with necessary funding and the tools to carry out their duties. Part 6 of the Traffic Management Act provides for the Civil Enforcement of Traffic Contraventions and is considered by TAG and indeed this Committee to be a key tool for many authorities to better manage highway networks. Despite the introduction of the Act in 2004 key powers have yet to be introduced and successive Secretaries of State have been unable to justify their reluctance to do so even though they exist in London. Although, not all authorities wish to take on all the additional powers - some consider the requirements onerous, for others, particularly our larger conurbations where congestion is a major problem, the powers are considered to offer significant benefits. TAG therefore requests continued support for their introduction.

Skills

5.15 As ever in a time of recession many skilled employees have been lost to the industry and training budgets have been sacrificed. For local authorities budget pressures continue to force reductions in areas which require revenue funding, such as traffic

management and road safety, consequently there is little prospect of skills development and skills shortages are inevitable.

6. Concluding comments

6.1 TAG can only advise that in order to tackle the problems associated with congestion and to deliver an effective transport network, authorities need to be adequately resourced, given or allowed to use adequate powers and that revenue funding is key. TAG is confident that within local authorities there is adequate understanding and expertise to adequately control congestion in the areas where congestion for pedestrians, public transport, goods and private cars is worst.

6.2 Please do not hesitate to contact me or other TAG colleagues if you require us to appear before the committee (which we would welcome) or if you require further information, explanation or copies of other documents.

Yours sincerely,

[name redacted]

[position redacted] TAG National Transport Committee on behalf of the Local Government
Technical Advisers Group

Attachments / Appendices as part of this submission:

1. Response to Government on Transport Investment and Economic Performance March 2014
2. TAG submission on NATA refresh Feb 2008

Appendix 2.1 Response to Government on Transport Investment and Economic Performance March 2014

Appendix 1 to HOC Transport Committee on Urban Congestion Dec 2016

Contact details:

*[name redacted]
[position redacted]
The Local Government
Technical Advisers Group (TAG)
[address redacted]
[telephone number redacted]*

[name redacted]
[job title redacted]
Department for Transport
33 Horseferry Road
London SW1P 4DR

24th March 2014

Dear [name redacted]

Transport Investment and Economic Performance

5. Introduction

1.1 As you may be aware TAG represents a large number of local authorities in the country, these include those with highway and transport responsibilities; such as Transport for London, most London boroughs, Metropolitan authorities, Unitary authorities, consultants providing highway and transport services for major local authorities and many of the districts and towns in two tier authorities. While 'second tier' authorities do not have direct responsibility for transport, they do have a major role in looking after significant towns including their economic health and the sensible overall planning of them including providing a reasonable environment and trying to ensure, through the Highways and Transport Authorities, that the transport system is fit for purpose. Overall we represent over 100 different authorities. Thus for any technical or professional group likely to respond to your Call for Evidence, we believe we are the most effective representative organisation likely to have a technical as well as public view on any policy issues.

1.2 TAG was first created as a joint officer body to coordinate across the various areas of Local Government and was formed by an amalgamation of the Associations of London Borough Engineers (ALBES), Metropolitan District Engineers (AMDE), Chief Technical Officers (ACTO) of the districts in two tier areas; One of the major reasons for this combination was so that advice to the new combined Local Government Organisation could come from one body. TAG still have a major role in advising the LGA and recent submissions from the LGA on transport issues usually reflect TAG advice.

1.3 As we were not aware until recently about your call for evidence we have not been able to consult our full membership (but have consulted our executive) on the form of this response before submission. It will up on our web site imminently and if we receive any other views or further important information we will relay it to you.

1.4 TAG have expressed concerns and made a number of suggestions to Government over the years on;

- the types of schemes most likely to help the economy,
- delivering transport and communication systems to serve the customers - the people, visitors and businesses of the UK
- the assessment and funding methods for infrastructure.

1.5 We do not intend to repeat our previous submissions to the DfT on these issues but if you are not able to find them please contact us. Nevertheless we do attach our recent response on the NN NPS for context, We summarise our fundamental points on

assessment, illustrate particular issues from our experience from a number of authorities and attach our response on the NATA refresh consultation of February 2008 - we believe this now slightly old response is still highly relevant.

6. Background on Assessments

2.1 We note in the document Understanding and Valuing the Impacts of Transport Investment from October 2013 that the 'Transport Business Case' assessment

considers the investment decision from five perspectives – the strategic case, economic case, commercial case, financial case and the management case. We are concerned that these seem divorced from the public service aspects of meeting peoples and businesses transport needs unlike the NATA Appraisal Criteria:

- “Integration – ensuring that all decisions are taken in the context of our integrated transport policy;
- Safety – to improve safety for all road users;
- Economy – supporting sustainable economic activity in appropriate locations and getting good value for money;
- Environmental Impact – protecting the built and natural environment;
- Accessibility – improving access to every day facilities for those without a car and reducing community severance.”

2.2 We note the government’s vision for Transport in the NN NPS and have suggested relatively minor changes that would make the vision a useful test to ensure that any scheme works to such a shared vision. Any scheme which does not meet such a shared vision should be rejected without any further assessment analysis. The suggested vision as included in our response to NN NPS is as follows:

“The Government will deliver with its partners national networks that meet the country’s long-term needs; supporting a prosperous and competitive economy and improving overall quality of life, as part of a wider transport system. This means:

- *Networks with the capacity and connectivity to support national and local economic activity and facilitate growth and create long term jobs (note - not jobs just during construction)*
- *Management of networks to support and improve journey quality, reliability and safety*
- *Networks which support the quality of the national and local environment and the move to a low carbon economy*
- *Networks which provide reasonable access for our communities to services and jobs and link to other communities and facilities.”*

2.3 Within our submission on NN NPS we summarised our overall views on assessment as follows:

- Schemes should not even be considered, let alone need to get to an assessment process, unless they meet reasonable national and local transport objectives; we would hold for the reasons above (*explained in detail in our response on NN NPS attached*) that there will be very few occasions when trunk road schemes are likely to meet such reasonable objectives.
- The present methodology is too complex, opaque and not adequately useful for the real politician decision maker.
- The seeming importance of a flawed cost benefit analysis method seems to carry a disproportionate weight in the overall assessment.
- Within the 'economic assessment' process there are the following major issues:
 - The evaluation is largely based on the difference between two enormous sums of time spent on the network with and without a scheme; each of these sums is based on a large number of assumptions, the process is therefore mathematically very unsound.
 - For major road schemes most of the 'benefits' appear for the peak traffic times (ie largely for car commuting – a mode and time that most highway and planning authorities do not want to encourage) and for the period 30-60 years in the future (where the assumptions taken have even less accuracy).
 - The impact of 'generated' traffic compared with so called 'natural traffic growth' and their impact outside the proposed scheme is never adequately considered.

2.3 TAG accepts that Transport Models are necessary to help predict how people and industry would react to any Transport System change. However linking models (which have been highly calibrated or adjusted to try and match a base year situation) to predict behaviour change with economic assessment introduces potential for a highly distorted view of the potential benefits to real travellers. TAG also recognises that there are some useful principles in the assessment methods but there is much work to be done before the methods are really useful. The recently published Post-Opening Project Evaluations completed for the Highway's Agency, highlight concerns relating to the forecasting of scheme benefits which are fundamental to the 'economic' assessment of a project.

2.4 While we have pointed out a number of other problems in our 2008 NATA refresh submission there are some other assessment issues we would wish to address specifically.

- On the infrastructure costs side of any assessment, some past infrastructure certainly has 'value' after 60 years however the 'vehicles' on the infrastructure are not always included properly – there are real costs to individuals in the UK economy in providing cars to 'fill up' the new roads which last typically 12 years; these need to be compared in any assessment with tram or train carriages which typically last 40
- It is notable that in some cases transport is artificially cheap at the point of use eg it does not really add value to the economy that low value added work like packing Kent potatoes is being done in Somerset

7. Socio-economic time savings assessment and real economic benefits

3.1 As mentioned in our 2008 NATA Refresh submission (attached) the present 'economic assessments', especially for road schemes, have potential for enormous errors.

Our members generally report that the schemes they try and implement are for economic regeneration or improving the environment. Congestion reduction does figure, however for major road schemes in urban areas evidence shows they are likely to be counterproductive but travel planning and public transport schemes work. Furthermore, if we are calculating socio economic returns in the traditional DfT/ Treasury way, road safety, other small schemes, travel planning and (smaller) public transport schemes have the highest returns. Thus, if the economic calculations are to be believed, the government should transfer a very large part of the funding away from national projects to much more local projects of these kinds.

3.2 While LAs normally promote schemes for regeneration or environment, to get 'through the hoops' and obtain funding we have to spend large sums on consultants who know how best to create a model and assessment system to 'show' an economic return.

It is relatively easy for consultants to identify various assumptions to tweak to produce the required result. One of the authors of this submission personally recalls from earlier in his career changing a vehicle speed assumption on the minor residential road network by 2 mph in both do nothing and future and it changed the economic assessment fundamentally. Similarly forecasts of growth, study areas etc can be readily changed.

3.3 Turning to real benefits to the economy, the 1999 SACTRA study probably investigated this more thoroughly than other efforts. As we recall they did come up with a theoretical argument that the savings to the economy could be the time savings however they could also be less than those or possibly greater. TAG would agree that there are agglomeration benefits to the real economy from some transport interventions. However such benefits are likely to occur most with improving accessibility and densification of cities. This is likely to occur most with local walking, public transport and other sustainable transport measures and trunk road enlargements are likely to work against these.

3.4 Generally we are of the view that a node or centre of an area will be stronger than a peripheral area and links to the peripheral area will often weaken that area to the benefit of the node (an exception is possibly a 'nice' area that can be an attractive commuter centre for better off people). Also a good environment is usually the factor that is most important to improve the economy; this is hardly ever delivered by building roads. It is poignant to note that Professor Peter Hills (ex Buchanan study and Newcastle University) remarked that if a Martian arrived in England and did a correlation between roads and economic prosperity they would find that roads did the reverse of helping the economy – this can be seen almost everywhere eg Hampstead versus Cricklewood, York versus Doncaster etc.

Concluding comments

4.1 TAG recognises that your staff try very hard to constantly refine and develop the appraisal techniques and *academically* we would agree that the UK system has possibly the most advanced assessment techniques in the world. However the result appears that we invest in infrastructure which often does not help the environment, the economy or reduce traffic congestion. It also adds a substantial on-cost to implementing schemes to help the UK economy and does not really provide the help needed for local or national politicians to make the decisions that are or should be theirs to make.

4.2 TAG would be pleased to contribute to any new studies of assessment or modelling techniques and would also be more than willing to explain in more detail our reservations on the present system.

4.3 Please do not hesitate to contact me or other TAG colleagues if you require further information, explanations, meetings etc.

Yours sincerely,

[signature redacted]

[name redacted]

[position redacted] TAG National Transport Committee on behalf of the Local Government
Technical Advisers Group

Attachments / Appendices as part of this submission:

TAG submission on NATA refresh Feb 2008

TAG Submission to Government on NN NPS



Appendix 2.2 TAG submission on NATA refresh Feb 2008

Appendix 2 TAG submission to HOCT Dec 2016 originally submitted to DfT Feb 2008

[name redacted]
[position redacted]
TAG Transportation Committee
[position redacted]
[telephone number redacted]
[telephone number redacted]
[email address redacted]

[name redacted]
Department for Transport
Zone 4/13
Great Minster House
76 Marsham St
London SW1P 4DR

29-2-08

Dear [name redacted]

NATA Refresh Consultation

Following telephone conversations in the Autumn, information on your programme for “Refresh of the New Approach to Appraisal”, and receipt of the consultation documentation, the Technical Advisors Group (TAG), wish to make the comments as described in this note. If you need to follow up any of these please contact me on [telephone number redacted] or by e-mail.

As you know TAG represents a large number of local authorities in the country, these include those with highway and transport responsibilities; such as Transport for London, most London boroughs, Metropolitan authorities, Unitary authorities and also many of the districts and towns in two tier authorities - where the county is responsible for Transport Issues. While these ‘second tier’ authorities do not have direct responsibility for transport, they do have a major role in looking after significant towns and the sensible overall planning of them including providing a reasonable environment. Thus of any group you are consulting on this programme we believe we are the most effective representative organisation likely to have a technical as well as public view on any proposals.

Our response is now structured under 3 general headings:

- Overall Comments
- Response to specific issues raised in DfT’s aims of NATA refresh
- Response to formal consultation questions on NATA

Overall Comments

Summary

We welcome the principle of a review but have very grave reservations on the form and direction of the review and overall we would like to see:-

- A significantly simplified process.
- Much less reliance should be put on old style transport economic principles.
- Time savings should not be given anywhere near the effective weight they are at present - reducing congestion/journey time should not be the key issue – certainly when it cannot be achieved with additional infrastructure because of induced traffic.
- Any ‘benefit’ that is contrary to policy should not be included or perhaps entered as a negative.
- Health and community benefits particularly for urban areas need to be brought about by applying appropriate transport policies including more walking and cycling and if this is not reflected in the assessment, the methodology could be said to be flawed.
- Present assessment methods seem to be directed to approving schemes to encourage mass movement between urban areas which we do not believe should be promoted by government for sustainability and environmental reasons.
- Similarly high speed standards are promoted by the existing methods which certainly should not be promoted in urban areas.
- Even if the present approach were reasonable for rural parts of the country the implications on the urban areas are seldom properly considered in a joined up

fashion and also the importance given to potential inter city or regional infrastructure could squeeze out the smaller/urban schemes.

Funding decisions

Before attempting to answer the detail questions in your consultation document we believe it would be helpful to give an overall view on the systems used to appraise schemes and assign funding. These general views have been expressed by TAG previously in terms of the LTP process and for other consultations by the DfT, House of Commons Transport Committee and studies such as the Lyons review.

Furthermore and also in this context we have concerns about the approval process for schemes. We understand that it is planned for a greater level of responsibility for scheme approval to be given to regional authorities. If this is to be a genuine delegation of authority for the final approval of which scheme gets given the go-ahead then a review of the cost benefit balance by the DfT centrally would seem to devalue such delegation.

Bureaucracy and complexity

From the Highway / Transport Authority point of view we have been concerned for a number of years over the level of bureaucracy that we have to deal with to justify schemes, sometimes on relatively small schemes. We are fully aware that the present LTP and LIP system (for TfL) produces vastly more paperwork and results in substantial extra staff and consultant costs over previous systems. Each district highway authority is now producing LTPs or LIPs with a volume of paperwork and analysis that dwarfs the content of TPPs for the largest local authority of just over 20 years ago. Our members confirm that up to 1/3rd of their staff time on developing major schemes is now involved with producing planning documents such as LTPs and assessments. This excludes consultant resources which often need to be called in to deal with the complications which often only they know how to deal with to best advantage.

While we recognise the cost of such studies and paperwork production is normally less than major road or public transport infrastructure schemes, we are getting nothing for this investment to help the public. We believe there is an urgent need to get back to a very much simpler system that ensures public money is spent on useful capital and even more importantly revenue schemes rather than studies and policy documents.

Policy and objectives of Transport assessment

Overall policy whether for local or central government now appears to be:-

- reduce traffic especially during peak periods,
- increase use of sustainable modes,
- reduce traffic congestion,
- improve the environment,
- reduce carbon footprint,
- improve safety,
- support economic development.

When the NATA process was first introduced in 1998 in the Integrated Transport Policy – A New Deal for Transport, there were the five simple investment criteria as follows:–

“Decisions on when and where to invest in network improvements, including measures to manage traffic, will be taken in the light of the new approach to appraisal based on the criteria:

- Integration – ensuring that all decisions are taken in the context of our integrated transport policy;
- Safety – to improve safety for all road users;
- Economy – supporting sustainable economic activity in appropriate locations and getting good value for money;
- Environmental Impact – protecting the built and natural environment;
- Accessibility – improving access to every day facilities for those without a car and reducing community severance.”

These criteria were well supported by most professionals including TAG members. The interpretation of these in the NATA web-tag based guidance in 2003 appeared to be a step backwards. It is noted particularly that in bullet point three above “and getting good value for money” in respect of economy was a very minor point amongst the total investment criteria. However as has happened in the past the “socio-economic cost benefit analysis” has again been raised to a very high level of importance in the assessment process. This is not only in weighting of the schemes for investment but also in the amount of analysis required just to deal with what seems to be a minor point. Some of the factors which help to improve the cost benefit ratio are clearly contrary to the overall thrust of the present transport policies at a national or local level.

We should make it clear that Value for Money in terms of achievement of all five elements included in the Integrated Transport Policy is of fundamental importance. However this requires a level of judgement, on all aspects included in the appraisal, by decision makers and not the consideration of one single fairly arbitrary figure. Furthermore as stated above (Funding Decisions section) we believe such assessment should be much more locally based.

The true role of many transport schemes in supporting economic development and especially sustainable economic has sometimes been used in rather a suspect way. This was extensively studied by SACTRA in the late 1990s. Generally economic development is fostered by local access and a good environment rather than large scale schemes. We recognise agglomeration (and density) benefits and these are discussed in our response to your consultation document (question 6 below).

Overall problems with the ‘cost-benefit analysis’ process

Before going into the elements in the cost benefit analysis we would first like to address the intrinsic unreliability of the mathematics in the analysis. The essence of the calculation is to add up all the (largely time) costs for vehicles using the proposed whole network subtract the ‘costs’ for the vehicles using the old whole network and divide by the capital costs of the scheme. Both the (time) cost totals are very large figures (which are developed using a number of assumptions) for which minor changes in either or both could change the cost benefit ratio dramatically. Curtailing the study network to concentrate around the proposed

scheme may produce an increase in mathematical predictability (by having a larger time cost difference relative to the capital cost) it totally under-represents any extra time costs from extra congestion (often caused in TAG towns and cities) by induced traffic from the new road scheme.

The values output from the analysis have also been changed dramatically in recent years by increasing the investment cycle to consider benefits over 60 years and to reduce substantially the discount rate. These changes do not always reflect reality, for example many roads justified on economic analyses have been replaced before 20 years let alone 60 years with “by-passes of by-passes” in many locations. If this happens for a proposal presently being considered the discount rate and amortisation period would clearly give a highly inflated artificial benefit.

Turning to more detailed considerations in the economic assessment, a number of items within it are counted towards a good cost benefit ratio where they are clearly contrary to policy. Anything increasing tax revenue for the exchequer by burning more fuel and collecting more tax must be a dis-benefit of a scheme rather than a benefit. It is absolutely illogical to consider this as a benefit of the scheme even if it could be explained in the pure financial / economic terms. Similarly any scheme adding to **urban** road congestion or just increasing car commuting in almost all urban areas is counter to central and local government policy. Thus for a road scheme which generates any extra peak hour traffic or even just saves car commuting time such benefits should be viewed at least as zero if not as a negative benefit. Showing such economic factors as benefits, we believe, provides misleading information to our decision makers.

In a similar vein it seems illogical and counter to policy that time savings in less prosperous areas are valued less and similarly pedestrian or bus passenger time versus car driver time. This is clearly counter to policy of helping more depressed areas and encouraging more sustainable modes.

Often in the actual calculation of cost-benefit the travel time savings in peak times are a very large contributor to the cost-benefit ratio and so distort the approval process for such schemes.

Also at a more detailed level most appraisal processes for new schemes are reasonably tightly constrained around the scheme itself. A small increase in traffic, even if a long way away from the scheme will generate disproportionate delays to traffic in an urban area which cumulatively could substantially reduce the economic benefits. While we would not support ever finer modelling to show this for each scheme it clearly paints a picture that any ‘economic’ benefits at congested times could be substantially reduced by a road scheme that induces any significant traffic - a clear finding from the SACTRA Review of 1993 and demonstrated since to be even more significant.

Response to specific issues raised in DfT’s aims of NATA refresh

We note the aims of NATA refresh and would have the following comments on the programme document ‘Refresh of the New Approach to Appraisal’:-

1) Make guidance more multi-modal. We welcome this but efforts should be made not to complicate any further.

2) Easier to use for small scale schemes and on infrastructure based decisions. Again we would welcome this and would stress a common line from Local Authorities that most of our transport problems are more revenue related rather than capital - involving support for public transport, smart choices work, maintaining existing roads etc, rather than providing new infra-structure.

3) More aligned with DfT objectives. We are concerned that these objectives should not just be DfT's they should be the whole Government including planning issues, all local government and indeed meeting the public's objectives.

4) Improved consistency with other advice such as Highway Agency's Design manual for roads and bridges. The Highways Agency are concerned primarily with inter-urban roads not for urban roads, their advice is related strongly to a "trunk road" approach for long distance traffic. It is very important that urban issues are properly considered and priority is given to the most important modes for access such as walk, bus and cycle.

Furthermore within the other road advice we have noted there is clear inconsistency with, for example, capacity design standards. The DMRB indicates design standards in excess of 2000 vehicles per hour per traffic lane on a high standard road. This standard is clearly at odds with road safety advice to keep a minimum of two seconds gap between vehicles on dry roads. This two second gap, if cars were infinitely short and absolutely evenly distributed, would mean a maximum capacity of 1800 vehicles per hour. We accept that if we do design roads to a realistic safe capacity, the capacity of the network through much of the country would be seriously overloaded now. Nevertheless an artificial capacity that is unsafe should not be included in the design standard. A design standard should now be more an issue of reducing traffic levels to a level the network can handle rather than thresholds for improving roads.

5) Ensure guidance provides coherent transparent expert advice. On the face of it we would thoroughly agree with this sentiment.

6) Update the price base for which costs and benefits need to be expressed. We would be concerned about any update of a price base on its own without consideration of policy issues, for example, as a matter of policy people walking or using public transport should be considered before the saving of in-vehicle car-travellers time especially in peak times. We understand that the present system values car driver (time) more highly than say walk or bus passengers which appears very perverse in policy terms. Any update of price basis should reflect such policy issues. We are also concerned at the evaluation of many issues in fixed economic/financial values hides a multitude of value judgements on items that cannot be realistically measured and compared with different impacts.

7) Reflecting Stern, develop strategy for making progress on valuing environmental impact. We would strongly support this and developments since Stern. We are aware that Stern has suggested that any carbon intensive infrastructure which may be out dated in the next few years should be viewed with extreme caution; this would apply to most major roads and airports.

8) Review summary information presented to decision makers including comparability of BCRs across modes. As mentioned above we are very concerned about the present methodology of calculating BCRs, however providing that any BCRs “benefit” which is contrary to policy is taken out of the equation, we would support presenting such modified BCR information as a sub criteria amongst the five NATA criteria.

9) Improve appraisal guidance at early stages in scheme developments. While we note there is guidance within the web-tag pages for simplified analysis we think this could be simplified much further, perhaps by using a simple policy sieve rather than the full weight of the Web-tag’s pages.

Response to formal consultation on NATA

Turning to the October 2007 document ‘The NATA Refresh: Reviewing the New Approach to Appraisal’ we have the following comments to the various questions raised:-

Chapter 2: Analytical Framework

1. The need to ensure proportionality of appraisal effort is noted in NATA, but users suggest that in practice the burden appears to be on the excessive side. How might we support promoters and analysts so that appraisal is proportionate?

Response: As described under the Bureaucracy and complexity heading above, we fully concur with the view that the burden is very much on the excessive side

2. If there were a light touch appraisal, how should sufficient robustness be maintained?

Response: There should be much greater reliance on policy filters or perhaps using other techniques such as Multi Criteria Analysis. Furthermore as also mentioned above a greater delegation to Regional and local authorities of their total budgets and priorities should reduce the central bureaucracy and improve decision making. It is notable that such an approach is in line with the Lyons report.

3. The Department and other bodies involved in strategic planning should consider wider dissemination of strategic analysis to provide the context for later stages in decision making. How should strategic appraisal tools be developed, balancing the right options being generated without unnecessarily analysing those that are unsuitable?

Response: Unlike the approach local authorities have been required to adopt for many years, the Department does not seem to consider transport planning for a whole area as an integrated whole before coming up with a proposal (and sometimes variations on the proposal) covering just one link. Without the proper context of a Strategic analysis of the problems throughout an area and a holistic approach to all solutions we will continue to get schemes being put forward that do not effectively deliver Central Government, Local Government or the public’s objectives and needs. When looking at schemes it is far better to assess a wide range of options using simpler appraisal tools but in an even handed way,

than to put most of the available resources into doing one option at a very high level of detail. Given limited resources inclusiveness should be the priority. This is more in accord with the Green Book guidance and Webtag.

4. In the future, option generation is likely to be more complex, integrating for example small-scale and better use options. The range of alternatives considered, including some possibly rejected at an earlier stage, may be informative to decision making. How might this information be presented?

Response: Small scale schemes and better use are part of the proper strategy development for the whole area. It is important that the Strategy is developed to meet the overall objectives for an area before assessing the 'value for money' of an individual scheme.

5. The analytical framework should continue to improve the linkage with the value-for-money assessment. As analysis widens its scope, the evaluation of schemes should also correspondingly broaden. Further, the framework should allow an assessment of the impacts of regulatory or other non-infrastructure options so that it is neutral over each option.

Response: The test should be – “ does the strategy meet the objectives and is it affordable” not a detailed cost benefit analysis of specific schemes. It is of fundamental importance that revenue based schemes are put on at least an equal footing to capital. This has been suggested many times over the decades including by the original ACTRA committee. We would particularly stress our earlier general comments that it is important to reduce bureaucracy and complexity in the analysis. Ever more complication increases the overhead reduces the effectiveness of public expenditure especially when such work can only effectively be delivered by the use of very complex models and external consultants.

Chapter 3: Economy, accessibility and safety

6. Over the Refresh, the extent to which the evidence for strategic decisions can be consistent with local or scheme specific evidence should be explored. How might the provision of more detail about the strategic analyses of economic, safety and accessibility impacts of Transport policies be made helpful to project appraisal?

Response: We fully concur that many aspects of life including health needs to be considered in the assessment of Strategic options or plans for an area. We also recognise the economic benefits of agglomeration but this is now an aspect that may be reducing with more remote working. Agglomeration appears to be a new aspect in assessment which could be readily linked with the idea of reducing the need to travel. This is critical to transport policy but also to the real agglomeration benefits. For example, it is the close proximity of businesses, minimising travel, which can produce three benefits: synergy, competition, and capacity. In many cases, particularly the service sector, this will be related to the density of development and the concentration of activity within short travel distances often by walking. It will be important not to confuse the extension of potential commuting distances (potential employees within a certain drive time) with agglomeration. Thus land

use planning, including zoning, relationship to relevant non-commuter transport networks, and density, are the key factors. Modelling the impact or valuing it would be confusing and probably counter productive.

Chapter 4: Environmental appraisal and assessing housing impacts

7. In providing decision makers with the evidence on environmental impacts there is always going to be a balance between taking appropriate account of the environmental impacts of transport interventions and the need to summarise evidence for decision makers alongside other impacts. Is the current balance between detailed assessment and summary appraisal information appropriate?

Response: The proper completion of the AST or similar should provide the best summary. However the standard and impartiality to which the AST is prepared needs enhancing. We would also suggest that there needs to be a rationalisation of the different methodologies between the current NATA and planning requirements for environmental assessment. As a thread running throughout our response the weight given to the calculated 'economic benefit' over all other aspects needs to be substantially reduced.

8. What are the priority areas for extending the use of the monetary valuation of environmental impacts?

Response: The monetary valuation of environmental impacts is not satisfactory at present and no extension should be contemplated until the current problems are addressed. Accurate measurement is supported, but the attached valuations are flawed conceptually (see overall comments) and depend on surveys of what people might be willing to pay. The overall point is that basing "hard" numbers like a BCR on a mixture of real world estimates, such as buying a bus or building a road, with derived values which are far more speculative, is not prudent.

Chapter 5: Assumptions and scenarios

Although there is no formal question from this chapter we agree that the Department should release and update regularly all assumptions and should make them known and readily available to decision makers. For example if all decision makers were to realise that the economic speed assumptions do not properly reflect what happens in real congested situations, the treatment of traffic growth and induced traffic between the do-minimum and do something options or that increased fuel usage actually helps justify a road scheme we are sure they would have a more pragmatic approach to approving schemes.

Chapter 6: Evidence from appraisal

9. Given there are a range of decision makers and the mass of evidence underlying appraisal is large and increasing, does the AST remain a useful format? How should the

AST be augmented to be a more effective way of conveying the information to decision makers?

Response: The AST was one the most potentially useful elements of NATA but has been poorly implemented on the ground. It needs to be altered to be consistent with the objectives in the latest Sustainable Transport document (for example including health).

10. How do we summarise the results of strategic analysis?

Response: As a first filter we believe all alternative area strategies should be checked for policy delivery or through multi criteria analysis or goals achievement methods before getting on to the detail of ASTs. At the AST stage, the ASTs for the alternative approaches considered should be presented, with the addition of a set of implications for local schemes. For example, the achievement of standards for street noise, of public transport accessibility, numbers of walk trips, and of GHG emission reductions should be cascaded down. Schemes would have to contribute or be given a negative rating in the local AST. Packages would tend to fare better than isolated schemes rather than the opposite, as present. This is another area where Government policy (towards integration) would be better supported by refreshing but, more importantly, implementation.

We are even more concerned about further text in this chapter which states '*The Department is committed to further work to provide a detailed specification of the BCR, as PSA Delivery Agreement 5 will use this ratio as an indicator of the Department's success in seeing better value for money from its investment over time.*' We do not think the present BCR estimation methods deliver sensible results let alone be given such fundamental importance - as explained elsewhere in this submission.

Chapter 7: Building analytical capability

11. From the range of techniques available to better communicate the appraisal advice, what should the Department consider?

Response: Notwithstanding our more fundamental comments, advice on appraisal, including the strong common sense element in documents such as the early Traffic Appraisal Manual (TAM), has often been provided but insufficiently read or followed. Now that the internet is available, webtag offers some improvement but the Department could consider using the web more actively, for example through debates, video, and particularly disseminating problems, solutions and assumptions that have been generated by practitioners. There is a problem in relation to the adversarial nature of major scheme Inquiries, but this should also be addressed not least by simplifying the process.

12. Do you have any suggestions about the consultative change process we envisage to ensure that you can participate as we develop changes to the guidance?

Response: The commitment to produce more material and hold further discussions is entirely appropriate for such a wide ranging and complex subject. It should be run in close co-operation with the debates around the Sustainable Transport process. It is important in such discussions to broaden the discussion and make it relevant and understandable to people not carrying out the detail assessments including particularly the decision makers.

13. The document identifies some issues and we would appreciate your views

on the priority – a ranking if appropriate – the Department should attach in

progressing these. We recognise that all the areas will need some consideration, but what are your views on their importance?

Response: We have already made our position clear that the whole assessment process needs to be simplified, reflect real policy priorities of all the authorities with an input to transport. We do not think that this can be achieved by addressing those issues listed in the questions. However for completeness within the priorities we have endeavoured to answer the detailed questions.

a. The Department should consider how best to support the continued interest

in the reliability and wider economic benefits of transport improvements. The

nature of these issues suggests the support would be wide, looking at data,

modelling issues in the context of innovative transport solutions. The need to

reconcile wider economic benefits and regeneration benefits is a particular area for guidance.

The importance of reliability in transport systems is very important for business and particularly future planning of depots etc. However this is better achieved on rail or with fine road networks; present strategies of high speed high capacity roads are intrinsically unreliable. The 'economic assessment is the area we have least confidence in as it does not reflect policy (e.g. a benefit is actually derived from extra peak hour car traffic as discussed above) and it still has an overwhelming role in the justification of schemes. In addition there is little sound evidence for the economic regeneration benefits claimed from more high speed roads.

b. The importance of journey time savings in the overall benefits of a scheme

suggest some further information about their composition would be informative. Whether this is possible should be explored.

Recognising the dominance of time savings in current appraisal and the need to understand their treatment across modes and who is gaining or losing and at what time (calculated travel time savings from cars at peak times has very limited value especially when such time savings encourage further car commuting) is important.

c. The Department will seek, engaging with the industry, to improve data and

methods regarding freight time savings.

Freight is very important, but predictability and reliability of journey times are probably much more critical to industry. Also leaving freight out of considerations of induced traffic leads to distortions.

d. The Department should consider how accessibility measures should be used in the NATA framework. In particular, should the information on the accessibility impacts in relation to local targets be presented, or should a more national approach be used? How should the accessibility impact be presented alongside the other impacts of interventions?

Accessibility is probably the main issue in identifying the need for any transport investment rather than the present approach of maximising mobility. Again for urban areas to deliver the required outcomes for the citizens and to deliver policy, accessibility by foot and public transport are the prime requirements. Walking line of sight mapping is now well developed, as are public transport accessibility and travel time contours. These are both informative and easy to understand.

e. The Department should consider how best to determine value for money within the transport appraisal framework using cost effectiveness analysis, in order to take account of economy-wide carbon and other environmental limits .

On the face of it this sounds to be an excellent objective however we are concerned if the outcome from analysis will leave more variables entering into the traditional monetary cost benefit analysis reducing the transparency still further for the decision makers.

f. The Department should develop desk-based analysis of the spatial aspects of environmental impacts. This can be used to facilitate strategic analysis, especially using GIS evidence, and support analysis of smaller schemes.

Some of this is quite well done already. Consistency and good practice would be useful.

g. The Department should investigate the extent to which transport's wider economic benefits can be associated with housing growth. The considerable change in land value due to the use of land for housing may – in part – reflect some benefits of transport enabling housing growth.

This is a complex area where double counting is likely to be a problem. While academic research is supported, it is a higher priority to get other elements in the appraisal right.

h. While work to join up freight, rail and aviation forecasting of trip generation is continuing, the Department should in the short-term consider how to ensure that the modal interactions are adequately represented in some specific areas. This is needed at a strategic level, to incorporate into the trip generation common assumptions, such as TEMPRO.

As stated above a strategic plan for the area under study is essential including, if required, models that allow for full changes in behaviour. We fully accept that part of that strategic plan must be future forecasts. However if the future forecasts are not in line with policy the options being put forward should not be followed and an alternative to change the expected

future should be implemented. Historical predict and provide have resulted in strategies that have failed to deliver the required policies e.g. the DfT or Highways Agency have promoted Trunk roads which have generated enormous problems for Urban authorities in delivering the needs of such areas.

i. The Department should consider defining common modelling scenarios to be used by those involved in strategic modelling and scheme level appraisal. These would recognise that some scenarios are policy determined. The evidence from alternative scenarios will need parallel tools to analyse uncertainty around scheme impacts.

As stated we believe that policy should determine appropriate strategies for an area. The “Do Minimum” option as presented frequently is not a viable option but alternative revenue based rather than capital based strategies could often better meet the needs of an area. This would require the preparation of some alternatives. General guidelines on these can be produced, for example a Smart Growth land use approach with Smarter Choices policies.

j. The Department’s guidance should continue to be developed on scheme costs. Such work should make decision makers aware about the risks around costs and how estimates become more firm with time. Risks may be mitigated through the financing of schemes. The overlap between cost appraisal and finance issues should be considered.

The use of optimism bias has caused some thought to be applied to this issue already and what is needed is some review of how this worked in practice, leading to further refinement of the guidance. Blanket application needs to be avoided. Revenue based schemes will always have lower and identified risks. After studies of the costs of all schemes would be helpful. At a more general level in consideration of funding regimes, financing of schemes to pass on risks to the private sector often prove very expensive especially especially when the risks are more in the control of the public sector.

k. The Department should look at the evidence emerging from Congestion TIF and other evidence on assessing packages and then consider how this approach can be widened beyond city and regional networks.

As for ‘j’ above evidence of performance of all investments needs to be critically assessed to see the long term effects. We would welcome closer working with the Department in the Congestion TIF areas as elsewhere.

l. The Department should continue to develop distributional analysis. In which types of interventions or transport problems should the priorities for this be?

If more freedom is given to the regions on what they believe they should be spending money to help their areas, this issue becomes less of a problem. Please see our earlier comments.

m. The Department’s support for determining whether a transport model is fit-for-purpose may supplement the standards by recognising the staged nature of designing solutions to complex transport problems. Should this be part of a

more general look at model validation?

Validation is important but there is an urgent need for greater understanding of the nature and limitations of models (across all modes). In particular the current models are very poor in relation to changing behaviour, since most of them are calibrated to existing behavioural responses. This issue should be addressed as a far higher priority. In any changes to the requirements for modelling we would again stress the need to minimise bureaucracy and overheads and also the fundamental limitations of such models if they are to be used for any 'cost benefit analysis'.

n. Developments to the Department's guidance should be issued with appropriate support. Appraisal tools assessing reliability and productivity impacts are demanding analytically and the Department should consider using workshops, training and the provision of data to enable analysis in these areas.

Far more progress can be made at the strategy level to improving reliability rather than analysing it for an individual proposal. For example regulated speeds have been shown to generate less accidents - a cause of much unreliability on the trunk road system. Similarly anything to reduce the peak loading on road links by demand management, Smarter Choices and simply finer networks are more robust for failure than coarser networks.

p. The Department is considering the scope to which a range of social research techniques may provide useful data involving the participation of the public at different stages in the appraisal process and to assess the social impacts of schemes, starting in the areas of option generation and in issues around public acceptability of proposals.

This is a very difficult area, involving different people's willingness to be involved, how articulate they are, how well supported they may be and what their personal agenda may be. Guidance on producing a range of alternatives, use of mediation techniques instead of adversarial inquiries, and trying to create the working atmosphere of the best EIPs should be prioritised.

We trust these comments will be useful in hopefully a more fundamental review of the appraisal processes. We would be pleased to take part in discussions with relevant people in the DfT and/or with other groups on our submission.

We confirm these comments have been circulated amongst the membership of TAG and reflect the technical views of the organisation, tempered by our public sector experience and public accountability.

Yours sincerely,

[name redacted]

[position redacted] TAG Transport Committee

JE 29-2-08

Appendix 3 Joint TAG ADEPT response on resilience (reformatted from PDF version)

Contact details: *[name redacted]*
[position redacted], ADEPT
[telephone number redacted]
[name redacted]
[position redacted] - National Transport Committee
The Local Government Technical Advisers
Group
[telephone number redacted]
Resilience Review Expert Panel 9nd May 2014
Department for Transport
resilience.review@dft.gsi.gov.uk

Dear *[name redacted]* and Panel
Review of the Resilience of the Transport Network

1. Introduction

1.1 Thank you for the opportunity to submit comments/evidence to the Review Panel. As you may be aware ADEPT represents Directors of Environment, Economy, Planning and Transport. The Local Government Technical Advisers Group (TAG) represents similar professionals mainly in London Boroughs, Metropolitan Authorities and Districts in two tier areas. We have come together in this submission to produce a single agreed response and have consulted members of our respective organisations before finalising this document.

1.2 As combined bodies representing authorities around the country, instead of answering the specific questions raised by the call for evidence, we are submitting a statement covering the key issues. However this does not take away from individual TAG or ADEPT member authority responses on specific examples. Indeed in this response we have tried to concentrate on generalities under various topic headings (listed as below) illustrated by a limited number of specific examples.

1.3 The severe weather experienced in parts of the country during last winter was caused mainly by rain and wind, with occasional frost. This resulted in high river levels and overtopping, exceptionally high waves and storms in coastal areas, and high ground water levels, all leading to prolonged flooding in many areas. Numerous properties suffered internal flooding, sewer and drainage systems were overwhelmed and many roads had emergency closures for safety reasons for up to several months, leaving communities and businesses often using long diversionary routes to conduct normal daily duties. Some diversionary routes suffered severe congestion.

1.4 The damage caused to the transport links were due to standing and flowing water, structural damage in coastal areas and fallen trees. In flooded areas this caused extensive damage to the fabric of the roads. The damage to the lower classes of road (C and unclassified) with an already large maintenance backlog could be foreseen. However it was alarming to see the speed of deterioration in A and B class roads which were previously in good condition. Despite Local Authorities diverting substantial levels of resource to deal with potholes and defects, there remains a large part of the network which is yet to be tackled. The true cost of the damage will only be known when asset condition data has been updated for the whole network.

2. Discussion topics

2.1 Reliability - Resilience continuum in transport strategy

2.1.1 Whereas the extreme weather this winter of winds and rain have caused problems particularly in southern England, recent years have tested winter preparedness for snow in many other parts of the Country. We attach a TAG response on a previous winter preparedness consultation as an appendix (*Please note available but not attached*). Furthermore various one off incidences can cause real problems of access over several hours or days and these often do not appear newsworthy nationally (e.g. the sink hole in the M2 that made access from East Kent very difficult for several days this winter).

2.1.2 Industry, commerce and the public need reliability and predictability from the networks more than speed. Recovery from an accident or incident or avoidance from random congestion from overloaded networks need much higher prioritisation in transport policy. This can best be achieved by ensuring we manage demand to a level that can satisfactorily be coped with by the transport system or if this is not politically acceptable we need to tell business and the public clearly that there is not a solution to congestion (or weather) problems. If we cannot reasonably ensure provision of services or flood prevention to an area this must also be made clear so that people and businesses can plan accordingly. It is inevitable that disruptions to the transport links during floods will have social and economic consequences. Yet communities appear unprepared for these consequences and often expectation is that disruptions can be avoided. Better communication at both national and local level may go some way to manage expectations and prepare transport users for the disruption.

2.1.3 Redundancy and availability of alternative routes are also critical to avoid reliability or severe weather incidences (the rail line to the West Country in Dawlish is the best recent example). A finer network of reasonably balanced road or rail routes is required not necessarily the widening of already very high capacity links (like the M25 or M1). There are examples of resilient transport in other countries with frequent severe weather conditions which can be adapted (It is notable that road networks in France away from the toll roads is very robust to provide diversionary routes to the Routes Nationales).

2.1.4 A good example to understand the impact of closure of routes was in Salisbury where closure due to flooding of a pedestrian underpass under A36 used by many students going to a secondary school caused major risks due to lack of safe alternatives. In this case the pedestrian link may not have ranked high amongst many priorities that the Highways Agency had to deal with during the floods, but the impact on the local community especially in terms of safety was significant.

2.1.5 One of the important aspects of recent floods was reliance on forecasts from Met Office and Environment Agency for weather conditions, river and ground water levels, and coastal storms. There is no doubt that there have been significant advances in methods to better predict these elements, however there is still some way to go before transport operators can accurately predict and plan in advance for all weather events, based on the predictions received from the responsible agencies. There is also room for improvements and investment in use of smart technologies (sensors, etc.) by transport operators for obtaining advance warning at locations on the network known to be vulnerable to disruption during severe weather.

2.2 End to end journey and communications

2.2.1 We do not believe that resilience of networks should be considered on the basis of ownership/management responsibility for the networks but how best to ensure that end to end of journey access for people or goods can be maintained. A very large part of the rail network is under a single management organisation albeit all rail journeys need buses,

walking, taxis, delivery vehicles etc. to complete. For roads only 2% of the road network is under the management of the DfT; almost all journeys must begin and end on the 98% of the network that is the responsibility of ADEPT or TAG member authorities. The changes planned for the Highways Agency provide the opportunity to consider the end to end resilience for parts of a number of journeys via the strategic route network. Journeys via local highways need to be seen in the same context.

2.3 Maintenance versus new infrastructure (revenue versus capital)

2.3.1 TAG and ADEPT have expressed concern over the years at the imbalance between the funding available for new and especially large national infrastructure at the expense of looking after our existing infrastructure. As a nation we should look after our existing infrastructure in terms of coastal defences, dredging or clearing minor or major waterways or just proper maintenance of our roads and railways, in conjunction with investment to develop and extend existing networks. In the recent past it has been easier to raise capital funding for schemes than improve transport resilience. At the same time revenue funding to maintain drainage and flood mitigation systems remains under severe pressure, and although lack of maintenance may not be noticed during normal weather conditions, it can lead to disruption or failure of the network during severe weather, often at the time that the link is needed most. A ring-fenced fund specifically allocated to improve resilience of transport networks should be considered.

2.3.2 For improved resilience in strategic transport infrastructure of regional and national importance, alternative funding sources may have to be explored if central government funding is not available. The assessment of benefits of major schemes ought to give more weighting to transport resilience than it currently does compared to economic and environmental outcomes. Examples include:

- The major road (M4/M5) and rail links to the south west peninsula have proved vulnerable during severe weather events in the recent years. Investment to upgrade A303 which suffered closure at two locations in recent floods and has a poor record in providing journey time reliability would provide a good alternative transport link to the region.
- In the south east, extreme weather disrupts the Channel ports and the M20 motorway. There is a need to mitigate this with the provision of an “offline” solution in the form of a lorry park; and closures of the Queen Elizabeth II Bridge at the Dartford Crossing during times of high wind, which through provision of a new Lower Thames Crossing, physically separated from the existing crossing, i.e. to the east of Gravesend, and in tunnel, would provide much needed transport resilience.

2.3.3 Recent floods disrupted normal operation of many businesses ranging from small (e.g. restaurants and shops in riverside and coastal areas) to large employment centres (e.g. business and industrial areas) as well as freight movements and deliveries. With the current focus on growth and employment and creation of Local Growth Fund, consideration should be given to investing in improvements to resilience of the transport links serving these businesses to secure economic resilience during future weather events.

2.3.4 Furthermore the decision making in how to deal with flooding in an area often rests with several agencies. Whereas LLFAs have lead flood management and highways management responsibilities in many areas, decisions by Environment Agency, utility companies and emergency services often has a significant impact on how the risk of flooding is managed. Improvement to resilience of transport therefore requires a multi-agency approach in many instances.

2.4 Design and review of access arrangements to and within settlements

2.4.1 Many road closures during recent floods occurred on the main roads through villages, as well as some of the side roads branching away, typically where houses exist on both sides. For historic settlements we need to:

- Maintain access as far as possible to settlements by reasonable maintenance of existing waterways coastal defences roads and railways (as in 2.3 above)
- Advise businesses and residents of settlements properly and fully where it will not be possible to maintain access in all weather conditions
- Review areas that will regularly suffer from adverse weather and really need to be abandoned to find locations where the activities could be maintained (if this is agriculture we need to ensure that we do not build on 'green land' before all 'brownfields' have been exhausted – ref. ADEPT, TAG and POS comments on NPPF etc.)

2.4.2 For new developments on low lying brownfield (see comment immediately above) sites it may be worthwhile looking again at design guides and recognise that the immediate local road network could be used for water storage and then boat access in flooding conditions to ensure housing remains habitable.

2.5 Future adaptation and resilience

2.5.1 Prolonged rainfall causing flooding will lead to road and rail delays and rail cancellations in the 2020s and 2050s which may have a severe impact if no adaptation occurs. Adaptive actions include improving drainage management plans and improvement of the standard and capacity of drainage systems. Adaptive capabilities are likely to be lower in the 2020s reflecting their long-term nature of infrastructure assets. There is greater certainty in benefits of adaptation for rail; substantial uncertainty on the benefits of adaptation exist for roads.

2.5.2 The Local Adaptation Advisory Panel for England (LAAP) has been set up to provide advice to central government from a local perspective, enhancing the capacity of local leadership to help build resilience. It will develop strong links with other important national partners and networks to remove barriers to adaptation and help shape a fully supportive framework for local adaptation. Many Council's already have their own plans to adapt to a changing climate. LAAP's role is to support local ambition, identify and share best practice and be an influential voice to government to ensure there is the right level of support to local needs. They will provide advice on how this work benefits business, residents and supports economic prosperity.

2.5.3 The National Adaptation programme is a useful tool in helping industry sectors, tiers of government and business deal with the uncertainty of climate change. The time-scales over which climate change is expected to occur and the extent to which it will impact on society are not clear, although impacts of a changing climate were strongly felt last winter. There is also uncertainty about expected weather conditions as a result of changes in climate. Uncertainty can magnify barriers to adaptation and attract government intervention that leads to a crowding out effect.

2.5.4 Climate models indicate that many parts of the UK are likely to experience rising average temperatures, more heavy rainfall (leading to flooding), rising sea levels and faster coastal erosion, more heatwaves, droughts and extreme weather events as this century progresses. The current Climate Change Risk Assessment (CCRA) shows that projected climate change presents a set of opportunities and threats for the UK economy. The latest Intergovernmental panel on climate change reports highlight further evidence of impacts and the importance of adaptation. In supporting the Review team's important work, TAG and ADEPT would be very pleased to meet the team to discuss any of the points raised in this response or any other issues arising from the review.

[name redacted]

[position redacted] TAG National Transport Committee on behalf of the Local Government
Technical Advisers Group

[name redacted]

[position redacted] Engineering Board of ADEPT
Attachments / Appendices available if needed

London City Airport response to the National Infrastructure Commission's Call for Evidence 10th February 2017

Introduction

1. London City Airport is one of the UK's fastest growing airports with a record 4.5 million passengers in 2016. LCY serves nearly 50 European and domestic destinations, as well as a daily service to New York JFK.
2. London City Airport makes a vital contribution to the UK's airport capacity and connectivity. In July 2016, the Government granted LCY with planning permission for the City Airport Development Programme (CADP) which will improve the airport infrastructure. CADP includes plans for 7 new aircraft stands, a parallel taxiway to maximise runway capacity, and a terminal extension to accommodate increasing passenger numbers.
3. The aviation sector and the connectivity it provides is a main driver behind facilitating trade in goods and services, business investment and tourism. LCY alone supports over £11bn of UK trade exports to key European markets each year. London City Airport (LCY) welcomes the opportunity to respond to the National Infrastructure Commission's Call for Evidence to provide input into the development of its National Infrastructure Assessment.

Airport capacity

4. According to DfT statistics, passenger numbers at UK airports are set to increase from 219 million passengers in 2011 to 315 million in 2030 and 445 million by 2050¹. This is an increase of 225 million passengers over the next 40 years compared to an increase of 185 million since 1970. It is obvious that the demand for air capacity is acute and will continue to increase. Such increased passenger demand makes it pertinent to include the aviation capacity debate in the analysis of the major infrastructure needs facing the UK over a 30-year period. The airport welcomes the DfT's current consultation on "Reforming policy on the design and use of UK airspace". Enabling the South East airport system to add more capacity through increased efficiency and connectivity between airports should be a top priority in the long-term needs-based infrastructure assessment.
5. Despite the Government's approval for expanding Heathrow, a third runway is still years ahead. In the meantime the passenger growth forecast clearly demonstrates that the demand for air travel will continue to rise and will not be addressed in the near future. This has created an opportunity for the National Infrastructure Commission to consider providing the Government with a recommendation on aviation capacity across the UK.
6. LCY welcomes the fact that the Government is going to consult on a new Aviation Strategy with the aim of finalising it by the end of 2018. It is however important to recognise that the UK needs a strategic assessment and direction for the further development of air travel in

¹ DfT: UK Aviation Forecasts

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/223839/aviation-forecasts.pdf

the short, medium and long term. This is even more relevant in the context of Brexit, when the UK would rely on strengthened connections with Europe and the rest of the world and therefore airports infrastructure should be part of the country's strategic Infrastructure Assessment. Based on the passenger growth forecast and in cooperation with airports, the National Infrastructure Commission should provide an overview of anticipated future demand and a recommendation on how the sector can respond -outlining areas of strategic opportunity for the future. The National Infrastructure Commission should recommend examining airport passenger figures on a yearly basis. This will allow the DfT to understand demand and infrastructure provision.

7. In July 2016 the Government granted LCY planning permission for the City Airport Development Programme (CADP). CADP will allow the airport to build seven new aircraft parking stands, an extended terminal building and a parallel taxiway.
8. LCY is expected to start construction in 2017 delivering much needed aviation capacity into the London system at least a decade before a new runway is built. With expansion LCY can add 30,000 additional flights per year to the London airports system and 2 million additional passengers by 2023. Our plan for expansion is in line with LCY's 2006 Master Plan which envisages LCY handling 6 million passengers by 2025. The Master Plan's ultimate vision for further future growth at LCY is for 170, 000 flight movements by 2030.
9. Granting permission for LCY to expand was clear indicator that the Government understands the need to enable travel and trade. The airport believes that it would be better to develop a strategy to respond to the passenger demand over the coming decades. The National Infrastructure Assessment should play a role in advising the government on a strategic direction for the development of air travel in the UK up to 2030.
10. LCY is located in London's Royal Docks which has been established as a Local Enterprise Zone and is currently undergoing substantial investment and development. To realise its full potential the area should be supported by significant investment in its infrastructure. An upgrade to the DLR, improved broadband and digital infrastructure could transform the Royal Docks into London's next global business hub. Improved surface access in the area—including more river crossings, an upgrade to crucial road capacity and Crossrail –can in turn have a wider economic impact on East London.

Improved surface access needed to create an integrated airport system

11. Airport growth is dependent on improved surface access which can allow airports to deliver their full potential and better respond to the increased demand. In the current constrained aviation environment it is important that improved surface access is seen as a crucial part of a transport strategy for an integrated airport system. The Infrastructure Commission's call for evidence provides an opportunity to assess the current infrastructure connecting airports and in this way identify the existing gaps to a wider integrated network of airports.
12. London City Airport has very good transport connections with the DLR having a stop at the terminal building. LCY currently has the highest percentage of passengers arriving by public transport in the UK. Crossrail will be transformative for east-west travel in London and once it opens its Custom House station it will offer a 40-minute journey time from LCY to Heathrow. Additionally, LCY has ambitions for a new Silvertown Crossrail Station which will act as a regeneration stimulus for Silvertown due to the greater connectivity the station would provide to the local area. It will ensure that LCY is even better connected to the

London's transport network – a direct connection to Heathrow and to Gatwick and Luton via Farringdon.

13. In the context of an increased demand and constrained capacity, a better connected wider network of airports can create an opportunity for passenger transfers. LCY can relieve pressure on other capacity constrained airports by taking some of their short-haul traffic and freeing up valuable slots for much needed long-haul traffic.

The planning system should ensure that infrastructure is delivered as efficiently as possible

14. Infrastructure development should be better accommodated by the UK planning system. LCY submitted its planning application in 2013 and received planning permission from the London Borough of Newham in February 2015. In March 2015, however, the Mayor of London, going against the recommendations of his planning team, directed Newham to refuse permission for CADP. LCY appealed this decision and our planning appeal and CPO process eventually led to approval in July 2016. Due to the protracted planning process and caused delays in LCY's ability to add much-needed new capacity in the South East.

For further information, please contact LCY's Policy and Public Affairs Executive

▶ London Councils' response

▶ National Infrastructure Assessment: Call for Evidence

London Councils represents London's 32 borough councils and the City of London. It is a cross-party organisation that works on behalf of all of its member authorities regardless of political persuasion.

Introduction

London Councils welcomes the extensive consultation activities undertaken by the National Infrastructure Commission on the National Infrastructure Assessment. We would welcome an ongoing conversation with the Commission, given that new evidence, policies and strategies continue to emerge. The text below represents London Councils views at this point in time.

Cross-cutting issues

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region? *Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.*

London has a growing population and not only needs infrastructure to support this growth but also to improve connectivity to other parts of the UK.

On transport, London Councils supports the following schemes:

- Crossrail 2, connecting Hertfordshire, London and Surrey, and providing regional benefits across the south east;
- Brighton Mainline Upgrade, removing the bottlenecks at East Croydon station and improving reliability between London, Gatwick Airport and Brighton;
- Crossrail 1 extension from Abbey Wood to Ebbsfleet for connections to High Speed 1;
- River crossings in East London and the lower Thames;
- Improved orbital bus, rail and road links in outer London;
- Financial incentives and a positive regulatory framework for uptake in electric vehicles, including commercial light-vans.
- Southern access to Heathrow Airport and improvements to the South West mainline;
- East-West rail and road links between Oxford and Cambridge;
- North Downs rail link between Gatwick and Reading;

- Road and rail corridor Dover-Southampton (A27/M27/A259);
- Great Eastern mainline (connecting London, Ipswich and Norwich);
- East London rail connections to the Thames Gateway;
- Western access to Heathrow Airport from London and Reading;
- Midlands and West Coast mainline (connecting London, Luton, Bedford and Milton Keynes);
- New link from Felixstowe to Nuneaton and the East Midlands.

On digital, London Councils wants to see:

- UK adoption of the standardised wayleave produced by the City of London to speed up fibre connections;
- Preparatory work to secure the rollout of 5G.

On energy, London Councils wants to see:

- A decentralised energy system based on cleaner energy technology;
- Incentives for individuals and organisations to install cleaner energy technologies on their buildings;
- More emphasis on demand management, including energy efficiency measures for current buildings and planning standards for new builds;

On water and wastewater, London Councils wants to see:

- Strategic adoption of SUDS across new and retrofitted buildings;
- Changes to regulation that remove the automatic right to connect to a sewer, requiring developers to maximise their site capacity for managing its own wastewater and rainwater;

On flood risk management, London Councils wants to see:

- Changes to the financing of capital schemes that allow consideration to be given of funding flood defence works to protect commercial property and strategic assets.
- A continuation of the local prioritisation of projects for funding by Regional Flood and Coastal Committees, giving local politicians oversight over flood risk in their areas.

On solid waste London Councils wants to see:

- Greater policy and regulatory focus on waste minimisation, with increasing recycling rates as a secondary priority.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Infrastructure needs to enable businesses in the UK to thrive; be that through fast broadband connections, proximity to national, regional or international transport gateways, or because they can get their goods quickly to market. The physical infrastructure of transport and digital is inevitably backed up by waste and energy infrastructure and the need to 'green' and decarbonise our activities. Infrastructure should be an enabler of business, rather than an inhibitor (for example, sending staff home because upload speeds are faster there than in the office).

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

There is some infrastructure that is integral to building sustainable communities, such as public transport provision, digital infrastructure, localised energy generation, water supply and some waste facilities. There is other infrastructure relevant to the NIC's remit, which could potentially be located anywhere, providing important jobs for that locality, but also providing nationally significant infrastructure, such as certain waste and energy facilities that due to their nature could not be close to all the communities they serve.

Infrastructure needs to be designed in at the beginning of new developments, to make sure that places where people live 'work' for them and the lifestyles they are expected to lead. For example, a no-car development needs to have good public transport links; if a bus route cannot be secured into the development, the development becomes not only undesirable, but potentially very difficult to live in.

Infrastructure can be used to unlock sites, and often needs to be built ahead of housing in order to secure it. Masterplanning a site needs to understand these interdependencies and funding mechanisms need to be in place to enable this to happen. Business cases for strategic infrastructure, such as new railway lines, new energy and waste facilities should include the real value they are adding in accommodating existing and future demand.

However, we need to be realistic that a lot of infrastructure is needed in places already well-established and heavily built-up. Design and delivery solutions here need to identify whether new infrastructure is simply about improving what already exists or reshaping a place. It is worth stating that making the most of existing assets should always be the first consideration.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects? Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

We acknowledge the challenges around demand management and believe there is a lot more we need to understand about it. Demand management, however, is a valuable tool in helping shape infrastructure and investment decisions albeit its limitations. We do believe that more emphasis is needed on demand management measures, such as energy and water efficiency and should also be applied more strongly in waste management (reducing the amount of waste produced).

We think demand management can be best used where there are several positive outcomes available; for example in London the Hopper fare reduces the cost of bus travel, meaning more people take the bus. This in turn contributes to reducing the number of people using a car and therefore helps to improve congestion. The negative outcome however is more overcrowded buses. Demand management can then be used again to understand when increasing the frequency of the route is appropriate, before people switch back to car use.

We support demand management such as metering as it offers more holistic solutions, for example addressing the costs of utility bills for lower income households. We acknowledge this can in turn increase the amount of energy used, but if this energy is from a renewable source, the negative outcomes are reduced. As such we believe a 'whole system' look at demand management is necessary.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

We know that communities want to see existing assets maintained to an adequate standard. Allowing assets to decay to a position where they no longer provide the expected standard is damaging for public confidence, especially where assets are relied upon to protect communities, which is especially the case for flood defences. London Councils commissioned polling of Londoners on infrastructure in summer 2015 and on flood defences, 87 per cent of respondents living in inner London, compared to 58 per cent of respondents living in outer London, prioritised maintaining existing defences rather than building new ones. We know London Boroughs are equally concerned that there is sufficient ongoing funding for the maintenance of existing and new assets, as for installing new schemes.

We suggest a better understanding of assets at a national level, and levels of risk with regards to maintenance regimes. This would enable a prioritisation of maintenance of existing assets alongside construction of new assets. It is important to bring both schedules together rather than viewing them as separate.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

We believe that packaging of schemes and/or aspects of work within those schemes could be used to a far greater extent at all levels of infrastructure, national and local. We note that the Environment Agency actively packages schemes for flood defence works in order to achieve efficiencies, and we suggest a similar approach is taken in other infrastructure sectors where it is not already. Determining whether to use consultants or train internal staff is another factor in competition and collaboration, as well as in skills.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered? Note: by "funding", the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

Regardless of who pays for infrastructure, the process by which funding decisions are made needs to be drastically accelerated. We believe there is a bigger role for greater standardisation of agreement between government and local parties. For example, it took the Mayor of London and the London Borough of Croydon four years to agree a business rates retention deal to secure regeneration and infrastructure upgrades in Croydon. The next local authority who wishes to negotiate such a deal will take equally long. There needs to be a single, standardised agreement and process, with due diligence, rather than bespoke negotiations for each funding agreement.

Greater use of 'user pays' principles can only be achieved with fiscal devolution from government, which in turn ensures that not only can an infrastructure asset be paid for, but its long-term maintenance secured as well.

London Councils supports the recommendations of the London Finance Commission for the Government to work with the GLA, TfL and the London boroughs to develop a consultation paper on the objectives, principles and design options of a land value capture charge¹. Mechanisms for extracting value uplift on property brought about by infrastructure investments should also be considered. Infrastructure investment, usually paid for through fares and taxes, results in property price rises and new development. Evidence from TfL shows existing mechanisms only extract a small fraction of land value gains from transport investment (for example extension of the Jubilee Line). Further modelling predicts future transport schemes in London are also likely to produce large land uplifts.

A sample of eight prospective TfL projects that cost around £36 billion (including Crossrail 2, the Bakerloo Line Extension and the DLR extension to Thamesmead) could produce land value uplifts of about £91 billion. Under existing arrangements, local transport schemes capture less than five per cent of this uplift in value.

- 8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?** *Note: projects that "can be funded" but "will not be financed" refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.*

London Councils takes the view that this is a major factor in slowing infrastructure investment in the UK. For example, one funding source for Crossrail 2 is from the payback gained in house prices, which the Treasury will see through increased stamp duty receipts. Due to the risk appetite of government, this is delaying the project's progress.

- 9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?** *Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.*

London Councils believes resilience to flood risk and climate change is a major consideration in interdependencies. This requires that infrastructure takes account of future projections, for example of sea level rise, flood risk zones and changing land use; and appropriate solutions for the future are developed in the present. Flood risk and climate change is relevant not only in the siting of physical infrastructure such as roads and bridges, but also for the UK's energy and water supply requirements in future generations. Consideration should also be given of the interrelated aspects of digital and transport infrastructure. Transport is a sector where digital solutions have not yet made a significant impact on transport patterns, nor seen a marked increase in working from home or flexible solutions. However, this could change in the future, and so needs to be considered when determining the transport infrastructure investment the UK needs in the longer-term.

¹ https://www.london.gov.uk/sites/default/files/devolution_-_a_capital_idea_lfc_2017.pdf

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

London Councils cautions against any attempts to reduce the amount of public consultation or opportunity for the public to better understand proposals. That said, we have noted already that greater standardisation in the way that funding is negotiated with government would speed up the timescales for infrastructure projects. Local and regional projects that have funding secured should not get caught up in national government interest or bureaucracy, when the project is not of national significance.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

We want to see greater adoption of green infrastructure and sustainable drainage measures to ensure that new infrastructure does not worsen flood risk and contribute to create greener, more pleasant and biodiverse environments that do not exacerbate the effects of urban heat islands. Use of green energy sources should always be considered, along with more of the environmental practices already commonplace; for example reusing aggregate, tree planting and building materials that reduce the impacts of noise. The concept of Circular Economy should be at the heart of decision making, particularly regarding waste management but also in other areas, such as construction. When ageing infrastructure comes up for renewal, options for improving the environmental impacts of its replacement should always be considered. This could include a change of location if appropriate and should look at the wider impacts, such as transport, biodiversity, amenity, social and economic.

Transport

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? Note: "travel patterns" include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

We are concerned about the projected increase in vans in London, as regardless of whether these vehicles are low emission vehicles, they will contribute to congestion. Driverless vehicles present a set of challenges that need further investigations; currently London Councils remains concerned the impact this technology may have for London in terms of congestion.

We envisage a continued increase in cycle couriers and the transition of the entire taxi fleet to low emission vehicles. Climate change and the impacts of the urban heat island effect may hamper efforts to encourage people to walk and cycle more, if conditions to do so are unpleasant. We have yet to see any great impact of technology on the way people work and an increase in working from home. By 2050, this may be more prevalent, and we want to see this supported by better part time and off peak ticketing. London's population is projected to increase at almost twice the rate of the rest of England, and public transport investment needs to keep pace with this demand, otherwise congestion will worsen.

- 14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?** *Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.*

London Councils supports the progress boroughs are making in establishing freight consolidation centres to reduce the impact of 'final mile' deliveries. We believe freight consolidation, along with greater use of the river in London, can contribute significantly to improving the relationship between freight and the city. Restricting car use and encouraging people to reduce car use will be important going forward.

- 15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?** *Note: this includes travel in and between rural areas, as well as between urban areas and international travel.*

In London, we need fast, through routes connecting people in London to other places; for example as the Thameslink line already achieves, and as the Elizabeth line will do as well. Better connectivity as well as faster journey times are vital to ensure the UK's competitiveness. As discussed above, tackling congestion is very important, and London is due to receive new airport capacity before 2050.

- 16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?**

Road user charging extends the principle already part of public transport and taxi trips to private cars. Car clubs play a role in this, alongside road user charging as mechanisms for encouraging people to stop owning their own car and instead hire one as necessary. Any proposals for 'mobility as a service' need to take into account the impacts on the lowest paid as they travel to work or school, and the impacts high travel costs have on social isolation and loneliness.

Digital communications

- 17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?**

We feel government's role is not to second-guess the market but to focus on bringing those left behind by existing improvements up to speed and quickly. We want government to identify how it can incentivise or regulate providers to address the need of the 'final mile' hard to reach and often unprofitable areas. We note the government's recent work in this area to bring a digital connection in line with other utility connections, but believe there is still more to do in this area. Areas of London continue to suffer from poor broadband speeds, and so access to good, reliable broadband is not an issue reserved only for rural areas. Whilst we welcome efforts to ensure the UK is well-placed to adopt 5G quickly, this should not be at the expense of providing everyone with a reliable, fast connection. We note the City of London's recent work in developing a standardised wayleave that can be used across the UK to speed up the process of agreeing new internet connections between providers, tenants and building owners; and that the GLA is currently producing a standardised wayleave for mobile connections.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing "regime" refers to the current market, competition and planning frameworks. "Digital communications" includes both fixed and mobile connectivity.

We are not convinced that making digital connectivity the 'fourth utility' will resolve all the problems associated with rollout. We want to see government introduce a planning requirement for fibre-ready connections to be installed within new buildings, and for the wayleave toolkit to be adopted as best practice by government.

Energy

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

More support and strategic planning is needed by government to assess the most effective methods. Energy efficiency remains important as this reduces demand for heat regardless of fuel source and therefore should take high priority. Further research into carbon capture and storage needs to be undertaken.

The Committee on Climate Change notes that the continued roll-out of low-carbon heat networks through the 2020s will require a supportive planning policy framework and a financing framework. The government will need to establish a process for determining the direction of travel for heat decarbonisation post-2030. This includes identifying stakeholders and their roles, and which decisions need to be made during the 2020s.²

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.

London Councils wants to see a range of solutions: increased energy efficiency of buildings; increased use of low carbon gas; increased electrification of heat; increased decentralised (district/local/community) energy systems (as efficiency is lost through transmission); and increased use of "fringe technologies" such as solar thermal, geothermal and heat pumps. To achieve this, the government needs to set out a long-term plan, and provide investment (see comments above).

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

We note that one scenario used by the Committee on Climate Change is for electric uptake in the UK to increase significantly to 13.6m electric vehicles on the road by 2030. This would have an impact on energy infrastructure; storage will be important alongside the decarbonisation of the power system. Innovative solutions around demand side response and vehicle to grid technology would assist with this.

² <https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf>

Water and wastewater (drainage and sewerage)

- 22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?**
Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

London Councils supports the rollout of metering and we want to see greater uptake of strategic sustainable drainage systems (SUDS) across London and the UK. Water stress needs to be given much greater consideration when development sites are identified, particularly as this is a pressure that needs to be considered from the beginning, as solutions are difficult to add once buildings and layouts are designed.

- 23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?** *Note: this can include, but is not necessarily limited to, governance frameworks across the country.*

We want to see stronger requirements on developers to introduce SUDS and greater retrofitting of existing buildings. The right to connect to a sewer needs to be discontinued, to force developers to give much greater consideration to the water that can be managed on site. We see a continued role for local authorities and water companies working together on ensuring developers include adequate sustainable drainage in their development. Not having an automatic right to connect to a sewer (and especially a surface water drain if this is nearest) would help improve this approach.

London is already building the Thames Tideway Tunnel to better manage demand, but we note that Thames Water still predicts severe capacity constraints in some parts of London, regardless of this new infrastructure.

- 24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?**

London's local authorities are part of the Thames Regional Flood and Coastal Committee which is funding 'slow the flow' land use management pilots in the upper part of the Thames catchments. At a very local level, there needs to be greater public awareness of the implications of paving driveways, perhaps for neighbours several streets away. Local authorities could play a greater role here if planning permission were required for such changes. In London the Greater London Authority is mapping where there are opportunities for effective installation of SUDS measures.

Flood risk management

- 25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?**

London Councils believes that flood resilience should focus on protecting homes and significant economic assets to the UK. We need to be mindful of a changing climate and locating developments in flood plains and this includes in cities like London. As a country we need to improve the way we determine which areas will flood, and we need to do this in cities as well by making space for water and for water to drain.

- 26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?** *Note: “innovative technologies and practices” can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.*

The Thames Regional Flood and Coastal Committee is looking at piloting schemes in the upper Thames catchment. These are valuable, as they help protect green assets, but we also know that they do not protect against the worst floods. A number of boroughs install property level protection for homes at risk of flooding where a large scheme is not viable. We need increased use of construction materials that repel water, and to ensure householders are educated in the benefits of these materials. We welcome the innovative approaches in flood risk, and note that there is a much more limited approach in the drought and overheating aspect of water management.

Solid waste

- 27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?**

We are concerned that the focus on increasing recycling rates is misplaced when the focus should be on waste minimisation. As such we want to see changes to regulation that require greater action from business to reduce their packaging, and of what remains, ensure it can be firstly reused and secondly recycled. We hear mixed views on whether London and the UK have enough infrastructure to meet its waste needs – a robust and comprehensive review would be welcomed. The transition to a circular economy should reduce requirements for landfill, which should be an ambition of the UK anyway.

- 28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?** *Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.*

London Councils is supportive of achieving a more circular economy as a key principle to move to better waste management to reduce waste and become zero carbon. Planning and leadership would generate long term certainty which will enable the correct infrastructure to be delivered so we would like stronger government commitment to circular economy principles across all department including BEIS, DEFRA and DCLG.

New targets for reuse and recycling place a financial burden on local authorities as capture rates for traditional materials will need to be increased and new materials added to collection and disposal services. At the moment local authorities bear all the costs of waste management but have no control over materials entering the waste stream so see none of the benefits. This makes a strong case for extended producer responsibility to incentivise the circular economy approach as far upstream as possible. Once circular economy principles are implemented it makes no sense to continue to measure recycling by weight as materials move out of the traditional waste stream to new uses. We support targets and measures which encourage the best environmental or economic outcome.

It is expected that further investment in waste processing infrastructure would be required to ensure the appropriate capacity is available. There is currently a lack of investment in recycle processing infrastructure so confidence needs to be renewed which could be provided by government. An additional barrier to the circular economy is space for new industries and storage especially in urban areas.

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support longterm sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of “highest value” should include benefits and costs, as far as possible taking a comprehensive view of both. “Long-term” refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

The greatest need is to provide for existing communities poorly served as a result of chronic overcrowding. Schemes which promote longer distance commuting represent poor value for money. Modal shift of freight to rail is essential if we are to achieve long term sustainable growth.

2. How should infrastructure most effectively contribute to the UK’s international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

We need to create a network suitable for piggy-back freight. Use of existing lines with action to overcome the bottlenecks, diverting around them, is likely to be more cost effective than building a new line.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

The housing is crucial. It must be close to places of work which may mean that infrastructure is geared to relocating offices more than housing.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

Your note partly answers the question, but there is clearly scope for more demand management, notably road pricing.

5. How should the maintenance and repair of existing assets be most effectively

balanced with the construction of new assets?

A priority should be to ensure that there is a network of secondary routes that minimises delays when the primary route is being repaired, e.g. an alternative rail route when the Cornish coastal link is flooded, alternative road routes for buses when a road is blocked, particularly by flooding which takes several days to repair, or alternative provision of step-free access when a lift is taken out of service.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Proposals should be drawn up by people with no vested interest in their delivery. We get schemes that are best value for those constructing it, we need best value for passengers and freight users.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Greater decentralisation would result in more lower cost higher value schemes. A Land Value Tax would ensure contributions from those in receipt of windfall benefits and compensation to those unexpectedly disadvantaged.

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

Transport should be treated as a means to development, the same as water and electricity. It exists to facilitate economic activity, not to make a profit itself.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

No observations.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as

possible and on time?

Planning should be recognised as an asset to sustainable growth. It should be properly funded, and planning briefs should be drawn up by planning authorities not would-be developers.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

This needs a robust and balanced planning regime.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

Analysis should be undertaken by disinterested parties. Those with a vested interest can always find a technique that generates data which advances their own cause

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

Optimistic: more walking, cycling and shift from air and private car to rail and bus.

Pessimistic: people travelling further to achieve the same end, and the problem of an ageing population resolved by worsening air quality.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: “high value transport investments” in this context include those that enable ‘agglomeration economies’ – the increase in productivity in firms locating close to one another.

Planning to support greater contra-flow commuting would achieve the greatest efficiency. Measures that streamline interchange, or that iron out bottle-necks, would be the most cost effective expenditure on transport infrastructure.

15. What are the highest value transport investments that can be used to connect

people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

Bus services regulated to ensure that buses complement trains where the volume of traffic does not justify a rail link.

16. What opportunities does 'mobility as a service' create for road user charging?

How would this affect road usage?

We believe road charging has the potential to regulate usage to the general good.

National Infrastructure Assessment call for evidence 10 February 2017

Via email : NIAEvidence@nic.gsi.gov.uk

London TravelWatch is the statutory body representing all transport users in London and rail users within the wider London Rail Area which includes London's airports

London TravelWatch welcomes the opportunity to respond to the commissions' consultation, as it touches on areas of significant concern to users of London's transport networks, and which London TravelWatch as a passenger representative body has carried out significant research in recent years. Our previous response to the previous consultation relating to London is set out in Appendix A.

London TravelWatch has produced a series of transport user priorities for the 2016-20 Mayoral term based on our research and our passenger contacts. This response reflects these priorities:

1. Sustained investment to meet London's ever-growing transport needs
2. A road network that makes the best use of scarce capacity
3. As many of London's rail services as possible coordinated by the Mayor
4. Reliable bus services that keep up with the pace of change
5. Simpler fares, better value for money and a fairer deal when things go wrong
6. A co-ordinated approach to transport interchanges
7. Transport networks accessible to all
8. Reliable, accessible and timely information
9. Everyone able to travel without fear of crime or anti-social behaviour
10. Disruption effectively managed

Consultation questions

Cross cutting issues:

- 1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?**

These would be ones that make the best use of existing infrastructure, but where disruption to existing users is kept to a minimum. Appropriate mitigation should be put in place before major works are commenced to give users or passengers alternative means of completing their journeys or doing their business, particularly if the infrastructure project is on a 'live' part of an existing network used by large numbers of people while the project is taking place. An example of this would be the Thameslink upgrade project.

New infrastructure projects should be fully integrated into the maintenance programmes for existing infrastructure – the Thameslink upgrade has had many instances where failure to do this has resulted in much more extensive and costly disruption from a failure to do this.

There should be no fixation on the size of infrastructure investments, although London TravelWatch fully supports projects such as Crossrail 2, Western and Southern rail accesses to Heathrow Airport, HS2, upgrading the rail route to Stansted Airport.. Highest value can often be achieved from smaller scale projects. This might be new platforms on rail lines adjacent to existing rail stations. London TravelWatch has long advocated ¹the construction of additional platforms on the Chiltern line at West Hampstead, the South London line at Brixton and on the Lewisham – Victoria route at Brockley are examples of where considerable connectivity and productivity benefits could be achieved for a relatively modest outlay, making better use of the existing adjacent London Underground, London Overground, Thameslink, Southeastern and Southern services and stations. An example of where such benefits have already been achieved is the linkage between Hackney Downs and Hackney Central stations by a new pedestrian walkway. This has freed up extra capacity into Liverpool Street station, but also reduced journey times for many passengers and opened up new job opportunities across north east London that would otherwise have not been possible, but for a very modest outlay.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Airports, rail stations and other interchanges are the 'shop windows' of the UK that give the first and last impressions of the UK to overseas travellers, and therefore ensuring that these are of top quality is therefore really important. London TravelWatch has developed an assessment tool² for determining how well these interchanges perform, and what operators and authorities can do to bring in improvements. An inefficient and unpleasant experience at such a location will reduce the attractiveness of the UK as a whole and therefore reduce its international competitiveness. For airports serving London we have recommended a series of improvements to road, rail, bus, taxi and private hire car services that would substantially improve the user experience and by extension the UK's overall competitiveness.³

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Infrastructure and housing should be considered as part of a whole land use planning environment, whereby the need to transport or transmit people, goods and energy is minimised, and where priority is given to the most efficient modes. This would include prioritising walking, cycling and public transport in housing schemes.

¹ http://www.londontravelwatch.org.uk/documents/get_lob?id=4254&field=file

² http://www.londontravelwatch.org.uk/documents/get_lob?id=4040&field=file

³ http://www.londontravelwatch.org.uk/documents/get_lob?id=3894&field=file

Creation of 'hubs' of retailing and services around public transport interchanges would also reduce trip rates and congestion on the road network. Examples of this might be rail stations with adjacent food superstores where commuters are able to link their shopping trip to before or after their rail journey to and from work, rather than make a separate trip to a food superstore. In the case of energy, for sustainability production should be closest to the place of use e.g. the use of solar panels on buildings or alongside rail routes that use electricity.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Circumstances for this will vary, but ultimately there is not necessarily a maximum for demand management in any sphere of public life.

5. How should the maintenance and repair of existing assets be more effectively balanced with the construction of new assets?

Evaluation of how many users or passengers affected by a maintenance regime on existing assets and how many would benefit from a new asset, and how much disruption both options would cause.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

This depends on whether there is competition for the market (franchise concessions, competitive tendering etc) or competition in the market (parallel routes and competitive pricing for individual users). Infrastructure usually requires competition for the market rather than competition in it. Competition for the market has the potential to drive quality and provide equality of universal access. An example of this might be tendering of road maintenance for an existing road network and the addition of new roads.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

On the road network a change from Vehicle Excise Duty and taxation of fuel to a roads pricing model based on congestion and vehicle utilisation would be a major incentive to make more efficient use of the road network and public transport.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well functioning markets?

Yes there will be occasions where private finance will not be available because of the risks involved are too great or unknown. In which case direct government payment will be the only appropriate means.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Localisation of responsibility for service delivery and production would make our infrastructure system more resilient and more able to respond to changes in demand or service disruption. The transport sector and information provision are increasingly dependant on electricity supply and radio based communications and therefore resilience in these sectors is very important. However, infrastructure itself presents numerous opportunities to address this such as solar and wind power electricity generation on station buildings, highway embankments etc. or the use of rainwater collection systems for reuse of water where a drinking water standard is not required. Other examples might be permeable car park surfaces to absorb rainwater or the use of small scale hydroelectric power from streams and rivers passing beneath railways or roads. Encouraging this kind of sustainable investment in these sectors should be integral to all industry plans and thinking.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

London TravelWatch has no view on this question.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

In the first instance it should be through making best use of existing infrastructure through demand management, and concentration of development to minimise the impact on the environment. In transport, this would mean providing more and better interchanges that would encourage modal shift towards more sustainable modes, but at the same time increasing and improving consumer choice.

The natural environment can also be used to protect infrastructure and make it more resilient if understanding of methods and capabilities is applied correctly. For example, use grass and selected tree planting to protect road and rail embankments and cuttings from collapse or flooding.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Modelling of cost benefits and operation of infrastructure is using data from the past to predict future usage and revenues. However, the past is not always an accurate predictor of the future and so an element of judgement needs to be applied when making decisions based on cost benefit analysis. Some infrastructure schemes may not necessarily 'stack up' according to conventional cost benefit analysis but may well be worthwhile to do if there are other credible reasons for pursuing a scheme, such as making better use of another piece of infrastructure.

Transport

13. How will travel patterns change between now and 2050? What will be the impact of the adoptions of new technologies?

New technology will always have an impact on travel patterns. Some trips will be reduced, but others introduced. However, experience of the recent century would suggest that overall trip rates will increase regardless of the adoption of new technologies. International travel and movement of goods however will be subject to political and social pressures associated with globalisation, and any change to the attitude and practise towards globalised trade will have an impact on traffic levels to and from ports and airports. This will mean that predictions of traffic growth are likely to be less accurate, and more unpredictable in future.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Making best use of existing transport networks is likely to produce the highest value in relation to urban areas. For the London area London TravelWatch has produced a report⁴ listing and exploring potential schemes that would do this. Doubtless in other urban areas there are also projects that could deliver similar benefits. Improvements to public transport, cycling and walking can also deliver significant benefits to freight and private transport in terms of reduced congestion and reduced journey times. Likewise investment in freight infrastructure can have major benefits for public transport, cycling and walking. Examples of this might be upgrading and electrifying the rail route between Felixstowe and Harwich ports to the West Midlands via Ely, would free up capacity on rail routes between East Anglia and London, within London on the North London Line of London Overground and on the West Coast Main Line between London and the West Midlands: or a smaller scheme such as changing the junction arrangements for the Angerstein Wharf branch railway in South East London would bring significant reliability and capacity gains for passenger railways throughout that area. Similarly, investment in cycling, walking and bus priority schemes will also make better use of existing roads in and around urban areas.

15. What are the highest value investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Similarly to urban areas, making best use of existing transport networks is likely to produce the highest value of investment outside of urban areas. In particular making public transport financially sustainable by growing usage, and designing bus route networks such that rural areas are served by services that link major urban areas should be regarded as important goals to pursue.

⁴ http://www.londontravelwatch.org.uk/documents/get_lob?id=4254&field=file

16. What opportunities does 'mobility as a service' create for road user charging? How should this affect road usage?

Road user charging represents a significant opportunity to change the way in which road space is allocated, paid for and managed, and to incentivise the use of sustainable and healthier means of transport. London TravelWatch supports the concept of road user charging, but it will require extensive consultation on the detail to ensure that any schemes brought forward are effective but fair.

Questions on digital communications, energy, water and wastewater (drainage and sewerage), flood risk management and solid waste are not part of the remit of London TravelWatch and so we do not feel able to give answers to these. However, we would make a number of observations on these subjects where they have an impact on transport users.

All of these sectors affect transport through their use of the road network, and the installation, repair and maintenance of power lines, telecoms, sewers and water supply because of the resultant road works has a big impact on road congestion, journey times and buses. This requires careful management of roadworks and we would urge the use of licensing schemes for these to reduce the impact of such works on transport users.

In relation to flood risk, this also a big impact on passengers and users of both road and rail networks. Flood risk can arise from natural disasters and human mismanagement (e.g. water main burst). For both road and rail the first mitigation of this risk is basic maintenance of both the water infrastructure and keeping the road and rail infrastructure clear of rubbish and litter. An example of this was the flooding of Clerkenwell tunnel in January 2015⁵ where a burst water main at road level led to flooding of the railway tunnel below. However, failure by Network Rail to clear litter and rubbish in this tunnel from at least 2007 onwards led to the tunnel drains being blocked and this then caused the flooding, and massive disruption to train services across London and the South East region. Similar examples have occurred elsewhere with culverts, embankments, cuttings etc. These failures cause massive disruption to passengers' journeys and are very costly to correct. Network Rail and highway authorities must be incentivised to prioritise this basic maintenance.

Other mitigations should include provision for flood and rainwater to soak away. In urban areas this might require a planning block on additional hard surfaces or a policy of replacement of hard surfaces with permeable ones. A further mitigation, but also one which would improve resilience of water supply would be to mandate the use of rainwater harvesting systems in new developments or the encouragement of water butts at domestic properties.

⁵ <https://waterstink.com/2015/01/31/thames-water-network-rail-argue-over-farringdon-flooding/>

Culverts, streams and rivers flowing underneath road or railway lines could also be converted to provide hydro-electric power to the grid. Such schemes would also have the effect of protecting the road and rail assets from the effects of flooding. Network Rail and highway authorities should be incentivised to invest in such schemes.

Appendix A

National Infrastructure Commission call for evidence, 8 January 2015

Via email: londonevidence@Infrastructure-Commission.gsi.gov.uk

London TravelWatch is the statutory body representing all transport users in London and rail users within the wider London Rail Area which includes London's airports

London TravelWatch welcomes the opportunity to respond to the commissions' consultation, as it touches on areas of significant concern to users of London's transport networks, and which London TravelWatch as a passenger representative body has carried out significant research in recent years.

London TravelWatch has produced a series of transport user priorities for the 2016-20 Mayoral term based on our research and our passenger contacts. This response reflects these priorities:

1. Sustained investment to meet London's ever-growing transport needs
2. A road network that makes the best use of scarce capacity
3. As many of London's rail services as possible coordinated by the Mayor
4. Reliable bus services that keep up with the pace of change
5. Simpler fares, better value for money and a fairer deal when things go wrong
6. A co-ordinated approach to transport interchanges
7. Transport networks accessible to all
8. Reliable, accessible and timely information
9. Everyone able to travel without fear of crime or anti-social behaviour
10. Disruption effectively managed

Consultation questions

1. What are the major economic and social challenges facing London and its commuter hinterland over the next two to three decades?

Transport is a derived demand. It therefore follows that it needs to respond to the economic and social challenges of population growth, job creation and distribution, the supply of housing, the affordability of fares and regional connectivity. Provision of transport can open up opportunities for education, employment, and the provision of services that would otherwise be difficult to access; it can allow development of housing that is both desirable and affordable: and develop regional economies through the benefits of aggregation, knowledge sharing and sociability. Equally,

congestion, crowding, a poor living environment and the lack of effective and reliable transport services can hold back the development of new housing, the creation of new jobs and educational opportunities. The challenge is to improve accessibility in a way that is affordable to both the fare payer and taxpayer, and which meets the aspirations for service standards for both.

The capacity constraints that create congestion and crowding issues are in our view the most important issues that the infrastructure commission should focus on, and where investment is most needed. Creating additional capacity can be done in a number of ways, and will range from large projects such as Crossrail 2 to modest small scale investments e.g. improving walking routes within interchanges or additional entrances to existing stations. These smaller schemes can add considerable value compared to their modest costs in creating new capacity, relieving crowding and congestion that exists already, improve connectivity and reduce journey times.

The need for this continued and enhanced investment in capacity is reflected in the views of passengers. During focus groups for our recent affordability research⁶, it was apparent that even amongst low earners, there was a clear desire for investment aimed at reducing journey times, crowding and congestion, even if this meant more expensive ticket prices, although there was an overall resignation to the high cost of travel. Behind this was a recognition that better transport connectivity gives better access to a wider range of job and educational opportunities, allowing for career progression and increasing income, and housing that would better suit their circumstances and aspirations.

In a complex city such as London, where the most journeys are made using a variety of modes this suggests that improving the number and quality of public transport interchanges⁷ is the most cost effective way of delivering additional capacity on the transport network, delivering economic growth and sustaining population growth. London TravelWatch argues that the investment in London's transport in recent years has been the catalyst that has allowed London's economy and population to grow.

This growth has in part been sustained by the continuous income stream that fares on the public transport network and the Congestion Charge on roads, and it would be important that this is protected to allow investment to continue, and in the case of roads there is an argument that pricing should play a greater role. Nevertheless passengers tell us through our research⁸ that their primary concerns are the

⁶ http://www.londontravelwatch.org.uk/documents/get_lob?id=4100&age=&field=file Living on the edge: the impact of travel costs on low paid workers in Outer London.

⁷ http://www.londontravelwatch.org.uk/documents/get_lob?id=4040&field=file Interchange Matters: Passenger priorities for improvement

⁸ http://www.londontravelwatch.org.uk/documents/get_lob?id=3780&field=file The London Travelling environment : what consumers think

affordability of the transport network, its' reliability and the travelling environment that they experience.

Affordability

London TravelWatch with its partners Trust for London and London Councils recently conducted research on transport affordability in London⁹. This found that:-

- Most people living in London are resigned to the high cost of travel; they need to get to work and have no choice but to put up with the costs involved because they lack viable alternatives.
- 64% of all Londoners who commute to zone 1, which equates to around 1 million people tend to choose the quickest or best journey available to them to get to work, including many people on a lower income. 36%, or a projected 500,000 commuters, are not using the quickest or best journey option available to them.
- However, travel cost is one of the main factors in the route chosen by one in four, or a projected 180,000 people, commuting to Zone 1 from outer London and the equivalent of around 145,000 workers living in outer London choose the cheapest route to work rather than the shortest or most convenient.
- 9%, or a projected 70,000, outer London residents who commute to zone 1 could get to work faster if they spent more.
- Over one in five, or a projected 156,000, commuters who commute from outer London¹⁰ to zone 1 have to cut other spending to pay for travel to work.
- London residents earning more than £600 per month have to work approximately 20 minutes every day they work to pay for that day's commuting costs. This increases sharply to 54 minutes for those earning £200 to £599 and 1 hour 56 minutes for those earning less than £200.
- Travel to work accounts for almost one tenth of a manual worker's average earnings.
- Lower earners are more likely to use the bus and some choose this method to reduce their travel expenditure.
- Everyone is concerned about rising travel costs but people on low incomes are worried that further increases could affect their ability to earn a higher salary by working in Zone 1.

⁹ http://www.londontravelwatch.org.uk/documents/get_lob?id=4100&age=&field=file Living on the edge: the impact of travel costs on low paid workers in Outer London.

¹⁰ For this report, outer London is the 14 boroughs situated around the edge of the Greater London Authority area plus the boroughs of Brent, Ealing, Haringey, Barking & Dagenham and Merton.

This concern with cost is a challenge, as there will need to be a balance between securing funds for investment and the need to restrain cost increases for transport users.

London's passengers, through the fares they pay, cover a significantly greater proportion of operating costs of their transport system than other areas of the UK and comparable cities in Europe. This has the benefit in that this allows a much greater certainty of investment return and long term sustainability of the system.

However, rail passengers tell us that their number one priority for improvement is better value for money for the price they pay for their tickets¹¹.

Reliability

Bus passengers in London (who account for over half of all public transport users in London and over half of all bus users in Great Britain) tell us that they want their services to be more reliable, and have consistent journey times. This is especially true of younger people in education or entering the employment market, who are unable to afford faster modes of public transport or more expensive private transport.

Rail passengers also want their trains to operate more reliably, consistently and have sufficient capacity for them to travel in comfort. This will require upgrades to capacity of the network in terms of train frequency and length. The National Rail network in London needs to be provided with services that are of a 'turn up and go' nature i.e. at least every 15 minutes throughout the operational day.

Travelling environment

When we asked passengers about their travelling environment they told us of many concerns. Most importantly is their concern for their personal security, not just being a victim of crime, but just as importantly having to deal with anti-social behaviour.

Passengers also regard overcrowding, particularly at peak travelling times, as an important issue for them which exacerbates other discomforts such as noise. Finally, though not at the top of passengers concerns they do want stations, trains and buses to be clean and clear of litter and graffiti which they associate with anti-social behaviour.

2. What are the strategic options for future investment in large – scale transport infrastructure improvements – on road, rail and underground – including, but not limited to Crossrail 2?

¹¹ Transport Focus research <http://www.transportfocus.org.uk/research/publications/rail-passengers-priorities-for-improvements-october-2014> , London TravelWatch research . http://www.londontravelwatch.org.uk/documents/get_lob?id=3734&field=file and http://www.londontravelwatch.org.uk/documents/get_lob?id=3896&field=file

- How should they be prioritised, taking account of their response to London's strategic transport challenges, reliability, journey times and connectivity to jobs?
- What might their potential impact be on employment, productivity and housing supply in London and the South East?

As noted above the priorities for improvement in the transport network need to be focused on improving affordability (including passenger value for money and the ability to access a wide range of jobs and services), reliability, capacity (including reducing crowding and congestion), connectivity (including reducing journey times) and improving the overall travelling environment.

Therefore any transport schemes that are brought forward need to meet a number of tests that cover these elements :-

- Does it increase the accessibility of jobs and services?
- Does it improve the reliability of the existing network?
- Does it provide sufficient additional capacity where it is most needed?
- Does it reduce the incidence of crowding and congestion?
- Does it improve the overall connectivity of the London and South East region?
- Does it reduce overall journey times?
- Does it improve the overall travelling environment?

London TravelWatch has previously recommended¹² a number of infrastructure projects that would meet these tests, address the issues that have been identified above and increase the opportunities for employment growth and housing provision. These include:-

Rail

- Developing the Chiltern rail route within Greater London, with improved frequencies and a diversion of longer distance services to serve Old Oak Common (for the development corporation area and interchange with Crossrail and other rail routes).
- A bigger interchange at West Hampstead with platforms on the Chiltern and Metropolitan lines, reducing journey times and increasing accessibility of jobs and services
- Resignalling London's national rail routes to enable higher frequency services to be run
- Linking the Great Northern City branch (Finsbury Park to Moorgate) to rail routes in South London e.g. the London Bridge – Tulse Hill corridor, relieving

¹² http://www.londontravelwatch.org.uk/documents/get_lob?id=3916&field=file Potential future transport projects for London – June 2014

congestion in the City, but enabling development of areas such as that around South Bermondsey station for new housing

- Improving rail access to Heathrow Airport with western and southern rail routes, including the opportunity to develop housing and improve access to job opportunities.
- An electrified Reading – Gatwick Airport rail route – outside of London but of strategic importance to it, because of its ability to give an alternative to travel via London or by car via the M25.
- A reinstated and electrified Southall – Brentford rail link and an electrified West Ealing – Greenford rail route to improve access to jobs and open up new opportunities for housing, and to remove the need for non-standard diesel operation.
- New capacity at central London rail and underground stations through new entrances and link tunnels e.g. Covent Garden to Temple, new entrance to Waterloo East, City Thameslink to St. Pauls. Camden Town to Camden Road, Regents Park to Great Portland Street and linking the two Edgware Road stations.
- A new station at Maiden Lane serving the Kings Cross developments, but from the catchment area of the North London Line, improving access to employment and new areas of housing.
- Improving connectivity in South London by building a bigger interchange at Brixton with platforms on the London Overground and Victoria – Dartford routes, and an interchange at Brockley with platforms on the Victoria – Dartford route. These would open up access to employment and housing across a very wide area.
- Extending the Bakerloo line to Lewisham, Bromley North, Hayes and West Croydon, with significant opportunities to improve access to employment and encourage housing development.
- An ‘outer circle’ rail route linking London’s outer boroughs, to improve access to housing and employment.
- Upgrading the Felixstowe – Ely – Nuneaton rail freight route to allow diversion of freight services away from the Great Eastern, North London and West Coast Main Line routes to free up capacity for passenger services.

Light Rail

It is of concern that the role that light rail in London could play is being overlooked. Passenger loadings along some existing corridors and potential growth corridors will be such that light rail would be the appropriate mode. We have previously supported the proposed extensions to Croydon Tramlink, West London Tram and the Cross River Tram proposals. Like these latter two, there are many other corridors where high levels of bus passenger numbers would imply that light rail may be an appropriate mode. The potential of further light rail schemes in London should be investigated.

Roads

Unlike passenger transport schemes where the demand can, to some extent, be managed by price, additional road capacity in an urban transport environment will be self-defeating because of the latent demand for road travel. Similarly measures to encourage modal shift will have the effect of releasing latent demand.

London TravelWatch supports a wider, more sophisticated system of roads pricing in order that demand can be managed properly on London's road network and the need for additional road infrastructure can be assessed. This would enable more reliable essential motor vehicle journeys and have the additional benefit of releasing funds for investment in transportation schemes.

That said London TravelWatch has supported the mayor's east London river crossings subject to various caveat regarding tolls, the provision of public transport and assurances that the wider road network does not become more congested.

One of the key infrastructure investments in London is the continued programme of bus priority. London TravelWatch believes that buses should have priority on all bus routes and that there is much to do to achieve this.

Cycling and walking

London TravelWatch supports continued investment in safer cycling and walking to allow and encourage increased use of these modes of travel, especially for shorter journeys, thereby freeing up additional capacity on the public transport and road networks thereby improving journey time reliability, crowding and congestion.

In particular, reusing redundant railway infrastructure for cycling and walking schemes e.g. Finsbury Park to East Finchley and Alexandra Palace, to reduce traffic congestion on major arterial roads by offering alternative routes and modes of transport, and on improving the public realm generally. Other potential ideas could include a pedestrian and cycle link between Canada Water and Canary Wharf.

Interchange

Londoners, make more multi-modal journeys than elsewhere, typically using two or three different modes to get around. This means that interchanges play a significant role in the experience of London's travellers. Research by London TravelWatch shows what passengers think good interchange looks like¹³.

Good interchange is often overlooked, but is as important as the services from the interchange. Increasing the usefulness of existing routes and interchanges; adding new ones to existing networks where this would steer growth towards the areas and routes that have the capacity to absorb this, and to relieve existing congestion and crowding. Examples of this would be the extension of the Bakerloo line into South

¹³ http://www.londontravelwatch.org.uk/documents/get_lob?id=4040&field=file Interchange matters: passenger priorities for improvement.

East London¹⁴ and developing a Chiltern Metro, including additional platforms at West Hampstead.

3. What opportunities are there to increase the benefits and reduce the costs of the proposed Crossrail 2 scheme?

Co-ordination of HS2 at Euston with a future Network Rail scheme at their station. We have received assurances that any Crossrail 2 scheme would be built having regard to a future Network Rail scheme it would seem poor value for money if the Crossrail 2 proposals were developed in isolation. We strongly recommend that Euston is developed as a single scheme.

Interchange is really important to passengers who regard interchange as necessary, but not desirable. Crossrail would be an opportunity to develop first class interchanges at the stations served. We would expect Crossrail 2 to do as Crossrail 1 has and develop proposals for not only the stations, but also the public realm around them and the routes to nearby transport objectives such as the local town centre. Unlike Crossrail 1 any additional public realm works should be funded.

The stations served by Crossrail 2 should act as catalyst for promoting development and regeneration at, above or nearby.

Consideration should be given to the extension of Chessington branch of Crossrail 2 beyond the London boundary to Leatherhead to form a through line, and open up area around Malden Rushett for housing development.

4. What are the options for the funding, financing and delivery of large-scale transport infrastructure improvement in London, including Crossrail 2?

- What is an appropriate local and regional contribution – given the potential distribution of benefits to business, residents and transport users and the wider economy – and how could this be achieved?
- What innovative funding mechanisms could be considered to support delivery of key schemes?

As stated above the affordability of the public transportation system is very important both in terms of the proportion of an individual's income, but also as a tool of transport policy. The latter is often forgotten, but if the cost of public transport is too high we know it will be used less. Some of the demand will translate into private motor vehicle use which will exacerbate London's problems of congestion.

In order to secure the maximum social, economic and environmental benefits that a good public transportation system can contribute to then public investment is required. In addition to passenger fares, a mixture of funding from general taxation,

¹⁴ http://www.londontravelwatch.org.uk/documents/get_lob?id=3940&age=&field=file Bakerloo line extension consultation response.

roads pricing and land / property value uplift should be used. Additionally it is vital that all passengers pay their way and that this is assured through high levels of enforcement.

5. How have major metropolitan areas in other countries responded to similar challenges and priorities? Are there any lessons to be learned and applied to London?

London TravelWatch's limited resources do not allow us to give direct comparisons with other areas, however, we note that in dense urban areas such as Hong Kong, development has been successfully tied to the implementation of transport schemes. This approach has been done in London in the past e.g. the Metropolitan Railway constructed Chiltern Court above a reconstructed Baker Street station: In the 1980's British Rail redeveloped the former Holborn Viaduct station to include the low level City Thameslink station and office development above. This could be repeated in the future, but with careful consideration of the needs of existing passengers and users during and after the construction period.

Submission to The National Infrastructure Assessment: Call for Evidence

The Critical Role of Carbon Capture and Storage (CCS) in the Lowest Cost Decarbonisation of the UK Economy.

Submitted by [name redacted]

This submission

During 2016 at the request of the Secretary of State for Energy and Climate Change (now Business, Energy and Industrial Strategy) Lord Oxburgh chaired the Parliamentary Advisory Group on Carbon Capture and Storage. This group brought together parliamentarians from all major parties with figures from industry and finance to provide the government with independent advice on the potential contribution of CCS to cost-effective UK decarbonisation. Ian Temperton was a member of the group and acted as its secretary.

The primary purpose of this submission is to draw the National Infrastructure Commission's attention to this report and its conclusions and recommendations. The report was published in September 2016 and is entitled "Lowest Cost Decarbonisation for the UK: The Critical Role of CCS".

The Parliamentary Advisory Group, having completed its work, is now disbanded and so we provide this submission as individuals rather than on behalf of the group. We do however believe that this submission is fully consistent with the report of that group.

The report is 46 pages long excluding Appendices and hence while this exceeds your limit for submissions we hope you will consider the report in its entirety. We append the full report and ask you to consider the "Summary", "Recommendations" and "Milestones for Lowest cost decarbonisation using CCS" of the report to be a formal part of this submission to the Call for Evidence (these sections comprise seven pages). We have also included the six recommendations in this submission.

This rest of this short submission is in two sections: firstly we briefly highlight the key conclusions of our report, and secondly we specifically answer the questions in the Call for Evidence as they relate to CCS. We address the Cross cutting issues (Qs 1-12 – excluding 3 & 4) and the Energy questions (Qs 19-21).

We are available to discuss this submission and the Parliamentary Advisory Group report at your convenience should you wish to do so.

The Critical Role of CCS in the Lowest Cost Decarbonisation of the UK Economy.

CCS is critical to lowest cost decarbonisation

Our report concluded that CCS has a critical role to play if the UK is to meet its decarbonisation goals at the lowest cost. Despite the many setbacks in the development of CCS over the last two decades we critically assessed and then concurred with the analysis put forward by the Committee on Climate Change, the Energy Technologies Institute and others that the savings from using CCS as part of the decarbonisation programme run to several billion pounds per year. It is actually unclear, with the alternative technologies that exist today or are likely to exist in the necessary time-frame, that our decarbonisation goals can be achieved at all without a meaningful programme of CCS deployment.

The application of CCS across sectors makes it a national infrastructure priority

Underpinning this conclusion and similarly underpinning the importance of CCS as a part of the national infrastructure programme is its application across sectors in energy and industry. CCS can be applied in electricity, industry, heat and transport.

For heavy industry there are few if any viable cost effective solutions to mitigating its emissions other than CCS.

In heat CCS is essential for a pathway to decarbonisation. This is true whether hydrogen is chosen as the energy vector or electricity. Neither choice is possible without CCS, in the latter case to manage emissions from the enormous increase in winter generating capacity, of which at least part would need to come from fossil fuels.

The use of hydrogen appears to us to be a leading contender for the most cost effective decarbonisation of the UK's heating system. However this hydrogen will certainly be supplied most cost effectively, for some considerable time, from the processing of hydrocarbons and the associated disposal of their CO₂ via CCS. Hence without CCS at scale there is no hydrogen heating option. Given the timescales for a decision on the right approach for heat (early to mid 2020s in our view), development of CCS at scale is now time critical if the infrastructure is to be in place to make hydrogen for heating a viable option.

If a hydrogen supply infrastructure is developed based on CCS then it has the potential to form a critical part of the decarbonisation of transportation. While there is a clear focus on electrification for cars and light vehicles, hydrogen has potential applications in heavy goods transport and other difficult sub-sectors for decarbonisation in transportation.

CCS hubs as a national infrastructure priority

Our report highlights the need for the development of CCS infrastructure at key industrial hubs around the UK. Adding CCS infrastructure to existing industrial and energy intensive regions of the UK provides the lowest cost route to decarbonisation of the industry in those regions, while leveraging access to existing infrastructure for energy supply and transportation at those hubs.

The report recommends the development of 3-6 strategic national hubs for CCS around the UK.

Financing CCS in the UK

Our report makes two crucial recommendations on the financing of this CCS infrastructure which perhaps present the greatest policy challenge.

Firstly, CCS development in the power sector is absolutely critical. Only power stations provide the scale and creditworthiness needed to underpin the development of CCS infrastructure at reasonable cost. We believe that new stations with CCS could generate electricity at less than £85/MWh (on a Contract for Difference (CfD) equivalent basis) which is less than the cost of the Hinkley Point nuclear power station and considerably less than any offshore wind farm awarded a CfD in the UK to date. It is also at the level of the cap on CfD prices for offshore wind in the early 2020s. This can be achieved with existing technology deployed in a suitable commercial environment.

Our report recommends a programme of development of 3-6GW of CCS power stations at 3-6 strategic UK hubs providing 24-48TWh/year of electricity supply by 2030. This will sequester 15-30m tonnes of CO₂ from that power generation and make available the transport and storage infrastructure for 2-3 times that volume of CO₂ from other sectors.

Secondly, the state must play a significant role in the initial financing and development of those CCS power stations and their associated transport and storage infrastructure. Our work showed that there is no cost effective private sector financing approach for CCS and that costs will be minimised if a newly formed state-owned company takes this role. Key to this conclusion is the difficulty of placing the risk of “full-chain development”, that is end-to-end capture, transport and storage, and the risk of long-term storage in the private sector. We strongly believe that once initial projects are developed then this initially state-owned development company will be able to be privatised.

Hence we are proposing a financing approach which is not unusual in any way for other infrastructure sectors such as transport (for example HS1, HS2, Crossrail 1&2). It is however unusual for the power sector.

The government in its new CCS Strategy, and the National Infrastructure Commission in its infrastructure assessment, must recognise the essential role for CCS power stations in a future decarbonised energy system. It must also recognise that the development of this critical national low-carbon infrastructure requires a business and financing model which is more akin to that used in transportation infrastructure. This point will be critical to the success or failure of that new strategy, in our view.

We believe that the National Infrastructure Commission is uniquely placed to recognise both the crucial role of CCS as infrastructure for use across a number of sectors of the economy, along with the need to apply business and financing approaches from other infrastructure sectors to its successful development.

The six recommendations of the Parliamentary Advisory Group in CCS

Below are the six recommendations of the report.

1. Establish a CCS Delivery Company (“CCSDC”)

A newly formed and initially state-owned company tasked with delivering full-chain CCS for power at strategic hubs around the UK at or below £85/MWh on a baseload CfD equivalent basis. Formed of two linked but separately regulated companies: “PowerCo” to deliver the power stations and “T&SCo” to deliver the transport and storage infrastructure, the CCSDC will need c.£200-300m of funding over the coming 4-5 years.

2. Establish a system of economic regulation for CCS in the UK

The government will establish a system of economic regulation for CCS in the UK which is based on a regulated return approach. This will draw heavily on existing regulatory structures in the energy system and hence include: a CCS Power Contract based on the existing CfD or capacity contract to incentivise CCS for power; the regulation of T&SCo as other energy network operators; the introduction of an Industrial Capture Contract (see below); and the continued regulation of the energy network industry.

3. Incentivise industrial CCS through Industrial Capture Contracts

The Industrial Capture Contract, will be funded by the UK government and will remunerate industry for capture and storage of their CO₂. It will be a regulated contract which will have a higher price in the early period in order to deliver capital repayment in a timescale consistent with industry horizons. Industry will have access to transport and storage through short-term contracts. Early projects will use existing infrastructure and pure streams of CO₂.

4. Establish a Heat Transformation Group (“HTG”)

The Heat Transformation Group will assess the least cost route to the decarbonisation of heat in the UK (comparing electricity and hydrogen) and complete the work needed to assess the chosen approach in detail. The HTG has a likely funding need of £70-90m.

5. Establish a CCS Certificate System

Government will implement a CCS Certificate System for the certification of captured and stored CO₂.

6. Establish a CCS Obligation System

Government will also implement a CCS Obligation from the late 2020s as a means of giving a long-term trajectory to the fossil fuel and CCS industries. This will put an obligation on fossil fuel suppliers to the UK to sequester a growing percentage of the CO₂ associated with that supply. Proof of storage and hence fulfilment of the obligation being via presentation of CCS Certificates.

Answers to Questions in the Call for Evidence

Relevant cross-cutting issues

Q1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

CCS is widely recognised by bodies such as the Committee on Climate Change, the Energy Technologies Institute, the UK Energy Research Centre and others as the most critical and hence highest value energy and industrial infrastructure in a low carbon context. Our report fully backs the analysis that decarbonisation will be materially more expensive in the absence of the cost-effective deployment of CCS.

For the major industrial regions of the UK where there is existing energy infrastructure and industrial production, CCS is essential to both sustaining the existing level of economic activity in a decarbonising world and to providing new opportunities for growth and its associated employment and economic development.

Q2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

CCS infrastructure plays a critical role in maintaining the cost effectiveness and competitiveness of UK heavy industry and energy supply in a decarbonising world.

The UK clearly has regions which are critical gateways for energy import, export, production, transmission and consumption and these require access to CCS infrastructure at scale and at the lowest possible cost.

Q3 & 4 – not relevant to CCS

Q5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The development of CCS at critical UK hubs will enhance the value and extend the life of existing energy and industrial infrastructure at those hubs.

Furthermore there are opportunities to re-use existing infrastructure such as pipelines and power generation facilities which might otherwise be decommissioned.

Most importantly of all there is a substantial, but time-limited, opportunity for the UK to use its existing hydrocarbon fields as stores for CO₂. This has the potential to save the UK exchequer the costs of decommissioning those facilities.

The choice between re-use and new-build should be based solely on the need for the most cost-effective long-term solution, in our view.

Q6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Our report came in response to the second (some might say third) successive failure of a CCS Competition in the UK. Our view is that the government has designed inappropriate and unrealistic competitions to procure CCS developments from the private sector and this has led to project failure, unnecessarily high costs, and ironically a reduction in the opportunity for industrial collaboration and supply from existing component providers.

Our clear conclusion was that the high costs often associated with CCS developments and reportedly revealed by those competitions were a function of the design of the competitions rather than the fundamental costs of CCS.

Perhaps paradoxically, we believe that having a leading initial role for the state in the development of CCS going forward will increase the opportunity for involvement by an array of existing product and service providers while maximising competition and hence reducing overall cost.

An initially state-owned overall sponsor of CCS development will also facilitate the types of technical and industrial collaboration needed to overcome the challenges of developing the first UK CCS projects.

As we have noted above and in our report, a re-think on the business and financing model for CCS is needed which draws in lessons from other infrastructure sectors and we believe the National Infrastructure Commission is excellently placed to help the government to understand that.

Q7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The system of economic regulation which is proposed in the report draws heavily on the existing mechanisms used in UK energy. See below on financing.

Q8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

There is no private sector company willing and able to finance CCS projects while taking “full-chain” and long-term storage risks at the scale required and keeping costs to acceptable levels. Hence a fundamental re-think is needed of the way in which CCS projects are financed.

Therefore, the report recommends that an initially government-owned entity is responsible for the development of CCS power stations at strategic hubs around the UK. This entity will subsequently be privatised.

Far from distorting well-functioning markets this approach will enhance competition and allow the markets for product and service providers to operate more efficiently. This is because while there is

no viable market for full-chain CCS developers, there are very well-established markets for all the components of a CCS project. Hence addressing the component markets, as we recommend, rather than the non-existent, full-chain developer market, as the government has to date, will broaden the scope of economic opportunity, enhance competition and reduce cost.

Q9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

As noted above, the cross sector application of CCS is of critical importance to the UK.

Developing CCS infrastructure at multiple hubs and having multiple sources and sinks for CO₂ will also add much-needed resilience to the CCS system over time.

Q10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

CCS developments can sit within the existing planning regimes quite easily.

Our report does recommend the development of a new system of economic regulation for CCS in the UK. Even this however, draws very heavily on existing mechanisms, market infrastructure, regulation and regulators.

Q11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

CCS facilities are industrial plants which will not be beautiful. They will however be positioned at industrial hubs among other similar industrial facilities and so will not have any material additional impact on the natural environment

Q12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

The majority of reputable cost benefit analysis of the decarbonisation of the UK show a critical role for CCS. What is clear is that the decisions that should be made based on that robust long-term analysis are often affected by short-term considerations which while appearing to save money today, impose significant additional costs on future generations.

We would encourage the National Infrastructure Commission to pay attention to how such cost-benefit analysis is used in actual decision making.

Energy specific questions

Q19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

The report recommends the formation of a Heat Transformation Group which is tasked with the technical and economic work of determining the right solution for the decarbonisation of heating in the UK. For the urban and suburban environments this appears to be a choice between electrification with heat pumps and hydrogen as a replacement for natural gas. There is much work to do to determine the final answer and even more work required to plan the associated implementation.

This work needs to be properly funded and have a broad cross-industry representation. The report recommends a budget of £70-90m for the Heat Transformation Group to be spent over several years.

Generally it is considered that a decision will be needed in the mid 2020s ready for large-scale implementation from c.2030 onwards. While this may seem a long way off, there is much work to be done and most importantly if decisions are to fit within the existing regulatory framework of the energy network companies then early decisions and allowance for preparatory and planning work are needed in time for the next regulatory settlements in the very early 2020s.

The report sets this out in more detail and includes a Milestone chart for decisions which are needed (page 10 of the report).

It is very important to note that there simply is no hydrogen route without CCS and it seems inconceivable to us that any government would make a decision to go the hydrogen route without ever seeing a CCS project successfully developed in another sector. Hence the urgency for the first power CCS projects.

Q20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

The Parliamentary group did not directly address this question and the report focuses exclusively on delivering decarbonisation at the lowest possible cost. As a result what follows is solely the view of the authors of this submission

The largest uncertainty for the power sector over the next three decades actually centres on the decarbonisation of heat.

If electrification is chosen as the route for heat the seasonal winter power demand will be between three and six times the present winter maximum. The lower end of the range would require major improvements in the energy performance of buildings, wide deployment of heat pumps, strengthening of the grid and, conceivably but improbably, development of cost-effective inter-seasonal electricity storage.

Sufficient energy must be available on demand for the winter heating peak. The low-carbon dispatchable sources of this energy will be nuclear, some imported hydro, any stored renewable

energy and efficient thermal generation with CCS for fossil fuels. Biogas and biomass in thermal plants will also play a limited role.

It is very likely that the storage of fossil fuels, or the storage of hydrogen, each utilising CCS in some way, will prove more cost effective in providing this on-demand energy than the storage of renewable energy for this purpose.

If the hydrogen route is taken for heat, a range of possibilities opens up. Hydrogen initially generated from fossil fuels and sequestering the associated CO₂, could be progressively replaced by hydrogen generated efficiently from other low carbon sources such as nuclear, or eventually renewables. A hydrogen grid could also allow clean power generation in thermal plants and widen the opportunity for fuel cell vehicles particularly in heavy transport..

The key question is therefore whether we have electricity as our sole energy vector or whether we introduce hydrogen to make a system that might be both less expensive and more resilient. The information needed to make this choice objectively is not currently available. Whatever decision is made over the future of power generation, if it is to be robust it has to be made in the context of the decarbonisation of the energy system as a whole.

Because of its unique application across sectors of the energy market and its unique financing challenges, CCS will need to play a part in power sector decarbonisation between now and 2050 and it will also need to draw on the characteristics of the power sector to underpin the financing of the CCS infrastructure. There are very good economy wide reasons for CCS to play a special role in the power sector in this period.

Many models of UK decarbonisation have CCS serving other sectors of the economy but not necessarily power come 2050. This means that while power is crucial to the financing of a low cost CCS infrastructure, by the middle of the century the use of that infrastructure by the power sector may well be in decline.

Q21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

As noted above, if a hydrogen supply infrastructure is developed based on CCS for disposal of the associated emissions then this opens up viable zero-carbon hydrogen-based options particularly for heavy goods transport which is known to be a hard-to-decarbonise sub-sector of transportation.

10th February 2017

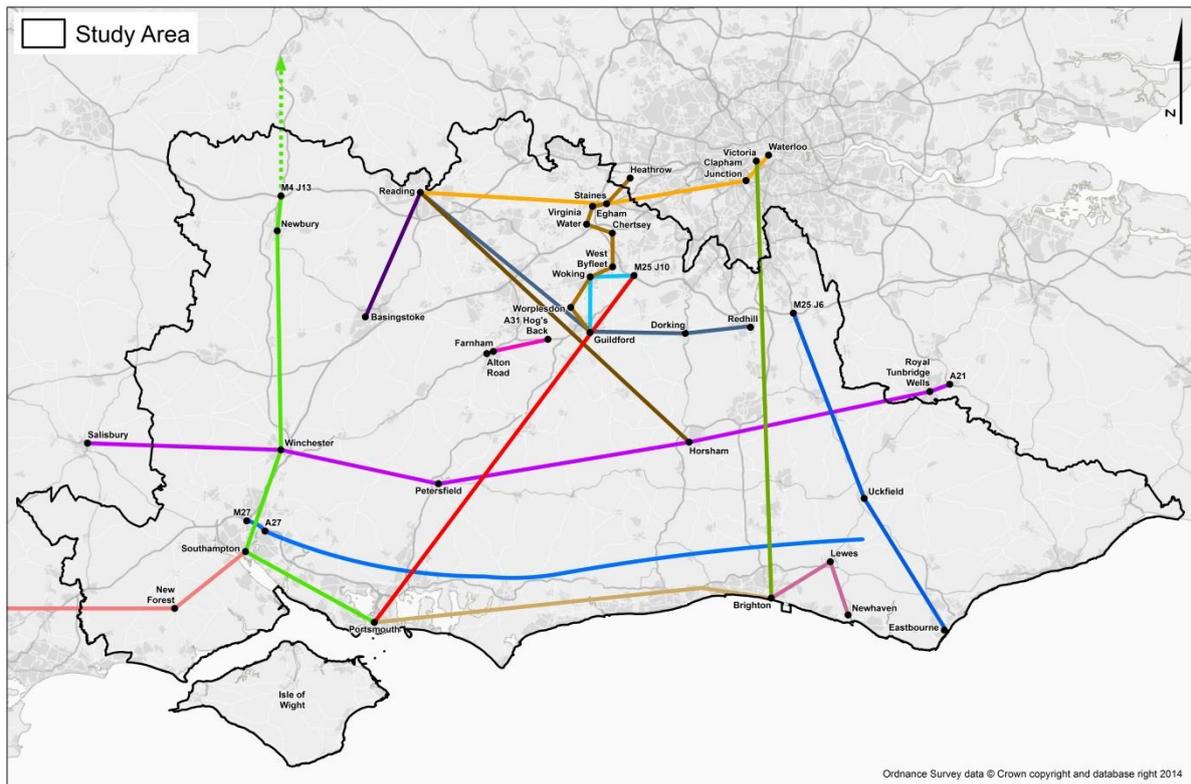
NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Dear Sir/Madam,

**NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE
Response from Enterprise M3 Local Enterprise Partnership**

Cross-cutting issues:

- 1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?**
 - High value infrastructure is key to economic growth across the transport, energy and smart cities agenda. It is important that Digital strategies within all sectors are considered at a national level within the context of every major investment to ensure consistency.
 - We have worked with our neighbouring LEPs and local authorities on a key study 'Influencing Strategic Transport in the South East' to quantify the economic case for improving connectivity along 17 major strategic movement corridors across South East England, A copy of the study is attached and the corridors are identified on the plan below.. The report estimates that the benefit to the economy would exceed £19.5 billion per annum, with more than 100,000 new jobs created. This additional economic activity would see the Government gain additional revenue of £1.2 billion a year from personal income taxation and just under £1 billion a year from corporation taxation. Conversely a failure to invest in congested transport links could seriously hamper economic growth.



- Enterprise M3 LEP has also identified a number of strategic transport asks, which supported our latest Local Growth Fund submission in July 2016,

- Guildford A3 Strategic Corridor Improvements
- M3 Junction 9 Improvements
- A3/M25 Junction to Wisley Interchange
- A31 Ringwood Junction with A338
- Southern Rail Access to Heathrow
- Electrification of North Downs Railway Line
- Woking Junction Rail Flyover – grade Separation
- Existing and New Guildford Railway Stations
- South West Main Line Capacity Improvements (inc Crossrail 2)
- A3 Strategic Package - NE Guildford
- River Thames Scheme - Datchet to Teddington
- A33 Basingstoke – Reading Corridor Upgrade
- A34 Corridor Upgrade
- A320 Corridor Upgrade
- A31 Upgrade

- These primarily sub-national schemes are essential to support local investment and provide the infrastructure capacity on transport networks to deliver economic growth, housing, jobs and increased productivity underpinned by our Strategic Economic Plan.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

- The Enterprise M3 economic area is a national asset which sits at the heart of the UK's digital industrial strategy and is unique in its scientific, technical and innovative capability. Success here does not only benefit our region; it resonates across the UK. Hundreds of international corporations, including BMW, BP, IBM, McLaren and QinetiQ, choose to base their headquarters here and go on to locate offices, staff and generate company offshoots throughout the UK and overseas. Enterprise M3 is an area which reaches out across the globe. It has the highest number of foreign owned companies of all LEPs outside London and it attracts many high-tech smaller companies as well as a world-class cluster of gaming businesses, who generate on average 45% of their turnover from exporting, with the top three target markets being the USA, China and Japan.
- Key International Gateways for businesses in the Enterprise M3 LEP area are Heathrow and Gatwick airports and the ports of Southampton and Portsmouth. To ensure they continue to function as an excellent, globally competitive location, the following key infrastructure schemes are needed:

- | |
|--|
| <ul style="list-style-type: none">• Western Rail Access to Heathrow• Southern Rail Access to Heathrow• Upgrade to the North Downs Line (combined with the above to link Heathrow and Gatwick)• Major improvement to Junction 9, M3 as the access to the ports of Southampton and Portsmouth |
|--|

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

- Housing development is often contested due to either a perception or a reality that adequate infrastructure does not follow. Infrastructure and housing have to be considered together if we are to seriously address the issue of the housing deficit. We hope to see this as a key of the Housing White Paper.
- A coordinated and integrated approach to infrastructure is needed to unlock and regenerate key sites by supporting developers and local authorities to accelerate housing delivery. There needs to be a focus on accelerating housing growth through upfront infrastructure, championing skills provision and creating a digital approach.
- Early engagement with strategic infrastructure providers is key. Siloed thinking and the way funding is allocated fails to capture the potential of these benefits of joint delivery across all infrastructure providers.
- Enterprise M3 LEP has developed cross working relationships with Network Rail and Highways England as providers of strategic transport

infrastructure and also works closely with local authorities, bus and rail operators. The emerging Sub-National Transport Body, Transport for the South East, will also cement partnership working and start to prioritise strategic infrastructure asks across the whole of the South East.

- In digital we are working to bring together leading academic expertise and key industry partners in a shared vision, the 5GIC will help to define and develop the 5G infrastructure that will underpin the way we communicate, work and live our everyday lives in the future.
- It is also important to develop and deliver a place based approach. Enterprise M3 has identified a series of Growth and Step Up Towns and developed cross-cutting delivery packages for each of these places, to help to ensure that this joined up approach will deliver the greatest economic benefit.
- We fully support the approach to infrastructure outlined in the Industrial Strategy and would echo the need to improve standards of performance on digital, energy, transport, water and flood defence infrastructure, and better align central government infrastructure investment with local growth priorities. We will ensure this will be reflected in the revised Enterprise M3 Strategic Economic Plan that will be published later this year will focus on how this is essential to raising productivity and living standards.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

- The focus will increasingly be on flexibility and on maximising the use of existing capacity rather than the provision of new capacity. It is difficult to overstate the potential impact of new technologies in offering new forms or alternatives to travel. There are many examples such as autonomous vehicles and digital rail, which have the potential to maximise use of existing networks. Digital systems can provide a vital platform for integrating and enabling this. Autonomous Driving will change the perception and experience of cars as they become less objects that have to be driven and more as a means of moving between two locations during which time can be used for other tasks such as work, rest, etc.
- 5G capabilities will deliver transport improvements including reduction in congestion as transport networks become far better co-ordinated.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

- Within Enterprise M3 Area, the types of initiatives that will help to ensure high value in our key centres are the Basingstoke Rapid Transport Network and Guildford Sustainable Movement Corridors, complemented by investment on strategic corridors, such as the Woking Rail Flyover and improvements to the A3 around Guildford.

- High value doesn't always mean large. Highest value will often be demonstrated by relatively small local schemes, such as sustainable transport. There is a need to ensure financial support for local investment is maintained and a reasonable balance is struck in terms of strategic and local infrastructure.

Digital communications:

17. **What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?**

- It is important to build on the world leading 5G Innovation Centre (5GIC) flagship project with existing test beds in Growth Towns of Guildford and Basingstoke and deepen links with our multi-site digitally focussed business. Enterprise M3 has invested in delivering the world's first 5G testbed in Guildford, connecting SMEs to the leading facilities of the 5GIC. Another is being rolled out in Basingstoke allowing businesses, especially SMEs, to investigate the commercial potential and market opportunities of 5G.
- The commercial potential of Surrey's 5GIC is being explored in Sunderland and Newcastle too, as the 5GIC begins a working collaboration with the North East LEP and the Digital Catapult Hub in Sunderland, including NE business parks, the Automotive Cluster and the Connected Health Cities Initiative.
- Another key area is that of big data and cyber security. To support 5G development and business in cyber security and big data Enterprise M3 is housing a number of specialist activities and providing a base for early stage start-ups and spin outs. The regional centre will be built to MoD requirements and based at the Former Proctor & Gamble site in Egham, adjacent to Royal Holloway University. It will also link to the Enterprise Zone at Longcross. This innovation centre will put the region in a strong position to enable training of the nation's next generation of coders within business and the community at all levels.
- In terms of access to and exploitation of cutting edge broadband access and the digital technologies that are enabled by it, the rural environment lags behind the urban and suburban areas. 5G will be able to address the digital divide and overcome difficulties in providing broadband connectivity in more rural areas where current fixed networks struggle to provide adequate service. Businesses in the Enterprise M3 Area frequently highlight the need for improved business park broadband connectivity. This can sometime be a real issue and sometimes one of perception and can impact upon productivity. Focus should be on business clusters in rural and urban areas and coupled with advice to get businesses adopting new technologies more quickly to increase their competitiveness and safeguarding and/or creating jobs. This also needs to be links to digital skills apprenticeship programmes which will address skills shortages in the sector and help support increased growth.

- In order to ensure the benefits from investment in 5G and digital technology are realised there is a need to set out how local authorities will enable the deployment of mobile networks and maximise the opportunities and benefits to residents and businesses. There is a need for this to be as a priority in local planning policy, to empower and encourage local authorities to coordinate the role that public buildings and infrastructure, such as lighting columns can be used to facilitate the deployment of mobile telecoms infrastructure.
- One of the challenges for our area is that we struggle to attract the younger, digitally-skilled workforce required for these businesses due to the high cost of housing and comparatively poor/patchy public transport network (as these employees are less likely to own a car). Particularly as we are so close to London this sort of workforce tends to just go there instead and is a limiting factor in where digital clusters are located.

Yours sincerely

[signature redacted]

[name redacted] – [job title redacted]

**Manchester Airports Group response to National Infrastructure
Assessment call for evidence. [No redactions].**



National Infrastructure Commission – Call for Evidence

Submission by Manchester Airports Group

10 February 2017

Summary

1. Infrastructure – from transport to housing, energy and broadband – provides the essential foundations needed to deliver jobs, growth and prosperity for all. **The National Infrastructure Assessment (NIA) is a significant positive step towards understanding the UK's infrastructure needs over the next 30 years.**
2. In setting out its 'Vision and Priorities' **the National Infrastructure Commission (NIC) should commit to an ambitious plan for growth**, taking the opportunity to explore not just where problems exist with today's infrastructure but also how an integrated programme of investment can transform the UK economy, balance growth across the country and shape our future as a competitive global trading nation.
3. **The NIC needs to become the driving force behind a more integrated approach to infrastructure development.** In the past, a fragmented approach to infrastructure development, focusing in turn on the needs of individual sectors, has cost the UK both financially and in terms of missed opportunities. With the negotiation of Britain's exit from the European Union about to get under way and with a new Industrial Strategy set to underpin the Government's economic vision, the NIA should focus on identifying the programme of infrastructure investment needed to deliver that vision. The NIC, taking a supra-departmental view, can add huge value to providing integrated planning across (and within) sectors to secure the long term interests of the economy.
4. **Aviation will be a cornerstone of the Britain's global competitiveness, providing the world-class connectivity that the UK's main economic 'engines' need to access global markets.** Connecting cities to each other and to international markets will increase productivity by allowing businesses to draw on a larger pool of skills and talents, establish larger markets and supply chains, and stimulate knowledge spill over. Infrastructure enables higher regional productivity to be unlocked, with the potential to add £208 billion to the UK economy over the next decade.¹
5. **The NIA needs to strike the right balance between addressing today's infrastructure problems and investing in opportunities to re-shape the UK economy.** For example, the rail industry has focussed too much on tackling pressure points with today's infrastructure, and too little on projects with benefits that, while harder to quantify, may have far greater societal value to the UK overall. The NIC should identify the appropriate tools and techniques for understanding the wider economic value of infrastructure investment, and build the confidence of decision makers in the value of such projects.
6. In our submission we identify **three key areas that the Commission should incorporate into the forthcoming NIA:**
 - **Transformation of east-west connectivity in the North through Northern Powerhouse Rail, connecting Northern cities with Manchester Airport.** The NIC has already assessed the value of this and developing this network beyond better links between Manchester and Leeds must be a key project for the NIA;
 - **Rail improvements to Stansted – developing an incremental, integrated plan for infrastructure investment along the West Anglia Main Line.** Repeated calls for investment since the Airports Commission's recommendation for urgent action in 2013 have highlighted the strategic benefits of journey time improvements to the airport.

¹ 'Unlocking Regional Growth', Confederation of British Industry, December 2016

Delivered in advance of four-tracking and Crossrail 2, these improvements would better connect the airport to its catchment across the region, supporting regeneration in the Upper Lea Valley, housing, jobs and economic growth.

- **A need for the NIC to consider the long term needs of the UK's strategic airport network**, including support for development of airports like Manchester and Stansted to reach full utilisation of their runway capacity. The NIA should outline how the need for additional capacity to 2050 should be considered. While recognising that the NIC is unlikely to offer a definitive judgement at this stage, the potential timing of the need for additional capacity must be addressed in the NIA and considered in detail in due course.
7. We also **highlight the strategic role of East Midlands Airport in providing vital air freight capacity**, which if supported would enable the airport to play an even greater role in development of hi-tech and advanced manufacturing clusters in the Midlands as part of the Government's Industrial and Midland Engine strategies.
 8. Central to the rationale for the priorities we have outlined is the need for the NIC to consider the value of a small number of strategic airports and how they can be supported through infrastructure investment to play an even more significant role in meeting UK's global access needs over the period to 2030. **Focussing on these strategic assets will deliver the strong economy envisioned in the Government's Industrial Strategy and achieve its goal of a truly global Britain.**

Introduction

1. We welcome the opportunity to make a submission to the National Infrastructure Commission's Call for Evidence and would like to see further direct engagement with the NIC over the coming months.
2. Manchester Airports Group (MAG) owns and operates four airports in the UK (Manchester, London Stansted, East Midlands and Bournemouth), handling around 56 million passengers per annum across multiple regions within the UK (North West and North Wales, South East and East, Midlands and South respectively).
3. Our airports are nationally significant infrastructure assets, providing essential connectivity both for the regions they serve and the wider UK economy, contributing £6.2 billion in GVA each year.
4. Following the vote to leave the European Union, the Government has renewed its focus on both improving trade relationships across the globe ("a truly global Britain") and supporting infrastructure improvements across the whole of the UK. This in turn comes under the broad umbrella policy of helping to stimulate growth across the whole of the United Kingdom or "a country that works for everyone".
5. In this submission we highlight the role that airports and international connectivity play within the wide body of national infrastructure, their supporting role in the economy, and the need to ensure that as the NIC plans for investments through to 2050 it considers how best to integrate international and national infrastructure networks to support the economy.

The role of the National Infrastructure Assessment

6. The NIC's proposed National Infrastructure Assessment (NIA) has the potential to make a significant contribution to the way the UK plans and delivers future infrastructure needs.
7. In setting out its 'Vision and Priorities' the NIC must commit to an ambitious plan for growth, taking the opportunity to explore not just where problems exist with today's infrastructure but how an integrated programme of investment can transform the UK economy, balance growth across the country and shape our future as a competitive global trading nation.
8. With the negotiation of Britain's exit from the European Union about to get under way and with a new draft Industrial Strategy set to underpin the Government's vision for the UK economy, the NIA should be focused on identifying the infrastructure needed to deliver that vision. Our sector, aviation, will be a cornerstone of the UK's global competitiveness, providing world-class connectivity to and between the engines of the UK economy.
9. While much attention has been paid to the Airports Commission process that has shaped the Government's policy support for Heathrow, its assessment of need and recommendations were explicitly limited to a 2030 time horizon. The Airports Commission made clear that another body should assess the need for further new capacity in the period to 2050 at some future point in time. The National Infrastructure Commission is the logical and appropriate body to take on that responsibility.

10. The Airports Commission also set out a number of short-to-medium term recommendations for Government, which were intended to make 'best use' of existing aviation capacity at other airports. The NIC should further consider the progress that has been made in delivering those measures and incorporate these into the immediate priorities in the NIA where appropriate, particularly as Heathrow's new runway is unlikely to be operational much before 2030.
11. We welcome the opportunity to make further submissions to the NIC and urge the Commission to engage more extensively with MAG and the aviation sector as its work on the NIA moves forward. In the following submission we have focused on those questions that are of greatest relevance to our business.

Highest value infrastructure investments (Q1)

12. Airports are some of the highest value infrastructure assets within the UK, providing access to global markets and acting as economic multipliers. Air connectivity is crucial to supporting UK businesses and the wider economy, facilitating trade in services and goods, enabling the movement of workers and tourists, and drives business innovation and investment. The Government's decision to take forward the Airports Commission's recommendation for a new runway at Heathrow accepts the fundamental principle that improving global connectivity will drive growth in the UK economy.
13. The UK benefits from having a number of well-developed international networks from other airports, including at Gatwick and Stansted in London, Manchester and Birmingham in the North and Midlands and Edinburgh and Glasgow in Scotland, for example. These airports are more than simply 'regional airports'. They form a network of strategic assets on which the UK's global connectivity will rely and which Government (and the NIC) should seek actively to support. With the right investment they can drive ever greater choice and value for consumers and act as drivers for regional economies.
14. The Government's draft Industrial Strategy is clear that airports are *"major local employers in their own right"*, but more than that, *stronger networks of international connections will "also help to promote trade and create jobs."*² To give an example, MAG analysis shows that the addition of two direct routes to China from Manchester Airport will be worth at least £500 million in economic benefits to the UK over the next decade.³ Two-thirds of this will be felt directly in the Northern economy in terms of increased jobs, economic activity and tourism.
15. Furthermore, analysis by York Aviation for MAG concluded that growth at Manchester Airport to its maximum capacity of 55mppa would generate benefits for the economy of a discounted GVA value of £76 billion in the North West, £94 billion in the North and £131 billion across the UK over the next 60 years.⁴ Crucially, this value begins to accrue in the short term because Manchester (as at other major airports) has the capacity to grow now.
16. In fact, for most of the sector there is sufficient runway capacity to meet demand for the next 10-20 years. While airport owners are investing in their infrastructure to meet passenger growth over that period, investment in the supporting road and rail

² <https://www.gov.uk/government/policies/industrial-strategy>

³ Since December 2015, Cathay Pacific fly four direct flights a week to Hong Kong. Since June 2016, Hainan Airways fly four direct flights a week to Beijing. Tourism spend only (based on projected 20,000 Chinese visitors per year), not including inward investment, jobs or infrastructure.

⁴ The economic impact of Manchester Airport, York Aviation, December 2016

infrastructure is needed to fully utilise this spare capacity and to maximise the value of a competitive network of airports across the country.

17. Sustaining a wider network of direct services from our airports will in large part continue to be driven by the quality of UK surface transport connectivity. An airport's penetration into a catchment of people wishing to travel is a key factor in airline investment decisions, so while we will continue to invest in airport infrastructure, it is government's commitment to long term strategic investment in road and rail to airports that will have a significant impact on the future 'size and shape' of the UK airport sector.
18. An important part of the NIC's remit is to "*contribute to sustainable economic growth across the UK*".⁵ As part of this, the NIA should identify and assess schemes that will maximise the value of capacity that is already available at airports like Manchester and Stansted. These airports will be responsible for meeting growth in air travel demand in both the medium and the long term, and the NIC should examine what rail and road improvements are needed to ensure that the benefits of global connectivity from major UK airports are more accessible for the greatest number of people.
19. The following key infrastructure investments would most effectively drive economic growth across the regions that our airports serve:

The North and north Wales:

HS2 & Northern Powerhouse Rail (NPR)

20. The Government recently announced the inclusion of a Manchester Airport terminus as part of the HS2 Crewe to Manchester western leg⁶, recognising the scope for significant wider benefits in jobs and productivity across the region. MAG supports the inclusion of a station at the airport because of the long term strategic value of linking HS2 into an east-west rail service (Northern Powerhouse Rail) that connects Liverpool, Sheffield, Leeds, Hull and Newcastle more effectively into the global connectivity provided by Manchester Airport.
21. In 2016, around four million return business-related air trips were made to/from this region, of which around 60% were by UK residents. The concentration of this demand for business travel is primarily around the core cities but as Figure 1 below shows, the propensity to travel for business is more than five times higher in Greater Manchester than Hull and Humber and twice that of Sheffield, a city less than 40 miles away.

⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/571097/Fiscal_Remmit_2016.pdf

⁶ <https://www.gov.uk/government/news/hs2-route-to-the-east-midlands-leeds-and-manchester-set-out-by-the-government>

Figure 1

LEP area	Total passengers (millions)	Business passengers (millions)	Inbound leisure passengers (millions)	Overall propensity to fly (total passengers per head of population)	Business Passenger propensity to fly (per head of population)
Greater Manchester CA	6.93	1.00	1.38	2.51	0.36
Leeds CR	4.32	0.50	0.60	1.43	0.16
Liverpool CA	3.51	0.33	0.82	2.30	0.22
North East CA	3.38	0.45	0.41	1.73	0.23
Cheshire & Warrington CA	2.56	0.46	0.32	2.79	0.51
Lancashire	2.45	0.22	0.26	1.66	0.15
Sheffield CR	2.30	0.19	0.25	1.25	0.10
North Yorkshire	2.29	0.27	0.33	2.00	0.24
Tees Valley CA	1.15	0.12	0.11	1.72	0.19
Cumbria	0.87	0.09	0.09	1.74	0.19
Hull & Humber CA	0.41	0.04	0.05	0.45	0.05

Source: Independent International Connectivity Commission Report, February 2016 – data based on CAA Passenger Statistics (2016)

22. Given the relative scale of the population and economic base across the North, this suggests that there is a significant disparity between the different regions in terms of their attractiveness to business and there is an opportunity to improve access to global markets by better connections to the available air connectivity. Transport for the North estimate that the true number of passengers travelling to/from the region should be around four million per annum higher than the 39.6mppa today (an increase of 10%).
23. Investment in the Northern Powerhouse Rail network, as outlined by Transport for the North, would reduce journey times between the North's core cities and Manchester Airport to between 30 and 60 minutes. Such a transformation in travel times could, based on analysis of CAA passenger data, increase the catchment area for Manchester Airport by more than 300%⁷. This would serve to extend the benefits of its global network across the North, bringing around 10 million people within a two hour public transport journey time, compared to just over three million today.
24. With the capacity to more than double the 25 million passengers currently served by Manchester Airport each year, the value of utilising this full capacity of the airport would be transformational. As described above, analysis by York Aviation, concluded that the cumulative benefits to the economy would have a discounted GVA value of around £76 billion in the North West, £94 billion in the North and £131 billion across the UK.⁸
25. We therefore agree with the NIC's own recommendation in High Speed North, that the design of the northern phase of HS2 should ensure latter phases of HS2 are planned and delivered *"so as to facilitate the development of the HS3 (NPR) network, enhancing connectivity between Leeds – Sheffield, Liverpool – Manchester (and its airport), and between Sheffield – Newcastle, as well as to onward destinations."*⁹

⁷ Steer Davis Gleeve, 2014

⁸ The economic impact of Manchester Airport, York Aviation, December 2016

⁹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507791/High_Speed_North.pdf

26. It is clear that such an investment would deliver transformational change to the quality of public transport and international connectivity available in the region, driving significant benefit through investment, productivity gains and economic growth. The NIC is in a strong position to ensure just this kind of integrated strategic planning – linking the NPR directly into Manchester Airport would deliver local, regional and global connectivity to the region. Supporting the development of Manchester Airport to its maximum potential in this way would deliver on the Government’s commitment to ‘making best use of existing aviation capacity’ while delivering large economic gains for the region.
27. The NIA should recommend urgent priority be given to the development of a full Northern Powerhouse Rail network and for the Government to release capital in Network Rail’s next Control Period (CP6) to undertake this development work.

Recommendation

The NIA should prioritise the integrated planning of surface access and global air connectivity. It should specifically recommend the development of a full Northern Powerhouse Rail network, connected directly through Manchester Airport, and the release of capital by Government to undertake the next phase of development, either as part of Network Rail’s next Control Period (CP6) or separately by Transport for the North.

South East/East of England

28. Almost four years ago, the Airports Commission recognised “*the strategic importance of Stansted Airport to the wider London airport system*”¹⁰ and identified an urgent need for investment in the West Anglia Main Line serving the airport. Since then there has been repeated calls to improve the infrastructure and deliver quicker journey times, better reliability and more aligned timetables. On 25 October, the Secretary of State for Transport acknowledged these calls for action, stating his desire “to see everything done as soon as we practically can to make sure the links to Stansted are as good as they are to London’s other airports”.
29. As the Commission identified, London Stansted is the only major airport in the London system with capacity to meet demand in the coming decade. In fact, Stansted will account for more than half of all passenger growth in London over that period. Sitting at the heart of the productive London-Cambridge corridor, serving an area whose outputs have grown by 65% more than the national average, and now has a total annual output of £121 billion¹¹, Stansted handles more than 24 million passengers each year (with a maximum runway capacity of around 43 million passengers). It is also the third largest air freight hub in the country after Heathrow and East Midlands Airports.
30. However, since the Airports Commission first recommendation, no infrastructure investment has been committed to improving journey times or reliability on this route. Furthermore, the Anglia rail franchise was let to Abellio in 2016 for a further nine years (to 2025) without specifying any timetable or infrastructure improvements for Stansted, despite requests to do so as part of the franchising process. The Transport Select Committee’s recent Report on Rail Franchising was particularly critical of this failure to prioritise Stansted services¹².

¹⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf

¹¹ https://www.london.gov.uk/sites/default/files/taskforce_brochure_a4_24ppv11.pdf

¹² <https://www.parliament.uk/business/committees/committees-a-z/commons-select/transport-committee/inquiries/parliament-2015/rail-franchising-15-16/>

31. Most recently, recommendations for upgrades to the rail infrastructure on the route were made by the West Anglia Taskforce¹³, which was set up by the then Chancellor and Mayor of London to take forward such plans. In October 2016, the Taskforce report demanded investment to secure 'Stansted in 40' - an incremental improvement to journey times as part of a programme of infrastructure upgrades projected to add £15 billion to the regional economy.
32. Incremental improvements, including changes to the timetable and minor infrastructure enhancements ahead of a larger programme for four-tracking as part of Crossrail 2, would be deliverable and highly effective in sustaining massive investment in housing and regeneration along the Upper Lea Valley (up to 100,000 homes), creating around 45,000 jobs and driving sustainable growth of the airport.¹⁴ In the longer term, these investments, including Crossrail 2, will further support development and growth in London Stansted's capacity; failure to invest in infrastructure improvements for a further 10-15 years would severely restrict the growth of one of London's major aviation assets.

Recommendation

The NIA should, in its Vision and Priorities document, identify the need for investment in Network Rail's next control period (CP6) to deliver urgent incremental infrastructure improvements on the West Anglia Main Line in the short term; with a commitment to four-tracking and Crossrail 2 in the long term.

East Midlands Airport (EMA)

33. East Midlands Airport is the largest pure freight hub in the UK and over the coming decades our vision is to double passenger numbers (10mppa), triple cargo tonnage (one million tonnes) and double employment (14,000) at the airport. As such, EMA performs an important function both for the national and regional economy, supporting the sustained growth of technology, aerospace and advanced manufacturing clusters, key sectors in the Government's Industrial Strategy.
34. Ongoing investment by DHL at the airport will make EMA its second largest cargo hub in the world, underlining the strategic importance of the airport's pure freight operation and role for the government's aspirations for a truly global Britain.
35. In the long term, to support the region and the airport's growth aspirations, surface infrastructure surrounding the airport will need to be expanded to provide the capacity to deal with such growth. In the absence of this, roads will become increasingly congested with freight traffic, slowing down aircraft operations which must run to time to meet international deadlines. The rail services and timetable to East Midlands Parkway is inadequate for the needs to most airport passengers (reflected in relatively low mode share) and is not supported by onward connections to the airport itself.
36. Working with Midlands Connect and the Midlands Engine, we are looking to secure improvements to rail provision and connections to East Midlands Parkway station through the upcoming franchise process – specifically to increase to four trains per hour. However, in the long term we believe the most effective solution to meeting demand and increasing capacity at the airport is likely to be a fixed light rail link that connects Parkway to the

¹³ https://www.london.gov.uk/sites/default/files/west_anglia_taskforce_tors.pdf

¹⁴ https://www.london.gov.uk/sites/default/files/taskforce_brochure_a4_24ppv11.pdf

airport terminal, Roxhill (a new rail freight hub), businesses at the nearby Pegasus Business Park and key freight businesses at the airport (such as DHL and UPS).

37. The arrival of HS2 to nearby Toton, while not a direct link, should include provision for significantly improved services to Parkway station, which will further drive the case for a fixed link to the airport. The NIA should consider how to effectively co-ordinate and sequence a programme of potential investments to facilitate expected growth at EMA and to crystallise the economic contribution made by both cargo and passenger operations at the airport.

The UK's international competitiveness and the role of international gateways (Q2)

38. Transport infrastructure is an essential component of productive economies and airports are the principal 'international gateways' for the UK – 73% of all visitors to the UK and 40% of freight by value arrives by air each year – facilitating trade, tourism and foreign direct investment. While air connectivity is undoubtedly key to unlocking a country's economic growth potential failure to invest in world-class connections to our international gateways effectively and efficiently via surface transport risks undermining the UK's competitive position.¹⁵
39. The UK's international competitiveness depends on, amongst other things, the agglomerated effect of efficient and well-connected cities and regions. Reducing the distance between population centres creates a more integrated labour market, more social cohesion and more productive regional economies. Connecting these linked economies to international markets via a strong network of strategic airports allows people, goods and capital to flow into and out of the country more effectively, enabling companies to get their goods and services to key international markets in a secure and timely manner, as well as facilitate the movement of workers to the most suitable jobs.
40. In the north of England for example, poor road and rail infrastructure means that access to global connectivity is not as good as it should be. As the recent Independent International Connectivity Commission Report sets out clearly, enhancing global connectivity starts on the ground, which means investing in the key 'landside enablers' for ports and airports. For many cities in the north, getting to Manchester Airport is too difficult or takes too long and therefore limits its effective catchment area. In turn, this affects airlines' ability to develop further their route networks even though demand for travel in the North is high.
41. In making this case for the Northern economy, the report concludes that *"improved global connections can only be achieved by making it easier and quicker for passengers to travel to and from the North. By increasing the proportion of trips which can connect globally direct from the region's airports and ports, as well as improving surface access to these key hubs, we can ensure that the potential of the North's airports is exploited for the benefit of the wider economy"*.¹⁶
42. An integrated rail network with HS2 and Northern Powerhouse Rail connecting the Airport with the North's core cities would have the effect of both dramatically improving access to the airport for passengers wishing to travel and supporting a broader, more frequent network of services.

¹⁵ <http://www.pwc.co.uk/industries/capital-projects-infrastructure/insights/connectivity-and-growth.html>

¹⁶ http://www.transportforthenorth.com/wp-content/uploads/International-Connectivity-Report_websafe.pdf

43. Furthermore, evidence suggests that connecting airports to their surrounding catchment areas will drive investment in skills and increase employment rates. This is a critical factor in delivering the Government's Industrial Strategy and particularly key to the growth of the northern economy. The Airports Commission noted the important role airports can plan in increasing national and regional productivity, concluding, "there is strong evidence that good transport links, and especially aviation connectivity, make an important contribution to enhancing productivity".¹⁷
44. Reducing the 'friction' of poor connectivity it is easy to envisage a virtuous circle where an increasingly highly-skilled, well-connected labour market attracts inwards investment and trade, which in turn supports better and more frequent international connections.¹⁸ The NIC should seek to prioritise the integration of surface access investment to airports to ensure road and rail services to the UK's major airports match projections of demand over the coming decades.

Recommendation

The NIC should undertake a specific analysis of surface transport requirements for UK airports, identifying investment priorities that will most effectively deliver integrated domestic (road/rail) and global (aviation) connectivity.

Airport Capacity to 2050

45. Considering the role of international gateways further into the future, it is also worth recognising that the Airports Commission's consideration of aviation capacity looked only at demand in London and the South East over the period to 2030. In its final report in 2015, the Commission was explicit that further consideration would be required of how to support demand in the longer term, recognising that, "continuing growth in demand for aviation will see the existing constraints in the UK's air transport system, and particularly the London airport sector, exacerbated".¹⁹
46. Consistent with that report, we urge the NIC to keep the issue of aviation capacity under review and to lead this next phase of assessment. Further, the NIC should ensure that full consideration is given to all options for expansion.²⁰ This must include full evaluation of airports across the country and their potential to play a different and larger role in meeting demand than they do today.
47. The potential of HS2 and Northern Powerhouse Rail, for example, would be to dramatically increase the share of demand that Manchester Airport would be able to meet, reducing pressure on the South East airports in the long term. The business case for NPR is enhanced by the integration of surface and air transport, and investment in the project would serve to deliver on the Government's wider policies to rebalance the economy, support a Northern Powerhouse and maximise the value of the UK's strategic airport network.
48. In the short and medium term, passenger growth at London Stansted Airport is likely to represent around half of all growth in the London aviation system and on current projections will be at maximum capacity by 2030. With respect to future runway capacity,

¹⁷ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf

¹⁸ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505705/northern-transport-strategy-spring-2016.pdf

¹⁹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf – 7.3, p135

²⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf

we do not seek to set out here the case for additional capacity or where it might be needed at this stage. However, we believe it is important that the NIA sets out a preliminary view on when that consideration of further capacity might be required, the process that might be followed for that work and a view on how a network of strategic UK airports could be developed over the next 10-20 years.

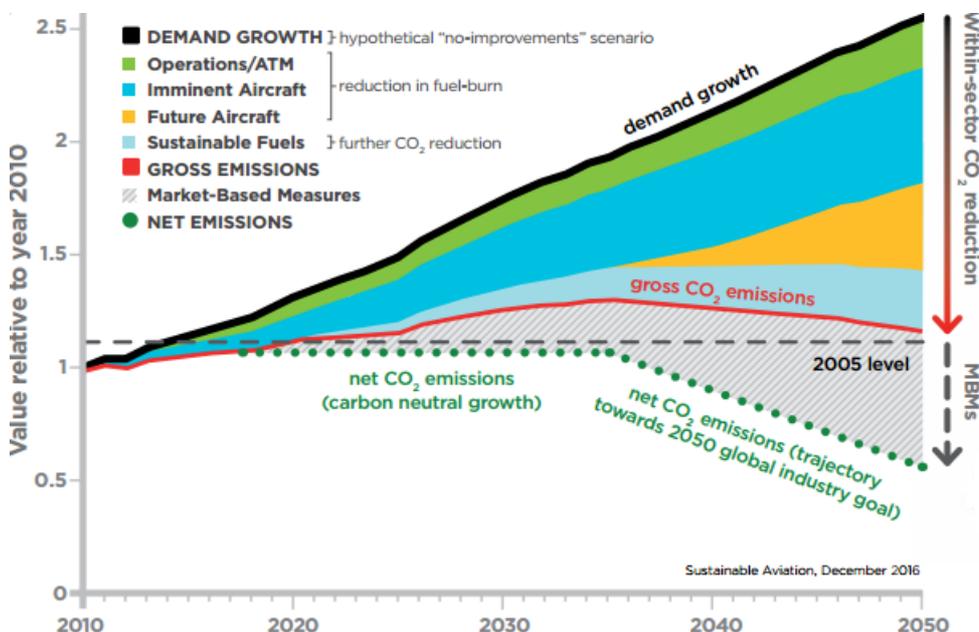
Recommendation

The NIC should keep the issue of future airport capacity needs in the UK to 2050 under review, and set out in the NIA its preliminary view on when further capacity might be required and the process for assessing the potential options.

Maximum potential for demand management (Q4)

49. In the case of transport, particularly in the aviation sector, the NIC must first consider the extent to which demand management or regulation is actually required. A large proportion of known demand for air travel in the UK (passengers and freight) can be met with existing capacity. Increasingly, the impact of aviation on the environment has been reduced, such that increases in activity (in terms of the number of movements) can be accommodated without increasing the impacts on air quality and noise, for example.
50. Sustainable Aviation²¹, an industry group which works to support the sustainability of the sector, has recently published the most up-to-date report on projected CO₂ emissions vs demand growth. It demonstrates a number of mitigation measures expected between now and 2050, demonstrating how CO₂ emissions should be broadly in line with the 2005 levels while at the same time accommodating significant sector growth.

Figure 2



Source: Sustainable Aviation Carbon Road Map 2016

²¹ Sustainable Aviation sets out the collective approach of UK aviation to tackling the challenge of ensuring a sustainable future for our industry. Launched in 2005, it is a world's first organisation of its kind, bringing together major UK airlines, airports, manufacturers and air navigation service providers.

51. Noise levels per aircraft movement too are expected to decrease, with the introduction of quieter aircraft types such as the Airbus A380 and the Boeing 787 able to offer significant noise reductions compared to their predecessors. Further design improvements such as blended wing body and engine shielding by fuselage and tail plane offer the potential to reduce perceived noise from aircraft by 65% by 2050.²²
52. In this sense, the NIC should not set off to 'manage' or reduce demand but to identify whether mitigation of the impacts of an activity are sufficient and assess whether the scale of impacts associated with an increase of supply can be similarly managed. As aviation consists of competing businesses in the private sector, the NIC should consider carefully the implications of seeking to intervene in the effective functioning of the market.

Competition and/or collaboration in the supply of infrastructure services (Q6)

53. The break-up of BAA has shown the benefits of encouraging competition between airports.²³ Airports are a competitive sector, both in terms of competition in the services they provide, and the infrastructure they build. The NIC's approach should recognise the role for competition between airports (and other potentially competitive sectors) and allow this to drive delivery of new infrastructure as far as possible. A stronger network of competing airports will also generate significant economic benefits by promoting direct connectivity from all parts of the UK.
54. This can be further strengthened by advising government to undertake fuller, more coherent integration of transport planning. This should recognise the essential linkages between rail/road investment and the wider airport catchment areas which support international connectivity, ensuring the value of access to airports is understood as part of any business case(s) development.
55. To take an example, an important part of the business case for Northern Powerhouse Rail, is the improvements in direct international connectivity that it will support by increasing the catchment area of Manchester Airport to the wider North of England. These rail improvements will allow the airport to build on its existing international network and create the critical mass required to support faster route creation, with benefits falling in the North. The point is supported by Transport for the North, which recently published recommendations from its independent International Connectivity Commission²⁴, suggesting a key aim for government should be to strengthen Manchester Airport's international network by improving surface connectivity.
56. If achieved, a larger network of direct international connections will feed back to the economy, supporting inward investment and productivity gains. This too has been referenced by the Government's own draft Industrial Strategy, citing the £500m benefit to the northern economy derived from direct links to China from Manchester Airport.²⁵
57. In terms of collaboration, the Transport Committee's recent report on rail franchising highlighted the Government's failure to deliver improvements to rail services to airports through the franchise process.²⁶ The consequence of this has been to shift the burden of financing onto Government funded infrastructure improvements further down the line, with

²² <http://www.sustainableaviation.co.uk/wp-content/uploads/2015/09/A4-Tri-fold-SA-Noise-Road-Map-Leaflet-Final-Version-230413.pdf>

²³ <https://www.gov.uk/government/news/cma-report-shows-benefits-of-baa-break-up>

²⁴ http://www.transportforthenorth.com/wp-content/uploads/International-Connectivity-Report_websafe.pdf

²⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/586626/building-our-industrial-strategy-green-paper.pdf

²⁶ <https://www.publications.parliament.uk/pa/cm201617/cmselect/cmtrans/66/66.pdf>

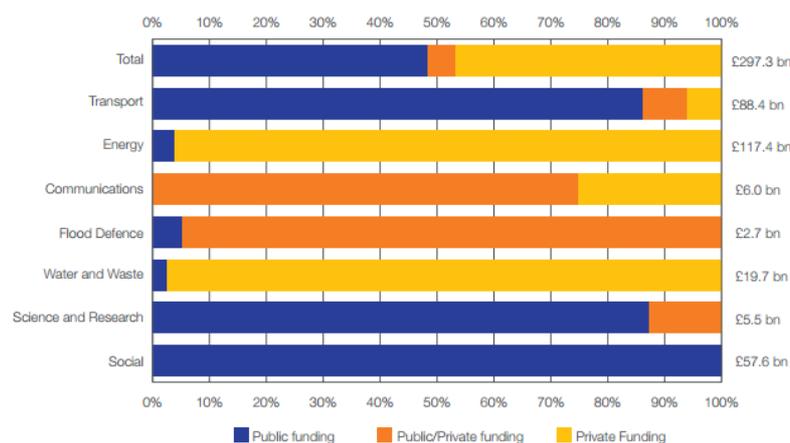
the opportunity for cheaper and more efficient operational improvements by the franchisee missed.

58. This points towards a lack of collaboration and integration between stated Government priorities, tendering and capital expenditure processes, as well as between rail, road and aviation departments. This conclusion is supported by the Committee's report: *"This outcome demonstrates to us another failure from the Government in taking to take a clear lead on integrated transport planning which is, as we concluded, the major obstacle to better surface access to the UK's airports"*.²⁷
59. Alongside the need to recommend infrastructure investments, the NIC must also ensure that it improves the processes behind future infrastructure decisions. A siloed approach to infrastructure development, with a focus on a particular sector alone, has the potential to cost future Governments both financially and in missed opportunity. The issues outlined above on the West Anglia Main Line should not be repeated, and a key role for the NIC is to be the driving force behind a more integrated approach to infrastructure development in the future.

Changes in funding policy to improve the delivery of infrastructure (Q7)

60. The UK has an ambitious target for improving its infrastructure. In March 2016 the Government committed itself to a £483 billion project pipeline, with the 2016 Autumn Statement releasing an additional £23 billion in order to support the UK's modern infrastructure needs.²⁸ This is, of course, welcome public Government spending but it is clear too that private investment is a vital part of the infrastructure spending mix.
61. While it has always been part of the UK financial framework, with mechanisms ranging from private finance initiatives through to Government guarantees, there is widespread variation in the ratio of private/public spending across different areas of infrastructure investment. Compared to other areas of infrastructure investment, transport infrastructure is often largely paid for by the Government, which demonstrates the complexity of securing third-party financing in the sector.

Figure 3



Source: National Infrastructure Delivery Plan, 2016-2021

²⁷ <https://www.publications.parliament.uk/pa/cm201617/cmselect/cmtrans/66/66.pdf>

²⁸ hansard.parliament.uk/commons/2016-11-23/debates/4F39F2C9-583D-407B-A529-3956F6A927F1/AutumnStatement [Column 902]

-
62. Our recent experience with Government and its agencies, including Network Rail, is that there is a growing expectation that we, as a private company, should pay the full cost of any improvement we wish to see prioritised – in this case, for the rail improvements to Stansted. This, however, ignores a number of factors, namely the wider benefits and strategic importance of the investment and the range of beneficiaries. It also ignores the significant contribution that airport passengers make to the rail farebox and franchise premium payments to help fund infrastructure improvements.
63. Once these contributions are taken into account, we support the principle of making appropriate contributions to UK infrastructure that promotes growth at our airports, particularly where the benefits are clear and well-defined for our business, customers and surrounding communities. Any further financing for infrastructure projects, however, requires a suitable framework that sets out clear risk and revenue sharing opportunities. As Baroness Jo Valentine, former CEO of London First, recently commented, *"policy-makers need to create the value before they capture it"*.²⁹
64. The incremental benefits to the airport, in this case, are modest compared to the increased farebox revenue and wider economic and social benefits. While it would be entirely feasible to make a contribution to funding a programme of improvements, there would be no commercial justification for MAG to pay the full capital requirement given the farebox premiums these will generate to Government over the life of the asset. We understand that this approach will be followed in connection with the Southern and Western Rail Access schemes developed (to support Heathrow's third runway) and the same principles should apply elsewhere where investment is being considered. Contributions must always be proportionate to the benefit that users derive from the scheme(s) or a mechanism must be found to return increased farebox revenue to third party investors.
65. Given the parlous state of Network Rail's capital programme, it is clear that the rail sector is a key part of the UK's transport infrastructure that could benefit from a new mechanism to attract private funding. In addition, the ability of the existing franchise system to deliver against wider Government aims has rightly been called into question by the Transport Select Committee and should be re-examined to ensure it has sufficient flexibility to incentivise third party investment.
66. Such mechanisms do not yet exist within the rail industry for outside investors, where, for example, the franchise system locks in ticketing revenue for the train operator and Department for Transport. This limits the likely participation of private companies to support investment in rail across the UK. It is worth considering that investment in rail services is likely to drive an incremental increase in passenger numbers and fare revenue.
67. Analysis from Steer Davies Gleeve demonstrated that the increase in farebox revenue alone would be enough to finance the proposed programme of improvements to the West Anglia Main Line. The possibility of using these incremental revenues to support and return investment to investors should be examined more closely as a potential new mechanism to access wider finance for rail projects.
68. The need to examine new mechanisms to invest in rail infrastructure is supported by Nicola Shaw's report in 2016, which recommends the Government *"explore new ways of paying for the growth in passengers and freight on the railway. Further options for involving private sector finance – for example, from letting a concession, or involving suppliers in technological investment – should be explored to release government capital, encourage innovation, and speed up delivery of improvements for passengers. Routes should also be required and empowered to find local sources of funding and financing, including from*

²⁹ Speaking at the London Infrastructure Summit, April 2016

*those (such as local businesses or housing developers, for example) who stand to benefit from new or additional rail capacity.*⁸⁰

Recommendation

To accelerate the delivery of investment in railway services and infrastructure, the Commission should encourage the Government to work with stakeholders to develop a clear and easily understood template for investing in infrastructure enhancements, including mechanisms for both risk and revenue sharing. Such a template has the potential to unlock significant third-party investment in the rail network, accelerating the delivery of enhancements that will be of substantial long term benefit both to rail users and the wider economy.

Projects that can be funded but not financed (Q8)

69. As outlined above, we believe the delivery of investment in railway services and infrastructure could be accelerated with the right framework, identifying opportunities for investment in infrastructure enhancements that include mechanisms for both risk and revenue sharing. Such a template has the potential to unlock significant third-party investment in the rail network, accelerating the delivery of enhancements that will be of substantial long term benefit both to rail users and the wider economy.
70. Our analysis of potential infrastructure improvements on the West Anglia Main Line via London Stansted Airport, for example, indicates that these kinds of project should be financeable by third party investors, were it not for the current structure of the rail industry. Changes to Network Rail's status mean that it is no longer possible for it to use its Regulatory Asset Base to deliver third-party rail enhancements. For example, the approach that was taken to financing improvements as part of the long term Chiltern franchise, known as Evergreen, would no longer be possible under the current framework. This previously provided a mechanism for third parties to secure infrastructure improvements on commercial terms, using incremental farebox revenue to remunerate the investment.
71. A range of new approaches need to be developed to enable other projects to be delivered in a similar way. We are confident that new structures could be developed that would have the potential to unlock significant third-party investment in the rail network, accelerating the delivery of enhancements that will be of substantial long term benefit both to rail users and the wider economy.
72. The Shaw Review into Network Rail funding and financing considered the role of third-party funding in delivering rail infrastructure and we would support further consideration by the NIC of these options for delivering infrastructure enhancements, and particularly future structures for Network Rail that will facilitate this type of third-party investment.

Improvements to the planning system and infrastructure governance arrangements (Q10)

73. While the 2013 Aviation Policy Framework set out broad support for the sector, it effectively deferred consideration of all policy until the end of the Airports Commission process. It is essential for UK airports' future planning needs that there is a clear national statement of policy support. We are concerned that the Government has chosen to use the Airports National Policy Statement (NPS) to facilitate only the delivery of a new runway at Heathrow without reference to the wider strategic policy and planning needs of the sector.

⁸⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/510179/shaw-report-the-future-shape-and-financing-of-network-rail.pdf

74. The National Policy Statement for Ports (2012), for example, provided for all new port development across the whole of the UK, and took into consideration, wherever relevant, “associated developments, such as road and rail links”.³¹
75. The Government's preferred vehicle – an Aviation Strategy – will take two years of consultation to complete. We would urge the NIC to consider the speed at which both policy and then planning processes take place so that the sector can plan and deliver sustainable growth that supports the UK economy. Further, the NIC should set out clear expectations that the Government will use the Aviation Strategy to outline clearly the development it supports (in policy and investment terms) as well as the conditions attached to growth.

Cost-benefit analysis techniques (Q12)

76. The Government's approach to cost benefit analysis on transport infrastructure is clearly varied. To take two prominent examples, the HS2 project and Airports Commission process as examples, the methods used for the former to calculate both economic value to the UK as well as productivity gains have received much criticism, summarised in the House of Lord Economic Affairs Committee paper, *The Economics of High Speed 2*.³² The methods for the latter, primarily those used for calculating and capturing productivity gains, too have been unreliable, a situation demonstrated by the differing benefit figures offered by the Government and Airports Commission (£61bn³³ and £147bn respectively³⁴).
77. The weaknesses and lack of confidence in the economic methods that are used to assess wider economy benefits are likely to be distorting public investment towards projects that have more easily quantified costs and benefits. In particular, this may lead to over-investment in projects that address capacity constraints (such as Crossrail and Thameslink), and under-investment in projects where the business case depends on unlocking long term development opportunities (such as Crossrail 2 and NPR). There would be significant benefit in the NIC developing new tools and techniques to build decision makers' confidence to invest in the latter category of projects.

Travel patterns between now and 2050 and the impact of new technologies (Q13)

78. The aviation sector demonstrates a clear upward trend in both the number of air transport movements and the number of passengers travelling through UK airports. Projections of growth have consistently underestimated the pace of growth but demand forecasts consistently show all the major UK airports reaching capacity between 2040 and 2050.

³¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3931/national-policy-statement-ports.pdf

³² <https://www.publications.parliament.uk/pa/ld201415/ldselect/ldeconaf/134/134.pdf>

³³ <https://www.gov.uk/government/news/government-decides-on-new-runway-at-heathrow>

³⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf

Figure 4



Source: Transport Statistics Great Britain, 2016

79. There are a number of factors that make it difficult to predict long term sector trends – population growth and age, the economy, society and technology to name but a few. In recent decades, technological and political change has had the largest impact on the aviation sector with the emergence of low cost airlines and ever more efficient aircraft challenging industry norms and driving significant growth.
80. To overcome some of these challenges, the Airports Commission developed a range of five alternative scenarios for future development of the aviation sector, aiming to reflect the kinds of risks and uncertainties that cannot be easily (or quantitatively) predicted from past events (such as the future development of airline business models). Each scenario then showed different implications for the respective market shares of hub-and-spoke and point-to-point networks and for the inclusion of UK airports in global route networks.³⁵
81. The Commission did conclude, however, that *“aviation is in a dynamic and constant state of evolution as airlines find new ways of adapting their businesses to respond to these changes, with two main paths of development being seen over the past two decades – one of consolidation, partnership and network integration; the other one of new entrants and expanding point-to-point travel.”*³⁶
82. Like the Airports Commission before it, the NIC cannot realistically attempt to predict and provide entirely for future trends. It is clear, however, that to meet demand in the long term and to ensure that growth is balanced across the country, further runway expansion will be needed beyond that proposed at Heathrow. At a global level, aircraft technology which allows airlines to fly smaller numbers greater distances at a reduced cost, making point to point travel more profitable and reducing a reliance on hubs for certain routes over time.
83. This increase in point-to-point travel, driven by significant advances in aircraft technology, ever more financially viable. Consultants ICF noted: *“[technology] will continue to drive new nonstop services, taking advantage of longer ranges and better fuel efficiency than*

³⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/439173/strategic-fit-review-of-airports-commissions-forecasts-and-scenarios.pdf

³⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf

historical long-haul aircraft. The trend towards new international services from hubs to non-hubs and even long-haul point-to-point will continue to grow, bringing new players and opening new markets at an unprecedented rate".³⁷ These increases in demand, combined with better access to airports and a reduced cost of aviation too are likely to spur the profitability of long haul routes away from 'hub' airports. We are already seeing evidence of this at Manchester Airport, with the opening of a range of new routes to China, America and Asia.

84. The benefits of direct aviation connections are well known³⁸ so the NIC should seek to set out a clear vision for infrastructure investment that supports a network of competing airports – including road and rail programmes that shape the choices available to passengers and businesses in the future. It is reasonable to expect that investment in Northern Powerhouse Rail, for example, would transform the travel choices for millions of people across the North, supported by a growing network of connections from Manchester Airport in particular.
85. Of course, to sustain projected passenger growth airports must ensure their own infrastructure is fit to meet demand. At Manchester and London Stansted Airports, we have plans in place to develop and replace terminal and airfield infrastructure to cope with projected demand, including terminal redevelopment and train station upgrades, but this work on site must be matched by supporting outside infrastructure too in order to make use of these national aviation assets.
86. Equally, the NIC must take into consideration what mode of transport is best for the country as a whole, looking at environmental impacts, costs to customers and so on. How the Government invests in infrastructure to support aviation growth will determine travel patterns. For example, airports which serve London, with high comprehensive public transport networks, have universally higher percentages of public transport than airports such as East Midlands, which do not.
87. Finally, as outlined above, the NIC must undertake to consider the long term capacity needs for UK airports beyond 2030, as recommended by the Airports Commission in 2015.³⁹

³⁷ Managing Airports – from Brexit to Self-Connect: A selection of articles from ICF

³⁸ <https://www.pwc.com/gx/en/capital-projects-infrastructure/pdf/pwc-air-connectivity.pdf>

³⁹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/440316/airports-commission-final-report.pdf

Lord Adonis, Chairman
National Infrastructure Commission
1 Horse Guards Road
London
SW1A 2HQ

8 February 2017

Dear Andrew

NATIONAL INFRASTRUCTURE COMMISSION CALL FOR EVIDENCE

I am writing in response to the National Infrastructure Commission's Call for Evidence to inform the development of a National Infrastructure Assessment.

Firstly, I would like to welcome the establishment of the National Infrastructure Commission: if we are to drive growth across the country as a whole, and increase the opportunity for all to benefit from that growth we must take a strategic approach to identifying the UK's long-term infrastructure requirements and examine how those requirements can best be met.

Infrastructure plays a critical role in creating the conditions for growth, supporting agglomeration economies, widening catchment areas so that companies have access to the supply chains and human capital they need to expand, diversify and compete on a global scale. It provides our people with better access to the opportunities that growth will bring, and to health care and other essential services. And it helps to create places that are an attractive environment in which to live, work and invest. We welcome the development of a National Infrastructure Assessment that will take a holistic view of infrastructure requirements - transport, digital, energy, water and waste water, flood risk and solid waste – over a 30 year time horizon.

If that Assessment is to underpin the National Infrastructure Commission's long-term approach to the major infrastructure investment decisions facing the country it is critical that it is underpinned by a robust evidence base. We therefore further welcome the opportunity to provide input into the development of that assessment.

The Greater Manchester Combined Authority and Local Enterprise Partnership have submitted a response to the Commission's Call for Evidence, which Manchester City Council wholeheartedly supports. However, I wanted to highlight a number of specific issues in relation to the Commission's thematic discussion paper "**The impact of population change and demography on future infrastructure demand.**" Given that the Commission's Assessment of population growth and demographic change will be based on ONS Mid Year Estimates, which have historically underestimated population growth in Manchester, it is particularly important to ensure that this aspect of the Assessment adequately reflects potential population and demographic change.

In addition, the growth potential of Greater Manchester and wider Northern Powerhouse ambitions mean that it is also important to ensure that the Assessment accurately reflects the likely spatial distribution of population growth.

The Commission is proposing to use the following population projections as inputs into scenario development, with a view to spanning “the range of plausible outcomes”:

- The ONS central population projection;
- The ONS low migration population variant;
- The ONS high fertility population variant;
- A projection based on the aggregate population in the ONS central population, but with sub-national populations less skewed towards London, with the shift in population distribution motivated by trends in house building.

Whilst using a range of projections to support the development of different scenarios seems sensible and is to be welcomed, it is debateable whether the proposed variants do, in fact, span the range of plausible outcomes.

Migration

It is concerning that the proposed methodology does not include a variant for continued high migration. ONS MYE in 2012 and 2013 significantly underestimated population growth in Manchester as a result of assumptions that forecast a reduction in international immigrants and an increase in internal emigrants. These assumptions ran counter to the high levels of international migration recorded through school registrations and National Insurance registrations in Manchester but were carried forward by ONS into the methodology used for 2012 and 2014 sub-national population projections. As a result, current ONS projections forecast a loss of 1,000 people each year due to fewer people arriving in the city from abroad and more people leaving to live elsewhere in the UK.

In contrast, Manchester City Council’s own forecasting model, which uses administrative data (such as geo-demographic profiling and data on students, child benefit, state pensions and the electorate, along with NHS, pre-school and National Insurance data) to quality assure and adjust ONS figures from 2001 and 2014 and sets net migration at an average growth rate of 6,000 per annum.

Whilst it is recognised that the Council’s own forecasting model cannot be used to underpin the national projections required to inform the NIA, they do demonstrate that the NIC should consider including a “high migration population variant” within the modelling to be undertaken.

This is ruled out in the discussion paper, because ONS higher migration, higher fertility and higher life expectancy variants have similar rates of implied population growth (on average at 0.64%, 0.6% and 0.57% respectively) so the view of the Commission is that the inclusion of a high fertility variant adequately reflects a higher growth scenario. But for cities such as Manchester that have a higher than average fertility rate and high levels of migration, this variant is unlikely to adequately reflect expected levels of population growth. Whilst Britain’s exit from the European Union may lead to restrictions on the free movement of people, the discussion paper acknowledges that it is not yet possible to estimate what the impact of those restrictions may be on migration levels. Britain’s post-Brexit immigration policy remains to be negotiated and the discussion paper acknowledges that other advanced economies that are not members of the EU, such as Canada, Australia and New Zealand have significantly higher levels of migration than currently seen in the UK. A “high migration population variant” should therefore be considered as scenarios are developed.

Rebalancing the country

A further issue with the proposed methodology is that it does not adequately reflect stated Government policy to rebalance the country, through increased investment in the North of England. Whilst the inclusion of a variant to reflect lower growth in London and higher growth elsewhere in the country is welcome, this variant is essentially 'policy off'. According to 'Zipf's Law' – a statistical relationship between city size and rank – there is a pattern in the relative size of cities across time and between countries. The second largest city is usually half the size of the largest city, with the third city half the size of the second. Based on this analysis England's major cities are smaller than would be expected, implying that London's growth therefore may not be sustained over the coming decades.

The scenario is therefore based on an assumption that some rebalancing would occur without active intervention by the Government and therefore doesn't reflect the Government's Northern Powerhouse Strategy and existing Government commitments to that Strategy. That strategy will both drive a requirement for additional infrastructure provision, and be driven by that additional infrastructure provision.

The discussion paper acknowledges that "the direction of causation between population and infrastructure demand is not necessarily one-way" and identifies the interaction between infrastructure and housing as most significant. "Ultimately, people can only live where there is housing. Housing, in turn, requires infrastructure." The NIC should consider a "policy on" scenario that reflects sustained investment by the Government and Northern cities, not only in infrastructure, but in key sector strengths and assets, in increased international trade and investment to drive growth and productivity across the North of England, in the skills of the population, and in the housing offer required to attract and retain that skilled population.

We are at a pivotal time in the UK's history: the Government's emerging Industrial Strategy, and the huge potential of the Northern Powerhouse that could underpin that strategy, provides a real opportunity to forge a bold, new positive role in the world following our withdrawal from the European Union, with strengthened trading relationships and more productive businesses driving growth across the country and increasing opportunity for all. If we are to capitalise on this opportunity the National Infrastructure Plan must respond to the different drivers of growth in different parts of the UK.

We look forward to working with you in future and actively engaging with the Commission in the future.

[signature redacted]
[name redacted]
[position redacted]

National Infrastructure Assessment Call for Evidence

Response from Manchester Digital

Manchester Digital

Manchester Digital is the largest network of digital and technology businesses in the North of England. Founded in 2001, it has over 500 paying member businesses, from start-ups to global e-commerce brands, covering the full digital, creative and technology footprint.

The organisation plays a significant role in the growth and development of the industry across Manchester city region, taking a lead on skills and talent development, infrastructure and the development of the ecosystem. As well as providing leadership for its members the organisation runs several highly regarded events such as the pioneering Digital Skills Festival, which brings together businesses, education and students, and the Big Chip Awards, covering the North of England and now in their 19th year. The organisation has also recently launched a software development apprenticeship, using a brand new delivery model, successfully placing apprentices in digital businesses, small and large.

Manchester city region has both the potential and the ambition to figure among the world's digital centres and was recognised in the recent Tech Nation report as the second centre for digital, tech and creative business in the UK.

Basis of our response

The basis of our response is who we are. Manchester Digital is a creation of digital and technology businesses. It is governed by an elected council of 12 people drawn from across the sector. It is therefore in a unique position to speak for the sector.

Summary of our response

We are responding solely on the questions concerning digital infrastructure. Together with skills this policy issue has considerable impact on our members.

We conclude:

- That investment in new dark fibre is the highest value digital infrastructure, needed to support digital tech growth and 5G.
- That decisions should be made now without delay.
- That the structure of the markets is holding back growth and innovation in the digital-tech sector and that:
 - Government should take steps to open up the market in dark fibre;

- Government should take steps to ensure that the 5G infrastructure (rather than services) is open, shared and accessible for SMEs to add value.

Question 17

What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

We concur with the current view coming from Government that the digital infrastructure that the UK will need to compete should support ever-increasing demands for speed, data volume, low latency, symmetry, reliability and QoS. This is vital for the development of the digital and technology sectors, where there is pent-up demand. It is also vital for the economy more generally.

These are the demands that users place on services. Our infrastructure must also support opportunities for economic development in how it is built, maintained and operated. We cover this in our response to Question 18.

To support these service demands requires a combination of direct fibre connectivity ('full-fibre') and 5G. Only these technologies have the capacity to meet the changing demand:

- Fibre, particularly dark fibre, offers almost unlimited capacity to those that are prepared to innovate.
- 5G, because it offers an integrated approach to wireless connectivity, offers the chance to stretch the capacity limits set by spectrum availability.

We agree with the current view that 5G and 'full-fibre' are effectively two aspects of the same integrated network infrastructure that the UK needs. Supporting the suite of technologies represented by 5G will require dense fibre penetration, particularly in cities.

Fibre is expensive to deploy. The UK lags behind other nations in its deployment of fibre.

Putting fibre in the ground is without doubt the highest value infrastructure investment required.

We believe that to maximise the value of new fibre, new, neutral aggregation points¹ are needed and that there is a role for Government in ensuring that these neutral spaces exist. However these are not as costly as fibre.

The pent-up demand for fast, affordable, reliable connectivity among digital and technology businesses in Greater Manchester is already putting a brake on growth and innovation.

Decisions need to be made now to ensure rapid deployment of fibre. This has been true for some years. It only becomes more urgent with time.

¹ For example the Digital Exchange model pioneered in Brighton

Question 18

Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing “regime” refers to the current market, competition and planning frameworks. “Digital communications” includes both fixed and mobile connectivity.

In our response to Question 17 we pointed to the pent-up demand for speed, data volume, low latency, symmetry, reliability and QoS among digital and technology businesses. These are service demands rather than infrastructure demands.

It is our view that Government policy has been overly focused on these ‘service demands’ in the past. They are important, but we believe the solution to them should emerge from the digital and technology sector - from our members. The role of Government is not to ensure the delivery of services to meet a specification, but to ensure that the infrastructure supports a functioning market that permits innovation and competition.

As the question implies, the role of Government therefore is to promote digital infrastructure as utility, able to support a rich value chain. This can be viewed as a ‘value grid’:

LAYER	FIXED	WIRELESS	HOSTING
Application (content)	social, websites, mobile apps, SaaS/cloud apps		
Application (network)	www, mail, voice, video, backup		
Service	Internet access (“layer 3”)		Virtual servers, cloud
Active	Point to point (“layer 2”)		Servers
Passive/base	Fibre	Antennae	Racks, power, cooling
Physical/property	Ducts and poles	Masts	Data rooms

The innovation in our sector is not confined to the top layer: our sector is about more than apps and content. Our members occupy all parts of the grid, adding value across layers and moving between technologies.

The opportunities to add value and cross vertical and horizontal boundaries in this grid are vital to the development of the digital and technology sector and for the wider business and consumer market for services. That is because these are the opportunities that allow:

- Smaller and startup players to grow;
- Innovation with service specifications and wraps;
- Differentiation.

However these opportunities are severely limited because of the market structure:

The dark fibre market is broken

Most of the value in the grid is above the active layer. Most of the investment is below the active layer. Most dark fibre is in the hands of a small group of carriers that are vertically integrated businesses. They can earn more by adding value themselves.

A consequence is that SMEs find it hard to access dark fibre. Prices are not transparent. There is not an open market. This has been recognised by Ofcom and other regulators².

We therefore believe that Government should take steps to ensure the existence of an open market in dark fibre, accessible by SMEs.

There are many ways to do this:

- Regulatory - for example through mandatory infrastructure sharing³
- Leadership - for example by encouraging public sector demand-asset aggregation⁴
- Legislative - for example with a 'dig-once' bill⁵

The cellular wireless market discourages innovation

The (cellular) wireless column in the grid has the same basic value/investment characteristics as the fixed column: most of the value is added above the active layer, most of the investment cost is below the active layer. Consequently the market acts to prevent smaller and innovating entrants from accessing the value chain. Also, in common with fixed line, an exacerbating factor is the lack of a mechanism for infrastructure sharing - whether market-based or regulatory.

SMEs that want to include cellular in their service wraps are limited to MVNO agreements, reselling services over which they have no control.

If the UK is to lead in 5G, then it is vital that this closed market is not replicated and that SMEs get access to a shared infrastructure.

We therefore believe that Government should take steps to ensure that new 5G infrastructure is shared, open at lower layers, and accessible by SMEs.

There are various ways to do this:

- Regulatory - for example through mandatory infrastructure sharing, perhaps linked to spectrum allocation.
- Leadership - for example through Government investment in 5G standards development.

Manchester Digital Council, February 2017

² Eg PTS <https://www.pts.se/en-GB/Documents/Reports/Telephony/2008/Dark-fibre---market-and-state-of-competition---PTS-ER-20089/>

³ Eg ARCEP and 'mutualisation verticale'

⁴ For example work by Tameside Council in Greater Manchester

⁵ For example dig once ordinances in San Francisco and other cities and attempts to legislate in Congress

Response to National Infrastructure Assessment call for evidence:

Written evidence submitted by Frank Rogers, Lead officer for Transport for the Liverpool City Region Combined Authority

Merseytravel, on behalf of the Liverpool City Region (LCR), greatly welcomes this important opportunity to make a submission to the National Infrastructure Commission's call for evidence on the National Infrastructure Assessment looking at requirements over a 30 year time horizon to 2050. We welcome the ambition and foresight proposed by this. Our submission focuses upon infrastructure requirements relating to Merseytravel's perspective particularly around the cross cutting issues and transport. We will leave other partners to comment on the other themes.

The LCR welcomed the opportunity to discuss this work on the 15 December 2016 through the round table session that the National Infrastructure Commission held in the Liverpool City Region. We would welcome further opportunities to be of further assistance to the National Infrastructure Commission with this work.

CROSS CUTTING ISSUES:

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

Our unique history, our cultural and environmental assets and architectural distinctiveness have already made Liverpool City Region a globally renowned destination. Built up around a port city with a rich, cosmopolitan maritime history, bringing together diverse cultures, communities and assets the City Region is a unique place. Liverpool City Region is built on a rich history of international maritime trade and world-leading innovation and achievement in science, culture and civic life. It is internationally renowned with an outstanding physical environment, more listed buildings of architectural distinction than any other UK city outside London, and an iconic waterfront recognised by UNESCO as a World Heritage Site. With a beach-lined coastline and easy access to mountainous national parks including Snowdonia and the Lake District, the LCR is seen as one of Britain's most liveable places.

The Liverpool City Region is one of the fastest-growing economies in the UK, and has the highest productivity of any of the 6 core Northern city regions. For all that, it has some obstacles to overcome in creating long-term sustainable growth, including reducing levels of unemployment, increasing graduate retention levels and reducing public sector reliance. None of this is unique to Liverpool, and we would highlight the Northern Powerhouse Independent Economic Review (NPIER) for providing evidence for transformative long term growth of the whole North of England.

Transformative long-term growth is based around recognising that there are specific 'capabilities' (as opposed to industry sectors) where the North has a strength and/or competitive advantage. The Liverpool City Region is well placed to capitalise on this, having substantial levels of activity in the NPIER capabilities. However, as the report

identifies, there are infrastructure investments that are prerequisites to enabling this growth:

“Transformational improvements to the North’s transport connectivity are also critical, both between and within cities. Enhanced pan-Northern city-centre to city-centre rail links, east-west and north-south are needed to facilitate the bigger labour markets that support the success of knowledge-based firms – and, to be effective, they must be integrated with city-region local public transport networks, which are joined-up with wider networks, involving frequent rail services, light rail and bus, all supported by smart, multi-modal ticketing. Global connectivity, for people and for goods, is also essential if the North’s Smart Specialisation opportunities are to be realised fully.”

NPIER 2016, Executive Summary, p16.

Already the City Region is exerting a step-change, with the recent opening of the Liverpool 2 container terminal that more than doubles the port’s capacity, funded by private sector investment. “Logistics” is one of the NPIER’s identified capabilities of the North, and greater use of the port-centric logistics can generate substantial benefits across the country through fewer freight miles.

In addition to this, the Liverpool City Region also has a trend of strong long-term growth in its visitor economy (the city itself being the 6th most visited city in the UK by overseas visitors), including in expanding high-value conference, cruise and sports markets. The Visitor Economy in Liverpool City Region is a success story not just for Liverpool and wider city region, but for the entire UK. The growth experienced over recent years has helped create a sector which, according to the latest STEAM 2015¹ figures released in July 2016, contributes over £4.1 billion in GVA to the local economy and supports 51,000 jobs. Liverpool City Region attracts over 61.49 million visitors per annum. As a result it is one of the most significant and successful industry sectors in the city region.

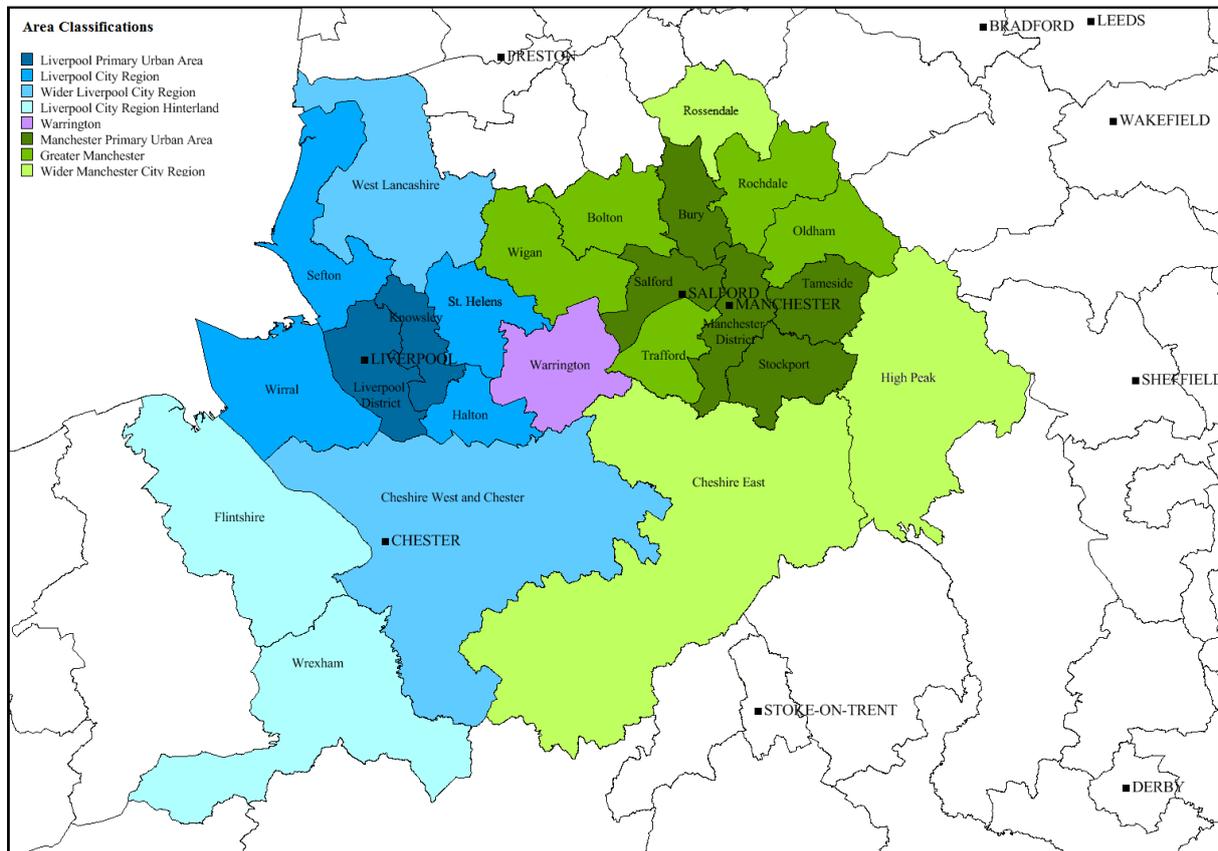
The city region has inherent strengths in high value industry sectors, including:

- Advanced manufacturing
- Food manufacturing and processing
- Life sciences
- Low carbon & renewable energy
- Financial & professional services
- Digital & creative
- Maritime & logistics

There are four Enterprise Zones located in or near the Liverpool City Region including Mersey Waters, Sci-Tech Daresbury, Deeside, and Cheshire Science Corridor. The city region economy includes notable names such as Peel, Jaguar Land Rover, Unilever, Cammell Laird, Alstom, Dong Energy, Ineos, Typhoo Tea, etc.

¹ STEAM is the Scarborough Tourism Economic Impact Monitor provided by Global Tourism Solutions. It is an industry standard model used across the UK by local authorities and Destination Management Organisations

Often a mistake has been made in different studies when evaluating the size of the Liverpool City Region; for example, by just using the ‘primary urban area’ (which is just Liverpool and Knowsley), or 6 districts which make up our LEP and Combined Authority area (Liverpool, Knowsley, St.Helens, Halton, Sefton and Wirral). However, our analysis shows that the functional Liverpool City Region extends beyond the LEP and CA boundaries, drawing in West Lancashire, Cheshire West & Cheshire and Warrington, thus representing a much larger population and economic base.



It should be noted that our functional LCR geography – whether in terms of commuting populations, business activity or transport networks – reaches further (see map), covering West Lancashire, Warrington, Chester & West Cheshire and adjacent parts of North Wales; many of these areas are already partly served by the Merseyrail network, with all areas mentioned seeing strong plans for growth enshrined in the City Region’s Long Term Rail Strategy. West Lancashire and Warrington are in fact already associate members of the Combined Authority, with the natural overlap with North East Wales represented in part by the ‘Mersey Dee Alliance’ and the North Wales Mersey Dee Rail Taskforce.

There are fundamental linkages between North Wales and North West England in terms of jobs, retail, tourism, education & healthcare. However, because economic data is collected independently on both sides of the border, the combined strength is not fully recognized. Strategic planning of rail infrastructure in the Mersey Dee and North Wales Region needs to form part of an integrated multi modal approach, recognizing the importance of the North Wales cross border corridors serving Ireland, North Wales, and Northern England and beyond, with the existing enterprise

and labour market of this shared economy providing significant potential to help deliver the objectives of the Northern Powerhouse.

The Growth Track 360 Rail Prospectus, published in July 2016 by the North Wales and Mersey Dee Rail Task Force (a cross-border alliance of business, political and public sector leaders), outlines aspirations for the future in terms of rail services and infrastructure improvements needed. The prospectus calls for substantial and transformational rail investment to enable growth in the cross border economy of the North Wales & Mersey Dee region. Transport investment will act as a key enabler to help the region to act as a gateway to the Northern Powerhouse and European TEN-T routes and play a key role in this wider economy.

However, the prospectus has not fully considered the available rail capacity east of Chester, especially in the Manchester area, and the many conflicting demands for that capacity. Significant investment will be necessary in North West England if the aspirations of North Wales are to be delivered in full.

The portfolio of city region strategies aim to protect and enhance our distinctive quality of place, to improve quality of life for our residents and attract and retain those investors, skilled workers and visitors who will contribute to future economic growth. There are a number of infrastructure constraints for the city region including:

- Liverpool Lime Street Station
- Access to the Port of Liverpool
- Trans-Pennine Capacity and Journey Times
- Liverpool Central Station
- Merseyrail Network
- West Coast Main Line Capacity
- Surface access to Liverpool John Lennon Airport
- Connectivity to Wales

For the Liverpool City Region, in line with the findings of the NPIER and to respond to these infrastructure constraints for people and goods, the following are the critical high-value investments that would enable transformative growth:

- **A new twin-track high speed rail line between Liverpool City Centre and the High Speed 2 mainline**
 - Providing improvements to the proposed HS2 service offer and enabling Northern Powerhouse Rail (NPR)
 - This is vital to free up capacity on both the current East-West and North-South rail lines serving Liverpool, where even with enhancements there will not be sufficient paths for the growing freight traffic out of the Port of Liverpool and other freight terminals.
 - It is also important in terms of enabling Liverpool to maintain a competitive level of connectivity to London and the South East, with similar journey time reduction to other key Northern cities.
- **A new multi modal terminal station in Liverpool City Centre for HS2 and NPR**
 - Linked to existing transport nodes and improving the travel experience in the City Region

- Lime Street may not be able to accommodate high speed rail services so new station better option to take forward.
- **Further roll out of high speed rail to other parts of the UK.** This would further improve the customer offer on the rail network by expanding high speed rail into a national network and help provide new capacity.
- **Merseyrail Modernisation Programme**
 - Stage 1 – New Rolling Stock fleet (and associated infrastructure upgrades) now ordered from Stadler
 - Stage 2 – Liverpool Central Capacity Enhancement
 - Later stages – network expansion, new stations, stations devolution
- **Improved connectivity to other parts of the UK**
 - Key ‘missing’ markets for Liverpool City Region include North Wales, the West Country, South Coast and Scotland
 - Service and infrastructure enhancements required
- **More Rolling Stock and Longer Trains** – increasingly the rail network is enjoying substantial growth and there is a shortage of rolling stock leading to many services becoming overcrowded thereby compromising the customer journey experience. Consequently there is a need for longer trains to be used on many routes including long distance intercity routes where Cross Country is a particular issue with only 4-5 car trains. Ideally all train services on long distance intercity and cross country routes should be 8-12 car.
- **Rail Electrification** including key routes such as Transpennine, CLC, Hope Valley, Calder Valley, Borderlands Line, North Wales Coast Main Line, etc. as a rolling programme in line with the conclusions of the Northern Sparks Report (March 2015) by the Northern Electrification Task Force.
- **Higher Priority given to Rail Freight investment nationally**
 - Liverpool 2 Container Terminal is now in place
 - Routes need capacity and capability to handle larger, faster and more frequent freight services
- **Development of an East-West ‘freight super corridor’ across Northern England that is gauge cleared to W10.** This would link the major ports (Mersey, Humber, Tees and Tyne) to a series of multimodal logistics hubs and help make the North a linchpin of a global trade corridor for the movement of freight from North America to/ from Europe. There are opportunities for the development of a chain of multi-modal logistics parks adding value to the distribution chain. In this way, connectivity for freight will be leveraged to add significant value to the Northern economy.
- **Increase use of inland waterways and coastal shipping for freight.** While our road and rail networks have constrained capacity, the coastal waters around the UK are an untapped resource that can help relieve things.
- **Improvements to Port of Liverpool access.** The recent private sector investment in Liverpool 2 which will more than double the container capacity of the port is part of the LEPs ‘Superport’ growth sector (covering ports, airport, logistics operators and support services); an area which substantial growth is expected over the following years, in line with the NPIER. However, there are capacity issues on the road and rail networks serving the area. Although (at a highly localised level) improvements to the port and other terminals are a matter for the operator, other crunch points exist on both local and national networks. For example, capacity for freight on both the Chat Moss line and CLC is limited, and there are crunch points on the WCML both

North and South as well as on trans-pennine rail routes. This makes a full NPR network as well as a direct HS2 link (above) important. The recent opening of the 'Liverpool 2' deep water berth has resulted in a doubling of capacity at the Port, from 750,000 TEU p.a to 1.5m TEU p.a. Such a significant increase in potential throughput can only be accommodated with the implementation of a comprehensive multi-modal approach to traffic movement to and from the Port estate, incorporating rail, short sea shipping, inland movement along the Manchester Ship Canal as well as road. There are capacity issues on the A5036 linking the port to the motorway network and currently Highways England is consulting on two potential options. We must find a way of getting goods from the port, to their ultimate destination in as quick, efficient, and sustainable form as possible, and whilst causing as little disturbance to those living along the way. To do that we will work closely with Highways England, Network Rail, the port authority and the local authority to ensure that as much cargo as possible leaves the site by rail and on water. But planning timescales are long, some goods cannot be transported by anything other than by road, and so in the meantime we must look to develop a road scheme that seeks to balance the needs of those living close to the affected areas whilst also standing the tests of time and provides the capacity for the port to expand in the decades to come.

- **Improved surface access to Liverpool John Lennon Airport (LJLA).** LJLA is a growing regional airport, with currently c.5.0 m passengers per annum. It already contributes an estimated £440m GVA per annum to the Northern Powerhouse, with the capability for this to increase to £1bn. The key gateway airport for the Northern Powerhouse will always be Manchester Airport, but LJLA has its own distinct strengths, with its market covering not just the Liverpool City Region but stretching to North Wales, the Midlands, Yorkshire and even Scotland. Improving surface access to enable seamless journeys will help make LJLA yet more attractive to new routes and drive upwards its economic contribution to the area, not least in increasing levels of inbound tourists.

Our independent economic assessment has shown that with an improved HS2 offer and delivery of the NPR Conditional Outputs, the benefits for the Liverpool City Region that could be realised include £15 billion boost to the Liverpool City Region economy, 20,000 new jobs, 10,000 new homes, and 2.9 million more visitors.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

International gateways serve two distinct passenger markets; inbound (overseas visitors) and outbound (domestic travellers going abroad). For both, maximising improvements to surface access is important (though noting from CAA data that inbound visitors tend to be more likely to use public transport at UK airports than outbound visitors). The improvements needed and their justifications for delivery will do the following to improve the UK competitiveness on the global stage:

- Improved surface access increases the airport's catchment; this gives operators considering establishing new routes to/from the UK a wide

choice of options – and may mean that inbound travellers are more likely to be able to locate a flight closer to their end destination in the UK.

- Increased aviation connectivity can be an important factor in attracting inward international investment to the UK. There may be little to improve in terms of new routes when considering the London area and Manchester, for example, but improving aviation connectivity to LJLA, Doncaster and Leeds/Bradford is likely to represent more of a step change for these areas.
- Improved surface access can make it easier for the UK to grow its inbound visitor economy, through making the journey between the airport and the visitor's destination as seamless as possible; there are some sizeable growth markets identified by Visit Britain. This should mean considering not just surface access between an airport and its nearest city but (where reasonable) how to improve surface access from that airport to all key cities. For example: flights from South America only serve London, meaning that if visitors and investors from these areas are to have their spend/investment dispersed to the regions, this wider surface access must be considered.

In terms of freight, there are some substantial competitive gains to be made through focussing on port-centric logistics, looking to ensure that imports and exports are able to use the port in closest proximity to their market / source respectively. For example, increased use of Northern ports offers the user reduced distribution time and costs for their goods, whilst also offering the UK net national savings through reduced lorry miles on congested infrastructure around London and the Southeast whilst contributing to reducing air quality levels. It can also help rebalance the UK economy and ease pressure on the congested London and South East.

Note that some 'gateways' which though technically 'domestic', are in fact international. By this, we urge consideration to the links to Northern Ireland (and to a lesser extent the Isle of Man). From a transport operation perspective there is little difference between the links to Northern Ireland and those to elsewhere in Europe, besides differing taxation levels at each end of the operation. Further, when it comes to the links to/from Northern Ireland, many users may in truth be international passengers, having a destination in the Irish republic. This should be remembered in any work. The recent TfN report on International Connectivity (Feb 2017) may also be relevant in this context. http://www.transportforthenorth.com/wp-content/uploads/International-Connectivity-Report_websafe.pdf

Liverpool City Region has three important international gateways which are Liverpool John Lennon Airport, Port of Liverpool and the Liverpool Cruise Terminal.

Liverpool John Lennon Airport:

Liverpool John Lennon Airport mainly has a passenger role with limited freight traffic at the moment. Liverpool Airport is one of the fastest growing airports in the UK. In 2016 it generates £250m GVA per annum for the LCR (with the capability for this to increase to £625 million), £440m GVA per annum to the Northern Powerhouse (with the capability for this to increase to £1billion), supports 6,000 full time equivalent jobs

in the LCR (with potential for this to increase to 12,280 full time equivalent jobs), supports 11,900 full time equivalent jobs in the Northern Powerhouse (with potential for this to increase to 22,860 full time equivalent jobs), handles nearly 5 million passengers per annum, supports 700,000 visitor arrivals per annum, and offers flights to destinations across Europe. Main airlines serving Liverpool include EasyJet, Ryanair, Flybe, WizzAir and Blue Air for example.

Port of Liverpool:

The Port of Liverpool is an important maritime gateway and is one of the UK's top five container ports alongside Felixstowe, Southampton, Tilbury, and London Gateway. The largest volume and density of large warehousing (over 97k sq ft / 9k sq m) of any UK region is located within a 70 mile radius around Liverpool. It is likely that the Port of Liverpool will increasingly be seen as a preferred option as cargo owners discover the benefits of delivering their products and goods much nearer to their end destination. Liverpool's location at the heart of the UK offers a distinct advantage, with over 65% of the population of the UK and Ireland living within a 150 mile radius of the city. They have 15 shipping services providing deep-sea and short-sea connections to the USA, Canada, Spain, Italy, Portugal, Cyprus, Israel and Turkey. Port forecasts have indicated that rail traffic from the port has the potential to grow to around 38 trains per day per direction.

Peel Ports has invested £400 million over the past three years constructing Liverpool2, to expand the UK's largest transatlantic port and create one of Europe's most advanced container terminals. As one of the most operationally efficient and modern terminals in Northern Europe, it is capable of accommodating the world's largest container vessels, future-proofing the facility to allow global shippers 'ship-to-door' access to major import and centres at the heart of the UK. Together with their Cargo200 initiative to cut road and rail miles from freight logistics, Peel Ports is leading the way in helping businesses to reduce costs, congestion and carbon emissions in their supply chains.

The Mersey Ports have a strategic importance in petrochemicals dominated by the oil industry, through the Tranmere Oil Terminal connected by pipeline with the refinery at Stanlow and the Eastham Refinery via The Manchester Ship Canal. The Liverpool City Region has a strategic national importance in the petrochemicals industry with major assets such as Stanlow, Eastham and Runcorn located in the area involving major companies including Essar Energy, Shell and INEOS.

Additionally the Port is a major short sea shipping hub for the Irish Sea area with ro-ro ferry services to the Isle of Man, Dublin and Belfast (key operators including Stena Line, Seatruck Ferries, P&O Ferries and Isle of Man Steam Packet) and container feeder services to Dublin, Belfast and Glasgow and from English Channel Ports (including Southampton, Rotterdam, Antwerp and Le Havre) for example. These feeder services to the English Channel Ports connect Liverpool to deep sea container services to the Far East, India, Africa and South America.

As well as rail and road, another inland transport link from the Port of Liverpool is the Manchester Ship Canal. The Manchester Ship Canal is a 36-mile long seaway linking Liverpool and Manchester. It's a unique, innovative, 'green highway' into the

heart of the UK, carrying around 8 million tonnes of cargo a year, removing freight from overcrowded roads and rail. The Manchester Ship Canal is the UK's largest inland seaway. Peel Ports currently operate an innovative container ship shuttle service from the Port of Liverpool to Manchester along the Ship Canal. This shuttle service is the most environmentally-friendly bulk logistics solution on offer in the UK, and already serves major retailers. The shuttle service makes an important contribution to the UK's carbon footprint reduction targets by delivering waterborne goods right to the heart of the country.

Liverpool Cruise Terminal:

Alongside the port, the Liverpool Cruise Terminal at Pier Head also plays an important role in the visitor economy. <http://www.cruise-liverpool.com/> In 2016 Liverpool's cruise industry brought in around £7 million to the local economy as the city welcomed 63 cruise ships with, in total, 114,676 passengers and crew. In 2017, the Liverpool Cruise Terminal will celebrate its 10th anniversary and play host to 63 ships bringing in more than 111,000 passengers and crew. Now, building upon this success, city region partners are developing plans to construct a larger improved cruise terminal facility able to handle turnaround cruises with up to 3,600 passengers. This improved cruise facility will help handle future growth in the Liverpool cruise market, continue its customer service excellence and position it to handle the next generation of super cruise liners.

The LCR is a must see tourism destination and delivers world class, ground breaking events including the Liverpool International Music Festival, International Mersey River Festival, Liverpool Sound City Festival, Liverpool Biennial, Royal de Luxe Giants, etc. To have the iconic three Cunard Queens (Queen Mary 2, Queen Victoria and Queen Elizabeth) gather together on the River Mersey in their company's spiritual homeport and birthplace in 2015 for Cunard Line's 175th anniversary celebrations was a spectacular sight and nothing short of majestic and showed a global audience that the city region is a world class destination.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

There are some obvious gains to be made in terms of:

- Reducing generalised journey times between housing and work
- Offering options that mean low carbon options are attractive.

Both of the above options offer substantial economic benefits, whether through user benefits such as reduced travel times and lower emissions, or health benefits (as recognised by the HEAT tool) through increased active travel.

Going forward, we cannot be sure what the digital future looks like, but ensuring digital capacity to support increased homeworking would seem to be critical.

We would also urge careful consideration of infrastructure, to ensure that it aids economic growth, and recognise the economic risks that may exist in some schemes induced traffic is a potential outcome.

We need to place greater emphasis on facilitating low carbon, electric and low emission vehicles and the promotion of active travel, especially walking and cycling.

We need to ensure the coordination of transport and land use planning so that denser urban development can be served by mass transit systems. Densification enables more efficient, interconnected mobility solutions which could alleviate congestion and improve air quality.

Spatial Planning shapes the places where people live and work and the country we live in. Good planning ensures that we get the right development, in the right place and at the right time. It makes a positive difference to people's lives and helps to deliver homes, jobs and better opportunities for all, whilst protecting and enhancing the natural and historic environment and conserving the countryside and open spaces that are vital resources for everyone. But poor planning can result in a legacy for current and future generations of run-down town centres, unsafe and dilapidated housing, crime and disorder, retrofitting of sustainable transport solutions and the loss of our finest countryside and green spaces to development.

Housing provision needs to reflect the economic ambition put forward in City Region Growth Strategy and the Government's Industrial Strategy.

Housing is just one element of many that go towards creating sustainable communities; it is not the only or most important element. All the various elements are of equal importance e.g. health, education, shops, community facilities, etc. Delivering just houses and not communities will just create dormitory suburbs and towns and so lead to greater commuting and long distance commuting; this will then have significant implications for the transport infrastructure. Currently there is a major shortage of affordable housing and housing to meet the diversity of everyone's needs. In some areas such as London and other major cities the predominance of global wealth and use of housing as an investment vehicle is risking driving out affordable housing for locals. Therefore a comprehensive package of bold and transformative actions needs to be urgently delivered to address this housing crisis. If not people will be forced to live further and further away from their place of work and this will lead to greater commuting adding to the transport challenges. Also not tackling the housing crisis adequately will compromise our nation's economic ambitions.

Sustainable housing does not just mean an energy efficient build, but it must also encompass housing design and how the resident will live in the house and access the necessary services. Good building design, location and build quality are all very important in creating housing that can create long term sustainable communities.

- Foster a balanced, integrated and sustainable approach to development in order to deliver homes (in a variety of sizes and tenures to meet all needs including affordable housing), jobs and better opportunities for all, whilst protecting and enhancing the natural and historic environment, key social

assets and public amenities as well conserving the countryside and open spaces and ensuring high quality design for development.

- Tackle climate change, decentralise energy infrastructure, promote energy efficiency & renewable energy and move towards zero carbon development.
- Ensure that development is based around the need for access by all forms of transport, management of parking in new development and expectation that developers should contribute to cost of public transport access in areas that are not well served by existing public transport services.

There is a very urgent need to address concerns over air quality. There is clear evidence that NO₂ emissions have negative health effects, including respiratory symptoms, asthma prevalence and incidence, cancer incidence, adverse birth outcomes and mortality. This will require a bold package of measures including Clean Air Zones and electrification and decarbonisation of transport including buses, trains, cars, freight, etc. Clean air and carbon reduction are critical elements of infrastructure that serves the needs of future generations. By 2050, zero carbon emissions should be the norm, as should zero NO_x and PM emissions.

4. What is the maximum potential for demand management, recognising behavioral constraints and rebound effects?

Rising demand places significant strain on our transport systems in terms of capacity which then can struggle to keep pace. For example on the railways there has been very substantial growth in demand which is causing track capacity constraints and on-train capacity constraints. Track capacity constraints need to be overcome in order to run more frequent services. On-train capacity constraints need to be overcome by operating longer trains rather than the 2-3 car trains that are typical at present. There is a significant rolling stock shortage across the rail network. Long distance intercity routes like Cross Country are a particular issue with only 4-5 car trains. Ideally all long distance intercity and cross country routes should be 8-12 car. Likewise local commuter rail networks need to have longer and more frequent trains.

On road networks, ever growing car use creates traffic congestion hindering public transport and freight movements. Therefore there may be a need to introduce some form of demand management or road user charging on a national basis. This revenue then could be reinvested to help maintain and upgrade the road network. Rise of autonomous and driverless vehicles may not help the situation either and could just increase car use and thereby contribute further to traffic congestion.

As our major cities become 24/7 economies, customer expectations of public transport increase with more expectation for 24/7 services. London increasingly is moving in this direction with its night tube and night bus networks. But over the timescale of the National Infrastructure Assessment it is likely that most major cities will have to move in a similar direction for their local transport. It is vital that the role of walking and cycling for short trips and huge modal shift potential to walking and cycling seen in most exemplar, prosperous European cities is transferred and embraced here in the UK. Planning for a huge increase in trips made by foot and cycle should heavily influence the commission's thinking.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The analysis behind investment needs to be carefully constructed to be consistent, but here we would urge for attention to be paid around metrics such as “Jobs/GVA maintained” in addition to “Jobs/GVA created”. This should recognise in the ‘do minimum’ any disbenefits through not maintaining and repairing existing assets.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Infrastructure requirements must be set within the context of the economic ambition set at the national level through the Government’s Industrial Strategy. There is a need for this to link with a spatial dimension through National Policy Statements and ideally a National Spatial Plan which currently is lacking. Relationship with housing policy, research & development and education / skills training policies is also vital.

There also needs to be place based delivery below national level through devolved bodies such as devolved administrations, sub-national bodies (Transport for the North etc), and county and city region authorities. It is vital that devolution is accompanied by appropriate devolution of both powers and resources. Again there needs to be synergy at these levels with economic ambitions set out in Growth Strategies and a spatial dimension through city region spatial plans and local plans.

Lastly economic ambition and infrastructure requirements need to be supported by education and skills training to provide the talent to realise these needs and ambitions. Without the skilled people delivery will be compromised.

Infrastructure decision making systems need to be efficient but robust to ensure adequate scrutiny of impacts in regard to economic, social and environmental issues.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

As above, one key step here is identifying those investments where a substantial risk is that of generating induced traffic demand (with associated negative impacts on the environment). Here we would recommend part of the options assessment should be to explore other (potentially multi-modal) solutions.

Transitioning everything including transport to a low carbon economy is essential. If we don't reduce carbon, transport, energy emissions etc there will be dire consequences for future generations by 2050 if not earlier. Plus the fossil fuel era is ending globally. Low carbon infrastructure, supporting zero transport emissions must be the guiding principle for future infrastructure planning.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Current recommendations around WebTAG (including making use of LUTI models where it is proportionate to do so and using local data as a sensitivity test against the core economic case) represent a step forward in improving cost-benefit techniques and are to be commended. However the Government still is far too preoccupied with narrow economic benefits rather than the full life costs and impacts of infrastructure – how they support quality of life, happiness, health and well-being, tourism etc.

There are still weaknesses with WebTAG which can result in BCRs both overestimating and underestimating scheme impacts. These include:

- A lack of recognition of additionality, which seems to be based on flawed economic theory. For example, a scheme which encourages inward international investment is going to have substantial economic impacts. We suggest this is a priority for research to help schemes.
- The NTEM dataset associated with WebTAG is often out of synchronisation with other official datasets (for example, the subnational population projections). We would argue that, although WebTAG recommendations allow for other data to be used alongside NTEM, either NTEM should be refreshed once new official data is available or users should be encouraged to use these datasets in lieu.
- Further, when it comes to looking at trips forecast within NTEM, this element of the package does not seem to work logically, suggesting an ongoing growth of car drivers but relative stagnation of rail trips. This does not match up with either recent trends or most other forecasts. Suggest the model is looked at anew in this regards, possibly in the light of some of Network Rail's work in this area.
- WebTAG overall (and its data sources) are not set up to deal with schemes that provide a step change in an area's economy; this needs recognition.

Geographic coverage of the analysis used is not always appropriate or accurate. We would recommend that in terms of schemes the analysis should cover the widest geography possible, to ensure all benefits and disbenefits are captured. Example: an investment in improving rail access to the Port of Hull should measure not just the change in mode around Yorkshire but also allow for the fact that less traffic may be

using southern ports. When it comes to analytical units used for areas, we would also urge that these be relevant, transparent and consistent; specific examples of geographic units that are demonstrably inappropriate for analysis include:

- LEPs – Local Enterprise Partnership boundaries represent political areas and may not necessarily represent functional economic areas.
- PUAs – Primary Urban Areas are drawn from a theoretical construct that fails to employ any ground-truthing as to whether they represent a cohesive area.
- ONS TTWA – ONS’s work in estimating travel to work catchments is valid from a certain perspective, but fails to understand the overlapping nature of travel catchments, with cities naturally having greater primacy than towns. Hence, Shrewsbury’s catchment in practice encompass Ludlow, rather than the two being separate.

TRANSPORT:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

The drive towards smarter zero carbon and zero emission transport systems will lead to more efficient and sustainable urban centres. Increases in computer and processing power will enable this shift and will lead to more effective, real-time use of big data. Big data and the Internet of Things will enable communication between different modes and with the wider environment, leading to truly integrated and inter-modal transport solutions that maximise efficiency gains. Augmented reality technology could transform the onboard journey experience, ticketing and customer information. Cloud-based services will become more widespread driven by the uptake of smarter mobile devices and faster connectivity.

In order to provide sufficient transport capacity for the growing volumes of goods and people, intelligent and integrated transport solutions will become essential. In addition to growing demand, people’s expectations of seamless and integrated mobility are increasing and their transport needs are evolving.

Smart communications technology will become one of the key infrastructures of future cities, helping to improve the efficiency and coordination of systems. However as transport becomes more reliant on technology the importance of improving telecommunications infrastructure such as fibre-optic superfast broadband, wi-fi and 4G and 5G will increase. At the moment in many areas this infrastructure is woefully inadequate. Improving connectivity and smarter devices will enable cloud-based services to become widespread and more user-friendly. Smart technology will enable real-time information for travellers and more integrated services. Interoperable tickets, valid for trains, buses, car-sharing schemes and bicycles, could encourage intermodal travel by providing seamless connections to other modes.

Integrated ticketing and payment systems, such as the use of smartcards, phones or bank cards as a single device to pay for journeys, linked to personalised real-time travel information, further simplify inter-modality and improve customer experience.

Greater use of Intelligent Transport Systems (ITS), will enable better traffic flows, more accurate road pricing, and enhanced capacity and safety. ITS encompasses a range of technologies used to manage transport – from sensors and surveillance to ticketing and payment systems – that are used to monitor and manage travel conditions. ITS equipment continuously generates new data about the transport network, and enables operators to make real-time interventions to manage traffic and travel.

The growing reliance on smart technologies and systems, however, can give rise to issues of safety and security, especially in the form of cyber-attacks. In addition, use of data gives rise to concerns around privacy and the secure handling of data, including personal and financial details. One of the greatest risks to transport organisations is the combination of both physical and cyber-attacks on their infrastructure. The increased risk is the result of the surge of social media applications, online technologies and self-service user terminals, and increasing threats of terrorist attacks.

In a new report published in Nov 2016 entitled “Cyber Security and Intelligent Mobility”, supported by IBM, The Institute of Engineering Technology (IET), the Intelligent Mobility Partnership (IMPART) and the Digital Catapult, the Transport Systems Catapult cites numerous trends in the realms of technology, cyber security, mobility, and society are all converging to make it a much more complex environment in which to deliver safe, secure, and reliable mobility services and infrastructure. https://s3-eu-west-1.amazonaws.com/media.ts.catapult/wp-content/uploads/2016/11/24133246/3416_Cyber-Security_Report_Final-1.pdf

While fossil fuels have dominated the ground transport sector for the last century, it is expected that electricity and alternative fuels will play an increasingly important role in both private and public transport in the future. It is likely that most vehicles will be electrified or run on alternative fuels to some extent, and well-developed networks of chargers to support battery electric vehicles will be vital. Wireless charging infrastructure could also be embedded in the road, providing induction charging for electric vehicles on the go. Alongside low emission and low carbon transport there is likely to be more importance given to walking and cycling especially for shorter, local journeys as well as public transport. If healthy living is not encouraged then this will store up health issues for the future and only add to the challenges faced by the NHS, mental health and social care. Technology will increasingly help reduce the need to travel through things such as video conferencing, etc.

The Internet of Things will enable the rise of technologies such as intelligent vehicles that can measure the latest traffic, road and weather conditions. These vehicles will be able to communicate with each other and the wider environment, transmitting their speed and direction and warning other vehicles about traffic and safety hazards. Wireless sensor networks combined with ultra-low power sensors and drones will make it possible to monitor the condition of a wide range of structures like bridges or tunnels, alerting authorities to weaknesses or disrepair.

Autonomous vehicles, enabled through increased connectivity, could fundamentally change urban mobility and have a number of implications for governments, including rethinking transport policies and existing regulatory frameworks, the role of urban

infrastructure, auto licensing and traffic enforcement, parking and taxi provision. Already you can see the impact of technology with Driver Only Operated trains and in some areas such as Docklands Light Railway even driverless trains. Connected or driverless vehicles could become mainstream transport with major impacts on buses, taxis, private car, etc. Private cars are likely to focus more on prestige luxury brands and for the pleasure of the driving experience and collector value, while mainstream day-to-day vehicles may become driverless pods replacing cars, taxis, buses, etc.

Fully automated vehicles will open up new markets for automotive companies to sell to older people, or those with physical or mental impairments. Driverless vehicles will likely cause changes to the infrastructure of cities, as roads could be made narrower and roadside signage could be reduced. As driverless cars will travel safely in closer proximity to other vehicles, the capacity of existing infrastructure could be improved.

Vehicle convoys can reduce congestion and cut fuel consumption. A complete uptake of driverless vehicles will depend on the development of comprehensive regulatory frameworks as well as public trust around security and safety issues. Resilience to weather issues, terrorism and cyber-attacks will also be important to consider in this context. An incremental uptake of autonomous vehicle technologies is more likely. This includes steps to automation within vehicles but also the use of autonomous vehicles within a confined area. Applications could include parking assistance and taxis / buses operating on pre-set routes or within a defined location.

The UK Technology Strategy published by the UK Transport Systems Catapult in 2016 <http://tsctechstrategy.co.uk> and gives a good overview of the challenges we will face as we move towards uptake of new technologies in mobility.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

As an island nation the UK's economic success has always been founded on maritime trade. While history has seen individual ports flourish and decline, their central role in facilitating commerce, migration and exploration has remained constant. Today, the UK relies on its ports and their supporting road and rail freight infrastructure to connect its producers and consumers to the global economy. Therefore freight and logistics plays a vital role in the economy of the Liverpool City Region with the SuperPort Liverpool initiative and the Northern Powerhouse.

Global trends in supply and demand are driving larger shipping sizes and freight volumes, and the rise and fall of commodities and industries require the ports and logistics sectors to be responsive and adaptive to changing patterns of trade. These pressures have had cascading effects on national and regional infrastructure, with the road and rail networks already proving insufficient to meet the demand for higher capacity, efficient freight corridors. These changes also impact on skills needs.

Key infrastructure needs from a freight perspective include:

- **Higher Priority given to Rail Freight investment nationally**
 - Liverpool 2 Container Terminal is now in place

- Routes need capacity and capability to handle larger, faster and more frequent freight services
- **Development of an East-West ‘freight super corridor’ across Northern England that is gauge cleared to W10.** This would link the major ports (Mersey, Humber, Tees and Tyne) to a series of multimodal logistics hubs and help make the North a linchpin of a global trade corridor for the movement of freight from North America to/ from Europe. There are opportunities for the development of a chain of multi-modal logistics parks adding value to the distribution chain. In this way, connectivity for freight will be leveraged to add significant value to the Northern economy.
- **Increase use of inland waterways and coastal shipping for freight.** While our road and rail networks have constrained capacity, the coastal waters around the UK are an untapped resource that can help relieve things.
- **Improvements to Port of Liverpool access.** The recent private sector investment in Liverpool 2 which will more than double the container capacity of the port is part of the LEPs ‘Superport’ growth sector (covering ports, airport, logistics operators and support services); an area which substantial growth is expected over the following years, in line with the NPIER. However, there are capacity issues on the road and rail networks serving the area. Although (at a highly localised level) improvements to the port and other terminals are a matter for the operator, other crunch points exist on both local and national networks. For example, capacity for freight on both the Chat Moss line and CLC is limited, and there are crunch points on the WCML both North and South as well as on trans-pennine rail routes. This makes a full NPR network as well as a direct HS2 link (above) important. The recent opening of the ‘Liverpool 2’ deep water berth has resulted in a doubling of capacity at the Port, from 750,000 TEU p.a to 1.5m TEU p.a. Such a significant increase in potential throughput can only be accommodated with the implementation of a comprehensive multi-modal approach to traffic movement to and from the Port estate, incorporating rail, short sea shipping, inland movement along the Manchester Ship Canal as well as road. There are capacity issues on the A5036 linking the port to the motorway network and currently Highways England is consulting on two potential options. We must find a way of getting goods from the port, to their ultimate destination in as quick, efficient, and sustainable form as possible, and whilst causing as little disturbance to those living along the way. To do that we will work closely with Highways England, Network Rail, the port authority and the local authority to ensure that as much cargo as possible leaves the site by rail and on water. But planning timescales are long, some goods cannot be transported by anything other than by road, and so in the meantime we must look to develop a road scheme that seeks to balance the needs of those living close to the affected areas whilst also standing the tests of time and provides the capacity for the port to expand in the decades to come.

Urban logistics systems form the backbone of a functioning city and economy providing the goods and materials needed to successfully operate a city. The way goods and services are delivered has wide ranging implications for urban life, including congestion, safety, noise and air quality considerations.

Congestion and environmental pressures are leading to the development of alternative and more efficient logistics systems to reduce freight in city centres. Some of these last mile logistics solutions include electric cargo bikes, underground freight pipelines, delivery lockers at stations, and 'closed loop' systems where vehicles making inbound deliveries into the city pick up outbound recyclable waste for disposal and returns from retailers. Other reduction measures, such as consolidation centres, also aim to lessen the impact of freight movement in cities.

Furthermore, manufacturing might increasingly return to cities; 3D printing, or additive manufacturing, is a revolutionary technology that could lead to reduced transport of certain goods, which could be printed on site or closer to consumers. It is expected to transform the supply chain, reducing the need for mass-produced manufacturing, transport and storage. Increasing automation within warehousing will impact jobs. Urban areas need to ensure that their planning policies seek to ensure that all major new distribution parks are rail (or water) connected and seek to ensure that 'last mile' deliveries are completed by low/zero emission modes where possible.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Key infrastructure needs include:

- **A new twin-track high speed rail line between Liverpool City Centre and the High Speed 2 mainline**
 - Providing improvements to the proposed HS2 service offer and enabling Northern Powerhouse Rail (NPR)
 - This is vital to free up capacity on both the current East-West and North-South rail lines serving Liverpool, where even with enhancements there will not be sufficient paths for the growing freight traffic out of the Port of Liverpool and other freight terminals.
 - It is also important in terms of enabling Liverpool to maintain a competitive level of connectivity to London and the Southeast, with similar journey time reduction to other key Northern cities.
- **A new multi modal terminal station in Liverpool City Centre for HS2 and NPR**
 - Linked to existing transport nodes and improving the travel experience in the City Region
 - Lime Street may not be able to accommodate high speed rail services so new station better option to take forward.
- **Further roll out of high speed rail to other parts of the UK.** This would further improve the customer offer on the rail network by expanding high speed rail into a national network and help provide new capacity.
- **Improved connectivity to other parts of the UK**
 - Key 'missing' markets for Liverpool City Region include North Wales, the West Country, South Coast and Scotland
 - Service and infrastructure enhancements required
- **More Rolling Stock and Longer Trains** – increasingly the rail network is enjoying substantial growth and there is a shortage of rolling stock leading to many services becoming overcrowded thereby compromising the customer

journey experience. Consequently there is a need for longer trains to be used on many routes including long distance intercity routes where Cross Country is a particular issue with only 4-5 car trains. Ideally all train services on long distance intercity and cross country routes should be 8-12 car.

- **Rail Electrification** including key routes such as Transpennine, CLC, Hope Valley, Calder Valley, Borderlands Line, North Wales Coast Main Line, etc. as a rolling programme in line with the conclusions of the Northern Sparks Report (March 2015) by the Northern Electrification Task Force.

16. What opportunities does “mobility as a service” create for road user charging? How would this affect road usage?

Mobility as a service should be coordinated by public sector otherwise could lead to dominance of the car and corporate monopolies.

Traditional models of ownership are changing, especially within younger generations. For example, the trend towards a shared economy of service provision rather than product ownership means that consumers are increasingly likely to purchase access to a car rather than buy their own car. Services like Uber, Gett, Hailo and Lyft are evidence of the shift from providing mobility as a product to providing mobility as a service. Mobility services could help counter growing car ownership and improve affordability and efficiency.

Access to cars, car sharing and taxis are likely to become part of a wider trend towards the retailing of packages of mobility. So people can use smart devices to access information and make payments for the transport that meets their particular needs and budget. This could include access to car hire, taxis, public transport and bike hire.

The retailing of mobility packages could also become increasingly detached from the operation of those services with a race between increasingly large corporate entities to be the ‘Amazon of mobility’ in a global market of enormous value.

A wide range of players are likely to enter this space – including large automobile, energy, telecoms companies, the internet giants alongside existing public and private sector public transport providers.

However this risks the creation of corporate monopolies and dominance of car based forms of transport rather than public sector led integrated transport across all modes coordinated on a city region basis for example.

There are also scenarios where the public sector could lead by adding taxi, car share and car hire options to a core public transport offer – perhaps through strategic alliances with the automotive industry. This appears to be the objective for many urban areas in countries like Germany and Austria.

A recent report in July 2016 by the Transport Systems Catapult (TSC) suggests we are at the beginning of a Mobility as a Service (MaaS) revolution that will change the way many people travel and may see a move away from traditional car ownership. The report highlights what the future of MaaS could look like and how policy makers

and the transport sector can innovate to meet the changing expectations of consumers. The TSC is calling on policy makers and the private sector to work toward a shared vision for how to make MaaS a success. Several trends identified in the report support future growth of MaaS concepts, with consumers increasingly expecting their transport to be delivered as a 'service'. Adoption of MaaS would also incentivize technological advances around improving journey experiences.

https://ts.catapult.org.uk/wp-content/uploads/2016/07/Mobility-as-a-Service_Exploring-the-Opportunity-for-MaaS-in-the-UK-Web.pdf

CONCLUSION

Over the period covered by the National Infrastructure Assessment, it will be vital to transition to smarter, low carbon and low emission forms of transport. We should embrace the opportunity of changing technology to better integrate all modes of transport, improve the customer experience, enable more efficient operations and enable seamless journeys. Infrastructure also needs a spatial dimension as integration with spatial and land use planning is essential to realise these ambitions.

Also transport infrastructure has interdependencies that need to be taken into account with other infrastructure sectors such as telecommunications, energy, housing, education and skills, research & development, natural resources etc. Resilience to weather issues, power outage, terrorism and cyber-attack is essential.

A comprehensive package of bold and transformative actions needs to be urgently delivered to address the current housing crisis. If not people will be forced to live further and further away from their place of work and this will lead to greater commuting adding to the transport challenges. Also not tackling the housing crisis adequately with bold action will compromise our nation's economic ambitions.

Likewise there needs to be a strong focus on encouraging sustainable transport, healthy living, walking and cycling. If this is not done there is a risk of storing up health issues for the future and compounding the challenges facing the NHS, mental health and social care which in turn will compromise our nation's economic ambitions.

In the short to medium term for the Liverpool City Region, our infrastructure priorities from a transport perspective focus on:

- High Speed Rail
- Rail Electrification
- Merseyrail Upgrade
- Ensuring that transport networks have the necessary capacity to meet demand and changing customer expectations.
- Move to a smarter, low carbon and low emission transport system
- Support and enable the economic ambition of the Liverpool City Region including its major gateways and assets such as Port of Liverpool and Liverpool John Lennon Airport for the movement of people and goods.

We welcome the ambition and foresight of the proposed National Infrastructure Assessment and look forward to working with the Commission as it develops. While

it is hard to predict what the world will look like in 2050 it is clear that our economic ambition as a nation must be underpinned by infrastructure, R&D and education / skills in order to remain competitive on a global scale and must adapt to global trends such as technological change, demographic change and climate change.

Response to National Infrastructure Commission Call

In addition to investment in rail, local roads and the motorways my constituency has an urgent need for two larger schemes: the Botley Bypass and the Chickenhall Link Road. Both schemes are supported by local partners and authorities.

Botley Bypass – Summary

Botley Bypass has been proposed for many years and a route is formally safeguarded in both the Eastleigh Borough and the Winchester City Local Plans. Botley experiences a significant amount of traffic travelling along the A334 Botley High Street, particularly during peak periods, causing noise and air quality issues and difficulties for pedestrians and shoppers wishing to cross the High Street. The High Street has been identified by Eastleigh Borough Council as an Air Quality Management Area, where improvements are needed. Congestion along the route causes journey time delays with stop-start conditions during peak periods. Survey work has identified that whilst approximately 20% of traffic on the A334 Botley High Street is local traffic, over 80% is through-traffic which has origins and destinations outside of Botley Village. The through-traffic is largely associated with vehicles travelling between the Fareham/eastern Hampshire areas and the North Hedge End area/Winchester in the north. This includes traffic diverting from the congested M3 and M27 motorways at peak times. Forecast levels of new development in the wider Botley area over the next 20 years combined with traffic growth is likely to compound existing traffic issues. For these reasons the justification for a bypass for Botley is now much greater than in previous years. A new bypass could bring significant benefits to the High Street in terms of reduced traffic volumes, improved pedestrian accessibility, improved air quality, reduced noise pollution and enhanced quality of place

Chickenhall Lane Link Road - Summary

A new link road between the A335 Wide Lane (adjacent to Southampton Airport Parkway rail station) and Chickenhall Lane, including improvements to Chickenhall Lane.

Scheme involves:

- New bridge over A335 and Southampton-Eastleigh railway lines
- New bridge over the Eastleigh-Hedge End railway line
- Road passes to the north of the Airport Runway.

The current cost estimate is £100 million. This is because there are a lot of ground works required to raise or lower the level of the proposed route to contend with gas mains, railway lines and flight paths of aircraft. Drivers currently have to join the M27 eastbound from junction five near Southampton airport, whereas they can join both the M3 northbound and southbound at Leigh Road, which also leads to the M27 westbound towards Southampton and Bournemouth.

Local Need:

- Eastleigh Borough Council has recently reaffirmed its longstanding commitment to the scheme (25 years support).
- Solent LEP is supportive of the scheme.
- Hampshire County Council believe that this scheme can and should be funded including partnerships and the Department for Transport.
- Traffic congestion in the Borough is extremely high. This new road will provide another route out of Eastleigh.

- Projected new housing in the Borough will exacerbate the already dire infrastructure need.
- Junction 5 redevelopment design was originally planned to link into the Chickenhall Link designs
- Growth in passenger numbers at Southampton Airport and link road is vital for surface access to Airport

Benefits:

- Large amount of land unlocked for housing in the Bishopstoke area.
- Strengthen potential future bid for Enterprise Zone in the area which has received support from the Business, Innovation and Skills Minister.
- Network rail land freed up for development.
- Improve poor air pollution and congestion by reducing standing traffic.
- Unlock area for Southampton University sponsored Science Park.
- Delivers jobs, improves local economy and increases productivity.

Development of this link road will also have an impact on the Eastleigh Cord.

- The current estimate for the Eastleigh Cord is £180 million.
- An attractive alternative to the car for access to the Airport from the east. Will enable commuter journeys into Southampton city centre and Eastleigh Riverside from the Hedge End and Botley area to be made by rail without the need to change trains at Eastleigh.
- This would help to relieve congestion on the strategic highway network.

Strategic Issues

Eastleigh constituency is positioned in an ideal place for strong economic growth once infrastructure issues have been addressed.

Southampton Airport is based in the constituency and is poised for expansion. Nearly 2 million passengers passed through the airport this year. A reduction in journey times on the train from London would allow for this success to increase. Journey times to the Solent Area need to be reduced to less than an hour and I support the Solent in 60 scheme.

Southampton Port, the best cruise port in the world, is nearby and acts as a hub for car distribution in the South to Europe and beyond. This therefore requires significant investment in the Solent and Eastleigh infrastructure] networks in order to expedite rapid transit. There are also plans to increase the capacity of the port which signal further demand for investment in neighbouring infrastructure in particular the strategic road network.

Eastleigh is located very close to the strategic road network however throughout the constituency I receive complaints about excessive ramp times and severe delays on the M27. I have been working with Highways England on a new Junction 6 which would reduce congestion for my constituents. This is urgently needed and would contribute to economic output. Additional pressure on the network is present at Junction 5 where substantial new development is not sustainable with the severe ramp times.

Conclusion

My constituency currently suffers from dire traffic and an acute infrastructure deficit. These two schemes would go some way to alleviate the situation and would unlock significant economic

output. Additional investment is required to provision a Junction 6 and to ensure that the currently congested strategic road network in the area is sustainable for future growth.

10th February 2017



essential materials
sustainable solutions

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Mineral Products Association Ltd
Gillingham House
38 - 44 Gillingham Street
London SW1V 1HU
Tel +44 (0)20 7963 8000
Fax +44 (0)20 7963 8001
info@mineralproducts.org
www.mineralproducts.org

Email: NIAEvidence@nic.gsi.gov.uk.

Dear Sir/Madam

NATIONAL INFRASTRUCTURE ASSESSMENT - CALL FOR EVIDENCE

The Mineral Products Association (MPA) is the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries. With the recent addition of British Precast and the British Association of Reinforcement (BAR), it has a growing membership of over 480 companies and is the sectoral voice for mineral products. MPA membership is made up of the vast majority of independent SME quarrying companies throughout the UK, as well as the 9-major international and global companies. It covers 100% of GB cement production, 90% of aggregates production, 95% of asphalt and over 70% of ready-mixed concrete and precast concrete production. Each year the industry supplies £20 billion worth of materials and services to the Economy and is the largest supplier to the construction industry, which has annual output valued at £144 billion. Industry production represents the largest materials flow in the UK economy and is also one of the largest manufacturing sectors.

Further to the consultation on the above document, we note that this is a call for all interested parties to submit *“evidence, ideas and solutions”*. We were largely supportive of the aspirations of the initial consultation; however, our comments appear to have gone awry and been overlooked in the NIC’s initial assessment of consultation responses. Our initial comments have therefore been attached below as Appendix 1.

In response to the current consultation, the UK infrastructure aspirations have the potential to have significant implications for the UK mineral products sector and mineral planning system.

As we move towards Brexit it is imperative that development in the UK, supports UK industry. The recent Hendry Review on the Role of Tidal Lagoons, which ran in parallel to the initial NIA consultation, recognised that *“the National Policy Statement process should also include an assessment of the sustainability of the main construction elements for a longer-term tidal lagoon programme”*. Further, Hendry also concluded that *“tidal lagoons would help deliver security of supply; they would assist in delivering our decarbonisation commitments; and they would bring real and substantial opportunities for the UK supply chain”*. (our underlining)

Tidal Lagoons would undoubtedly be considered as National Infrastructure Projects and the opportunities for UK supply chain for the wider scope of projects identified in the consultation document, are significant.

The Mineral Products Association is the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries

Registered in England as Mineral Products Association Limited No. 1634996
Registered at the above address

It is therefore important that National Infrastructure Projects are not considered in their own 'bubble', as appears to be the case at present. Currently, there appears to be a fundamental dislocation between infrastructure policy and the supporting policies for those activities (such as minerals and construction products) needed to support and enable the delivery of projects. To ensure that National Infrastructure Projects can be delivered effectively, the supporting activities required to ensure delivery have to

The Cardiff Bay Barrage is a good example of this, with the original £200m cost for the infrastructure leveraging a further £2.3 billion of public/private investment to redevelop and regenerate the Cardiff Bay area in following years. Scaled up (to say one of the larger Tidal Lagoons in the Bristol Channel), the demands on resources and skills could be considerable. However, these opportunities to unlock and compound the growth potential realised by national infrastructure will only be realised if they are fully accounted for in the wider policy and planning processes.

In order to realise the potential for indigenous supply, these essential supporting assets need to be factored in to the planning for the entire lifecycle of National Infrastructure Projects, so the needs and opportunities pre- and post- construction are fully considered. This will allow opportunities to improve the role of competition or collaboration in different areas of the supply of infrastructure services.

Such projects overlap with the nature of the projects identified in the current National Infrastructure consultation. Whether public or private infrastructure proposals are being considered, the Government's approach to steel is equally as applicable to the mineral products sector for National Infrastructure Projects and other major developments, to ensure the UK minerals industry can compete on a level playing field. The measures applied in this PPN 11/16 and the associated guidance are designed to ensure that government applies a more strategic and transparent approach to the sourcing of steel in major projects. Procurement decisions should always be made on a quality/cost/risk basis and whilst procurement will ultimately occur during the construction phase, the procurement strategy should be outlined at the earliest opportunity and considered during the permitting process. This would lead to better value for money, while helping to address any barriers that prevent UK suppliers from competing effectively and ultimately contributing to the UK's international competitiveness.

- Infrastructure - such as rail and roads
- Construction - such as the building of and or refurbishment of prisons, hospitals, universities, housing, community centres, bridges and schools
- Flood defences
- Defence related projects (ensuring consistency with the Defence and Security Public Contracts Regulations 2011 as appropriate)
- Medical equipment
- Energy related projects - e.g. new nuclear technology

The UK Government Procurement Policy Note: *Procuring Steel in Major Projects - Revised Guidance Action Note: PPN 11/16*, (13 December 2016), is a practical guide on how contracting authorities in both central government and the wider public sector can design their major projects (involving steel) to ensure best value for money by recognising relevant wider social and environmental benefits. The PPN applies to any major procurement project where steel is a critical component. There is no set value as to what constitutes a major procurement project, as this will differ between contracting authorities. However, the PPN states that major procurement projects are likely to include, but are not be limited to the following:-

be identified. These activities then need to be given proper consideration so that the potential needs and opportunities can be considered in advance, along with any risks or gaps that may have to be addressed.

At present the unwritten assumption appears to be that if you create the demand for construction materials this demand will be met. While the UK undoubtedly has a rich and varied resource of indigenous construction minerals, in order for these to be realised in practice both the mineral products industry and the wider mineral planning system require greater visibility around what scale of demand is likely to be required by infrastructure projects to allow suitable provisions to be made alongside the existing base demands in the market. This forward planning should allow the most cost-effective and sustainable solutions to be put in place to support the delivery of infrastructure projects. Needless to say, this takes time and therefore needs to be planned in advance of, or at least in parallel to, the National Infrastructure Projects themselves.

It is important to recognise that mineral product resources are not evenly distributed around the country and that a considerable amount of inter-regional trade in materials already occurs to meet the base load demand for construction aggregates in the market. Consequently, it is likely that many areas of primary mineral supply will be required to support the demands from multiple National Infrastructure Projects. The timings of prospective individual infrastructure projects therefore need to be understood, so that both the anticipated total cumulative and annual peak demands can be determined in order for sufficient production capacity and associated transport/delivery infrastructure to be put in place. This will ensure the demand management can be fully considered.

The National Infrastructure process must be aligned with the mineral planning system and vice versa. The full and proper consideration of resource requirements for National Infrastructure Projects should form an inherent part of Mineral Local Plans and the Local Aggregates Assessment to ensure the timely delivery of the raw materials necessary. This will allow the aspiration for infrastructure to be designed, planned and delivered to create better places to live and work, to be fully considered from a spatial and time perspective at the earliest opportunity. It will also ensure that the planning system and infrastructure governance arrangements can be dovetailed to ensure infrastructure is delivered as efficiently as possible and on time. It is widely recognised that quarries offer significant opportunities for biodiversity net gain. This would allow infrastructure projects to effectively contribute to enhancing the natural environment. Quarry restoration schemes may also present opportunities for water storage and flood management allowing integration for certain National Infrastructure Projects identified within the consultation document.

We would welcome the opportunity to discuss the above matters with you further and look forward to hearing from you in due course.

Yours faithfully



[signature redacted]



[name redacted]



[job title redacted]

historically. There is an implication of major infrastructure projects into this process has proved problematic. National Planning Policy Framework, but factoring in the potential development of minerals for construction work and other applications, in accordance with the authorities (generally Counties in England) aims to ensure adequate materials supply. The mineral planning system, managed by other construction work and the impacts on key elements of the infrastructure developments does not appear to take account of the interaction with (skills) and natural (minerals and raw materials). Currently the process of considering to the management and sustainable utilisation of indigenous resources both human aspirations are accountability and achievable. Consideration must therefore be given in putting society's needs at the heart of Government Policy, it is important that the and regular review built in to statute.

paragraph 4. However, this programme must be a rolling programme with a formal Government to consider infrastructure planning for the 30 year period identified in responsible for local planning for periods for 15 years, it is not unreasonable for Central Government to the development plan process where local authorities are planned approach to the delivery of national infrastructure, even more so in a post Brexit climate. Akin to the development plan process where local authorities are We strongly support the aspirations of the document in seeking a long term and works to this objective?

What issues do you think are particularly important to consider as the Commission

- improve the UK's international competitiveness
- improve the quality of life for those living in the UK
- foster long-term and sustainable economic growth across all regions of the UK

Q1. The Government has given the National Infrastructure Commission objectives

(For more information, visit: www.mineralproducts.org)

The Mineral Products Association (MPA) is the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries. With the recent addition of British Precast and the British Association of Reinforcement (BAR), it has a growing membership of 480 companies and is the sectoral voice for mineral products. MPA membership is made up of the vast majority of independent SME quarrying companies throughout the UK, as well as the 9 major international and global companies. It covers 100% of GB cement production, 90% of aggregates production, 95% of asphalt and over 70% of ready-mixed concrete and precast concrete production. Each year the industry supplies £20 billion worth of materials and services to the Economy and is the largest supplier to the construction industry, which has annual output valued at £144 billion. Industry production represents the largest materials flow in the UK economy and is also one of the largest manufacturing sectors.

Mineral Products Association Response to National Infrastructure Commission consultation "The National Infrastructure Assessment - Process and Methodology" Introduction

essential materials
sustainable solutions



Appendix 1



arising from major projects - they will be met. While this has been the case it cannot be guaranteed unless the demand implications of infrastructure projects are better factored into mineral planning and regulatory systems. As such there is a key requirement for early engagement between developers of infrastructure schemes, materials suppliers and the planning and regulatory authorities with regards to sustainable materials supply.

Q2. Do you agree that, in undertaking the NIA, the Commission should be:

- **Open, transparent and consultative**
- **Independent, objective and rigorous**
- **Forward looking, challenging established thinking**
- **Comprehensive, taking a whole system approach, understanding and studying interdependencies and feedbacks?**

Are there any principles that should inform the way that the Commission produces the NIA that are missing?

Yes, we agree that in undertaking the NIA, the Commission should meet the criteria identified above. In addition, the NIA must be accountable, particularly where decisions on infrastructure challenge or conflict with the local political agenda, in the interests of a wider society. A key aspect of the interdependence between infrastructure and other construction projects and the supply of mineral products and associated materials is set out in our response to Question 7 - Cross Cutting Issues.

Q3. Do you agree that the NIA should cover these sectors in the way in which they are each described?

Yes. However, as is all too often the case, the provision of raw materials has been overlooked. Each and every sector referred to is wholly reliant upon the provision of the minerals products derived from extracted raw materials. All built development, such as major energy proposals; transport infrastructure; and flood defences, is reliant upon the aggregate minerals extracted from the ground or dredged within UK waters. Further, the added value minerals products associated with water purification; agricultural land improvement; energy deliverability and digital technology must not be underestimated.

Individual projects need to give appropriate consideration to the resources required and collectively this should be considered in the NIA, in terms realising the potential for utilising indigenous resources. In addition, however, the NIA should not underestimate existing commitments of the minerals sector, any limitations in production capacity; inherent delays in the planning and regulatory regimes; and the surety to allow companies to invest in resource security and sustainable supply; increases in production capacity and ability to deliver to major projects. Moving forward as major infrastructure projects are delivered, these will inevitably trigger further growth and investment, which again influence the demand for raw materials.

Q4. Are there particular aspects of infrastructure provision in these sectors which you think the NIA should focus on?

Yes. As detailed above, the provision of indigenous raw materials and mineral products

Q5. The NIA will seek to pull together infrastructure needs across sectors, recognising interdependencies. Are there are particular areas where you think such interdependencies are likely to be important?

Yes. All projects will have an influence on raw material supply patterns, be this through the provision of borrow pits specific to individual developments such as transport infrastructure, or the consequences of importing raw materials from

distance, by a road or rail network which may already be at capacity, or where there is insufficient loading or discharge capacity through wharves or rail sidings which are put under ever increasing pressure through non compatible development and encroachment. Further, major projects may give rise to a windfall of resources and the minerals products industry is appropriately placed to ensure a managed flow of resources in to the market.

Q6. Do you agree that the NIA should focus on these cross-cutting issues?
Yes.

Q7. Are there any other cross-cutting issues that you think are particularly important?

Yes. UK infrastructure ambitions have huge implications for the UK mineral products sector - with national resources being used to support national infrastructure. However, in order to realise this potential, these essential supporting assets need to be factored in to the planning for the entire lifecycle of projects, so the needs and opportunities pre- and post- construction are fully considered.

Cardiff Bay Barrage is a good example of this, with the original £200m cost for the infrastructure leveraging a further £2.3 billion of public/private investment to redevelop and regenerate the Cardiff Bay area in following years. Scaled up (to say one of the larger Tidal Lagoons in the Bristol Channel), the demands on resources and skills could be considerable. However, these opportunities to unlock and compound the growth potential realised by national infrastructure will only be realised if they are fully accounted for in the wider policy and planning processes and managed appropriately.

It is therefore important that national infrastructure projects are not considered in their own 'bubble', as appears to be the case at present. Currently, there appears to be a fundamental dislocation between infrastructure policy and the supporting policies for those activities (such as minerals and construction products) needed to support and enable the delivery of projects. To ensure that infrastructure projects can be delivered effectively, the supporting activities required to support delivery have to be identified. These activities then need to be given proper and timely consideration so that the potential needs and opportunities can be considered in advance, along with any risks or gaps that may have to be addressed.

At present the unwritten assumption appears to be that if you create the demand for construction materials this demand will be met. While the UK undoubtedly has a rich and varied resource of indigenous construction minerals, in order for these to be realised in practice both the mineral products industry and the wider mineral planning system require greater visibility around what scale of demand is likely to be required by infrastructure projects to allow suitable provisions to be made alongside the existing base demands in the market. This forward planning should ensure the most cost-effective and sustainable solutions can be put in place to support the delivery of infrastructure projects. Needless to say, this takes time and therefore needs to be planned in advance of, or at least in parallel to, the infrastructure projects themselves and considered during the consenting process.

It is important to recognise that mineral product resources are not evenly distributed around the country and that a considerable amount of inter-regional trade in materials already occurs to meet the base load demand for construction aggregates in the market. Consequently, it is likely that many areas of primary mineral supply will be required to support the demands from multiple infrastructure projects. The timings of prospective individual infrastructure projects therefore need to be understood, so that both the anticipated total cumulative and annual peak demands can be determined in order for sufficient production capacity and associated transport/delivery infrastructure to be put in place.

Q8. Do you agree with this methodological approach to determine the needs and priorities?

We agree with the general methodological approach but would raise one related issue. The consultation (paragraph 6.4) refers to the need to “appraise the quality and condition of the UK’s existing infrastructure assets” but it is not clear how the NIC could or should deal with infrastructure condition issues which are more related to revenue spending than capital budgets. For example, there is evidence that the condition of probably our most extensive infrastructure asset, the road network, is in poor condition in many parts of the UK. While the condition of the national road network in England is managed by one organisation, Highways England, and there is a specific regulatory regime operated by the Office for Road and Rail, there is no overview of the 95% plus of the network operated by numerous local highway authorities. Given that the quality of local road conditions is an issue of significance to virtually the entire population of the UK and has economic, social and environmental implications, it would seem appropriate for the NIC to have a role in assessing and, where necessary, improving the condition of the local road network. It does not seem to be a rational approach to invest in new and improved road capacity without a complementary focus on the quality of the existing network.

Q9. Do you have examples of successful models which are particularly good at looking at long-term, complex strategic prioritisation in uncertain environments?

No

Q10. Do you believe the Commission has identified the most important infrastructure drivers (set out below)? Are there further areas the Commission should seek to examine within each of these drivers?

These four drivers listed are very significant. However as indicated earlier there also needs to be a focus on supply chain issues including materials supply and capacity, the impact of land use and mineral planning and regulatory and permitting issues; and the effects these may have on the deliverability of any infrastructure project.

Q11. The NIA will aim to set out a portfolio of investments that best meets the demands of the UK in the future. Do you have a view on the most appropriate methodology to determine that portfolio?

No

Q12. In your view, are there any relevant factors that have not been addressed by the Commission in its methodological approach?

None other than comments made in this response.

Q13. How best do you believe the Commission can engage with different parts of society to help build its evidence base and test its conclusions?

Engagement with society on major developments has well established principles through the planning process and the development management procedures.

General Comments

In addition to the questions specific comments, we raise the following additional points for consideration.

- 1
- Para 4 - Whilst it is appreciated that long-term planning requires detailed consideration, the timescales identified are less than ambitious in light of some of the critical decisions which need to be made on matters such as energy supply.
- Para 18 - Again the timetable is far from ambitious. Further, it is imperative that the HM Treasury response takes full account of social and sustainability issues.
- Paras 23 - It can equally be stated that politicians do not always take the long term view and simply focus on the life of parliament. This applies to both local and central government.
- Parag 30 - It is imperative that the legislation has a statutory periodic review mechanism and appropriate safeguards to ensure projects are deliverable and accountable.
- Para 38 - The absence of an ambitious timetable, i.e. by 2018 for the report to be published, will be compounded by the additional 12 months for Government to respond to the NIC, i.e. by 2019. There will be an election in 2020 and as such it is unlikely that much will be pursued within the life of this parliament.
- Para 63 - We support the strategic thinking behind the NIA process.
- Para 65 - We are pleased to see that interaction will be a fundamental part of the process.
- Para 79 - We trust the Minerals Products Association will be consulted during the "call for Evidence" in Autumn 2016.
- Para 80 - It is imperative that the Minerals Products Association is given the opportunity to be present at the roundtable meetings.
- Para 82 - We trust the expert panel will consider raw material supply issues and the Mineral Products Association will have the opportunity to contribute to this work.



essential materials
sustainable solutions

Mineral Products Association Ltd

Gillingham House
38 - 44 Gillingham Street
London SW1V 1HU
Tel +44 (0)20 7963 8000
Fax +44 (0)20 7963 8001
info@mineralproducts.org
www.mineralproducts.org

The Mineral Products Association is the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries

Registered in England as Mineral Products Association Limited No. 1634996
Registered at the above address

Response to the National Infrastructure Commission's Call for Evidence from the Mineral Wool Insulation Manufacturers' Association (MIMA)

1. Introduction:

The Mineral Wool Insulation Manufacturers' Association (MIMA) is a trade body providing an authoritative source of independent information and advice on glass and stone wool insulation. MIMA actively promotes the benefits of mineral wool insulation and the contribution it makes to the energy efficiency of buildings and the comfort of their occupants.

We represent four of the leading insulation companies in the UK - Isover Saint-Gobain, Knauf Insulation, Rockwool and Superglass.

MIMA welcomes the opportunity to feed into the National Infrastructure Commission's (NIC) Call for Evidence. The results of the exercise are intended to inform the Vision and Priorities document, due to be published in summer 2017, as well as the first National Infrastructure Assessment itself in 2018.

Key message:

Investment in the quality and energy efficiency of buildings in the UK is an urgent, infrastructure priority. Energy efficiency is an integral part of a well-functioning energy system which is fit for the future.

Improving our building stock – a physical asset – delivers a wealth of infrastructure “services” ranging from economic growth, improved consumer health and well-being, greater national energy security and significant carbon emissions reductions.

The NIC has confirmed that **building energy efficiency is within the scope of the NIA**, and so we hope the information from MIMA, and from others in the energy efficiency sector, serves as a spring board for further detailed analysis, where needed, by the Commission and its collaborators.

Through our role providing the secretariat to the Energy Efficiency Infrastructure Group (EEIG)¹, MIMA has been in regular contact with officials at the NIC, and so our submission to this Call for Evidence reiterates and consolidates certain information already provided, but also references a number of new and relevant projects which reported recently or are due to be published this year.

We also note that the NIC plans to continue to seek expert advice and challenge by establishing panels and hosting roundtables along with regional roundtables, sectoral seminars and social research. **MIMA and its members look forward to being activity involved** in these sessions.

¹ The EEIG is an informal group of 20+ influential organisations who have expertise in the functioning of the energy efficiency sector and an interest in seeing its links to growth and well-being realised.

The International Energy Agency in their Energy Efficiency Market Report 2016² made the statement: *“As the world transitions to clean energy, efficiency can make the transition cheaper, faster and more beneficial across all sectors of our economies. Indeed, there is no realistic, or affordable, energy development strategy that is not led by energy efficiency. For the IEA, it is the first fuel... And yet energy efficiency is far from fulfilling its potential. Globally, two-thirds of the economic potential remains untapped. An entire 70% of the world’s energy use takes place outside of any efficiency performance requirements.”*

The same is true for the UK, and particularly for the existing building stock. In 2016, the Committee on Climate Change stressed that *“energy efficiency should be improved across the existing building stock. This can reduce emissions and energy bills, improve competitiveness and asset values for business, improve health and wellbeing, help tackle fuel poverty and make buildings more suitable for low-carbon heating in future.”*³

Therefore, MIMA welcomes the NIC’s acknowledgment of the importance of looking at the future of heating and the shift to low carbon solutions in the context of the UK’s carbon targets, and the important role that increasing energy efficiency will play.

Buildings are one of the largest energy using sectors, and therefore any robust long-term infrastructure plan for the future energy system must include investment in energy efficiency to reduce energy demand and increase energy security.

2. Why energy efficiency upgrades to buildings are a priority/long-term infrastructure need

Energy efficiency is a highly cost-effective way of meeting Government economic, energy and climate change goals and improving consumer health and well-being.

➤ **Energy security and energy system objectives**

Driving energy efficiency across the board – to balance demand and supply of **both electricity and gas** – is a wise choice. Around 80% of heat demand is currently still met with natural gas.⁴ No matter what our future energy mix, it will always make sense to invest in the fabric and energy efficiency of buildings.

Not only does demand management and energy efficiency help to de-risk national supply strategies, which could easily be thrown off track by changes in the global market, it is also one of the most effective ways of protecting consumers from the full force of energy price rises and volatility in energy markets.

² Energy Efficiency Market Report, IEA, 2016,

<http://www.iea.org/publications/freepublications/publication/mediumtermenergyefficiency2016.pdf>

³ Next Steps for UK Heat Policy, CCC, 2016 <https://www.theccc.org.uk/publication/next-steps-for-uk-heat-policy/>

⁴ Department of Energy and Climate Change (DECC): *The Future Of Heating: Meeting The Challenge*, March 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/190149/16_04-DECC-The_Future_of_Heating_Accessible-10.pdf

By way of example, analysis by the UK-GBC⁵ in 2014 highlighted that the UK could **reduce its reliance on imported gas by 19% by making UK homes more energy efficient**, saving £2 billion in gas imports every year. BEIS's (then DECC) 2012 Energy Efficiency Strategy also found that energy saving measures cost less on average per unit of power than large-scale power generation, and through cost-effective investment in all forms of energy efficiency, **the UK could be saving 196 TWh of energy in 2020** - equivalent to 22 power stations.⁶ Furthermore, a report by Verco and Cambridge Econometrics in 2014⁷ found that energy security could be significantly enhanced if all homes were to achieve an EPC rating of C by 2030. In that scenario the country could see a **reduction of gas imports of 26%**, worth £2.7bn per year by 2030.

In terms of electricity, it is also vital to make solid progress on energy efficiency as we work towards decarbonising the electricity grid and a greater proportion of homes become electrically heated. Electricity is currently a more expensive and carbon intensive form of heating compared to gas, and even as this begins to change, we must not waste this clean heat.

Failing to insulate homes properly would mean consumers paying for low carbon energy which is needlessly wasted.

Investing in the fabric of the building stock reduces the amount of energy needed to achieve the same levels of comfort in the home. Energy capacity is then freed up, potentially reducing the need for further investment in new infrastructure in other areas of the energy system. In doing so, energy efficiency helps to **de-risk security of energy supply strategies**.

Again, the IEA has noted in their Energy Efficiency Market Report 2016, that internationally, *“Reducing infrastructure investment requirements in the electricity system is another important benefit of energy efficiency. Energy efficiency improvements since 2000 saved an estimated 1,600 terawatt-hours of electricity consumption in 2015 equal to 15% of total electricity generation in the IEA. Servicing this hypothetical additional demand would have required new power supply. To estimate the additional generation capacity and investment required, the Energy Technology Perspectives energy supply model was used to run a scenario in which electricity consumption is 15% higher in 2015...The modelling results show that energy efficiency avoided 578 gigawatts of new generation capacity and USD 1.2 trillion in investment across IEA countries.”*

Fabric measures can also help to flatten morning and evening peak loads. While only 2-3 million homes rely solely on electric heating, this still constitutes a significant part of peak UK winter energy demand. Large numbers of gas homes are also meeting this peak demand

⁵ A Housing Stock Fit of the Future, UK-GBC, 2014 <http://www.ukgbc.org/resources/publication/housing-stock-fit-future-making-home-energy-efficiency-national-infrastructure>

⁶ The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK, DECC, 2012 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65602/6927-energy-efficiency-strategy--the-energy-efficiency.pdf

⁷ Building the Future: The Economic and Fiscal Impacts of Making Homes Energy Efficient, Verco and Cambridge Econometrics, 2014 <http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf>

with plug-in electric heaters providing top-up heat which again likely coincides with peak times of the day.

Replacing inefficient appliances with the most efficient appliances is part of the answer, but making homes more energy efficient would also reduce some of demand for electricity, such as for secondary heating, in the first place. 4.2 million English households currently have **secondary electric heating**.⁸

Similarly, when **smart meters** are rolled out, they could soon be followed by “time of use tariffs” which will aim to shave peak demand by setting higher peak prices. Without careful management, this could have a potentially regressive effect on poorer households, pushing them away from peak use, whether it’s no longer cooking dinner at dinner time or heating their homes first thing in the morning. Ensuring fabric renovation options are available will allow such homes to retain heat, meaning homeowners can comfortably move away from the winter peaks but still stay warm.

Looking ahead, the country anticipates increasing taking up **microgeneration technologies** for heat and power such as Solar PV, Solar Thermal and Heat Pumps. Again, it is of fundamental importance to ensure that we simultaneously upgrade and insulate the fabric of buildings to minimum levels, otherwise risking the waste of renewable energy generation, and in the case of heat pumps, reduced performance of the systems. The “fabric first” principle is a key tenet of energy policy and was reiterated in BEIS’s recent response to the Feed in Tariffs consultation.

The move towards **smart homes** with technology which enables people to control their heating, hot water and appliances should also be matched with a quality building. Being able to precisely control when your heating comes on, in order to be comfortable and save energy, has much greater value and impact in a building which is not simultaneously leaking heat.

From an energy security perspective, the most secure energy system we can create is one which invests in demand management and energy efficiency, alongside decarbonisation and security of supply.

➤ **Carbon emission reduction objectives**

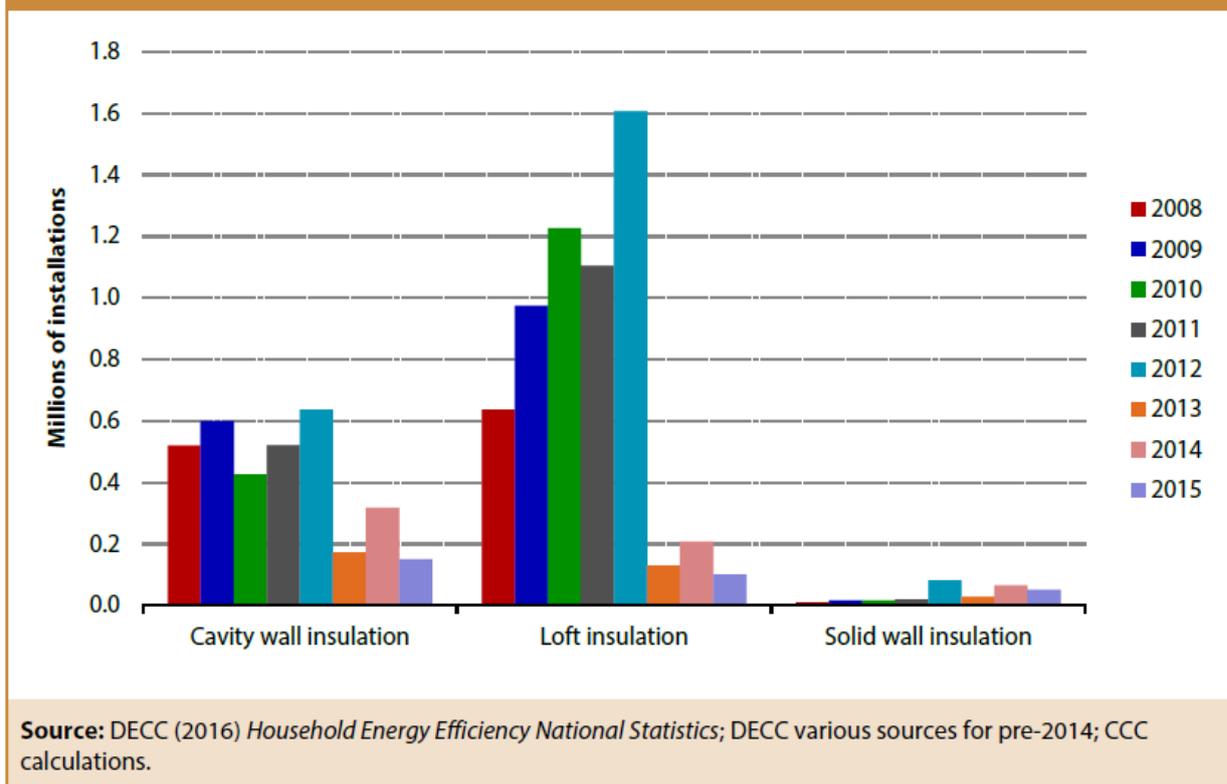
In terms of our climate change commitments and targets, failure to deliver an ambitious energy efficiency programme is likely to make it more difficult and costly to meet carbon budgets.

At present **more than a third of all energy used in the UK goes towards heating either water or air in buildings**. If demand side measures – particularly those improving the fabric of UK buildings – are not fully considered as part of wider infrastructure choices, the UK risks being locked into a high carbon energy system.

⁸ Cambridge Architectural Research Ltd et al, Further Analysis of the Household Electricity Survey 2013.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/275483/early_findings_revised.pdf

The Committee on Climate Change has recently raised strong concerns about the lack of progress in the energy efficiency sector. Their 2016 Progress Report to Parliament⁹ found that: “The total number of energy efficiency measures installed under government schemes in 2015 was down 49% on 2014 and 87% on 2012 across cavity wall, loft and solid wall insulation. This was due to the reduction in installation under the Energy Company Obligation (ECO) during 2015, which was already delivering far less than previous policies in place to 2012. This lack of progress reflects the **weakening of energy efficiency policy during this period.**”

Figure 3.4. Annual insulation installation rates (2008-2015)

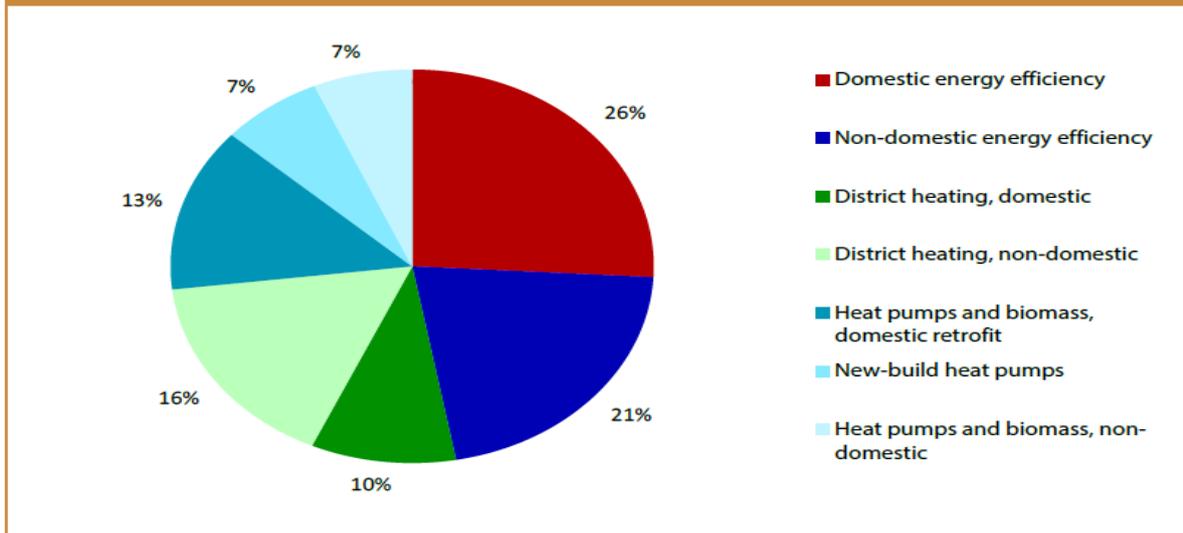


The CCC made the firm recommendation that a stronger policy framework to drive residential energy efficiency improvement is needed - addressing gaps and strengthening existing policies, including for the able-to-pay, increased funding for fuel poor households, and providing an effective approach to the private-rented sector. They also noted that Scotland, Wales and Northern Ireland have allocated tax-payer funds to support uptake of energy efficiency measures in buildings and work with local authorities on area-based delivery. **Scotland has also made energy efficiency a national infrastructure priority.**

Such policies are vital for meeting carbon budgets. The CCC assumes that **26% of direct abatement in buildings comes from residential energy efficiency**, and that emissions savings from residential energy efficiency are mainly fabric efficiency, with cavity wall insulation contributing the most.

⁹ Meeting Carbon Budgets – 2016 Progress Report to Parliament, Committee on Climate Change <https://www.theccc.org.uk/publication/meeting-carbon-budgets-2016-progress-report-to-parliament/>

Figure B3.1. Direct abatement in 2030 in buildings, central scenario



Source: CCC analysis.

Source: CCC (2015) Sectoral Scenarios for the Fifth Carbon Budget.

In summary, the CCC is concerned that current policies will not deliver the level of energy savings needed to meet policy targets. A new policy or package of measures to encourage energy efficiency in able-to-pay households is also essential to achieve the necessary emission reductions from buildings. The CCC says “A new scheme will have to be simple, provide a stable and long-term framework, develop trusted intermediaries, help households to overcome financial barriers and the range of nonfinancial barriers (e.g. information, perceived risk, hassle, and social norms) and have effective delivery and communication.”

➤ **Fuel poverty and health objectives**

There are a growing number of examples of consumers wishing to make their homes more energy efficient, but being unable to access the remaining support, because government-driven delivery is now almost solely in the hands of energy suppliers, since other programmes and schemes were cut.

This has far reaching implications. For the average consumer, energy bills may be up to £300 per year more than they could be. For the 2.3 million households in fuel poverty, the decision to under-heat their home to save energy and money is sometimes the only option. Cold homes can put people’s health at risk, especially vulnerable groups such as the elderly or very young.

Living in cold conditions is linked to a number of negative physical and mental health impacts. For example, the Hills Fuel Poverty Review found that low-temperatures in homes can create conditions which increase the likelihood of cardiovascular events, some of which may result in death, exacerbate the risk of respiratory disease and cause physical discomfort, which can contribute to mental health issues.

The ONS provisionally estimated there were over **24,000 cold-related winter deaths** in England and Wales in 2015/2016.¹⁰ The cost impacts of cold homes and fuel poverty on the NHS is an estimated £1.3bn per year.

In the future, as the population ages, more people will fall into vulnerable categories, struggling to pay needlessly high energy bills or suffering the effects of living in a cold home. Energy efficiency is one of the most cost-effective ways to protect vulnerable groups for the long-term.

BEIS cites modelling done prior to their 2012 Energy Efficiency Strategy to value the health benefits associated with some energy efficiency investments. The findings show that these can be significant. For loft insulation, these benefits alone outweigh the costs of installing the measures, even before energy savings are taken into account.

There is now wide-spread concern that the new version of Energy Efficiency Obligation¹¹, which will mainly focus on improving energy efficiency in fuel-poor households, is not ambitious enough. The CCC in their 2016 Progress report estimated that **annual funding of at least £1.2 billion** a year would be needed to meet the government's target of an Energy Performance Certificate (EPC) rating of C by 2030 for fuel-poor households in England. *“The announced [level of] funding from ECO and the income redistribution of the Warm Homes Discount will be inadequate for this objective.”* Furthermore, BEIS’s current target is to improve the energy efficiency of 1 million homes, is less than half of the actual number in fuel poverty.

➤ **Economic and employment objectives**

The Government’s stated objective in the 2017 Industrial Strategy¹² is to *“improve living standards and economic growth by increasing productivity and driving growth across the whole country.”*

Energy efficiency is acknowledged as making a significant contribution to economic growth in the Strategy, and, as a result, the Government plans to commission a review of the opportunities to reduce the cost of achieving decarbonisation goals in the power and industrial sectors. The review will cover how best to support greater energy efficiency, amongst other policies.

Although the focus of the Industrial Strategy is on the non-domestic sector, reducing domestic energy bills means an increase in the disposable income of households, which in turn leads to higher consumption and economic growth.

¹⁰ Excess winter mortality in England and Wales: 2015/16 (provisional), ONS

<https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/excesswintermortalityinenglandandwales/2015to2016provisionaland2014to2015final>

¹¹ Energy Company Obligation (ECO) Help to Heat, BEIS, 2017 <https://www.gov.uk/government/consultations/energy-company-obligation-eco-help-to-heat>

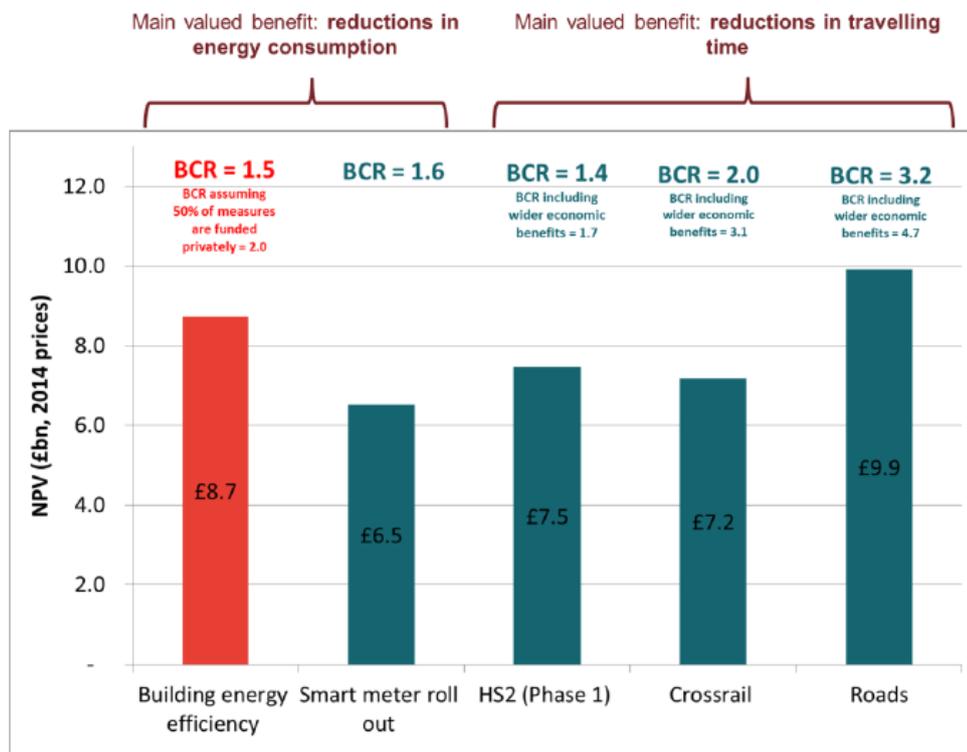
¹² Building our Industrial Strategy, HMG, 2017

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/586626/building-our-industrial-strategy-green-paper.pdf

For instance, authoritative research by Frontier Economics in 2015¹³ showed that a national programme of investment in the energy efficiency of the building stock in Britain, over a period of ten years, is capable of delivering major economic and social benefits – in the order of **£8.7 billion**. This net benefit is comparable to other major infrastructure road and rail projects, including HS2 (Phase 1).

The report concluded that there is a **strong case for Government to make home energy efficiency an infrastructure investment priority** and to develop an infrastructure programme to deliver it. This finding holds, even without quantifying many of the social benefits of energy efficiency measures, for example health and wellbeing improvements.

Figure 1. Summary of infrastructure scheme assessments



Source: Frontier Economics, based on sources detailed Box 1 on page 17. The NPV is the present value of the difference between the stream of costs and benefits of each scheme. The BCRs represent the ratio of societal benefits to Government costs (In line with Webtag guidance). The NPV figures do not include wider economic benefits. The base year for the present values varies between 2010 and 2013.

In addition, macroeconomic modelling by Cambridge Econometrics and Verco in 2014¹⁴ suggests that a major energy efficiency programme would have a significant positive impact on economic growth. It also demonstrated that **for every £1 invested in energy efficiency, £3.20 is returned to economy**.

In particular, energy efficiency measures in homes:

¹³ Frontier Economics, Energy Efficiency: An Infrastructure Priority, 2015.

<http://www.frontier-economics.com/documents/2015/09/energy-efficiency-infrastructure-priority.pdf>

¹⁴ Building the Future: The Economic and Fiscal Impacts of Making Homes Energy Efficient, Verco and Cambridge Econometrics, 2014 <http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf>

- bolster employment and output in the construction sector
- reduce consumer expenditure on energy
- increase expenditure on consumer goods and services

This has a net impact of creating jobs and output. Furthermore, a large proportion of the jobs created will be closely linked to the locations where the measures are put into homes, supporting local economies, and potentially assisting with the Government's stated aim of spatial rebalancing of the economy.

In 2014, the energy efficiency market accounted for over 136,000 jobs in the construction and manufacturing industries. The modelling estimates an increase of **91,000 additional jobs by 2020** as a result of a major energy efficiency programme.¹⁵

It's also not hard to see why consumer spending power increases when the energy efficiency of homes is improved. For example, the Government estimates that energy efficiency measures to be delivered under the ECO's Affordable Warmth obligation alone will result in **£2.76 billion lifetime energy bill savings**. In terms of savings per household, for those treated under ECO, the policy could deliver a net saving on their annual dual fuel bill of up to £300.

Despite these significant economic benefits, the Treasury has not allocated any public capital funds to support home energy efficiency programmes even though it plans to spend over £100 billion of public capital funds on infrastructure projects by 2020. Instead, the Government has largely relied upon the Energy Company Obligation, which uses a levy on energy bills to generate investment in home energy efficiency. Political pressure to reduce energy bills in the short term for consumers has led to a reduction in the levy which has **reduced building energy efficiency investment by a third since 2012**.

3. Why the improvement of building energy efficiency is an infrastructure programme

It has long been recognised that investment in infrastructure has a positive effect on economic growth by increasing productivity and attracting investment, as well as boosting employment in the construction and other industries.

Visible, major construction projects, such as power stations and roads are most commonly thought of as infrastructure. Increasingly communications, connectivity and networks on a smaller scale and within local communities play just as big a role in ensuring our economy has the solid base needed to continue to grow. The inclusion of Smart Meters, which will be installed in individual properties, in the list of priority projects in the National Infrastructure Plan demonstrates our increasingly modern view of what constitutes infrastructure, and therefore what can drive economic growth.

- ***The UK's building stock is also part of our national infrastructure***

¹⁵ Building the Future: The Economic and Fiscal Impacts of Making Homes Energy Efficient, Verco and Cambridge Econometrics, 2014 <http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf>

A nationally coordinated programme of investment in the quality and functionality of our building stock - including in the 27 million existing homes – will drive growth and employment, just like other infrastructure projects.

The analysis by Frontier Economics in 2015 explains in more detail why domestic energy efficiency investments constitute infrastructure. In brief, reductions in energy demand, delivered through an energy efficiency programme would **increase available energy sector capacity** just as effectively as delivering new large capital investments, such as new generation plant, networks or gas storage. While domestic energy efficiency investments are not in themselves large monopoly assets, investing in them can have the equivalent impact on the economy as investing directly in such assets. This equivalence is recognised in supplementary guidance to HM Treasury’s Green Book, which states that **investment in energy efficiency reduces the need for investment in other energy system infrastructure**.

ResPublica built on these findings in 2015¹⁶ by recommending that, in addition to classifying energy efficiency as a national infrastructure priority, there is a case to **devolve infrastructure spending** to the city or local level, which MIMA also supports:

“As the Energy Bill Revolution and others have proposed, we advocate that energy efficiency should be made a national infrastructure priority: included in the top 40 priority infrastructure investments. But in keeping with our support to devolve powers and fiscal responsibilities to the lowest appropriate level, we also argue that Government should devolve infrastructure spending, where appropriate, to city regions.”

The inclusion of energy efficiency in the NIA was also recommended by Parliament’s Energy and Climate Change (ECC) Committee in 2016 following their inquiry into energy efficiency and demand reduction (Recommendation 7):“...the National Infrastructure Commission must consider the infrastructure requirements of meeting the UK’s carbon budgets and long-term legally binding carbon reduction targets. **Energy efficiency will be a crucial part of the mix.** The Government and the National Infrastructure Commission should assess the potential benefits of designating energy efficiency as a national infrastructure priority.”

The Government responded to the ECC Committee’s report on 11 July 2016, stating “DECC will continue to work with the Commission as it prepares its National Infrastructure Assessment. As per the Commission’s consultation document, this will examine the future of heating and **important role that increasing energy efficiency could potentially play.**”

4. Demand reduction potential

The quote below from the IEA’s Energy Efficiency Market Review 2016 gives a sense of what is possible, even at relatively low levels of investment in energy efficiency.

“Energy efficiency levels in IEA member countries improved, on average, by 14% between 2000 and 2015. This generated energy savings of 450 million tonnes of oil equivalent (Mtoe)

¹⁶ After the Green Deal, ResPublica, 2015 <http://www.respublica.org.uk/our-work/publications/after-the-green-deal/>

in 2015, enough to power Japan for a full year. These savings also reduced total energy expenditure by 540 billion United States Dollars (USD) in 2015, mostly in buildings and industry. While GDP grew by 2% in IEA countries, efficiency gains led to the flattening of growth in primary energy demand.”

Importantly, the IEA highlighted that **energy demand growth slowed, while global GDP grew.**

In the UK, domestic energy consumption reductions in the past have been even more pronounced, driven to a large extent by energy efficiency measures (and partly by austerity). Under previous policies, between 2005 and 2015 UK homes saw a huge 23% drop in (weather adjusted) median gas consumption.¹⁷ At today’s prices this means that approximately £4 billion less per year will be spent on gas alone across the UK’s 27 million homes than if consumption had remained at pre-2005 levels.

DECC’s (now BEIS) Energy Efficiency Strategy 2012 also references modelling by the Building Research Establishment modelling which suggests that, if no energy efficiency gains had been made since 1970, energy use would be almost double the current levels, adding about £1,000 to the average annual energy bill.¹⁸ Energy consumption, per household, is now at its lowest point since pre-1970 levels.¹⁹ **This is a great UK success story meaning we are already far more energy secure than we otherwise might have been.**

However, the job of retrofitting the UK’s housing stock is only half done. The UK’s housing stock still remains amongst the “leakiest” in Western Europe.²⁰ Over 20 million out of the 27 million homes in the UK are still below EPC Band C – the rating considered to represent a reasonable level of energy efficiency.²¹ The reasons for this become clear when examining the remaining energy efficiency technical potential. For example, the latest Impact Assessment for the ECO shows that in Great Britain there are still:

- 7.8 million of the 8 million solid walls to be insulated;
- 5.4 million cavity walls to be filled;
- 5.8 million lofts to be fully insulated; and
- around 5 million party walls to be insulated. The estimated fuel bill cost to consumers from heat loss through party walls alone is around £465 million a year.

¹⁷ Energy Consumption in the UK, BEIS, July 2016 - Table 3.01 <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk>

¹⁸ The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK. DECC, 2012 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65602/6927-energy-efficiency-strategy--the-energy-efficiency.pdf

¹⁹ Energy Consumption in the UK, BEIS, July 2016

²⁰ A Housing Stock Fit of the Future, UK-GBC, 2014 <http://www.ukgbc.org/resources/publication/housing-stock-fit-future-making-home-energy-efficiency-national-infrastructure>

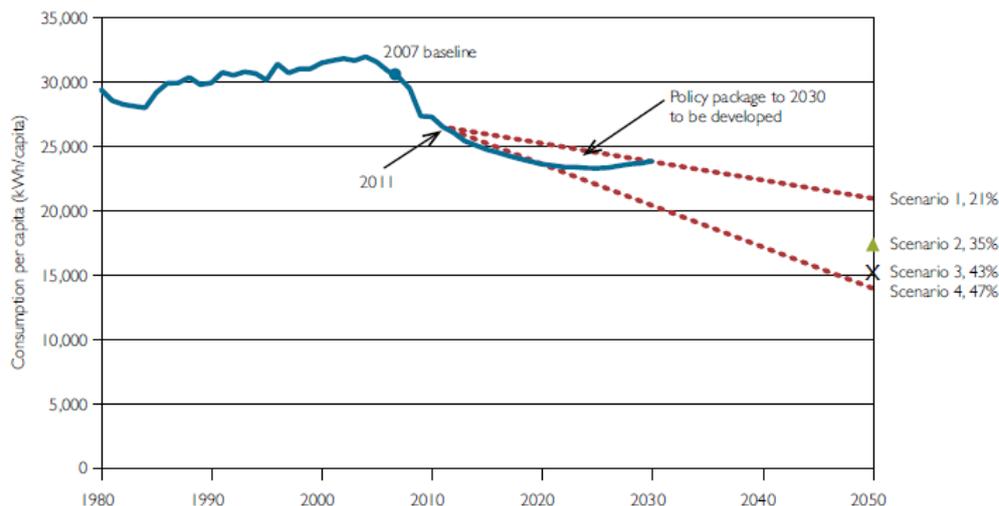
²¹ Live Tables on Energy Performance of Buildings Certificates <https://www.gov.uk/government/statistical-data-sets/live-tables-on-energy-performance-of-buildings-certificates>

Analyses of the future cost-effective demand reduction potential differs depending on the assumptions used. Many scenarios, such as those produced by the National Grid, make choices about whether levels of energy efficiency are low or high, for example, and then estimate the corresponding energy consumption levels in the future.

In light of this variation, we recommend the NIC works with the sector, and with modelling experts to produce a definitive and up-to-date estimate of the technical and cost-effective level of demand reduction possible, for use in the NIA.

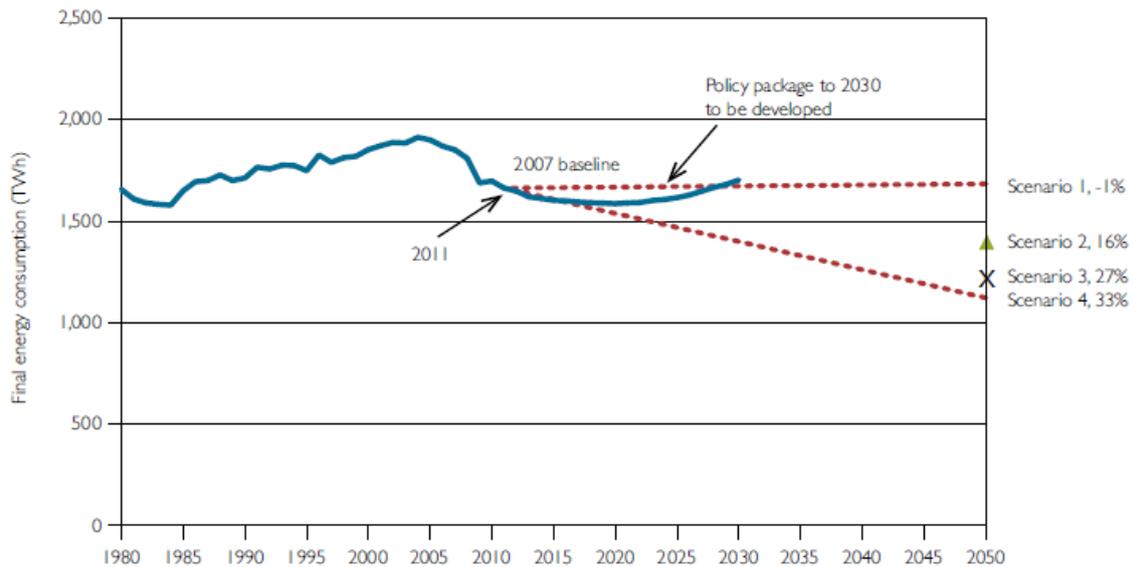
This analysis should draw on existing estimates, such as BEIS’s 2012 estimates based on the 2011 Carbon Plan 2050 scenarios. These said energy efficiency would need to “contribute a reduction in final energy consumption per capita between 2007 and 2050 of 31-54%.” Figure 3 shows that, after moving to a 2011 baseline, the Carbon Plan Scenarios would require **per capita savings of between 21% and 47% between 2011 and 2050.**

Figure 3: UK final energy consumption per capita compared against carbon plan scenarios: 1980-2050²³



In terms of final energy consumption, the Carbon Plan scenarios translate to a range from a 1% increase in absolute final energy consumption from 2011 to a 33% decrease.

Figure 4: UK final energy consumption compared against carbon plan scenarios: 1980-2050



The policy package was thought to be on track at the time (though this will no longer be the case), but even then BEIS stressed that additional action would be needed to maintain progress on energy efficiency after 2020.

Currently, overall energy demand is roughly stable. However, it is expected to rise after 2025 as the impact of historic energy efficiency policies declines. In the absence of a major policy intervention, current levels of energy efficiency and the impact of fossil fuel prices are likely to be insufficient to offset the impact of economic and population growth.

➤ **The rebound effect**

It is often asserted that improving the energy efficiency of the homes of low income households, in particular, has reduced carbon benefits. It is assumed that these households are likely to take back much of the potential energy savings as extra warmth and hence the carbon savings are less than in the homes of warmer, better-off households.

Whilst it is true that poorer households sometimes forgo some of the potential energy savings in favour of a warmer internal climate:

- Even within the coldest homes, there are cost effective carbon and monetary savings because the fuel poor want the extra money to pay for other essentials, as well as the extra warmth
- The rebound in cold homes tends to only happen with the first energy efficiency improvements. Once the home has reached a higher level of warmth, there will be less rebound. Therefore, any “discount” should be applied at a lower level for example when homes are improved to EPC Band C or better.

- The rebound effect is less likely to be found in relation to electricity, for instance from more efficient lights and appliances. There is also less of a rebound, if any, with hot water use, but this has not been properly researched.

We are aware that The Centre on Innovation and Energy Demand (CIED) is currently investigating the source, nature and magnitude of rebound effects in a number of UK sectors. Led by the Centre for Energy Policy at the University of Strathclyde, this new project is investigating the impact of energy efficiency improvements throughout the UK economy and along international supply chains, as well as using sophisticated multi-sector macroeconomic models to capture a much wider range of economic effects.

However, it is clear that most reliable economic modelling already accounts for rebound effects. The Cambridge Econometrics analysis referenced above, for example, assumes a large comfort/rebound factor of 40% for fuel poor homes.

5. Delivery vision

We now need to make investment in the quality and efficiency of our building stock, and particularly dwellings, an urgent infrastructure priority.

While some energy efficiency improvements are already financially attractive, many measures need public sector support to lever in further private investment. Consumers generally only take up these options when sufficiently incentivised to do so, and businesses will only invest and innovate in supplying the market if they are confident that incentives will remain in place.

The reasons policies so far have not succeeded in delivering the technical potential (or even the cost-effective potential) are varied and complicated. But we would argue, it comes down to a failure to deliberately and concertedly drive demand for energy efficiency across the board towards an agreed target or goal.

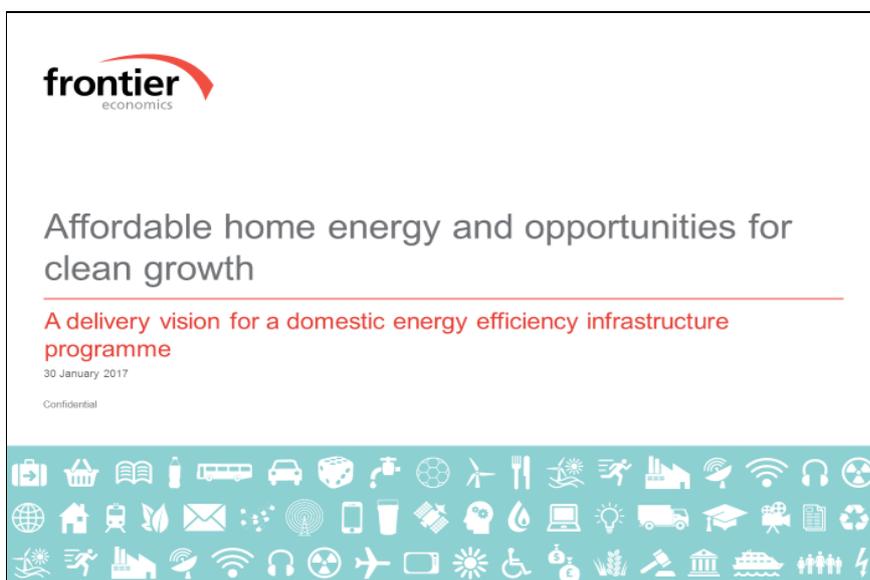
The UK instead focused on piece-meal policies, often designed to remove barriers to uptake, such as the upfront cost in the case of the Green Deal. Such policies are more likely to be successful only in cases where consumers were already persuaded on the benefits of energy efficiency in the first place. Where there is latent demand.

The ECO has proved to be more successful than the Green Deal, demonstrating that creating fixed targets e.g. to save a specified amount of carbon and making organisations responsible for driving sufficient demand to meet the target, works in terms of driving numbers – but in some cases, this has been at the expense of quality.

There is now a clear opportunity for the NIC and the Government to put in place the plan for improving the UK's existing housing stock through the infrastructure “architecture” to fully insulate our buildings. We need to integrate energy efficiency into national infrastructure planning.

With energy efficient buildings classed an infrastructure priority, and an appropriate long-term vision outlined, delivery can be implemented through a set of coordinated policies designed to drive the uptake of measures, including support for zero or low interest loans, cost neutral stamp duty reform which rewards home owners with energy efficiency homes, and a programme of targeted capital investment. Only through a commitment to improving our building stock at a national level can we – the sector and government – attract sufficient investment and achieve efficient coordination and delivery of national energy efficiency objectives.

The NIC is aware that the EEIG is working with Frontier Economics to create a Delivery Vision. Good progress is being made, and this should be finalised in Spring 2017.



Lastly, making building energy efficiency a public infrastructure priority has widespread support, including from other leading UK business associations and businesses, including the CBI. And in Scotland, the five main parties, including the Scottish Conservatives, have already committed to improving home energy efficiency through a “national infrastructure project”. More than 200 businesses, charities and consumer groups are now calling for energy efficiency to be an infrastructure priority including Age-UK, Kingfisher plc., Co-operative Energy, the Energy Saving Trust, Keepmoat, Willmott Dixon and Worcester Bosch.

6. For further information, please contact:

[name redacted]
[job title redacted]
Mineral Wool Insulation Manufacturers Association
(MIMA) Email: [email redacted]
Tel: [phone number redacted]

10 February 2017



National Infrastructure Commission: Call for Evidence

Response from Mobile UK

February 2017

About Mobile UK

1. Mobile UK is the trade association for the UK's mobile network operators - EE, Telefonica UK (O2), Three and Vodafone. Our goal is to realise the power of mobile to improve the lives of our customers and the prosperity of the UK as a whole.
2. As mobile increasingly becomes the device of choice for running daily life both at home and at work, customers, quite rightly want better coverage, more capacity and greater capabilities. Our role is to identify the barriers to progress, and work with all relevant parties to bring about change, be they Government, regulators, industry, consumers or citizens more generally.

Introduction

3. Mobile UK welcomes the opportunity to respond to the National Infrastructure Commission's *National Infrastructure Assessment*.
4. Mobile UK welcomes the creation of the National Infrastructure Commission (NIC). We also agree with the statement in the recent *Connected Future* report that mobile connectivity is critical to the growth of our economy and that the Government must play an active role as a digital champion.
5. Mobile network operators are committed to meeting the rising demand from customers for more capacity and coverage throughout the UK. However, it is dependent on many factors and stakeholders across national government, local authorities and the devolved nations to ensure that the environment for mobile infrastructure is built to allow rapid deployment and limits barriers.
6. Mobile UK has previously submitted evidence to the NIC and stands ready to assist further to expand on points made in this submission.
7. This submission sets out Mobile UK's priorities for the National Infrastructure Assessment (NIA) and, in addition to the set questions of the Call for Evidence, we have outlined our key priorities.

National Infrastructure Assessment

8. Mobile UK supports the ambition set out by the National Infrastructure Commission to produce an NIA once in every Parliament, setting out a comprehensive assessment of the UK's long-term infrastructure needs on a 30-year time horizon.
9. Mobile UK also strongly supports the NIC's assertion that the NIA should span across national and devolved governments, as well as regulators.

Administration Office: Gore End, Newbury, RG20 0BD: Registered Office: 1 Carnegie Road, Newbury, RG14 5DJ

10. Mobile UK welcomes the NIC's inclusion of digital communications as an individual sector of focus.

Mobile Communication – Critical Infrastructure

11. Mobile communication is part of the UK's critical infrastructure and is integral to people's lives. At the end of December 2015, there were 85.3m mobile connections (79.7m active mobile handsets and 5.6m active mobile broadband connections)¹. 95% of the adult population has a mobile phone.
12. The increase in coverage, capability and capacity of mobile networks has led to an explosion in demand for mobile data. 4G is driving greater volumes of data usage. A total of 106 petabytes was sent over all mobile networks in June 2016, a 44% increase over the previous year. The average volume of data consumed per subscriber now stands at 1.3 gigabytes per month up from 0.9 gigabytes in 2015.²
13. Improved 4G services, and the rollout of 5G has the potential to increase this demand further. It is expected that 5G will form the critical backbone of many of the UK's key services such as e-health, the internet of things and autonomous vehicles.
14. Mobile network operators have played a central role in driving this progress by continually investing in their networks, value added services, and subscriber acquisition. In the current cycle the mobile network operators are investing around £2 billion per annum in new coverage, capacity and capability. In turn, business and consumer customers have shown extraordinary ingenuity in harnessing the power of mobile, to be more creative and productive, to offer new services, and to improve lives.

Communications Infrastructure

15. It is our experience that the best results are achieved if Government, mobile network operators and other stakeholders work cooperatively. Changes across a broad range of policy need to be considered
 - a. Reform to planning regulations for telecommunications apparatus, enhancements to Permitted Development Rights
 - b. Reform to planning regulations for housing and other construction, requiring developers to make greater provision for electronic communications
 - c. Other improvements within local authority planning (LPA): updating planning guidance, better training and more resources for planning officers, so that LPAs do not become a bottleneck
 - d. The business rates regime: make marginal investment more viable with business rates exemptions in selected areas (for example National Parks)
 - e. Access to public assets and other landowners: encourage Government to make it easier for mobile network operators to access suitable locations on which to place their apparatus
 - f. Develop partnership schemes for the parts of the country where there is no commercial business case but where additional societal gains can accrue from wider coverage (for example, in the efficient delivery of public services)
 - g. Coordination across Government: all measures will be much more effective if there is

¹ Ofcom – Communications Market Update, Q4 2015

² Ofcom – Connected Nations, 2016

good coordination between government departments and between the Westminster Government and the devolved governments.

16. When looked at from an international perspective the UK's average mast height is low bearing in mind that the ability to cover a wider area depends on how high a mast can be built. In the UK, the average mast height is 17m. In France, the comparable figure is 30m, in Sweden it is over 70m. It is also disproportionately expensive to build mobile infrastructure in the UK.³
17. In addition to masts it should also be noted that small cell antennae form a significant and growing part of the infrastructure required to deliver mobile connectivity and coverage. In cities, to maintain bandwidth and capacity an extraordinarily dense network of small cells is required in addition to existing mobile infrastructure. As demand increases as more and more devices come online this will be exacerbated. In London alone it is estimated that as many as 500,000 small cells will be needed to support 5G services, a number far greater than the UK's entire existing stock of 37,000 mobile masts. To ensure bandwidth and capacity keep up with current and future demand further reform is required in the legislation that underpins digital communications infrastructure. This is vitally important if the UK is to match its goals and remain a leader in this field.
18. It should be noted that Mobile UK welcomes recent reforms to planning in England, and consultations in Northern Ireland and Scotland on similar reforms, alongside the Welsh Government's announcement of a Mobile Action Plan for Wales, but these changes only provide additional height and rights within the existing framework. The infrastructure that will be required for 5G networks is likely to be significantly different from what is currently required for 4G. This is not to suggest that maximum heights and numbers of apparatus will always be required but flexibility to deploy infrastructure is equally important.
19. It is vital that when the need for reform is identified it is accelerated to keep up with rapid changes in technology and usage. For example, reform to the Electronic Communications Code, currently being progressed as part of the Digital Economy Bill, was intended for 4G rollout. With 5G round in prospect it is important reforms put in place now are kept under review and adaptable to future demands.
20. Mobile coverage needs to be at the forefront of strategy and planning both at a national and local level. Pro-connectivity policies should be woven into Local Plans and growth strategies and linked across national and subnational bodies, including Local Enterprise Partnerships. It is encouraging that the Government is consulting, as part of its recent Housing White Paper, on requirements on local authorities to have planning policies setting out how high quality digital infrastructure will be delivered in their area, and accessible from a range of providers.

Answers to Specific Questions

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Mobile coverage and capacity must be hard-wired into the planning process. New developments create additional demand on mobile networks impacting upon capacity and bandwidth. It cannot be the sole responsibility of the communications providers but must be a partnership developed at the inception of development planning. Mobile UK supports the NIC's assertion that the mobile network operators and local authorities should work together to build a better picture of local area requirements combined with network expertise.

³ Mobile UK

To achieve this there must be strong commitment at the local level as well as the national level to work with mobile network operators. Local authorities must also show leadership and include pro-connectivity policies as part of their Local Plans and take a 'joined-up' approach to telecoms provision and planning applications, especially considering local economic development, sustainability, and social inclusion considerations.

The Government and the NIC also need to take a stronger approach to the timely adoption of Local Plans to provide certainty to mobile network operators. At present a significant number of councils across the country are still to adopt their local plans. Mobile network operators invest significant resources into the quality of coverage and capacity of their networks. Without accurate projections of local council's growth plans it effectively leaves mobile network operators in the dark as to where demand will come from. Better adoption rates of local plans will provide a better picture of future demand and therefore where future capacity investment will be needed.

Further consideration is required around 'emergency works' or the need for temporary sites. Often mobile network operators are served a Notice to Quit (NTQ) which call on mobile network operators to remove existing infrastructure on new developments with minimal prior notice. Alternative sites are often difficult to find or fail to provide coverage to the original footprint. Even if a suitable site is found it will often result in a break in service as necessary planning permission is sought. In addition, the knock-on effect to other nearby sites can result in cuts to capacity due to the removal of essential network infrastructure or increased traffic to cover the lost equipment.

Mobile UK believes that the planning and regulatory regimes continue to require reform to ensure that the UK's current and future communications requirements are considered.

Mobile UK stands ready to work with the NIC, national and devolved governments and other stakeholders to consider further necessary reform. However, it is important that there is strong leadership and Mobile UK and the mobile network operators would welcome the NIC, with its long-term focus and deep understanding of the UK's future infrastructure needs, adding its powerful voice.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Mobile UK believes that the current planning and regulatory regime continues to require reform, not only to enable mobile network operators to meet their current network obligations but also to provide the flexibility to ensure that future requirements for mobile coverage are met.

As stated previously the mobile network operators are investing more than £2 billion each year in new coverage, capacity and capability.

Mobile UK believes due to the incremental and evolutionary improvements to mobile technology planning must be looked at more broadly and the following needs to be considered:

- Reform to planning regulations for telecommunications apparatus, enhancements to Permitted Development Rights
- Reform to planning regulations for housing and other construction, requiring developers to make greater provision for electronic communications
- Other improvements within local authority planning (LPA): updating planning guidance, better training and more resources for planning officers, so that LPAs do not become a bottleneck
- Access to public assets and other landowners: encourage Government to much more to make it easier for mobile network operators to access suitable locations on which to place their apparatus

The planning system does not encourage investment in infrastructure and often hinders the upgrading of existing infrastructure.

It must be noted that one of the key issues in assessing the effectiveness of the current system is not percentage approval rates, which are generally good. Rather it is the time/cost/resource it takes to navigate the system. It means the industry is building the infrastructure the regulations allow rather than the infrastructure that will deliver the coverage UK consumers and business are demanding. Doing nothing is not an option.

Additionally, changes to the planning system, should, as far as possible, be future proofed to allow for new developments in technology, future releases of spectrum for mobile services and new demands for connectivity in a rapidly changing world.

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Mobile UK cannot project how travel patterns will change but it is clear that mobile connectivity can act as an enabler to more efficient, safer and intelligent transport solutions. Mobile technology can assist in the monitoring and management of traffic flows and direct drivers to avoid traffic thus limiting congestion and reducing commute times. In-car connectivity that calls emergency services automatically in the event of a collision can help to save lives while also providing accurate location data to the emergency services to provide assistance and clear blockages to the transport network.

Mobile connectivity is being embraced by public transit systems to connect vehicles to their operations centres and to the public themselves providing real-time route and schedule management. Mobile broadband also increases productivity as customers and businesses can utilise transit time on rail and public transport to conduct business.

However, it is important to note that to fully realise mobile connectivity on the railways and highways better arrangements and channels of communications are required with the respective bodies.

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

Mobile network capacity is not enhanced by a singular one-off investment, such as a new runway. The mobile network operators are currently investing £2 billion every year to upgrade their networks to improve coverage and customer experience. Mobile network operators will need to invest continually in new capacity, coverage and technologies, as will the transmission providers, to ensure that the sector has the necessary bandwidth to connect mobile masts into the wider network.

Ofcom must continue to release spectrum in a timely manner to meet current and future demand and capacity. There must be a fair and transparent process for allocating spectrum but it must be recognised that higher spectrum costs, both in auction and license fees, impacts on investment potential. The UK has one of the most highly competitive markets and this has proved an efficient engine for economic growth and participation. However, the sector is one of the most intensively regulated. It is important that the balance of regulation is optimal to protect the customer and to keep pace with the advancement of mobile technologies and the internet. Flexible, light touch regulation creates the right environment for continued mobile sector investment and innovation.

Mobile UK also calls on the NIC to take a leadership role in ensuring that the Government and devolved institutions consider mobile infrastructure and coverage when investing in significant public infrastructure. For instance, the high-speed rail project, HS2, has recently passed its third reading in the House of Lords and is expected to receive Royal Assent later this year. With construction yet to begin it provides a unique opportunity to build in mobile infrastructure as it is constructed rather than aiming to retrofit once it is complete, as happened with the Channel tunnel and is now happening in the London Underground.

Mobile infrastructure needs to be hard-wired into national and local government strategic thinking from the outset.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Mobile UK agrees with the NIC that mobile connectivity is an essential service. However, we would disagree with the premise that the mobile sector is a utility such as gas or water because operators seek to differentiate themselves through the quality of the service they provide, e.g. extent of coverage, data speeds, and value added services. This has profound implications for the way in which the sector, which has always been highly competitive, is regulated.

Throughout this response, Mobile UK has proposed a broad range of measures to improve the 'digital communications regime'. While mobile network operators are committed to keep investing in more capacity and coverage, there is no doubt that the task would be made easier with greater collaboration and co-operation with our stakeholders.

We all have a stake in the future of mobile networks. Commercial, personal and Governments are identifying many new applications for mobile platforms, such as e-health, connected cars, pollution management, energy management and water conservation. But none will realise its full potential without delivering the nuts and bolts of the underpinning infrastructure. Mobile UK is willing to work with anyone to identify barriers and bring forward practical solutions that will ease the task of delivering a mobile signal wherever and whenever it is required.



Action for Warm Homes

National Energy Action (NEA) response to the National Infrastructure Assessment Call for Evidence

Introduction

NEA is a national charity that has been working for over 35 years to end fuel poverty and tackle exclusion in the energy market locally and nationally¹. Despite our work and national and local action to reduce fuel poverty, the number of households living on a low income in a home which cannot be kept warm at a reasonable cost has continued to rise and affects approximately 4 million homes across the UK². NEA's vision is that 'no one is living in fuel poverty' but due to a lack of investment in energy efficiency programmes this is unlikely to happen in the average lifetime of a baby born today³.

NEA warmly welcomes this opportunity to respond to the National Infrastructure Commission's (NIC) call for evidence. To date NEA has responded to two NIC consultations⁴ and we welcome NIC responding positively to calls for energy efficiency to be a key focus, indicating energy saving programmes should be closely linked to any strategy for decarbonising the UK's heating supply⁵. We illustrate in our response how enhanced energy efficiency programmes could help reduce the cost to energy consumers of the transition to the low carbon energy system and simultaneously improve the quality of life for the most vulnerable⁶. This action would also help meet existing statutory targets (carbon budgets, fuel poverty targets⁷ and minimum energy performance standards in the private rented sector⁸). We also discuss the need for NIC to adequately address wider distributional impacts when making its recommendations to the UK Government within the NIA and we provide further details on how these areas could be addressed below.

Finally, NEA notes it has engaged constructively with NIC on these areas, at a bespoke workshop and directly in 1-1 meetings to make this strong case. As NIC is aware, EEIG is working with Frontier Economics to create an energy efficiency Delivery Vision report which will be finalised in Spring 2017. NEA is also a key member of the Energy Efficiency Infrastructure Group (EEIG) and works closely with a growing number of Non- Departmental Public Bodies, industry partners and NGOs to highlight the benefits of this approach. This has notable support:

Bright Blue 2016

"The economic benefits of incentivising home energy improvements should be viewed in the same way as infrastructure investment, as they comfortably meet the government criteria⁹"

Policy Exchange 2016

"Make energy efficiency a national infrastructure priority¹⁰"

Committee on Fuel Poverty 2016

"We believe that the benefits of designating energy efficiency as a national infrastructure priority should be assessed, thereby potentially helping to unlock access to public infrastructure funding¹¹"

ResPublica 2015

"Energy Efficiency should be made a national infrastructure priority¹²"

CBI 2015

"A new government must act swiftly to make energy efficiency a national infrastructure priority¹³"

Last year the Climate Change Committee (CCC) also highlighted that the Scottish Government have announced that Scotland's Energy Efficiency Programme will be a National Infrastructure Priority. This move has since been emulated by the Welsh Government and the Infrastructure and Wales' Investment Plan aims to drive improvements in the energy performance of buildings and tackle fuel poverty¹⁴. Mirroring energy efficiency as an infrastructure priority consistently across the whole of the UK would help unlock access to public infrastructure funding and help the Government meet its fuel poverty, private rental sector and carbon reductions commitments.

NEA therefore requests a clear statement from the National Infrastructure Commission that making energy efficiency a key national infrastructure priority will be included as part of the National Infrastructure Assessment. According to Lord Deben (the Chair of the CCC) and Lord Stern (Chair of the Grantham Research Institute on Climate Change and the Environment at the London School of Economics) no other infrastructure investment can deliver so much¹⁵.

Domestic energy efficiency can reduce the UK's energy demand economically

An ambitious energy efficiency programme would capture substantial macro-economic benefits for the UK. The report "Building the Future: The economic and fiscal impacts of making homes energy efficient" produced by Cambridge Econometrics and Verco, noted an ambitious energy efficiency programme can:

- return £3 to the economy per £1 invested by central government;
- help create a 26% reduction in imports of natural gas in 2030;
- save domestic consumers over £8 billion per annum in total energy bill savings;
- increase relative GDP by 0.6% by 2030;
- increase employment by up to 108,000 net jobs; and
- help reduce carbon dioxide emissions by 23.6MtCO₂ per annum by 2030.

UK Government estimated in their 2012 Energy Efficiency Strategy that cost effective investments in energy efficiency could save the UK 196TWh in 2020, equivalent to the output from 22 power stations¹⁶.

The Government also determines cost-effectiveness using Marginal Abatement Cost Curves and this ranks specific household interventions (such as wall insulation) based on their cost-effectiveness for abating greenhouse gas emissions. The MACC allows decision makers to assess how much progress is already being made and subsequently consider what it would cost (or save) to make more (or less) progress from that point. The same approach to constructing MACCs for climate change or overall energy efficiency policy can also be applied to fuel poverty and DECC have established FP-MACCs to assess, at different points in time, what the most cost-effective interventions are and how much progress these interventions could potentially make towards fuel poverty objectives¹⁷. The measures included within the current FP- MAC curves highlight meeting fuel poverty targets can be done cost effectively and will generate positive savings for society.

The benefits of energy efficiency have also been illustrated in an international context. The International Energy Agency (IEA)'s report 'Capturing the multiple benefits of energy efficiency' demonstrated the potential for energy efficiency to deliver new jobs and economic growth, reduce pressure on health services, improve energy security and reduce carbon emissions (at the same time as providing a long-term, sustainable solution to unaffordable fuel bills for all consumers). The report also found that that large scale energy efficiency programmes can lead to increases in GDP of up to 1.1% per year; can create significant employment (8-27 job years per €1million invested) and can have a benefit to cost ratio of 4:1¹⁸.

There is also further evidence that demand on the electricity network can be reduced through energy efficiency and can be implemented as an alternative to network reinforcement. We set out in our previous response to the NIC¹⁹ a summary of a number of those trials, and note that previous Low Carbon Network Fund (LCNF) schemes need to be sustained to provide long term results. Alternatives to reinforcement that may be appropriate could be encouraging a distribution network operator to help replace inefficient electrically heated systems; providing a contribution towards connecting a household to a modern efficient district heating or gas network; helping fund solid wall insulation; providing capital towards lighting improvements, low cost energy saving appliances or battery storage alongside microgeneration.

Improving domestic energy efficiency can improve quality of life

Currently, low income households living in the least energy efficient dwellings face extra costs to keep warm above those for typical households. In England this can be summed for all fuel poor households, a so-called 'aggregate fuel poverty gap'. The difficulties faced by individual households can also be calculated and currently fuel poor households living in the least efficient homes pay an extra £1,345 per year to keep warm compared to a typical household²⁰. These costs are largely outside the control of these households – given the capital investment that would be required to improve their energy efficiency - and instead people rely on trading off the temperatures at which they live against other necessities, exacerbating health related issues. Currently these issues are so acute, the physical impacts of living in a cold, inefficient home causes unnecessary suffering and premature mortality²¹ and is a bigger killer than smoking, lack of exercise and alcohol abuse²². Excess winter deaths in England and Wales alone were an estimated 24,300 in 2015/16²³. Over a five year period, the average number of excess winter deaths in England and Wales is 28,218. Based on the World Health Organisation's estimate that a minimum of 30% of Excess Winter Deaths are due to people living in cold homes, an average of over 8,000 people die each winter because they cannot be kept warm at a reasonable cost²⁴.

Beyond the impacts on the frail and elderly, children living in damp and mouldy homes are particularly at risk; almost three times as likely to suffer from coughing, wheezing and respiratory illness²⁵. Existing evidence also highlights infants living in cold conditions have a 30% greater risk of admission to hospital or primary care facilities²⁶. This in turn impacts on educational attainment, either through increased school absence through illness or children unable to find a quiet, warm place to study in the home²⁷. Home energy improvements have been associated with an 80% decrease in the rate of sickness absence from school for children with asthma and recurrent respiratory infections²⁸. Financial stress about energy bills causes huge anxiety which can exacerbate mental health problems, leading to depression and potentially suicide²⁹. Currently, more than one in four adolescents living in cold housing are at risk of multiple mental health problems³⁰.

Problems such as unhealthy low temperatures and damp are also more likely depending on tenure. In particular, the least efficient privately rented homes (such as poorly converted flats and shared properties such as bedsits and hostels) are causing the greatest hardship and the most acute risks for their residents³¹. Inner city areas have very high numbers and concentrations of Houses of Multiple Occupation (HMOs); 41% of England's shared housing stock is in the capital (195,000 homes)³². Astonishingly, HMO properties will not be fully covered by national standards for PRS³³ despite a recent NEA survey which highlighted these worst rental properties have such inadequate heating and insulation that it is impossible to keep them warm and free from damp³⁴. There is also a pressing need to ensure social landlords maintain the historic improvements in this tenure and tackle the remaining stock not improved by the previous Decent Homes programme. This can be achieved by setting a clear aspiration to bring social housing into line with the aforementioned PRS target.

Finally, whilst it is a scandal that cold homes continue to kill thousands of vulnerable people each year, the associated cost of morbidity is equally stark. The current scale of these problems in England alone costs health services approximately £3.6 million per day and in the past four years alone over £5 billion of tax payers' money has been spent treating the symptoms of cold homes³⁵. Addressing these needless costs through further action on energy efficiency and capturing the full benefits of affordable warmth will help avoid the disastrous costs of inaction.

Distributional impacts on different segments of society must be considered

Between 2004 and 2016 domestic electricity prices increased by 80%, whilst gas prices have doubled. In 2004, the UK was a net exporter of energy. By 2010, more than 25% of UK energy was imported, and 40% of gas. Dependency on imports for all fossil fuels negatively impacts the UK's trade balance and energy imports for gas accounts for approximately £30m per day (over £10bn per year). The extent to which the UK can insulate itself from this import dependency (and other raw products such as steel to build new power stations or over headlines) will have a clear key impact on all types of consumers, particularly the most vulnerable.

The average proportion of a household's income spent on energy has doubled since 2004, with low income households continuing to pay a disproportionately higher percentage of their outgoings on fuel, whilst their incomes have stagnated or reduced. The UK has among the highest rates of fuel poverty and one of the most energy inefficient housing stocks in Europe³⁶. Currently no public money is going to be spent this Parliament on improving energy efficiency levels in domestic properties in England - the only nation without a Government-

funded energy efficiency programme for the first time in over 30 years, with delivery of home energy efficiency improvements slowing dramatically as a result³⁷. This has resulted in there currently being little prospect of meeting fuel poverty commitments in England³⁸ and the other UK nations are not on track to meet similar commitments. The Committee on Fuel Poverty (CFP) have estimated the overall cost of meeting national fuel poverty commitments in England. Overall, an investment of £20bn is required to get all (current) fuel poor homes in England to at least an EPC C by 2030³⁹. According to the Committee on Fuel Poverty⁴⁰, the Climate Change Committee (CCC)⁴¹ and think tanks such as Policy Exchange⁴² current resources are less than half of what is required to meet these commitments.

This lack of public funding is in spite of domestic energy consumers predicted to contribute an estimated £14 billion to the Treasury⁴³ this Parliament, £30 billion over 10 years⁴⁴. Just before the last General Election the Treasury raised an additional £500 million pounds creating higher energy bills⁴⁵ and dramatically impacting low income consumers' ability to heat and power their homes and their life chances. These funds can be used to invest in improving national competitiveness by reducing energy demand - many other EU governments⁴⁶ channel many of these resources back to consumers, future-proofing their economies and helping improving national competitiveness by reducing energy demand.

In addition, whilst NEA fully recognises the need to decarbonise and maintain the competitiveness of energy intensive users, we are deeply concerned by the future impacts of exemptions for Energy Intensive Industries from the indirect costs of the Renewables Obligation and Feed-in Tariff Schemes. Without adequately addressing these concerns, the actions proposed will result in a further erosion of the 'polluter pays principle'. Overall we contest there is no need for the burden of policy costs on energy bills to increasingly be shouldered by domestic consumers. These acute concerns are evident as a result of the UK Government moving away from funding compensation via general taxation. We highlight to NIC that financing any Energy Intensive Industry exemptions out of general taxation is significantly less regressive. If this approach is not adjusted, additional costs presented by this new policy will cost fuel poor households in England somewhere between £115 to £185m over the lifetime of the policy and all domestic consumers (again just in England) broadly between £1.1 to £1.7bn. This additional hardship will put a strain on already stretched public resources and services.

Households living off the gas network

The circumstances of some households leave them particularly vulnerable to high energy prices, when low household income is exacerbated by other factors. For example, some households are reliant on more expensive and inefficient sources of space and water heating. Others live in properties where thermal standards of their dwellings cannot easily be improved in a cost-effective manner.

Currently off-gas customers need to pay far more than gas customers in a similar property. This is clearly illustrated in table 1, below. There is an emerging consensus that different policy solutions are required for urban off-gas consumers, many of whom live in flats and use electricity, and rural off-gas consumers, who generally live in houses and rely on heating oil, LPG and solid fuel.

Table 1: Typical space and water heating costs by fuel type			
Fuel type	Heating system	Tariff	Annual cost
House coal	Open fire with back boiler	-	£1,363
Electricity	Storage heating, electric radiators + immersion heater	Economy 7 DD	£1,680
Natural gas	Gas-fired condensing boiler, radiators + hot water cylinder	Single tier DD	£1,061
	Gas-fired boiler, radiators + hot water cylinder		£1,272
Liquid propane gas	LPG-fired condensing boiler, radiators + hot water cylinder	-	£1,560
	LPG-fired boiler, radiators + hot water cylinder		£1,893
Oil kerosene	Oil-fired condensing boiler, radiators + hot water cylinder	-	£729
	Oil-fired boiler, rads + DHW cylinder		£886
Source: Sutherland Comparative Heating Costs, Northern England, January 2016, based on 3-bedroom semi-detached house.			

The impacts of policies on bills will be particularly acute for electricity only customers. CSE's report for the Fuel Poverty Advisory Group (FPAG) and Consumer Focus 'The Hardest Hit: Going beyond the mean' highlighted that, in 2020, consumers with electric heating (11% of all consumers) will be most affected by the cost of Government policies, as well as tending to have lower incomes than those with other forms of heating. These consumers are projected to pay 19% of the total cost of energy policies yet will only receive 7% of the benefits. Currently, only 27% of consumers with electric heating receive some form of benefit from energy policies, compared to 40% of all consumers. The UK Government's own analysis also highlights that whilst policy costs currently represent c.7% (£89) of the household electricity and gas bill; this is set to double to 14% in 2020. The CCC also found that a further £55 would be added to average annual bills from 2013 to 2020, mainly to support investment in low-carbon electricity and a further £75 from 2020 to 2030 due to assumed increases in the carbon price⁴⁷ (as shown in figure 2, below). We are concerned that the Government has not investigated the impact of these policies on the 'fuel poverty gap'. However, the UK Government's most recent fuel poverty statistics do highlight the relationship between increased fuel poverty risk and living in an off-gas property. In particular:

- **The worst properties are more likely to be located off the gas grid:** 70% of F/G rated fuel poor properties (the least energy efficient housing) are off-gas. Over 70% of F/G properties have expensive and hard to treat solid walls and, on average, fuel poor households in F/G properties face an annual fuel poverty gap (the excess amount a fuel poor household needs to spend to keep warm compared to a typical household) of £966 and £1,345 respectively. This is more than triple the average gap across A to D rated properties
- **Off gas households are more likely to be in severe fuel poverty:** because they heat their homes with more expensive fuels, fuel poor households off the gas grid experience, on average, excess fuel costs of £670 per year, more than double the average fuel poverty gap of the on-gas fuel poor (£302). Overall, the Energy and Utilities Alliance (EUA, 2017) estimates that households not connected to the gas grid are 1.5 times more likely to be in fuel poverty than those with a mains gas connection
- **Off-gas properties are more likely to be located in rural areas:** the extent of off-gas properties increases with increased settlement dispersal, with only around 5% of urban areas off-gas (Baker et al., 2008). Fuel poverty is more prevalent in rural locations than urban areas and rural households also face a number of other pressures, including declining service provision and reduced employment opportunities

We provide further information about the demographics of fuel poverty in our previous response to the NIC⁴⁸.

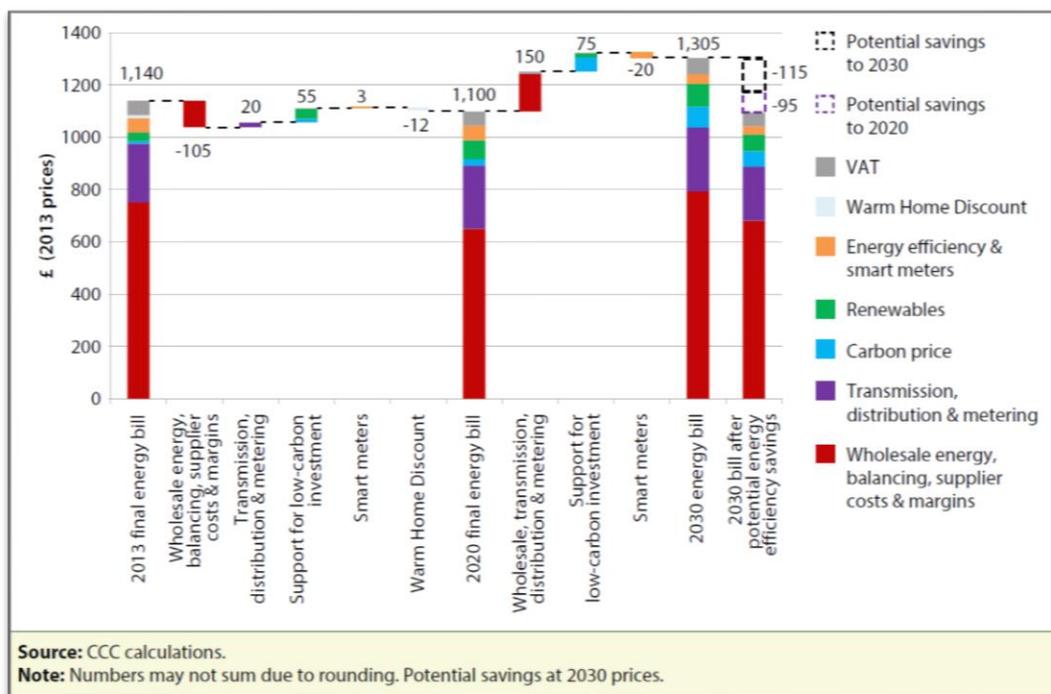


Figure 2: Changes in the typical dual fuel bill, 2013, 2020 and 2030 (reproduced from Committee on Climate Change)

Gas Distribution Networks and their role in helping off gas households

As a result of these issues in off-gas properties, Ofgem has proposed that GDNs will connect 18% more households (91,203 households) to the gas network until 2021 compared to the original GD1 connections target. Whilst in the longer term, a further extension of the gas network may not be compatible with decarbonisation targets, NIC should support the case for assisting GDNs meet the targets out to 2021.

But there is a funding gap which has detrimentally impacted the delivery of gas connections to fuel poor households. Specifically, households eligible for a gas connection under the Fuel Poverty Gas Network Extension Scheme (FPNES) are often not able to access funds that will cover the cost of the gas central heating system. This issue has been raised by GDNs and recognised by Ofgem. For example, the regulator noted stakeholder responses to an August 2014 consultation on the future of FPNES highlighted a 'clear disconnect between the current relevant energy efficiency schemes (ECO and Green Deal) and the Scheme [FPNES]. Specifically, the move to ECO/Green Deal was seen to have had a detrimental impact on the accessibility of in-house funding, especially in England⁴⁹. These concerns are borne out in practice. Following an information request, the four GDNs supplied NEA with data on the number of fuel poor connections completed as part of their RIIO-GD1 targets to date.

	2013/14	'14/15	'15/16	'16/17*	% of target completed
England	7,377	7,638	8,875	6,722	44
Wales	1,440	1,064	882	404	75
Scotland	4,983	3,699	2,616	1,535	75
Great Britain	13,800	12,401	12,373	8,661	52

*Data was collected in December, estimated figures for 2016/17 are up to end November 2016
 Source: NEA calculations based on data provided by GDNs

Table 3 shows that, although GDNs are around halfway to meeting their April 2021 target of 91,203 connections, progress at the regional level is mixed. In particular, connections in Scotland are far ahead of the other nations. With four years remaining to the 2021 target, 75% of the Scottish sub-target of 17,130 connections has been achieved. By contrast, only 44% of connections targeted for England have been completed.

NEA estimates a £43.5 million gap over the ECO transition period. Additional funds are urgently needed for private tenure homes in England and Wales where the majority of connections remain for completion. NEA therefore proposes a £25 million per annum non-gas fund and is pressing for this to be committed by the UK Government in its spring 2017 budget to cover the ECO transition period. These funds should be reserved for first time gas heating systems in non-gas homes which are eligible for connections through FPNES. NEA estimates a £37.5 million fund could support an estimated 9,375 households and deliver up to £142 million in lifetime bill savings. The fund administrator should encourage a whole-house approach to connections through pooling funding and delivery resources across GDNs, suppliers and local partners. Existing work highlights potential exists for the impact of any new funding to be amplified via co-funded initiatives by either local government, private and social landlords; utility companies, electricity network operators as well as other key actors such health agencies, charities and community groups. The exact split of which funds would be available for each GDN area could be based on the current apportionment of the revised targets (see table 4, below) across each GDN area.

GDN	GDN areas								Total	
	England									
	East	London	North West	West Midlands	North East	South	South West	Wales	Scotland	
NGG	12,046	2,880	13,330	8,360						36,616
NGN					14,500					14,500
WWU							12,590			12,590
SGN						10,367			17,130	27,497

This response also draws on NEA's current Technical Innovation Fund. This programme specifically aims to facilitate community-level trials of innovative solutions utilising energy saving measures and approaches not traditionally within the scope of current retrofit or energy saving programmes. Grant recipients from the programme are working to install a range of technologies and work with NEA to ensure that robust monitoring and evaluation takes place. The projects are delivering 1,488 measures, plus further additional measures through match funding. There are 30 technologies being tested using 81 products, providing vulnerable groups with the opportunity to be early adopters of innovative measures. Examples of innovative heating measures being installed include hybrid and ground source heat pumps, district heating, domestic CHP and biomass, new heating control systems, heat stores, battery stores and heat recovery systems. There are also several projects trialling smaller complimentary technologies with the potential to reduce energy consumption or improve comfort. NEA are committed to ensuring the findings of this work feed into the Commission's evidence base for decision making and where relevant this response draws on early learnings, as well as evidence from other programmes and initiatives.

Thermal comfort taking is understood and accounted for in projections

It asserted by some parties that improving the energy efficiency of the homes of low income households has reduced carbon benefits, as these households are likely to take back much of the potential energy savings as extra warmth and hence the carbon savings are less than in the homes of warmer, better-off households. This could, in theory, make interventions less cost effective.

However, whilst it may be true that poorer households may forgo some of the potential energy savings in favour of a warmer internal climate, even within the coldest homes, there are cost effective carbon and monetary savings to be made. Those living in fuel poverty can use the extra money to pay for other essentials, as well as the extra warmth.

Also, the rebound in cold homes also only happens with the first energy efficiency improvements. Once the home has reached a higher level of warmth, there will be less rebound. Government statisticians currently apply a blunt discount in savings in all homes, but we argue that the discount should be weighted towards the least efficient F and G-rated homes, and then at a lower rate thereafter for example when homes are improved to C or better. The rebound effect is less likely to be found in relation to electricity, for instance from more efficient lights and appliances. Finally, there is also less of a rebound, if any, with hot water use, but this has not been properly researched.

It is vital to note, however, that the impacts of such rebound onto the potential for energy savings from energy efficiency in the UK is understood and accounted for in projections.

Key recommendations

We believe that the following action is required:

- I. The National Infrastructure Commission should make energy efficiency a key national infrastructure priority and include it as part of the interim and final National Infrastructure Assessment.
- II. We urge the NIC to highlight the quantum of the shortfall between the level of ambition presented by statutory targets (carbon budgets, fuel poverty targets and minimum energy performance standards in the private rented sector) with current delivery rates and what can be achieved via existing policies to the UK Government.
- III. Given the economic, social and environmental benefits NIC would also press the UK Government to clearly set how statutory fuel poverty commitments in England are to be met and the need for them to be adequately resourced
- IV. An immediate stimulus for the energy efficiency industry would be generated if the Government stated clearly how the worst PRS properties in England and Wales will not be rented out from 2018-2020, in line with national statutory targets and Social housing and HMO properties should be improved to the same national standards as the Private Rented Sector.

- V. In order to monitor ongoing distributional benefits, NIC could urge the UK Government to continue to report on the impact of policy cost on bills each year with a regular timeframe for publication. The Government should also include an estimate of how the overall gross contribution of any energy policies, paid for by energy consumer levies, increases the aggregate and average 'fuel poverty gap' for that year in England. In addition the UK Government should work with the Devolved Nations to assess, and report on, how energy policy costs added to consumer bills impact on fuel poverty levels in NI, Wales and Scotland.
- VI. NIC should recommend that where possible the burden of policy cost on bills should be better balanced between tax payers, electricity and gas customers. In particular, if the Government continues to implement an exemption for Energy Intensive Users from the indirect costs of the Renewables Obligation (RO) and Feed in Tariffs (FiT) schemes these exemptions should be paid for via taxation. This is more progressive as the tax system accounts for differences in income.
- VII. NIC could also recommend HMT should work with HMRC, Ofgem and BEIS so that suppliers do not recover VAT that is currently applied on top of network and/or environmental charges. How levies are recovered is also critical, NIC could also urge for additional relief to be provided for low income energy customers that are reliant on electricity to heat and power their homes as they hardest hit by policy cost on bills and also have the biggest fuel poverty gaps
- VIII. To support first time gas heating systems in homes which are eligible for connection to the gas network through the Fuel Poor Network Extensions scheme, we ask NIC to support our proposal that the UK Government commits to a £25 million per annum non-gas fund in its spring 2017 budget to cover the 18 month ECO transition period.

¹ Please visit www.nea.org.uk

² The UK fuel poverty figures relate to 10% definition published by DECC June 2016. Available at: <https://www.gov.uk/government/collections/fuel-poverty-statistics>.

³ Government has a statutory target to fuel poor households up to an energy rating of band C by 2020. Currently only c. 20,00 fuel poor households are being brought up to band C per year and so we estimate it will take c. 95 years to bring all current fuel poor households up to this level, which would mean the Government could miss their target by 80 years.

⁴ National Energy Action (NEA) response to the National Infrastructure Commission consultation on the National Infrastructure Assessment ; and National Energy Action (NEA) response to the National Infrastructure Commission call for evidence – Energy Priorities

⁵ National Infrastructure Assessment, Process and Methodology, Consultation Response, 2016 p. 14

⁶ These opportunities have begun to be responded to in other nations across the UK. The Scottish Government has announced that Scotland's Energy Efficiency Programme will be a "National Infrastructure Priority". This move has been emulated by the Welsh Government and the 'Infrastructure and Wales Investment Plan' which also aims to drive improvements in the energy performance of buildings and tackle fuel poverty.

⁷ In England, the statutory target is to ensure that as many fuel poor homes as is reasonably practicable achieve a minimum energy efficiency rating of Band C, by 2030. This is supported by interim milestones. For more information see Cutting the cost of keeping warm :

A fuel poverty strategy for England, UK Government, March 2015.

⁸ From April 2018, landlords will not be able to rent out properties with energy efficiency ratings below EPC Band E (exemptions apply).

⁹ Better Homes: Incentivising Home Energy Improvements, Hall and Caldecott 2016, p27.

¹⁰ Too Hot to Handle? How to decarbonise domestic heating, Howard and Bengherbi 2016, p.14.

¹¹ A report on initial positions, Committee on Fuel Poverty 2016, p4.

¹² After the Green Deal: Empowering people and places to improve their homes, recommendation 5, Rosenow and Sagar 2015.

¹³ Effective Policy Efficient Homes, Confederation of British Industry (CBI) 2015, p2.

¹⁴ CCC, Meeting Carbon Budgets – 2016 Progress Report to Parliament, June 2016.

¹⁵ Letter to the Times, Lord Deben and Lord Stern, 2nd April 2015.

¹⁶ DECC Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK (November 2012)

¹⁷ Fuel Poverty: a Framework for Future Action – Analytical Annex (DECC, July 2013)

¹⁸ Capturing the multiple benefits of energy efficiency, International Energy Agency, 2014.

¹⁹ National Energy Action (NEA) response to the National Infrastructure Commission call for evidence – Energy Priorities, p.7

²⁰ The Government's most recent fuel poverty statistics, "Annual Fuel Poverty Statistics Report 2016", Office of National Statistics

²¹ Earlier this year the BBC's Panorama also highlighted people are still getting ill and 9,000 people died needlessly because of cold homes in England

²² Association for the Conservation of Energy (March 2015) Chilled to Death: The Human Cost of Cold Homes, page 2

²³ Office of National Statistics, Excess winter mortality in England and Wales: 2015/16 (provisional) and 2014/15 (final) (ons.gov.uk)

²⁴ Further analysis on excess winter deaths are attributable to cold indoor temperatures was carried out by Sir John Marmot for Friends of the Earth : The Health Impacts of Cold Homes and Fuel Poverty, Marmot Review Team, 2011.

²⁵ Marmot Review Team (2011) The Health Impacts of Cold Homes and Fuel Poverty. Friends of the Earth and the Marmot Review Team, London.

²⁶ Child Health Impact Working Group (2006) Unhealthy Consequences: Energy Costs and Child Health. Boston, MA: CHIWG.

²⁷ NEA (2013) The Many Faces of Fuel Poverty. Page5.

²⁸ Somerville M et al. 2000. Housing and health: does installing heating in their homes improve the health of children with asthma? Public Health; 114, 434-39.

²⁹ Christians Against Poverty (2015) The poor pay more: Prepayment meters and self-disconnection.

³⁰ NEA (2013) The Many Faces of Fuel Poverty. Page5.

³¹ Fuel Poverty and Houses in Multiple Occupation, produced by Future Climate and National Energy Action, 2016.

³² Ibid

³³ The regulations apply to the domestic private rented sector in England and Wales. This is defined in section 42 of the Energy Act 2011 as properties let under an assured tenancy for the purposes of the Housing Act 1988, or a tenancy which is a regulated tenancy for the purposes of the Rent Act 1977.

³⁴ Fuel Poverty and Houses in Multiple Occupation, produced by Future Climate and National Energy Action, 2016.

³⁵ NEA press release, Cold homes claiming needless lives and costing every local Health and Wellbeing Board in England over £27,000 each day, 26 February 2016

³⁶ Still the Cold Man of Europe – briefing, Association for the Conservation of Energy, October 2015.

³⁷ CCC, Meeting Carbon Budgets – 2016 Progress Report to Parliament, June 2016

³⁸ The Fuel Poverty (England) Regulations 2014 are now law.

³⁹ This breakdowns as £1.9bn to meet the 2020 EPC E milestone, a further £5.6bn to meet the 2025 EPC D milestone and a further £12.3bn to meet the 2030 EPC C target. A further £6bn would be required to ensure all low income households (not just those that are currently fuel poor) are brought up to EPC band C by 2025. This investment does not fall to central Government solely; it must be defrayed across a number of parties (central government, private and social landlords; LAs, utility companies, escos, gas and electricity network operators as well as other key actors such health agencies, charities and community groups.

⁴⁰ This breakdowns as £1.9bn to meet the 2020 EPC E milestone, a further £5.6bn to meet the 2025 EPC D milestone and a further £12.3bn to meet the 2030 EPC C target.

⁴¹ Addressing fuel poverty and meeting carbon budgets go hand in hand (CCC), 7 October 2014.

⁴² Warmer Homes - Improving fuel poverty and energy efficiency policy in the UK, 2015, Policy Exchange

⁴³ We estimate that £11.82bn will be collected in England, £1.33bn in Scotland, £690m in Wales and £190m in Northern Ireland

⁴⁴ This analysis of the revenues the Treasury receives from domestic consumers is based on Government sources to estimate how much expected revenue they will receive from a) the European Union Emission Trading Scheme (EU ETS), b) the Carbon Price Floor (CPF) and c) VAT on an average electricity bill. We have then combined this with expected VAT revenues from domestic gas bills. These estimates are all based on the Government's own assumptions regarding energy consumption and this includes an unfounded assumption that EU products policy will increase the domestic energy efficiency of electric appliances substantially

⁴⁵ This figure is the estimated income from the Carbon Price Floor 2015-16 compared to 2014-15. Source: Carbon Price Floor, 14 May 2014, House of Commons Library

⁴⁶ According to a recent report: The economic case for recycling carbon tax revenues into energy efficiency, Prashant Vaze and Louise Sunderland, February 2014: 13 countries in the EU have pledged to return part of the proceeds from the EU-ETS auctions to climate and energy efficiency programmes.

⁴⁷ Committee on Climate Change, 2014, Energy prices and bills – impacts of meeting carbon budgets

⁴⁸ National Energy Action (NEA) response to the National Infrastructure Commission consultation on the National Infrastructure Assessment (2016)

⁴⁹ The Findings of our Review of the Fuel Poor Network Extension Scheme, Ofgem 2015

To: Commission Secretariat
National Infrastructure Commission

Date: 10th February 2017

Ref:

Circulation: NIAevidence@nic.gsi.gov.uk

Contact: <name redacted>

Tel: <telephone redacted>

Fax:

Email: <email redacted>

The National Infrastructure Commission call for Evidence

Introduction

The NFU represents 55,000 farm businesses in England and Wales. The NFU welcomes the opportunity of being able to provide evidence which will shape the development of the National Infrastructure Assessment.

Sir John Arnitt said when the call for evidence was announced *'How can infrastructure best support growth, how should we decide what we repair and what we build, and who should pay for it – these are the sorts of big questions we need to answer. That's why the Commission is asking for your views across these and a range of issues as we launch the next stage of our National Infrastructure Assessment.'*

It has been highlighted in the Call for Evidence booklet that *'The Commission will consider the demand and supply of infrastructure services, such as journeys or communication, as well as infrastructure assets, such as roads or fibre optic cables'*. It is further stated that the NIA will be developed by assessing the infrastructure system as a whole using a robust, common methodology to develop needs assessments that take account of strategic cross-sector considerations and resilience implications.

With this in mind the objectives of the National Infrastructure Commission (NIC) are to

- (i) Support sustainable economic growth across all regions of the UK,
- (ii) improve competitiveness and
- (iii) improve quality of life.

Over the last two years a number of nationally important infrastructure schemes have come to the fore with projects going ahead such as the A14 Improvement scheme from Huntingdon to Cambridge, Hinkley Point C Power Station and the proposals for the land take to build HS2 Phase 1. It is clear that farmers and growers are increasingly extremely concerned by the impact of such infrastructure proposals. The concerns are regarding both the land that is to be directly taken to build the infrastructure and the land that is needed to meet all the environmental mitigation requirements that accompany each infrastructure development. Infrastructure in rural areas creates uncertainty as well as the long term damage to farm business livelihoods.

Farmers and growers do though recognise the importance of investing in the nation's infrastructure. This infrastructure is needed to ensure cost effective communication and transfer of goods and services within and beyond our borders and in the long term will help with our national economic growth and competitiveness. But for those in rural areas the practical reality is land being taken out of production for infrastructure, including losing buildings and other fixed equipment and farm diversification projects

The voice of British farming

Although every effort has been made to ensure accuracy, neither the NFU nor the author can accept liability for errors and or omissions. © NFU



NFU supported by

NFU Mutual



are being similarly displaced. This risks future farm growth and jobs rather than supporting economic growth in the rural areas. Further, it is hindering rural businesses in being able to improve their competitiveness and is having a negative impact on the quality of life of farmers and their families rather than improving it. Therefore the objectives of the NIA should underlie how governance structures are developed, with the Commission putting in place measures to ensure all projects are 'rural proofed' and can demonstrate how they are benefiting farming and rural communities affected by the proposals.

As an example, HS2 Phase1, the high-speed line will cut through many farms severing land. Some farm businesses will not survive the amount of land that is compulsory purchased and others will have to completely reorganise how they run their businesses in order to survive the impact of scheme. However, they will not benefit from the high-speed train as there are no connecting stations between London and Birmingham.

Further, the NFU has long argued that inadequate Government investment in agricultural infrastructure has undermined our domestic food security and productivity. Investment is needed in reservoirs for water storage for irrigation and rural broadband provision. This includes the removal of planning barriers. Presently infrastructure directly benefitting agriculture does not feature as an area that is being directly looked at by the NIA.

The NIA must look at the impact of infrastructure development in rural areas and on individual rural landowning businesses. There needs to be a balance and the impact of developing and building the infrastructure needs to be reduced so that the impact on rural businesses during construction is minimised. At the present time rural businesses seem to be having to take all the impact from the development of the schemes and then not benefiting in any way from the infrastructure. Infrastructure development needs to be used as a catalyst for getting better infrastructure connections for farmers and rural communities rather than just leading to the blighting of farms.

One of the major infrastructure challenges is the amount of land take required for all infrastructure schemes and it is essential that the Commission must address this. The NFU believes strongly that it is important to treat farmland as part of a critical national business producing our food and not simply as an open space which is automatically available for alternative uses including significant infrastructure projects which are now regularly being brought forward.

As 75% of the UK land area is countryside, it is essential to create a governance structure that takes into account the impact of infrastructure on farmers, farm land and rural businesses and enable them to have a fair deal. Rural areas host around half a million businesses, equivalent to over 25% of all registered businesses in England and 15% of jobs. Unless the resultant assessment addresses these concerns it will potentially leave a productivity gap for farming and rural businesses.

The Rural Productivity Plan made clear the linkages between the National Infrastructure Plan and the need for rural economies to be better connected to the wider economy. However there has been no progress report to date on the Rural Productivity Plan's objectives since they were introduced in August 2015 and the NFU is disappointed that this present Call for Evidence only appears to contain one reference to 'rural' (in a transport planning context).

The NFU has been lobbying on the areas that are being covered by the NIA for a number of years. In the NFU's 2015 Manifesto we specifically asked for Government departments to act together in recognising the importance of agriculture and food production. This places greater emphasis on 'rural-proofing' of all legislation and across all government departments.

The NFU would like to see a major review of the statutory compensation arrangements for nationally important infrastructure projects (e.g. HS2, HS3, A14 widening, A303 Stonehenge, National Grid Richborough Connection and the North West Coast Connection). All of these schemes are compulsory purchasing land and the infrastructure will affect farming practices and operations on a daily basis. The aim has to be for fairer and swifter compensation for property lost. It is going to become more and more

The voice of British farming

Although every effort has been made to ensure accuracy, neither the NFU nor the author can accept liability for errors and or omissions. © NFU

NFU supported by



difficult for landowners to find land to purchase and replace land taken for infrastructure. The value of land around any development will be inflated due to increased demand and so simply valuing land at market value is not enabling a landowner to be no worse off in financial terms after acquisition. In short the principal of equivalence is not working in practice and is failing farm businesses.

Summary of Asks

Summary of particular asks to NIA include:

- To treat farmland as part of a critical national business producing our food and not simply as an open space
- Reduce the impact on farmers from infrastructure development and reduce long term blight
- Farm businesses are being impacted the most by national infrastructure projects but are often less likely to directly benefit leading to a social imbalance
- Review statutory compensation arrangements for compulsory purchase so that equivalence can be achieved – the realisation of how difficult it will be for farm businesses to replace land taken
- The unacceptable undervaluing of farmland and farm businesses over habitat mitigation
- To finding a balance for environmental mitigation which is sustainable
- Increase on-farm water storage and reservoir building with financial support and tax incentives and by reducing red tape for reservoir applications.
- Accelerated rollout of high-speed broadband to all rural areas to provide universal coverage equivalent to urban areas and this to include mobile coverage
- Landowners to be fairly compensated for infrastructure to enable high speed broadband and mobile coverage
- Ensure that planning rules enable farmers and farm enterprises to compete and grow with expanding potential markets and conform with regulatory requirements.
- The need for detail design of projects to be carried out earlier in the process of a DCO application
- The need for early engagement in the design process – farmers often see the important detail far too late in the process
- The lack of proper consideration given in design for the practical functioning of farm businesses
- Environmental Impact Assessments must consider more accurately the effect of land take and loss of buildings on the viability of farm businesses
- Ensure that Defra's reform of the water abstraction licensing regime delivers an adequate supply of water to meet the increasing demand for UK-grown foods such as fruit and vegetables.
- Establish with industry a cross-Government land-based renewable energy strategy utilising anaerobic digestion, biofuels, biomass, by-products, solar and wind.
- Greater consistency in low-carbon energy policy across incentives, planning, grid access and energy storage.

The NFU has responded to the particular questions raised as follows:

Cross-cutting issues:

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time.

The planning system works best when it engages with those communities effectively and provides them with relevant and up to date information and certainty as to when development is to be delivered. If the National Infrastructure Commission develops a plan solely for the benefit of business and people living in urban areas and providing infrastructure for their benefit, then it will perpetuate inequality in rural areas and fail to meet its stated objectives.

The NFU has no objection in principle to the continued use of the Planning Inspectorate to determine national infrastructure projects, but believes there needs to be more upfront meetings and discussions

The voice of British farming

Although every effort has been made to ensure accuracy, neither the NFU nor the author can accept liability for errors and or omissions. © NFU

NFU supported by



between the developer and landowner who is to have land compulsorily purchased prior to the application being submitted for a DCO. This is to allow fuller an understanding of how projects are going to be developed. In some cases such early engagement can reduce the impact on the farming business because it is early enough in the process to slightly change the line/route of the proposed scheme. From our experience, changes to the design can only be accommodated by engineers if consulted at very early stages of the design process.

It is clear to the NFU from their involvement in Development Consent Order (DCO) process for Nationally Significant Infrastructure Projects that developers are often submitting applications for a DCO before they have even designed the scheme to a satisfactory stage to be able to provide the necessary design information to landowners. Even now landowners are waiting to receive the final design of the A14 between Huntingdon and Cambridge when the examination of the application took place in the summer of 2015. The NFU believes that the Planning Inspectorate must look more closely at how developed the design is of the project before accepting applications. Presently when landowners are asking for design details and plans these cannot be given by the developer and the response is always that the final design has not been carried out. Farmers are having land compulsorily purchased from them without actually knowing how the development will finally affect them because design is not completed within the examination window. The Planning Inspectorate therefore needs to be involved at an early stage to ensure parameters are established and achieved before applications are accepted.

The parameters for valuing farmland exist in the National Planning Policy Framework, but there needs to be a more informed view of farm businesses taking into account the need to accommodate valuable land for agricultural use, homes and other rural businesses and services. 61% of farms contain diversified farming activities, with this trend expected to increase. Environmental Impact Assessments (EIA) are slowly improving as the impact on agricultural land and soils is considered, but the EIAs still never highlight the rural jobs that will be lost due to the land and buildings that may be taken for the scheme. As a result the impact on farm businesses is constantly underestimated.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The NFU agrees that it is critical that infrastructure should protect the natural environment and that habitat mitigation planning is a crucial part of any development scheme. But as the NFU has stated over many years in regard to land take for mitigation on HS2 Phase1, where land take required for mitigation has been highlighted in multiples compared to the land lost for the development. This is amplifying agricultural land taken out of production and with no guarantees on environmental success.

The NFU believes that the area of environmental land lost should be replaced with like for like and that it is the quality and management of proposed environmental mitigation is the most important aspect. This will then lead to an enhancement of the natural environment. The NFU strongly disagrees with the suggestion made by Natural England in regard to ancient woodland that for any one hectare of area lost should be replaced with 30 hectares of new planting.

A balance has to be achieved especially when considering the infrastructure that is in the pipeline and will be coming forward for development in the next 5 years. The proposals that have been outlined for environmental mitigation are not sustainable in the future in a country of our size.

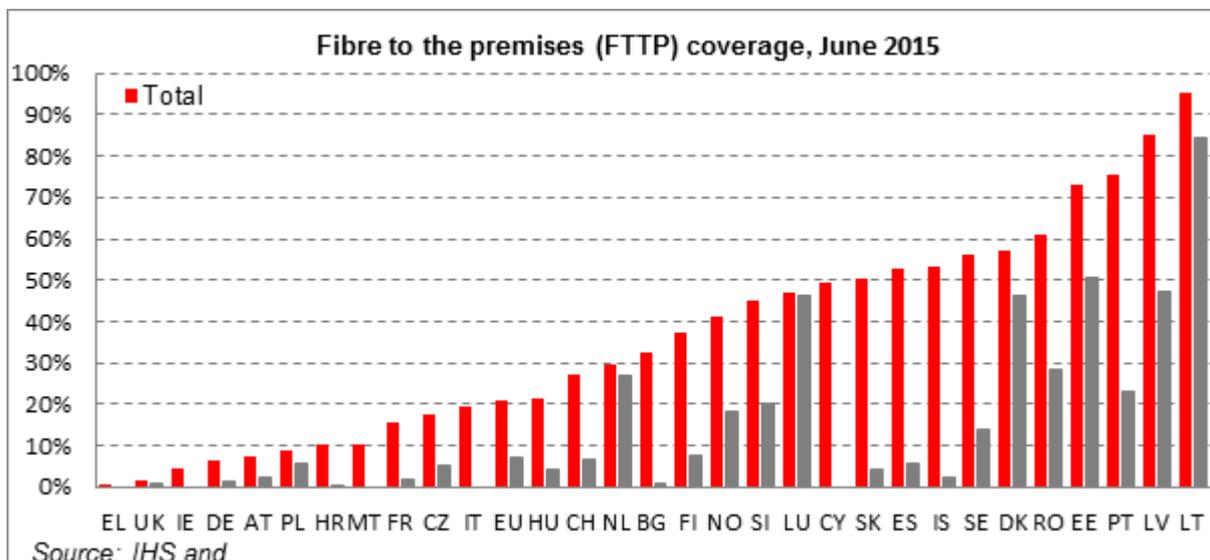
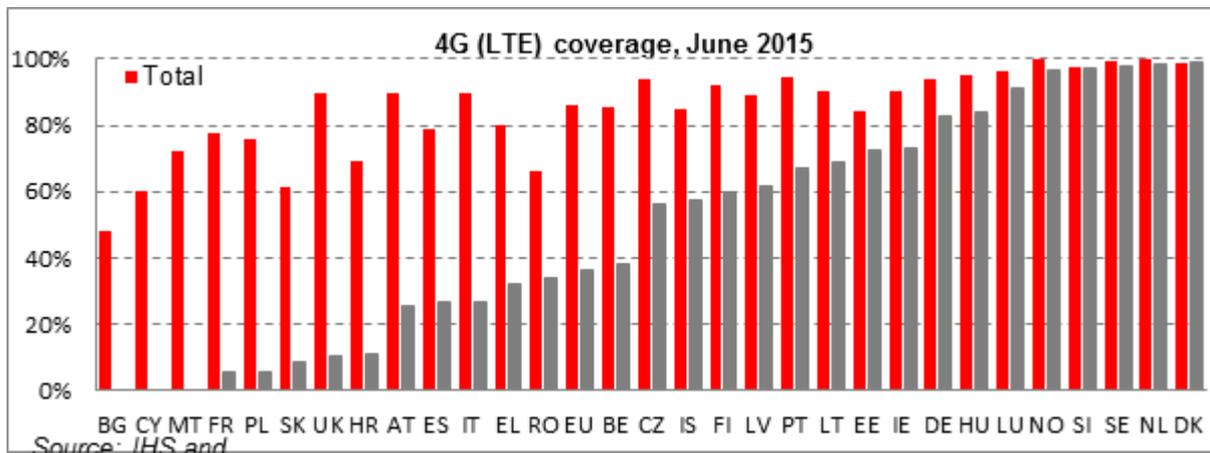
Digital communications:

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

The National Infrastructure Assessment has to contribute to the completion of the UK digital network and ensure that future proofed connectivity is available that works across all geographical areas and is accessible by all those who want to use it.

The NFU is not clear what the commission means by *taking into consideration the inherent uncertainty in predicting long-term technology trends*, as Government action by other arguably more forward thinking nations is actually driving such trends. South Korea and China already has 5G technology developed, due their national policy objectives driving technological advance. America and Germany are already advancing their technological needs.

As the graphs below show, the UK is falling behind two key technologies. For fourth generation (4G) and full fibre coverage, especially for rural area (grey columns), the UK urgently needs to develop an integrated strategy if it is going to be relying on them. The National Infrastructure Commission should play a key part in this delivery.



The NFU would stress that the National Infrastructure Commission should make the link at all times between mobile and fixed broadband services and that it ensures that any assessment strategy ensures delivery is complementary and maximises service coverage. This is an area where the UK could excel and deliver more market friendly conditions for farmers and rural businesses, which would ultimately benefit everyone. Connectivity is increasingly expected to be a universal requirement and not one that should stop when someone leaves an urban area or a motorway.

The NFU do not favour any specific technology and recognise that full fibre is only one solution for broadband connectivity and one which has not really been promoted in rural areas, where most farmers still rely on copper connections. When it is offered to farmers (largely without Government incentive) it is prohibitively expensive. Hence there is a concern that full fibre may not deliver full connectivity. It could be used where technically viable or could provide part of the solution when used with other technologies targeting rural coverage. Any assessment needs to work on the premise of incentivising the provision of such technology for farmers and rural communities (such as through wider infrastructure projects) and measure actual delivery on the ground. Access to backhaul services will be important for all technologies used.

There are limitations on accessing digital services via 4G currently due to speed, cost and atmospheric conditions as well as to the availability of the signal due to other market demands. NFU members have reported a reduction in voice signal quality and coverage when 4G has replaced 2G services. It is likely that there will continue to be significant rural gaps in 4G coverage, even if the 90% coverage targets the mobile operators have signed up are reached (95% possibly for EE). Given how the technology is providing an alternative form of communication for farmers across their land holdings, the NFU would welcome positive action to provide resilient broadband and mobile coverage and close the gaps which still exist following the closure of the Mobile Infrastructure Project. We know that the Emergency Services Network being rolled out by EE may offer some opportunity for improved coverage, but understand that it is being delivered primarily for emergency services use. Current issues with the roll out 4G technology should provide lessons about future spectrum releases and in particular how 5G services can be delivered in rural areas.

There are also many different examples of how broadband is being provided across rural areas internationally, the main difference being that other countries are not so reliant on full fibre for connections and are using different technology models and incentives. [HD mesh radio technology](#) has been used to serve communities as remote and mountainous as Hawaii, whilst closer to home [White Space](#) spectrum has been re-used to serve remote areas in Scotland and Wales, with academic research happening in Glasgow.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing “regime” refers to the current market, competition and planning frameworks. “Digital communications” includes both fixed and mobile connectivity.

It will be critical for digital infrastructure to be in place for UK farm businesses and indeed rural businesses if they are going to be progressive, profitable and crucially be able to compete in future world markets. Farmers and growers also need fair deals and practical agreements that allow them to host infrastructure and continue to farm. Market failure will be perpetuated if the National Infrastructure Assessment does not deliver workable solutions that benefit all parties.

Currently there is a major issue of rural market failure with digital communications that needs to be urgently addressed. There is widespread evidence that the existing communication regime is not going to deliver, without positive and accelerated Government intervention and the National Infrastructure Commission needs to ensure this is promoted.

NFU [member evidence](#) of over 800 farmers and growers in 2015 and 2016 confirms the vast majority of NFU members have sub 2Mbps upload and download speed, with only a few percent having speeds in excess of 24Mbps. This is a workforce of 464,000 people serving a wider food and farming sector worth £108 billion in 2016 without adequate digital connectivity and no government programme in place to address this.

With the implementation of the Access to Infrastructure Regulations, telecommunications providers can now gain access to physical infrastructure across different sectors (such as electricity, water and transport services, as well as the telecommunications sector itself). This is an area where the National Infrastructure Commission could make a real difference. There are major projects being proposed throughout the UK to deliver housing, energy infrastructure, road and rail links which cross through farmland and which could include ducts and physical access points for farmers. This should be a prerequisite of every major project and something that could be easily evaluated for success.

The EU set out [ambitious new targets](#) to achieve universal ultrafast broadband coverage (measured at 100Mbps by 2025) with the European Commission and European Investment Bank announcing a fund for broadband infrastructure to invest in infrastructure across underserved areas of Europe. The EU is exploring a range of technologies to achieve this, which the National Infrastructure Commission also needs to ensure are fully explored and exploited. There needs to be support for 5G specifically focused on farming businesses.

Energy:

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Decarbonising heat is an important subject area, since non-domestic buildings (including farm buildings) are responsible for a significant fraction of national energy use and GHG emissions. Farmers account for around 30% of the uptake of the non-domestic Renewable Heat Incentive (RHI) scheme so far, and biomass heating has been the most successful low-carbon technology, accounting for about 95% of both installation numbers and capacity. Recent cuts to RHI support for biomass boilers is not going to increase uptake of electric heat pumps, since the two technologies occupy different market niches and are rarely in direct competition.

Longer-term decisions about future heat supply and its infrastructure need to be made urgently. The Government does not appear to have identified the UK's likely sources of low-carbon heat beyond 2020. Alternatives to the current reliance on natural gas need to be deployed across the domestic, commercial and industrial sectors, at a rate much faster than current buildings and capital assets can be upgraded. This suggests that technologies best-suited to energy-efficient building envelopes and processes (such as heat pumps) will not be sufficient. Making better use of the gas pipeline network, replacing fossil natural gas with biomethane from AD, biomass-derived synthetic natural gas and hydrogen from power-to-gas plants, is one likely alternative. Much greater investment in local district heat networks (both urban and rural) will also be required.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.

The NFU agrees with other independent authorities that the UK power sector is most likely to be decarbonised before other parts of the economy. We believe that technological advances and falling costs are already becoming more important than clean energy incentives as drivers of economic decision-making for investors in a wide range of clean energy options. By the 2030s, we would expect the lowest-cost sources of clean electricity to be solar PV and onshore wind generation, followed by offshore wind power, with high levels of system integration enabled by batteries and other forms of electricity storage (which are also rapidly falling in cost).

Large dedicated biomass power plants and smaller biomass CHP plants are also expected to play a continued role in 'despatchable' power generation towards 2050, and may be coupled to CCS (carbon

capture and storage) in the future to deliver cost-effective carbon-negative energy services - supplemented by other novel technologies like tidal stream and tidal lagoon power.

Clear, consistent, long-term policy signals, a level playing field (free from fossil fuel subsidies) and carbon pricing will all be needed to maintain investor confidence in the transition to a zero carbon or carbon-negative power sector by mid-century.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

The NFU agrees with the Department for Transport's assessment that, although sales of light electric and plug-in vehicles are growing rapidly now, their use of renewable electricity is likely to contribute little more than 1% of transport energy use by 2020 - leaving biofuels as the most practicable and deployable form of renewable transport energy for the near future.

In the longer term, we expect the likely introduction of diesel-electric hybrid and battery electric transmissions in a range of tractors and other agricultural vehicles may create an opportunity for 'smart' charging of such vehicles in large solar PV roofed 'carport-style' machinery sheds. In order to limit the impact of electric vehicle charging on weak rural electricity networks, the Government should consider how to support and incentivise such innovation, in our sector and in other industries.

In addition to having access to low-cost solar charging, the NFU anticipates that the battery packs in such vehicles may also be able to earn income towards their recharging and maintenance costs by providing 'vehicle-to-grid' network balancing services while they are on-charge.

Water and Wastewater (drainage and sewerage):

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

Farmers rely on directly abstracted freshwater for cooling, washing, incorporating into products and growing crops. In England and Wales, farmers and growers use less than 2% of total water abstracted, so the current water allocation for food production is minor compared to the public supply and energy sectors.

Nevertheless, global climate change means that the UK will need to increase its home food and water security to offset potential disruption of food imports from countries that face even more extreme weather events than us.

We hope that the National Infrastructure Commission will acknowledge the needs of 'water for food production' in its analysis and in the development of its future plans, both for individual farm businesses and the agricultural sector as a whole.

Global climate change means that the UK will need to increase its home food and water security to offset potential disruption of food imports from countries that face even more extreme weather events than us.

In agriculture there is an increasing focus on the installation of farm reservoirs to secure water supplies for crop irrigation. However, it is unlikely that individual farm businesses will be able to make sufficient provision for two and three year dry winters, and multi-sector projects may come to the fore in future.

In our view, there should be a focus on those parts of the country (predominantly the south and east) where we face the greatest challenges to balancing water supply and demand in the future.

The NFU is keen for farmers and other businesses to improve their resilience by working with water companies. For example, Water Resources East (WRE) has brought together water companies, farmers, the energy sector and others to find ways to improve water resilience over the long-term.

The NFU believes that it will be important to find ways of allowing public water companies to develop new water resources; and aligned with additional storage capacity it will be important to use surplus capacity in ways that could also benefit farmers and other businesses.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand? *Note: this can include, but is not necessarily limited to, governance frameworks across the country.*

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

We favour a catchment approach which focuses on the greater involvement of all stakeholders in local water governance. We prefer the introduction of a programme to deliver the infrastructure that works on a catchment-by-catchment basis. This approach means that progress on implementation would be consistent with better understanding of the catchment and reacting to the local needs of users and the environment.

By identifying local areas and regions with different priorities for activity, a 'bottom up' process of engaging local stakeholders could emerge that could make effective links in co-ordinating the provision of new infrastructure with complimentary programmes on, for example, water demand management

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

It is essential that the expectations of the general public is managed as it will never be possible to completely protect anywhere from flooding. There must be greater communication that the more extreme and unpredictable weather patterns that we have experienced in the past few years are the greatest driver of changes in flood risk. The Met Office's 2014 state of UK climate report showed that we are not necessarily seeing an increase in total precipitation levels, but a move towards shorter, more intense rainfall events. To illustrate this point, 2014 saw the highest number of days ever recorded with rainfall above 1cm.

In order to balance the costs of any flood risk scheme against the value of assets it protects, it is first essential to ensure that all areas are properly valued. Currently all agricultural land is given a value for wheat in flood risk appraisals, the most prevalent crop in the UK. This does not reflect the true value of many higher value crops, such as horticultural crops, and our most productive land is predominantly situated in the floodplain, or along the East Coast which is liable to surge events.

A discounted value to agricultural land is also applied in flood risk appraisals. Currently the equivalent of 10 years' worth of direct support payment under CAP is removed for the value of land. Yet land can

become ineligible for CAP funding if frequently flooded and post-Brexit, there is no certainty as to the level of direct support payment farmers will receive.

Current appraisals also don't take into consideration that agricultural land is the conveyor of infrastructure which adjacent urban areas are dependent upon. Furthermore no value is added for the environment and ecosystems services the industry provides. Therefore, we believe reviewing the values of land and other assets is essential in answering the question of the level of flood resilience we should aim for in this country.

We believe it is essential when talking about future flood resilience that both rural and urban communities are considered. We note that the Government's 2016 National Flood Resilience Review made no mention to agriculture, food security and negligible reference to rural communities.

To improve urban and rural resilience, sustainable urban drainage systems (SuDS) should be installed which are able to store and slow the flow of runoff from newly created or altered impermeable surfaces, irrespective of its size or location in respect to the main river channel. The design and capacity of SuDS should consider precipitation levels now and those predicted for the future. In particular they should consider the shorter, more intense rainfall patterns we have mentioned above.

Greater clarity should also be placed on who is responsible for the maintenance of SuDS, as well as the ability to go back and retrofit or amend if it becomes apparent the current system is not sufficient in reducing impact to downstream flow regimes.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

Natural flood management techniques, in the right location, can have their place, but they **are not the universal panacea** and should only be used as part of a cohesive and carefully planned package of measures, such as maintenance and de-silting, looking at upstream attenuation and downstream conveyance to address shorter and longer term flood risk.

We have concerns that some schemes over-emphasise the contribution NFM techniques have in increasing the resilience of downstream people, property and infrastructure from flooding. For example, the c.100 woody debris dams in Pickering have the ability to accumulatively hold about 10,000m³ of water. In comparison the engineered dam built upstream of Pickering can hold 130,000m³ of water. As such 90-95% of the flood mitigation service from Pickering comes from the engineered dam, rather than from natural flood risk measures.

The evidence base for the relative ability for NFM to mitigate flooding events is still developing. As an example, the NFU sits on a working group with the Centre for Ecology and Hydrology which is undertaking a systematic review of all literature into how tree planting affects river flow regimes. Early results from this work show that there is relatively little observed evidence of changes in river flow regime caused by the implementation of NFM schemes, but there is a lot using modelling software.

Overall, NFM options have an important role to play in the flood risk management of a whole catchment, but we believe there is strong evidence that NFM is not a panacea solution. There is scope to trial NFM schemes further in larger catchments, but NFM will not in itself prevent extreme rainfall events which we have experienced at a greater frequency over the last few years.

NFM uptake is also limited because the schemes often do not meet cost-benefit ratios required to

receive central government flood defence grant in aid funding. This is primarily because it is difficult to measure the changes in flow regime they provide. Furthermore there are many regulatory hurdles to cross, such as works in rivers consents, planning permission and Environmental Impact Assessments. These barriers will need to be addressed to enable wider implementation.

Solid Waste:

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Our primary preference would be to follow the waste hierarchy when making waste/circular economy decisions. However these decisions, whether backed up by financial incentives or not need to be evidence based. Ideally with a cost-benefit analysis and an environmental impact assessment/life-cycle assessment alongside.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

The creation of waste and the requirement to dispose of it safely and responsibly is unavoidable to the agricultural sector. Barriers to a more circular economy include lack of facilities to recycle and dispose of agricultural waste locally leading to illegal waste operators targeting the agricultural sector. The rural nature of farming can mean it is often not cost-effective for collection service to operate, however alternative options must be created. The breadth of waste produced on farm can also be challenging which includes domestic waste/hazardous waste/flytipped material/medical and chemical waste. This needs to be addressed as part of the infrastructure challenge.

Utilisation of waste products on-farm through technologies such as anaerobic digestion, biomass boilers, recycling waste to land for agricultural benefit, the use of co-products into animal feed. This forms a significant impact on the circular economy and greater prioritisation needs to be given to these outlets and technologies.

Reducing food waste – this can often be caused by dysfunctional supply chains. Greater food waste reduction could be achieved by the supply chain becoming more integrated to prevent losses. Improvement in infrastructure could improve this situation, for example improving forecast systems used by retailers and processors as this would provide farmers with the ability to undertake important business decisions such as the area of land to rent and the volume of seed to plant

National Grid response to the National Infrastructure Assessment call for evidence.

About National Grid

1. National Grid is the owner of the high-voltage electricity transmission system in England and Wales, and the owner and operator of the national gas transmission system across Great Britain. As the System Operator (SO), for both gas and electricity in Great Britain, we are responsible for balancing supply and demand in the short term for the whole transmission system.

2. We welcome and support the call for evidence. This submission highlights the considerations we believe the National Infrastructure Commission should take account of when producing respective plans for the National Infrastructure Assessment.

Executive Summary

1. The sources of power are moving from large centralised, conventional power stations to decentralised, renewable sources. Therefore, when designing and planning infrastructure, it is important to focus on the system as a whole, rather than on its component parts. For the most appropriate energy solutions to be developed, a macro view of the energy network must be taken. By taking a whole system approach infrastructure can be built in the right place at the right time.
2. Advances in technology are transforming how we consume energy. Policy makers must create an environment that allows consumers transparency over their energy consumption, and the ability to benefit from demand management and smart technology. Smart metering and time of use tariffs can increase the potential for demand management.
3. We also believe that demand management will play an important role in meeting the challenge of delivering energy affordably and sustainably, and will reduce the need for investment both in generation and networks. We are at the forefront of enabling greater demand side participation in the energy market, through our Power Responsive Campaign. We believe that the full value of a smarter, flexible energy system (including electricity, gas, heat and transport) can only be realised with sufficient investment, innovation and necessary market reforms. However, there are unintended consequences of demand management. A uniform demand profile can create additional stresses on infrastructure that was designed to accommodate peak loads. Therefore infrastructure reinforcements may be required to accommodate the transition to a more flexible network.
4. We recognise the importance of the Planning Act 2008 in the development of infrastructure projects. The process of statutory consultation, the acceptance and scrutiny of applications by the Examining Authority and the role that the Secretary of State plays in making a decision provides a clear pathway for developers to follow. However, we believe that Ofgem should take account of the scrutiny that this process affords. The consultation process and the subsequent evidence that this provides demonstrates how regulated businesses are developing major infrastructure projects in an economic and efficient manner.
5. Greater confidence of demand, over a period of at least ten years, would enable planning of the network in the short and medium term to be much more economic and efficient, and would reduce any potential for over/under investment. Incentivising generators to build in optimal locations and at optimal times would introduce more certainty to the industry. It would enable network investment with a guarantee that generation would be built where it is required.

6. We believe there is no simple whole energy system solution for the decarbonisation of heat. It is likely that there will be a patchwork of solutions. Whilst renewable generation, such as wind and solar and the electrification of heat will be important in reducing carbon emissions, gas will continue to play an important part. Further work is required to determine how best heat is decarbonised.
7. To deliver a zero carbon power sector, regulations and incentives would be needed to support the green ambition along with high levels of environmental legislation and punitive taxes for carbon-intensive technologies.

NIA Cross-cutting issues:

How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

We are in the midst of an energy revolution. The economic landscape, developments in technology and consumer behaviour are changing at an unprecedented rate, creating more opportunities than ever for our industry. As we move away from the historical reliance on large thermal power generation, towards a more flexible diverse and smarter system, the need to design plan and deliver infrastructure needs to take into account this shift.

We have a key role in securing our energy future. There are some important choices to make about priorities for investment and focus for innovation in order to provide long-term value for consumers and to ensure we continue to meet their needs. Both gas and electricity can continue to play a key role in the UK's energy mix out to 2050 and beyond, enabling us to meet our carbon emissions target in an affordable way .

When designing and planning infrastructure, it is important that we focus on the system as a whole, rather than on its component parts. This will ensure robust and adaptable solutions for the future are developed. We welcome that the National Infrastructure Commission is following that approach, by considering cross cutting issues when compiling the National Infrastructure Assessment. Our view is that infrastructure development cannot take place in isolation, and must give consideration to the wider implications on other sectors. Energy is at the heart of this, and is inextricably linked to both housing and transport infrastructure. One should not be planned and designed without considering the other.

In understanding how energy infrastructure should be designed, planned and delivered, it is important to firstly reiterate the processes in place today. As part of an annual electricity planning cycle, the System Operator (SO) performs an assessment of the transmission network requirements, to identify where the transmission system requires reinforcement or new investment. From this, the SO reveals information to the three GB Transmission Owners (TO's) via a series of publications, starting with the Electricity Ten Year Statement (ETYS). The Future Energy Scenarios (FES) is then published to set out credible scenarios for the future. Finally, the Network Options Assessment (NOA) recommends which large network projects the TO's should invest in over the coming year. These recommendations safeguard the GB electricity network, making sure projects are delivered only if absolutely necessary and at the optimum time.

With onshore competition being introduced, the SO will provide the investment signals and options to a larger group of market participants. The SO will indicate where necessary developments or reinforcements are required to deliver enduring energy infrastructure. This allows the TOs to identify, plan, and design efficient solutions, and provides opportunity for them to apply their experience and innovation to secure additional value for UK consumers. This means that the range of different futures provided by the FES, allows infrastructure providers to deliver a range of long-term outcomes in the interests of the consumer.

We support a NOA that ensures the costs of building new infrastructure are appropriately balanced against the costs of a no-build solution. We see there is benefit to consumers from keeping infrastructure investment options open.

What is the maximum potential for demand management, recognising behavioural constraints and rebound effects? Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

The move to a low carbon economy coupled with rapid advances in technology and innovation are transforming our electricity supply. Emerging is a network of low carbon and renewable energy. But supply is only half the story. The challenge now is to exploit new opportunities to radically evolve our energy system by changing the way we use electricity.

Demand side response is intelligent energy usage. By knowing when to increase, decrease or shift their electricity consumption, businesses and consumers will save on total energy costs and can reduce their carbon footprints. It is the smart way to create new and efficient patterns of demand.

Our Power Responsive campaign goes some way to publicise the benefits of demand side response. Power Responsive is a collaborative approach to turn debate into action and realise the possibilities created by demand side solutions. It is a practical platform to galvanise businesses, suppliers, policy makers and others to seize the opportunity to shape the growth of demand side response collaboratively, and deliver it in practice at scale by 2020. There are many case studies demonstrating where we've worked with large retailers, manufacturers and the public sector as part of our power responsive campaign. <http://powerresponsive.com/case-studies/>

Demand flexibility covers a broad range of activities that can be undertaken to reduce or shift demand for electricity during peak periods, including the adjustment of consumption of electrical appliances or other facilities or deploying off grid sources of power. Demand flexibility can allow consumers and businesses to change how they use their electricity. Deploying automated systems to reduce consumption at times of high demand and increase it at low demand will allow users to save money and cut emissions without inconvenience. In addition, demand flexibility can support the integration of low carbon generation such as wind, solar or nuclear. Flexibility in how we consume energy lowers the need for flexibility in supply.

There is growing recognition of the important role that demand side flexibility can play in electricity markets. It reduces the need for new conventional generation and network infrastructure; supports the integration of growing intermittent generation; and helps suppliers to manage market risk.

Policy makers and the energy sector envisage that the scale and value of demand side flexibility is likely to grow in the future. BEIS and Ofgem recently released a joint call for evidence on a smart, flexible, energy system. Our own equivalent internal analysis shows increasing flexibility (interconnection, storage and DSR) could deliver up to £2bn of consumer value per year by 2030 and we have set an aspiration for 30–50% of balancing capability from demand side sources by 2020. The National Infrastructure Commission estimated that ‘smart power’ – interconnection, storage and flexible demand – could save consumers up to £8bn a year by 2030; and the Association for Decentralised Energy estimates potential for demand side response of 9.8 GW by 2020.

We believe that Government should provide the right arrangements to enable Smart tariffs to be created. Energy suppliers should be allowed to define these Smart tariffs with an element of freedom, to foster competition and provide benefit to the consumer.

Consumers will benefit from competitive pressure, and consumers will need appropriate (e.g. web portals, In House Display) to understand the impact of new tariffs on their energy bills. Consumers who are not flexible and those who are vulnerable will also need to be protected

In understanding the maximum potential for demand management, it is also important to understand that the existing infrastructure must be considered. With the majority of the electrical transmission infrastructure being designed and installed around the electricity demands of the 1950's and 1960's, the ambition to have increasing levels of demand flexibility must consider the system in which it is being applied to.

Demand management aspires to fundamentally flatten the demand profile, and eradicate unnecessary swings on the electricity system. A flatter, more predictable, load profile allows assets to be managed more efficiently, presenting benefits for the consumer. However, the uniformity of this demand profile can also create additional stresses on infrastructure that was designed to accommodate for time-based swings, and results in the equipment and components being operated closer to its engineering tolerances and thermal constraints. In some cases, the infrastructure reinforcements required to accommodate for the impacts of this could result in increased levels of investment in transmission infrastructure.

It is important to emphasise that we welcome flexibility of both increased connection and demand management. However, given our unique position in the energy market, we are also cognisant of the unintended consequences highlighted above. To this end we would welcome the opportunity to discuss further with the National Infrastructure Commission over the coming months.

How should maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Asset management is a fundamental technique to obtain the most value from a diverse portfolio of assets. It ensures maintenance and repair activities can be effectively balanced against the need to build new assets.

It is possible to determine the optimal time to carry out maintenance activities by having a thorough understanding of an asset. This reduces the risk of failure or the need to carry out a repair. However, in cases where maintenance or repair is not possible or cost effective, the construction of new assets may be required.

As we transition to a more flexible energy system, there is opportunity to balance maintenance and repair of existing assets against new build to meet changing demands. Alternative energy sources and system flexibility can allow, or even restrict, planned outages on the network.

By having an industry wide understanding of asset management, in line with ISO55000 and PAS55, and by looking at the network as a whole, rather than at a single asset, there is a greater ability to understand the net cost of carrying out maintenance versus upgrading or building a new asset.

What changes could be made to the planning system and infrastructure governance requirements?

The Development Consent Order (DCO) was introduced as part of the Planning Act 2008. The legislation set out to simplify and speed up the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIP).

This process requires considerable consultation and engagement with a wide range of stakeholders, including statutory bodies as well as the communities affected by the delivery of a development. The feedback of this engagement shapes the application, which is submitted to the Planning Inspectorate and Secretary of State for determination. We also have to obtain approval from our economic regulator Ofgem in respect of the funding of the development and construction of the project, as they determine whether our plans are economic and efficient.

The significant engagement we undertake through the DCO process could direct us to minimise the impact on the visual landscape. In areas that have the highest level of protection under the planning framework we may be required to bury our infrastructure underground. Whilst this will not be the lowest cost solution it may be necessary to allow us to obtain the appropriate planning consent from the Planning Inspectorate and Secretary of State.

We believe that Ofgem should take account of the scrutiny that this process affords. The consultation process and the subsequent evidence that this provides demonstrates how regulated businesses are developing major infrastructure projects in an economic and efficient manner.

What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Cost benefit analysis would more accurate if there were certainty over future capital costs, delivery times and energy policy. We attempt to lessen this ambiguity through our Future Energy Scenarios (FES), which we use alongside other market data to recommend reinforcements on the network for the Transmission Owner to build.

Greater confidence of demand, over a period of at least ten years, would enable planning of the network in the short and medium term to be much more economic and efficient, and would reduce any potential for over/under investment.

Incentivising generators to build in optimal locations and at optimal times would introduce more certainty to the industry. It would enable network investment with a guarantee that generation would be built where it is required.

Better knowledge of demand profiles obtained from smart meters would improve forecasting and result in more accurate cost benefit analysis. Similarly, greater visibility of behind the meter generation would also provide clarity to enable recommendations for future reinforcements or new build.

NIA Energy specific questions:

What is the highest value solution for decarbonising heat, for both the domestic and commercial consumers?

The decarbonisation of heat is a significant challenge and will require a mix of carbon reduction solutions, where both gas and electricity play a part.

DECC's (sic) 2013 Heat Strategy set out a roadmap that envisaged almost full electrification of heating by 2050. This was based on consumers using heat pumps and heat networks along with a small amount of gas. The industry raised many issues with these proposals due to:

- the huge investment required to increase GB's electricity infrastructure (a recent KPMG study showed a total cost of £274-318bn, costing consumers two and a half to three times more than keeping gas in a decarbonised system);
- challenges associated with heat pumps in the forms of installation disruption, size and high buildings efficiency requirements; and
- gas currently delivers around five times more peak demand in winter than electricity. And electricity alone is unable to meet GB's peak winter heating needs based on predicted capacity levels.

Contrary to the 2013 Strategy, there is a growing consensus among industry and academics that gas can continue to play a significant role in the UK's energy mix out to 2050 and beyond. This would enable us to meet our carbon targets in the most cost-effective way. Gas is seen as a fast and flexible fuel that fits in with people's lifestyles. Eight out of ten UK households currently use gas to heat their homes, and in 2015 gas produced more of the UK's electricity than any other fuel. We already have the network infrastructure to supply gas. Our transmission network comprises approximately 7,660km (4,760m) of high pressure pipe and 24 compressor stations, and it makes a great deal of sense for household and business consumers to continue to make use of these assets.

We believe there is no simple whole energy system solution for the decarbonisation of heat. It is likely that there will need to be a patchwork of solutions best suited to local areas and regions, with decisions made at both a national and local government level. The key options include renewable gas, hydrogen, carbon capture and storage (CCS), heat pumps, heat networks and energy efficiency. More work should be done to explore the viability and potential for each of these, and to understand the comparative costs and benefits. Recent reports have stated that the costs of achieving the 2050 carbon emissions target could be 50-100% higher without CCS, but demonstration projects are needed to prove the technology at commercial scale in the UK. The Government needs to provide a clear policy framework and strategy to incentivise investment in innovation and keep options open by taking incremental steps as technologies mature. Consumers need to be at the heart of any decisions to ensure that heat continues to be supplied reliably in the most affordable way.

What does the most effective zero carbon power sector look like in 2050?

Our Future Energy Scenarios set out credible examples of what the power sector could look like in the future. The Gone Green scenario is a world where policy interventions and innovation are both ambitious and effective in reducing greenhouse gas emissions. The focus on long-term environmental goals, high levels of prosperity and advanced European harmonisation ensure that the 2050 carbon reduction target is achieved. In Gone Green, policy interventions are a driving force behind realising a renewable, low carbon world.

Regulations and incentives are in place to support the green ambition and are effective, resulting in high taxes for carbon-intensive technologies. Funding is available to support innovation in green technologies such as renewable generation and low carbon heating systems and high levels of environmental legislation are in place.

In the building and transport sectors there is fast progress towards a more harmonised energy market, which also favours a high level of green ambition. Disposable incomes, and economic growth rates over time, are high. This allows individuals and businesses to invest in new products and solutions, despite high energy prices resulting from subsidies and taxation. Innovation in demand technologies helps to enable progress towards environmental targets. Society is actively engaged in reducing greenhouse gas emissions, therefore knowledge and adoption rates are high. This results in high installation rates for products such as insulation, home energy management systems and domestic batteries.

It would be likely that the traditional linear chain of Generation > Transmission > Distribution > Consumption has changed, with embedded generation and increasing numbers of consumers opting for their own installed generation solutions to reduce their energy bills.

Increasing numbers of technological developments, such as smarter energy systems, and embedded generation at both domestic and industrial scale, mean that asset investment deferral is the preference to new technology investment.

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

**National Grid
Business Development**

By email to: NIAEvidence@nic.gsi.gov.uk

Date: February 2017

Dear Sir,

NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE October 2016

Thank you for the opportunity to respond to the above consultation.

About the Respondent

National Grid Business Development (NGBD) responds in its capacity as an independent owner, operator and prospective developer of multiple classes of infrastructure in energy, transport and cross-cutting/smart sectors. NGBD has been established to deliver the organisation's strategic growth ambitions so it is legally and physically separate from National Grid's RIIO-regulated businesses.

Together with partners, NGBD has recently made commitments for investment of over €2bn in the construction of two new electricity interconnectors: North Sea Link to Norway and NEMO Link to Belgium. Other areas of current interest to us include "grid edge" developments for distributed energy resources, battery storage, smart cities and the development of efficient infrastructure for the larger scale deployment of electric vehicles and electrification of new and existing rail infrastructure. We also have experience from developing Carbon Capture and Storage infrastructure.

Our portfolio of operational businesses already provide a wide range of energy products and services to customers in competitive markets:

- a. National Grid Interconnector Holdings Limited: owns stakes in subsea electricity interconnectors to France and the Netherlands;
- b. Grain LNG: Europe's largest LNG import terminal, which is able to meet 20% of UK gas demand;
- c. National Grid Metering: manages and maintains over 14 million industrial, commercial and domestic gas meters across the UK; and
- d. National Grid Smart: a new smart metering business that provides services to support suppliers with the roll-out of smart meters across the UK.

Nature of our Response

Our response takes the form of this covering letter and an attachment. In the covering letter we explain the nature of our interest and experience as a respondent, and we summarise our key points.

In the attachment we provide specific responses to only those questions in the Call for Evidence where we feel we can add most value.

Key Points

We welcome the work of the National Infrastructure Commission and its intent to use this Call for Evidence to assist it in identifying long-term infrastructure challenges and priority areas for action over the medium term. We consider the following issues to be key with respect to those challenges and priorities:

Long-term infrastructure challenges	Priority areas for action over the medium term	Relevant to Call for Evidence Question No
How to stimulate private sector investment	<ul style="list-style-type: none"> ▪ Long term stability in energy and cross-sector policies backed up by commercial and regulatory frameworks with appropriate risk-reward balance ▪ There should be clear, consistent carbon policies to enable cost effective transitions and minimise asset stranding 	2, 6, 8
The right infrastructure to most effectively harness the smart revolution and distributed energy resources	<ul style="list-style-type: none"> ▪ New more holistic, collaborative, systematic and cross-sector tools for energy system planning especially in the context of cities and regions ▪ Showcase such modern approach in relation to the 14 new garden villages announced by Government ▪ Reforms to the legal and regulatory frameworks around distributed energy and storage to stimulate competition and investment in the sector without undue restrictions on ownership or unnecessary regulation 	1, 3, 6, 9
Optimal infrastructure decision making against a backdrop rapid technology development and uncertainty in future trends	<ul style="list-style-type: none"> ▪ Improved tools to ensure that as a minimum “least worst regrets” commitments are made to build key infrastructure. Do nothing / business as usual methods are likely to be sub-optimal; ▪ Application of whole life & multi-criteria cost/benefit approaches to infrastructure decision making 	5, 12
Decarbonisation of transport and heat sectors in step with changing consumer behaviours	<ul style="list-style-type: none"> ▪ Energy efficiency measures to minimise waste heat particularly from existing buildings ▪ Co-ordinated strategy for electric vehicle charging, which is flexible enough to adapt to future developments (such as bi-directional power flow) ▪ Better alignment between national and regional transport planning e.g. with respect to electrification of rail ▪ Strategy backed up by commercial and regulatory models that stimulate investment in district heating solutions (in urban areas) and heat pumps (in sub-urban areas) 	6, 13, 19

	<ul style="list-style-type: none"> ▪ Penetration of electric vehicles and heat pumps will likely require network upgrades – an opportunity arises to introduce new business models to stimulate competition and innovation 	
Implications of Brexit especially upon cross border trading of electricity and natural gas	<ul style="list-style-type: none"> ▪ Deliver current policy to increase level of electricity interconnection to ensure cost saving, flexibility and security of supply benefits ▪ UK should aim for post-Brexit arrangements whereby energy continues to be traded across borders in an efficient manner without tariff or non-tariff barriers, for the benefit of UK and European consumers 	2, 20
Role of CCS for clean energy and decarbonisation of industrial emissions	<ul style="list-style-type: none"> ▪ Clear CCS strategy backed up with governance arrangements (commercial & regulatory frameworks) to stimulate desired level of investment 	6, 20

We are happy to discuss our views contained within this letter, should that be helpful. For further details, please contact Jonny Hosford (jonny.hosford@nationalgrid.com). We look forward to the National Infrastructure Commissions Vision and Priorities document scheduled for publication in summer 2017.

Yours faithfully

[signature redacted]

[name redacted]

[job title redacted]

National Grid Business Development

Attachment 1 National Grid Business Development Response to National Infrastructure Assessment Call for Evidence, October 2016

National Grid Business Development (NGBD) responds in its capacity as an independent owner, operator and prospective developer of multiple classes of infrastructure in energy, transport and cross-cutting/smart sectors. NGBD provides specific responses to only those questions in the Call for Evidence where we feel we can add value.

QUESTIONS

The questions that the Commission has identified to assist respondents in focusing their submissions to this call for evidence are set out below:

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support longterm sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of “highest value” should include benefits and costs, as far as possible taking a comprehensive view of both. “Long-term” refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

Response:

Distributed energy infrastructure will underpin regional growth and many of the strategic priorities of local authorities. Key city challenges to tackle poverty, housing, transport, business growth, public health and waste all have implications for future energy system design. Set against a backdrop of falling local authority revenues and limited capital to invest, the private sector can be a catalyst to accelerate the delivery of connected city energy systems. These investments will not be high value in isolation but the design and delivery of interconnected technologies to exploit the generation of power and heat, energy storage, the electrification of transport alongside systems to connect citizens and communities will deliver the greatest returns to the region.

Significant progress in many areas of the UK has been made, but these successes have been isolated projects and not part of an overall systematic approach to city or town planning with the connection of energy infrastructure as one lever in the achievement of many strategic priorities. The 14 new garden villages announced in January 2017 offer the UK the opportunity to create the perfect environment for such technologies and to prove that energy may be provided in a sustainable manner using smarter planning for these ‘grid edge’ technologies.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Response:

Government supports a significant increase in the level of electricity grid interconnection between Great Britain and its neighbours. This is backed up by strong consensus (for example from studies undertaken by OFGEM and the System Operator) that increased interconnection brings multiple benefits including: improving the competitiveness of industry by lowering GB wholesale electricity prices, providing the flexibility and capacity to facilitate increased penetration of renewable energy sources, and improving security of supply (including access to more diverse sources of energy) for both the connected networks.

We believe an important priority for the medium term is to deliver the increased level of electricity interconnection that has been identified and to ensure the future trading arrangements with our neighbours enable best value to be obtained from such infrastructure. The prospect of the UK leaving the EU has raised uncertainty about the nature of the trading relationship post-Brexit. We believe a priority objective should be for the UK to secure an outcome whereby energy continues to be traded in an efficient manner without tariff or non-tariff barriers.

Having a flexible energy network with efficiently integrated solutions for heat, power, transport, communications, waste etc. should be a considerable attraction to foreign investment in the UK. Long term planning should provide pathways for optimum connection by new businesses – optimum in terms of ease of access, speed to connect and long term sustainability of competitive energy prices. Increasingly, modern businesses will also provide network services so there should be mutually beneficial outcomes from new connections.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Response:

With reference to response 1, the challenges, priorities, environment and opportunities of each town and city in the UK will be different and therefore the approach to distributed energy systems design needs to start with the strategic aims of the region and a number of scenarios regarding how the area could evolve over time if objectives are to be met. The current approach is for the directorates of local authorities to tackle individual objectives in isolation but utilities infrastructure design crosses directorate boundaries and requires an integrated approach. A piecemeal approach will not only deliver sub-optimal distributed energy solutions but will add considerable time to deliver.

We support the creation of cross-sector platform(s), which bring together a broad range of services for the benefits of customers. This system approach would facilitate diverse contributions, discussions, strategic planning and direction. It will

enable integrated and resilient energy, transport, digital communications, water and waste infrastructure. We consider that it would be appropriate for other key social aspects such as housing, education and health care provision also to be integrated into such thinking, perhaps culminating in all-encompassing regional development plans. Integrated plans with a consortia of technical partners, regional buy-in, cross departmental working and strong political sponsorship would be a constructive way forward.

We think this approach is likely to require greater interactions between government authorities and possible integration. We support consideration of improved (and consistent) metrics to assess overall socio-economic impacts across energy, environment, resilience etc. (which permit scenarios within sub-systems and roll up into the complete system).

National Grid is at the heart of our existing energy networks and we recognise the increasing engagement of customers is driving a shift of value more towards the consumer. Through our Business Development ventures we seek to bring our unique knowledge, footprint and insights into play through the provision of new infrastructure and services supporting decarbonisation and decentralisation. A key challenge going forward is to adopt a systems approach to energy infrastructure and put in place infrastructure governance arrangements that strike the right risk reward balance to underpin private sector investment by organisations such as ourselves.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

Response:

We consider there is a significant opportunity for demand management and conceptually it is ultimately limited by the appetite of the connected customers and flexible demand. As more distributed energy resources are rolled out such as batteries, the potential for demand management will increase in tandem.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Response:

We expect that a whole life costing approach should be considered when weighing up the case for replacement or asset life extension. Typically such analysis will involve calculation of the Net Present Value of estimated capital and operating expenditure over the life of the assets in question. Back to back comparison would

be performed to gauge the merit of alternative infrastructure scenarios of repair versus replacement. Sensitivity analysis can be carried out in relation to uncertain variables such as the future level of utilisation.

When considering how the costs and benefits of different infrastructure approaches should be appraised it is important to set objective overall priorities and desired outcomes. For example, recognising the rapid pace of change in the energy sector, the extent to which new solutions contribute to future proofing, consumer empowerment, and harnessing new technology could rank high as high priority objectives alongside cost and reliability. Such multi-criteria cost-benefit analysis is a way to give recognition to the wider enabling benefits that new infrastructure solutions can also bring versus perpetuation of traditional solutions.

Consideration of any new infrastructure projects should include an assessment of the knock-on impacts for existing 'networked' assets (e.g. there may be implications for other investment upgrades or operating costs) to realise the full potential of the identified benefits. This is particularly true when looking at aspects such as plans to electrify rail lines and the need to ensure interconnectivity between routes/operators that can support fully electric trains.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Response:

We believe there is a place for both competition and collaboration in the future provision of infrastructure services. We consider that important keys to unlocking these opportunities are holistic cross-sector planning, provision of appropriate commercial and regulatory structures, and stable policy to underpin investor confidence.

In relation to policies we support the adoption of stable long term energy policy straddling successive Parliaments. For example, prospective investment decisions on new electricity interconnectors are predicated on assumptions around carbon floor price and access to participation in the GB Capacity Market. Therefore, investor confidence for new interconnectors would be improved by setting clear long term commitments to these instruments.

The following are examples from our experience where competition/collaboration tied to regulatory/policy frameworks has already stimulated, or with appropriate actions in the medium term, could stimulate increased investment:

Electricity Interconnectors Cap and Floor. The launch by OFGEM in 2014 of the cap and floor regulatory regime for new cross border electricity interconnectors is a success story of a clear regulatory regime, understood by market participants and striking an appropriate risk reward balance to incentivise the desired action from the private sector. In light of cap and floor, two new interconnector projects, North Sea Link to Norway and NEMOLink to Belgium have entered construction and multiple

additional new interconnectors are under active development by a diverse range of new participants.

Competitively Appointed Transmission Owners (CATO). We support OFGEM's CATO approach where it can bring value to consumers.

Electricity Storage. Prevailing GB regulatory arrangements were not developed with regard to the technological changes in smart, flexible, distributed energy and storage which we now see offering such opportunity. We think priority actions should look at reforms to the governance arrangements for electricity storage. Re-defining storage as a separate class of asset, without undue restrictions on ownership, would ensure the market is opened up to the widest possible pool of participants. New entrants to this sector will drive innovation and formulate working collaborations to deliver new services.

Decarbonising Transport and Heat. A zero carbon vision for 2050 almost certainly places a high reliance upon a near zero carbon electricity system, expanded in capacity compared to today's grid, to facilitate a high penetration of electric vehicles and heat pumps. Such change is likely to necessitate significant upgrades to networks, and as mentioned in earlier responses, maximum societal benefit will come from holistic cross-sector planning. A potential priority action could involve the introduction of competition in the provision of innovative infrastructure solutions at distribution voltage which may be owned and licenced separately to the incumbent distribution networks.

Balancing Services. There is an opportunity to expand competition in the provision of balancing services to the System Operator. Service provision has historically been the domain of large centrally dispatched generators. Looking ahead, new service provision from demand side, distributed energy sources, electricity storage and interconnectors might entail significant up front costs. At present, the relatively short-term balancing services contracts available act as a barrier to such investment.

North Sea Grid. There is a potential opportunity for integrated solutions which create an interconnected offshore grid of transmission lines between countries together with connections of offshore wind farms to the shore. For this to work there need to be new forms of co-operation and co-ordination between governments and developers in relation to the timing of wires (infrastructure) and wind (generation) investments. There could be a role for new forms of regulation that facilitate anticipatory investment in a way that allows the point of commitment for infrastructure and generation investments to be decoupled.

Carbon Capture and Storage. CCS is an example of a sector where government's actions in the period 2007 to 2015 placed a strong emphasis upon competition – in this case competition between generation-led proposals. However this was not backed up by long term policy commitments and appropriate commercial and regulatory frameworks. There was insufficient focus upon the core carbon dioxide transportation and storage infrastructure need to support large scale deployment. The economics point to a strong case for collaboration in sharing transport and storage infrastructure in high intensity CO₂ clusters. The result is that whereas evidence shows CCS has an economic position in the decarbonisation agenda, and

significant UK and EU public funding was used to make detailed designs for two inaugural schemes, there is yet to be an investible pathway for its deployment. The lessons learned from CCS should provide food for thought e.g. when considering governance arrangements for new sectors like electricity storage and offshore grids.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

Response:

Dictated by funding policy, certain Government-led projects adopt a very rigid, phased approach to procurement that inherently leads to inconsistencies and inefficiencies by incorporating various organisational ‘handovers’ between the different phases of project development. With each phase often tendered separately, this potentially results in a lack of long-term alignment and accountability (i.e. the design house will not be responsible for successful operations).

By developing a funding policy that encourages private sector investment in infrastructure projects at the conceptual design phase, through a design, build operate and own contracting type model, this could potentially deliver multiple benefits that include:

- Embedding operational experience in the design and build phase;
- Allocating a single point of responsibility for solution integration;
- Aligning safety requirements throughout all project phases – design through to operation;
- Promoting choices made upon lowest whole-life cost;
- Enabling greater design flexibility;
- Operator-led compressed delivery programme;
- Best placed risk ownership; and
- Access to additional sources of finance through further private sector investment, if required.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

Response:

See our previous response to question 6. Infrastructure projects in the arena of CCS, North Sea Grids, Electricity Storage and Balancing Services are examples where there is investment interest from the private sector, but where the prevailing

market and regulatory arrangements don't yet provide an appropriate risk reward balance to underwrite capital intensive up front project construction costs.

While obstacles to market persist, public co-funding can be a helpful stepping stone for new projects, but this is second best to getting the right policy, market and regulatory frameworks in place.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

Response:

We believe useful medium term actions could be taken forward in relation to holistic regional planning, cross-sector risk assessments and collaboration.

Building on our response to Question 3, we think it is important to foster holistic regional development plans that consider interdependencies across different sectors such as energy and transport. A prime example is the need for cities to decarbonise transport to satisfy mandated clean air zone requirements by 2020. In order to allow a greater uptake of 'clean' modes of transport, it is highly likely that enabling infrastructure will need to be developed at scale.

If Local Authorities are to develop policies to compel a transition from hydrocarbon vehicles to electric (say for taxis), then there is likely to need to be a proliferation of rapid/fast electric vehicle charging points in key strategic locations. As rapid/fast chargers can cause operational problems (e.g. voltage control issues) for electricity Distribution Networks, then network upgrades may be needed to accommodate the required volume of charging points to support demand at the time it is required.

It is imperative that there is a clear, long-term plan that identifies all interdependencies across various sectors and enables optimal investment decisions to be taken. This will need to take into consideration anticipatory demand needs, including those likely to result from national and local policy decisions. Government should proactively seek to engage with different industries, such as the automotive industry, to identify where the major cross sector infrastructure challenges are likely to materialise and take proactive steps to develop a multi-sector response in advance of the problems becoming a potential barrier to economic prosperity and growth.

Making best use of North Sea resources is an area where new forms of collaborative spatial planning could be very beneficial. Collectively the North Sea countries have a shared interest in maximising North Sea resources for a variety of purposes including: oil and natural gas extraction and transportation, offshore wind generation, cross border electricity and natural gas interconnection, CO₂ transportation and storage, fishing, shipping etc. Actions taken in one sector can sterilise future opportunities for infrastructure development in another sector. We support collaborative initiatives such as the June 2016 Political Declaration on Energy Cooperation between the North Seas Countries.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Response:

We respect that local people should have a say in what is developed in their community. Options should be considered and lowest cost or lowest impact solutions should be discussed. In this regard, the framework put in place through the Planning Act 2008 places strong responsibilities upon developers who face significant risks associated with failure to attain planning consent.

Developers are being drawn to invest ever more effort to mitigate planning risks; for example carrying out more and more detailed up front “optioneering” design, or adopting higher cost solutions from the outset that may not be technically the most efficient but are judged to be more likely or faster to attain public acceptance. To the extent developers face abortive costs then planning risk creates a disincentive to bring forward private sector investment in such significant infrastructure schemes.

There should be recognition of the costs to society of this approach in terms of the stifling effect upon development of infrastructure schemes with potentially high socio-economic benefits and higher costs of those schemes that can be taken forward.

We perceive that these difficult societal choices are becoming increasingly important issues to be addressed in our infrastructure governance systems, so this should be one of the areas of long-term infrastructure challenge addressed in the ongoing work of the National Infrastructure Commission.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Response:

Infrastructure can make a highly beneficial contribution to protecting and enhancing the natural environment. For example electricity transportation infrastructure including cross border interconnectors can facilitate the optimal use of natural resources like wind, hydro and solar. In the case of European electricity transmission infrastructure planning ENTSOE uses a multi-criteria benefit assessment technique to recognise the impacts (whether positive or negative) that discrete infrastructure projects have upon the environment. There may be a case for analogous multi-criteria techniques to be deployed in the UK and in sectors other than electricity transmission.

We see increasing trends of heightened awareness in society of the infrastructure trade-offs between economic efficiency and impacts upon the natural environment. For example this is played out in debates about the relative merit of overhead or underground high voltage electricity grid assets. Evolving social attitudes in this area will pose a challenge for our infrastructure governance systems going forward.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

Response:

There could be a case to further build upon approaches already used in electricity and gas transmission (e.g. National Grid’s Future Energy Scenarios, and ENTSOE’s 2030 Visions) and those explored in projects such as DECC’s 2050 Energy Pathways and successor work taken forward through ETI and IET.

Generic methods could be applied in various sectors which might involve common techniques such as:

- (i) use stakeholder input to build transparent, credible scenario analysis of future demand for services;
- (ii) define optimal infrastructure appropriate to the different scenarios – the metrics used need to be tractable and transparent;
- (iii) undertake probabilistic analysis of possible outcomes. The NIC may need to be arbiter on assignment of probabilities;
- (iv) use results to identify “least worst regrets” infrastructure that should be built;
- (v) implement policy and commercial/regulatory framework to stimulate private sector investment in the desired infrastructure;
- (vi) periodic review against progress and recourse to state intervention if insufficient progress is made.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

Response:

We perceive the following trends:

- transition away from diesel into hybrid and ultimately electric or hydrogen transport;
- auto-pilot vehicles being able to operate much closer together thus increasing capacity of existing transport infrastructure;
- smarter education and working will result in less travel per annum;

- evolution of mobility as a service and greater automation is likely to reduce the private ownership of own vehicles, with remaining vehicles travelling further (especially when they are autonomous) – especially in large cities;
- greater stratification of transport options – platforms that optimise differing options e.g. bus / tram into central hub. Essentially, multiple types of vehicles will be optimised through platforms to get individuals from point A to B. Consumers will make the choice of cost of travel solution versus time of travel solution; and
- automation and shared mobility will enhance miles driven for new markets (Disabled, Elderly, Young, etc)

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: “high value transport investments” in this context include those that enable ‘agglomeration economies’ – the increase in productivity in firms locating close to one another.

No Response

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

No Response

16. What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?

Response:

Mobility as a service can be expected to increase the utilisation rates of individual vehicles, while potentially reducing the overall population of vehicles. In relation to current methods of taxation, this would imply the ongoing cost of the roads network would need to be smeared across a shrinking population of vehicles.

In parallel it can be expected that with increased uptake in electric vehicles the duty raised from forecourt diesel and petrol fuel sales will decline, or the price per litre would have to rise to collect the equivalent duty from a smaller volume of fuel sales.

Digital communications:

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

No Response

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing “regime” refers to the current market, competition and planning frameworks. “Digital communications” includes both fixed and mobile connectivity.

No Response

Energy:

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Response:

Increasing efficiency will be key to decarbonising heat for both commercial and domestic consumers. Introduction of higher standards for new buildings should be accompanied by a more rigorous approach to assessing the performance of existing buildings, analogous to the MOT test for a car. This would provide a proactive assessment of the state of efficiency of buildings and identify improvement measures. The focus would be to minimise waste heat. In this regard it should be noted that energy efficiency is a separate topic to the social issue referred to as fuel poverty; a focus on reducing the price per unit of energy would not necessarily lead to any reduction in waste heat.

In urban areas, we consider the highest value solution for decarbonising heat is district heating. In priority order, the fuel sources for a heat network should be:

- Waste heat that would otherwise be lost - from conventional or nuclear power plants, energy from waste, waste heat from industry, biomass CHP;
- Renewable sources - Heat pumps using electricity from a decarbonised grid, or solar thermal, biomass, biogas; and
- Gas fired CHP/boilers can be used as interim measure as back-up supplies and to meet peak demand.

In suburban areas, we consider the highest value solution for decarbonising heat is heat pumps using clean sources of electricity.

Our analysis suggests there is no universal optimal solution for the decarbonisation of heat. Instead we anticipate a patchwork of differing solutions tailored make best use of local resources to meet regional circumstances and needs.

Low carbon gasses from local waste are a key biomass resource which should be prioritised – displacing inefficient incinerators or energy from waste plants. See our further remarks on Municipal Solid Waste in response to Question 28.

Hybrid heating solutions can provide an optimized position for low carbon and least cost, which can be applied at both commercial/heat grids and individual domestic scale. In this model consumers retain a gas boiler (providing top-up heat on colder days) complemented by a small scale electric heat pump (for base load heat). The advantages are that value continues to be obtained from existing infrastructure (gas boilers using the gas supply grid) to meet highly seasonal peak demand for space heating. In tandem the significantly higher efficiencies of heat pumps are used to meet base load heat demand. The smaller scale deployment of heat pumps is more manageable in terms of the extent of transformation required of the electricity system. (If all heating duty were to be transitioned to electric heat pumps there would be massive implications for the level of investment needed in the upstream infrastructure in terms of low-carbon generation and electricity grid reinforcement – which in turn would push up costs).

Investment decisions for district heating need made when any new property development goes ahead (e.g. as per the London Plan), whenever there is a major urban regeneration, or whenever a major energy source or demand is investing (e.g. a new hospital, a new energy from waste CHP).

Investment decisions for heat pumps will happen when new homes and refurbishments happen.

Policy decisions should be made twenty plus years before decarbonisation is required, due to the cycle time of major heat investments.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

Response:

We consider that the most effective zero carbon power sector in 2050 will most likely include the following characteristics:

- Demand reduction due to improved efficiency
- A zero carbon electricity supply system facilitated by a combination of renewables, nuclear, CCS and new sources of energy. This acts as an important enabler for the decarbonisation of adjacent sectors in particular transport and heat;
- Some 15-20GW of electricity transmission interconnection to our neighbours as part of a larger national electricity system;

- High penetration of renewables, facilitated by falling technology costs, changing consumer patterns, smarter solutions for distributed energy resources and storage, and competition among new participants providing energy services;
- A step change in the deployment of localised district heating schemes and marked increase in deployment of heat pumps;
- A significant uptake in the deployment of electric vehicles, which both draw from and can back feed the network automatically to optimise against demand;
- An appropriate place in the energy mix for CCS to provide a contribution, most likely from specific regional cluster(s) sharing common transport and storage infrastructure to accommodate industrial and power sector emissions.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Electric vehicles present a significant opportunity to help the transition to a zero carbon power sector. Electric vehicles will require more renewable electricity production, plus investment in adapted and smarter networks. Biogas should be encouraged as a low carbon solution for certain categories of transport (e.g. long range busses, HGVs, etc.) where electric vehicles may not be optimum.

Uptake of Electric vehicles is growing fast in the UK and as a consequence deployment of charging infrastructure is also evolving. We expect electric vehicles uptake to increase and with it the need for associated charging infrastructure. Consideration should be given to how rapid/fast charging solutions can be developed in cities and other key locations at lowest cost for the consumer, and potentially incorporated into broader solutions that deliver benefits for the wider community.

One of the primary challenges to the widespread adoption of electric vehicles is one of convenience. This is particularly true when considering where vehicles can be charged and how quickly this can be done. Assuming residential charging is the primary method of charging electric vehicles, there will still remain a need for rapid charging at key strategic locations. To accommodate such charge points it is likely that in certain locations the electricity networks will require material reinforcement. Looking holistically it is likely to be the combination of electric vehicles and electric heat pumps taken together which trigger more significant network upgrades and more systematic, long term regional planning in this area would be beneficial.

With the increase in reliable distributed energy technologies, such as solar photovoltaic and energy storage, and the continuing fall in prices for such technologies, it is increasingly cost-effective to develop 'off grid' solutions that can support electric vehicle charging requirements. More innovative solutions could be envisaged that offer benefits beyond simply charging vehicles (e.g. Ancillary Services provision to the electricity System Operator). We perceive that such hybrid infrastructure could be part of the low carbon transition if the right risk reward balance can be achieved to underpin investment.

Water and wastewater (drainage and sewerage):

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

No Response

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

No Response

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

No Response

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

No Response

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

No Response

Solid waste:

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

No Response

28. What are the barriers to achieving a more circular economy? What would the

costs and benefits (private and social) be?

Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

Waste is the UK’s largest biomass resource and managed locally usually via incineration or relatively low efficiency energy from waste plants. Municipal Solid Waste (MSW) is a solid dry waste with heavy aggregates and recyclable materials removed. MSW can be converted via gasification to hydrogen and carbon dioxide. The resulting fuel gases can be converted to bio-Substitute Natural Gas (bio-SNG). methane) and could displace 100-150TWh of U.K. natural gas demand - equivalent to one third or more of domestic gas demand assuming continuing efficiency improvements. Alternatively the fuel can be used to achieve higher efficiencies from conventional energy from waste plants.

Conversion of local waste to bio-SNG is already being demonstrated at large scale and would appear to be a no regret option towards a more circular economy.

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London EC3M 8UD

Via email: NIAEvidence@nic.gsi.gov.uk

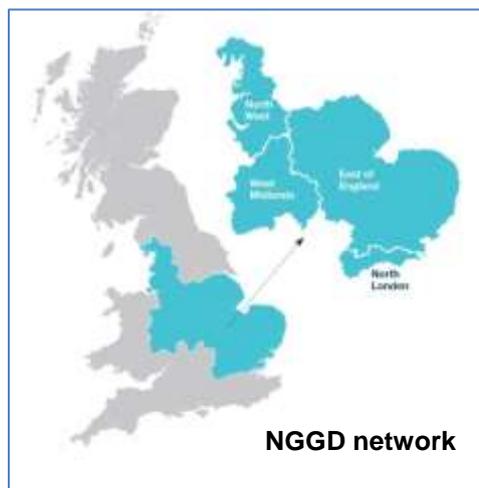
Friday 10 February 2017

Dear Sir/Madam

National Grid Gas Distribution Ltd response to the National Infrastructure Assessment Call for Evidence

National Grid Gas Distribution (NGGD) welcomes the opportunity to respond to this call for evidence. We own and operate four of the UK's gas distribution networks which provide a safe, reliable and efficient gas network that transports gas to eleven million homes, schools and businesses across our network area.

In November 2015 National Grid plc announced its intention to sell a majority stake in NGGD and, having announced the preferred buyers in December 2016, we are aiming for a completion of the sale process during the first quarter of 2017, As a result of the sale we will be the largest gas distribution company in the country and this response represents our first submission to the National Infrastructure Commission as a new entity.



We are delighted to respond to the Call for Evidence and believe that National Infrastructure Assessments present a significant opportunity to help shape the future direction of infrastructure and energy the UK.

We believe that decarbonising the UK's gas network is pivotal in order to assist in the country's transition to a low-carbon energy system and is the least disruptive and cost-effective way of meeting the demands of the 'energy trilemma' – security, affordability and sustainability. In addition to the answers in our submission we would draw your attention to our gas distribution series, 'Energy 2050: Future of Gas' which lays out a range of factors that need to be considered in the context of national infrastructure and the type of energy landscape we need in the future. The series appraises the key trends that will shape future demand for energy, and gas.

We have kept our response in line with the question structure suggested for ease of reference, and summarised the main points at the end of our submission.

We would welcome the opportunity to discuss our response in more detail with you at the earliest convenience. Should you require any additional information, please do not hesitate to contact me.

Yours faithfully

[signature redacted]

[name redacted]
[job title redacted]

NATIONAL GRID GAS DISTRIBUTION LTD

RESPONSE TO NATIONAL INFRASTRUCTURE ASSESSMENT¹

Executive Summary

One of the key investment questions facing our country in the coming decades is: How to decarbonise our heat and transport sectors.

There is an increasingly strong evidence base that shows that re-purposing the gas network to deliver sustainable, renewable, low carbon gas, represents the best value to consumers and tax payers. This is supported by the KPMG report², '2050 Energy Scenarios', the Policy Exchange "Too Hot to Handle" report³ and locational studies for Cornwall and Bridgend.

When planning and optimising our long term infrastructure requirements, whilst new investments must be considered, it is absolutely critical that the full value of existing assets is recognised. When planning the low carbon solutions for the heat and transport sectors, consumers and taxpayers will expect maximum use to be made of the historic investments they have funded in the UK gas networks, thereby minimising overall cost and disruption.

We therefore welcome this work by the NIC to review infrastructure requirements. It presents a timely opportunity for the NIC to provide informed guidance and direction to realise the full value of historic investments in solving one of the country's key infrastructure challenges.

We are happy to offer all the support we can to the NIC to show the role the existing gas network infrastructure can play at the centre of our long term plans to decarbonise our energy systems.

Question 1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

The existing gas network infrastructure is a relatively low cost asset that given the right policy decisions, can be used as the backbone of a low carbon sustainable energy system, heating homes, schools and businesses, and making a significant contribution to fuelling the low carbon transport of the future. We believe that alternatives, such as electrifying heat are both uneconomic and impractical in comparison.⁴

Existing gas infrastructure has great potential to support sustainable growth, both as a seed from which to grow new low carbon networks and as a conduit for sustainable gases. In support of growth and development, we could plan to develop a new strategic offtake from the national gas transmission network in the Northwest.

Similarly, we could examine reinforcing our strategic large diameter local transmission network to support new requirements whether for demand or to transport new sources of gas – shales, hydrogen or biogas.

¹ Please note that we have opted not to respond to all questions posed by the NIC. The question numbers listed correspond to the questions in the NIA Call for Evidence.

² KPMG 2050 Energy Scenarios

<https://www.energynetworks.org/assets/files/gas/futures/KPMG%20Future%20of%20Gas%20Main%20report%20plus%20appendices%20FINAL.pdf>

³ <https://policyexchange.org.uk/publication/too-hot-to-handle/>

⁴ KPMG 2050 Energy Scenarios

<https://www.energynetworks.org/assets/files/gas/futures/KPMG%20Future%20of%20Gas%20Main%20report%20plus%20appendices%20FINAL.pdf> p.72.

We have a substantial programme of asset replacement⁵ on our distribution network, removing old cast iron pipes and moving towards a poly-ethylene (PE) network. The new PE network provides a flexible modern transportation system for a variety of gases.

In addition, we are also expecting to deliver new local networks to support the growth of new towns and commuter belt developments. Gas continues to be the fuel of choice for new housing developments.

Question 3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Utilities, house builders and local government need to engage with communities to design and deliver holistic energy solutions that are integrated with other infrastructure requirements to meet the needs of that location. For example, facilitating forums with local authorities to gather community based solutions. Similarly, local production of sustainable gas may need to be combined with local gas energy storage or different network solutions. Security and reliability will need to be considered carefully for any decentralised energy solutions.

With regard to energy provision, with over 23m homes using gas as their primary heating source, consideration must be given to the existing energy infrastructure, to ensure it is being utilised effectively. In addition, we need to ensure that whilst designing the infrastructure, the delivery will cause minimal disruption/impact on the surroundings (both during installation and with regard to future maintenance.)

We need to ensure that the evolution of infrastructure matches (supports and responds to) changes in home and consumer requirements. Future gas networks transporting different blends of gas could need complementary evolution in home heating and cooking equipment.

Question 4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

In gas, demand management is a key factor in network design as networks are required to meet regulatory obligations to provide capacity on a 1 in 20 year peak demand day to their customers. To the extent that demand locally might not be met at peak and it is more economic than reinforcing the system, then gas networks can tender for interruption services from large industrial and commercial customers.

At a consumer level smart metering, particularly in electricity could have an important role in managing peak demand through time of use tariffs. More broadly government believes that greater consumer awareness of energy consumption and costs could lead to reductions in gas and electricity usage and capacity requirements, through behavioural change.

Of course energy efficiency must continue to be a focus, and we believe there is the potential for a significant reduction in domestic gas demand overall through this route. Smart meters will play a part, but programmes to target other energy efficiency measures, funded from both business and government will also be key. For example, a scrappage programme for all old non-condensing domestic boilers could on its own result in a large reduction in gas usage and emissions, as would better insulation and more thermally efficient new buildings.

Question 5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The management of an organisation's assets should be directed to achieving the organisation's aims and objectives. Good asset management optimises value-for-money across all assets, timescales and life-cycle activities.

Asset systems provide the means of delivering service to customers and the environment as a whole. Over time, assets deteriorate and demands on them change. Thus, there is a continual need to sustain an asset base that is fit for purpose. This involves operating and maintaining assets so that they achieve an optimal

⁵ Visit <http://bettergaspipes.co.uk/> for additional information.

life, replacing them once that lifespan is complete, providing new assets to fill in gaps in capacity and disposal of unwanted assets.

To meet any objective it is important to consider all options. Therefore, a particular need may be met in a number of ways including operational changes, replacement of assets, uprating assets and building new assets. All possible options should be considered on the same basis. Normally, this is achieved through an analysis of the benefits and costs of each option, considering the whole life aspects relevant to the assets in question.

Benefits of an option can be assessed on a consistent basis through calculating the amount of monetised risk reduction or mitigation that can be achieved. Risks include direct financial consequences to the organisation and indirect or societal costs. Each need for action will carry a total risk value that represents the impact of not carrying out any work – the ‘do nothing’ scenario. Any need may have one or more risk components that can all be translated into monetary terms. Each option will mitigate a certain amount of that risk and that difference represents the benefit.

Costs of options can be calculated using appropriate means such as unit rates, cost models and historical information. Cost benefit analyses taken over an appropriate period provide the means for assessing the best solution.

In addition, all solutions should be examined together to ensure that the overall collection of activities is optimised to produce a plan that is balanced in terms of risk reduction and achievement of cost and performance objectives. In this way, the maintenance and repair of existing assets is most effectively balanced with the construction of new assets.

Question 6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

NGGD recognises the public interest case for having competition in infrastructure services. NGGD, together with other gas distribution network companies, has been highly successful in facilitating competition in connections to, and extension of, the local gas transportation networks in Great Britain.

In 2010/11 only 38% of new and modified gas connections were undertaken by GDNs⁶, compared to 77% of electricity connections being undertaken by DNOs. Ofgem estimates that there are now over one million domestic and commercial consumers are now connected to discrete Independent Gas Transporter (IGT) networks.

Where NGGD does deliver connections or modifications to and extension or replacement of the local gas transportation network, this work is undertaken by our strategic partners who were awarded the work via competitive tender. NGGD also, in accordance with EU procurement rules, holds robust, competitive tenders for the purchasing of equipment and materials.

A significant amount of work is currently underway in terms of collaborating to improve the supply of infrastructure services. The UK Regulators Network has worked with stakeholders across multiple sectors, both regulated and non-regulated, to identify how to minimise costs incurred by developers of new infrastructure when they interact with existing in-situ infrastructure. This led them to publish, in late-2015, a suite of recommendations⁷ for utility and rail companies to improve their interactions with developers.

Question 7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The model used by Ofgem for energy networks ensures the efficient delivery of infrastructure services.

Since privatisation in 1986 until 2013 a “RPI-X”, where X is a measure of efficiency, regulatory framework was used to drive cost efficiency within network companies.

⁶ <https://www.ofgem.gov.uk/ofgem-publications/43258/connections-industry-review-2010-11dec-12.pdf>

⁷ <http://www.ukrn.org.uk/wp-content/uploads/2016/07/2015DecCSI-AnnualReportingGuidance.pdf>

In 2013, Ofgem implemented the “RIIO” (Revenue equals innovation plus incentives plus outputs) regulatory framework for gas distribution, gas transmission and electricity transmission network companies and have subsequently, in 2015, implemented it for electricity distribution network operators as well.

The RIIO framework not only continues to drive cost efficiency but also environmental, social and customer benefits as well as enabling network companies to over-deliver where there is a clear customer-focussed justification such as additional fuel poor connections. To achieve the carbon reduction targets set out in the Climate Change Act 2008, 80% reduction from 1990 levels by 2050, significant investment will be required in Great Britain’s energy infrastructure.

To ensure the most efficient provision of heat/energy to homes and businesses in addition to specific efficiency measures, as seen in RPI-X and RIIO, policy-makers and regulators should consider the holistic costs to consumers when assessing efficiency and making decisions. This holistic approach would include considering the combined costs of the commodity, network infrastructure, in-house appliances and subsidies.

The existing Price Control Review arrangements are broadly working effectively and driving the right industry behaviours.

- The arrangements have facilitated the implementation of well justified business plans and promoted stakeholder engagement particularly in the context of supply of natural gas, domestic heat, and network capability, which are all important priorities for our customers.
- Infrastructure investment leads to low wastage and low leakage, the 8 year RIIO timescale enables networks to plan their investment in a structured fashion to ensure benefits are realised and can be passed to consumers.

The stakeholder engagement for RIIO-2 is starting now, and we would welcome engagement with the NIC to gather their views on strategy for infrastructure and how they see energy networks delivering in the future.

In the area of fuel poverty “getting our customers physically connected” is working well but there could be more joined up thinking regarding fuel poor funding schemes to support delivery of the final solution for the customer (i.e. once the pipe is in, make it easier for the customers to install the boiler/heating etc. currently this can be done via ECO, Warm Zone, etc. but there is merit in reviewing this to provide a “one-stop shop”). Central funding for a boiler scrappage scheme, which could be targeted initially at the fuel poor, could also have significant benefits.

With large new investments, which can take a number of years, such as the national roll out of renewable gas production facilities derived from waste streams (BioSNG), risk can also contribute to project costs. In the energy sector, project risk as well as energy security, network availability, reliability and resilience and other safety risks are critical. To reduce risk, in some circumstances, a regulated delivery model may provide the best value to the consumer or tax payer.

Question 9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Current UK energy policy focuses on electrification for home heating. But electricity is likely to be more expensive for consumers, may not meet future demand and may not achieve the targets for cutting carbon pollution. We believe that gas will play a crucial role as a bridging fuel as the energy system becomes carbon-free and innovative solutions are being developed that could use the existing gas networks.

Building resilience into our network should involve minimising our reliance on a single energy source. By introducing new sources of gas we can use an existing asset, (that is sufficiently flexible to cope with day-by-day changes in demand as well as seasonal shifts), at minimal extra cost, which would be a sustainable, flexible, economic solution.

A key issue for consumers is that gas provides over 80% of the heat for UK homes with most of this consumed during the winter, and increasing levels of primary generation is gas fired, as coal and oil stations,

close as we transition to a low carbon future. On a peak day, a typical home connected to the gas grid will take four to five times as much energy from the gas supply than it will from the electricity grid. Replacing this gas demand from the electricity network, which must be balanced second by second, would be a significant investment challenge as electricity networks are not currently designed for this level of peak load. The UK therefore needs to maintain balanced energy delivery infrastructure to support essential services, economic prosperity and the needs of its citizens at an affordable cost, until viable alternatives emerge over coming decades. Through encouraging biomethane, Synthetic Natural Gas and potentially Hydrogen, the reliability and lower cost benefits of using gas can help the UK meet its climate change targets. This was illustrated in the KPMG report⁸, '2050 Energy Scenarios' which indicated the evolution of the gas network to meet our emissions targets could cost over £8000 less than the scenarios whereby all heat is electrified.

Question 11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The Natural Capital Committee, amongst other bodies, has highlighted the multiple benefits of a healthy and functioning ecosystem to health and wealth of society. It has also highlighted the need to protect and enhance environmental assets by creating bigger, better and connected spaces for nature.

The National Infrastructure Plan should incorporate natural capital into each of the main infrastructure sectors, following the mitigation hierarchy for managing impacts (avoid, minimise, restore, offset). An investment programme for natural capital should also explicitly feature in the National Infrastructure Plan.

The NIC is in a unique position to promote, embed and mainstream the use of green infrastructure as a tool to enhance the resilience to flood and climate change. Green infrastructure can also increase asset efficiency and reducing the whole life costs of national and local infrastructure assets and maximise their biodiversity and ecosystem service benefits. This includes the incorporation of green infrastructure into new-build linear infrastructure assets, retro-fitting it into existing assets and promoting the appropriate maintenance and management of this green infrastructure. It is also important that this is addressed in both rural and urban environments. In urban environments, infrastructure corridors provide real opportunities to connect people and green space, to embed sustainable drainage solutions and to preserve and plant more urban trees with benefits to temperature regulation, air quality and wellbeing.

The ability to properly account for both loss and restoration of natural capital through infrastructure development is crucial to capturing natural, social and financial value and should underpin decision making in managing, offsetting and compensating impacts.

A number of organisations are highlighting the organisational and societal benefits of such an approach and the value of tools such as natural capital accounting in delivering creative solutions to enhance and manage the environment to support local and national priorities and the delivery of net gain in natural capital value.

The deliveries of effective approaches to protect and enhance the natural environment are multidisciplinary and collaborative. The NIC could play an invaluable role in setting frameworks in place or developing new mechanisms to incentivise linear asset owners and managers to incorporate green infrastructure into their asset design, construction and management.

Question 12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

We support the application of CBA to inform better decision making and the targeting of resources to the right activities. In our business plans and discussions with Ofgem to determine the infrastructure investment for RII0-GD1 (2013/4 to 2020/21), a tractable CBA methodology was developed that improved the level of transparency and credibility. There were, however, both differences in CBA approach between GDNs and within GDNs across different asset types.

⁸ KPMG, 2050 Energy Scenarios
<http://www.energynetworks.org/assets/files/gas/futures/KPMG%202050%20Energy%20Scenarios%20-%20The%20UK%20Gas%20Networks%20role%20in%20a%202050%20whole%20en...1.pdf>

The Gas Distribution Industry has been working with Ofgem to develop a standard methodology for the monetisation of risks (benefits) across all assets types.⁹ This approach has driven a consistency in the way that benefits are quantified and produced a published standard which is available for review and challenge, a key foundation for improving credibility and transparency.

Further improvements could be achieved by involving a wider range of stakeholders in reviewing and refining the approach to CBA, allowing transparency. Whilst some aspects of CBA may remain opaque to non-engineers, economists or statisticians there is much that generalists can contribute in terms of the reason or underlying purpose of the CBA. Our stakeholders can help us maintain focus on what CBA as a tool is trying to deliver, rather than getting caught up in CBA for its own sake. We should also encourage the documentation of stakeholder involvement, whether as specialists or generalists, to help build confidence (credibility) in the models that have been built – i.e. publishing CBA with endorsement by independent specialists or recognisable ‘stakeholder champion’.

The link between CBA models and investment decisions also needs to be made more transparent. CBA may be one of a number of components informing a decision and its role needs to be clearly stated. The risk monetisation work in the gas industry provides a great opportunity to refine our investment choices and produce great benefits for our customers and society.

Question 13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

The adoption of Ultra Low Emissions Zones (ULEZ) and Clean Air Zones across the major cities in the UK, along with national policies to reduce emissions from the transport sector, will change current patterns. Gas is likely to play a significant role, particularly for freight and buses, by driving the adoption of more environmentally friendly vehicle technology.

For buses, there are a number of options for lower emission vehicles; hybrid, electric, compressed natural gas (CNG) and Hydrogen fuel cells. For HGV’s, the most viable route to lower emissions is currently the adoption of CNG as a vehicle fuel.

Compared with diesel, the adoption of CNG HGV’s and buses would have many positive impacts, including:

- Lower levels of NOx and particulate matter emissions
- Lower Well-to-Motion CO2 emissions, c.10-20%. Increasing to 60-70% with the use of BioCNG
- 50% quieter
- 40% cheaper to run in terms of fuel

Gas: The fuel of choice for HGVs and buses

Of total GHG emissions
25%
are attributed to transport

c. **24%**
Road surface emissions from HGVs and buses

c. **1.5%**
of UK vehicles

National Grid believes that gas could and should be the fuel of choice for HGVs and buses in the UK

- Support UK CO₂ reductions and cleaner air in cities
- Thorough utilisation of the gas network into the future
- Gas network forming the backbone of a national filling station infrastructure

A clean, quiet and cheap alternative to diesel

Given the backdrop of the implementation of emission zones, the environmental and economic benefits for bus and HGV fleet operators are compelling.

It has been predicted that changing travel patterns will result in 17,000 buses and 190,000 gas fuelled HGV’s by 2050.¹⁰

⁹ https://www.ofgem.gov.uk/sites/default/files/docs/2015/11/gdn_asset_health_risk_reporting_methodology_-_v2.0.pdf

¹⁰ <http://www.lowcvp.org.uk/assets/reports/LowCVP%20Infrastructure%20Roadmap-Methane%20report.pdf>

NGGD believes that gas could and should be the fuel of choice for HGVs and buses in the UK:

- Support UK CO₂ reductions and cleaner air in cities;
- Thorough utilisation of the gas network into the future;
- Gas infrastructure forming the backbone of a national filling network.
- **A clean, quiet and cheap alternative to diesel.**

Using compressed natural gas for long haul vehicles will act as a bridge to the low carbon economy by helping to decarbonise the sector and get us on the journey towards 2050.

The business case for renewable gas in transport

For renewable methane (bio and synthetic natural gas) used in transport, incentives can be claimed through the Renewable Transport Fuel Certificates (RTFC), which is essentially a subsidy like the Renewable Heat Incentive (see Future of Gas - Domestic Heat chapter.¹¹)

The scheme is currently restricted to gas transported from the source of production straight to the vehicle being fuelled. However, this can place limitations on the use of biomethane, especially where the source of production is located away from the point of demand.

This means the fuel would have to be transported by road tanker, diminishing its environmental benefits (the well-to-motion emissions footprint). NGGD believes RTFCs should apply to bio gas injected into the distribution grid, with a certification scheme to authenticate the source of supply and use.

This would remove the need for tankering fuel from production to vehicles, thereby realising the benefits of utilising the gas distribution network for delivering fuel. It would also decouple the geographic restriction of demand and supply, and act as a catalyst to incentivise the use of renewable gases in transport.

Of course as well, the level of support provided by different schemes must be in line with considered joined up policy across government to ensure the fuels and feedstocks are directed to where they can add the most value.

Question 14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

With the proven environmental and sustainability benefits. The investment in strategically located CNG filling stations is key to efficiently allowing people (buses) and freight (HGV's) to flow around major urban areas.

Public access CNG filling stations are best located where there is strong demand from a number of freight or fleet operators, located within close proximity of each other and with strong links to major traffic routes. Where these locations are close to higher pressure gas grid pipelines, the conditions are perfect for the siting of a filling station.

Vehicles fuelled from stations such as this enjoy Well-to-Motion CO₂ emissions that are lower than any other fossil fuel. This type of station lends itself well to the 'back to depot' refuelling fleet operator.

A small scale CNG filling station dispensing enough fuel for 60 trucks costs c. £300k, a station with the capacity to fuel 500 per day costs c. £1.4m to construct (Capex & Civils costs.)

Building the infrastructure covering all major UK trucking routes for at least 100 HGV friendly CNG refuelling stations will require an investment of around £150 million. The funding could be shared between private companies and the Government, and over time, these stations could dispense increasing amounts of renewable gas.

¹¹ <http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas/>

Question 15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Our answer to question 14 addresses some of the key issues posed by this question. However, we have provided additional information below.

In terms of siting CNG filling stations outside of urban areas, consideration should be given to the **major arterial routes that run across the UK**. A fuelling infrastructure built to serve this route would ensure that operators of CNG vehicles did not suffer any 'range anxiety'. Consideration should be given to ensuring a gas refuelling infrastructure was designed to be extendable if demand for new fuels such as hydrogen, that could also be delivered via the existing gas grid.

Development of a CNG fuelling infrastructure across the Trans-European Transport Network (TENT-T) corridor stretching from **Dover to Glasgow would support long-haul HGV's**. More details can be found in Directive 2014/94/EU¹².

To support the 2050 prediction of the number of HGV's and buses fuelled by gas, it is predicted that **800-1,000 filling stations will be required across the UK**.¹³

Question 19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

In summary:

- Of the various technologies that are available, we believe that renewable gas (biomethane) provides the most cost effective and convenient form of renewable heat delivery to consumers, and therefore that policy should be directed at maximising the opportunities for its production and distribution.
- Biomethane from anaerobic digestion can make a significant contribution, but thermal production of biomethane is very well placed to provide a step change in the volume of renewable gas, given a sufficient incentive in the form of a dedicated RHI tariff.
- The development of technologies and infrastructure for carbon capture and storage will enable the production of low carbon hydrogen by steam methane reforming. This offers a route to provide enough low carbon fuel to eventually completely decarbonise domestic and commercial heat.

NGGD has been in the forefront of utilities supporting the development of biomethane from anaerobic digestion (AD). We have facilitated the connection of biomethane plants to our networks, recognising that renewable gas has an important part to play in the decarbonisation of heat and transport. There are now over 60 biomethane plants supplying renewable gas into Britain's gas networks, with more planned to connect in 2017.

The reason NGGD has supported the development of renewable gas so strongly is that we believe it is the most accessible and affordable source of renewable heat, and that delivery of renewable gas through the existing extensive gas pipeline network delivers the best value for consumers. Alternative options for delivering low carbon heat are either more costly or rely on significant infrastructure investment - mainly in the home - which is a significant barrier to deployment for the majority of domestic premises.

Currently gas dominates the UK heat supply curve, with over 80% of the UK's buildings heated by gas, and over 23 million homes, typically using efficient modern gas boilers. Similarly, most industrial heat demands are fuelled by gas.

Heat demand is highly variable, when compared with current electricity loads, as can be seen in the work by Robert Samson, Imperial College below.

¹² <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014L0094>

¹³ <http://www.lowcvp.org.uk/assets/reports/LowCVP%20Infrastructure%20Roadmap-Methane%20report.pdf> p.36

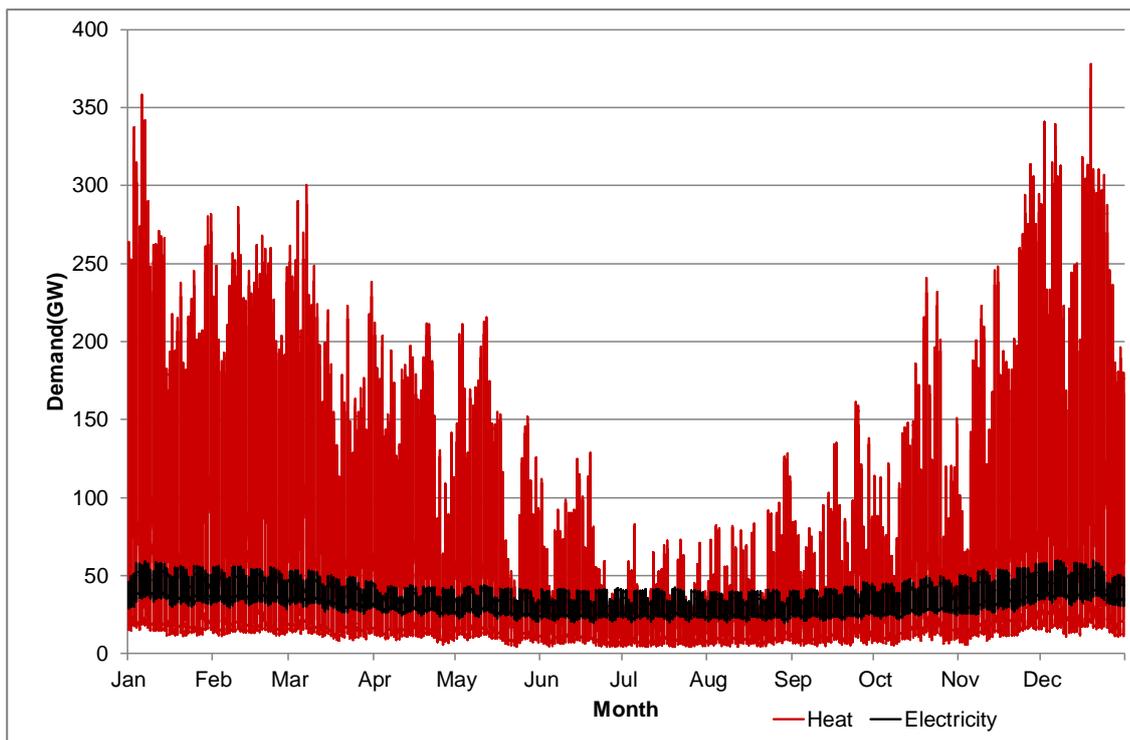


Figure 1: Comparison of half hourly electricity and heat demand variation¹⁴

The peak capacity load on a daily basis is more than five times the lowest day, and the peak capacity hour is more than ten times the lowest hour, which places particular challenges on low carbon solutions for heat.

The current potential options to decarbonise heat are:

Electrification: Efficient electric heat pumps will make an important contribution, but, as recognised in DECC's Heat Strategy¹⁵, major investment would be required to replace current consumer equipment and for the electricity network and generating infrastructure to handle the massive increase and variable demand for heat, making them an expensive solution to meet all heat demand. Persuading consumers to change from existing central heating systems, which have very high levels of customer satisfaction, to new electric solutions, which will require changes in lifestyle, is particularly challenging.

Biomass: Biomass installations require consumers with sufficient space for equipment and storage, limiting their use in urban areas. In practical use, there is concern that small scale biomass boilers can be inefficient and give rise to air quality issues because of high emissions of particulates¹⁶ and potentially nitrogen oxides.

Heat networks: Heat networks require a low carbon source of heat, new infrastructure and sufficient heat density of the load which constrains their use to urban areas (where in general an extensive gas network already exists). As for heat pumps, persuading consumers to move from their existing central heating system is challenging. We believe this option is far less credible in a retrofit scenario, but may be viable for new build when combined with sustainable fuels e.g. biomethane or biomass.

Renewable gas: The gas network is ideally suited to transmitting and distributing variable levels of energy, and is already sized to meet UK demand. Therefore, a solution which utilises the existing gas network to deliver low carbon fuel to existing, efficient installations with no modification to either the grid or end use equipment offers the prospect for best value to gas customers. Renewable gas also supports the continued consumer desire to use gas for domestic cooking purposes. Whilst a relatively small demand, cooking can be an emotive and personal issue for many consumers.

¹⁴ THE IMPACT OF FUTURE HEAT DEMAND PATHWAYS ON THE ECONOMICS OF LOW CARBON HEATING SYSTEMS, Sansom R et al, Imperial College, BIEE – 9TH ACADEMIC CONFERENCE 2012, OXFORD

¹⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/190149/16_04-DECC-The_Future_of_Heating_Accessible-10.pdf

¹⁶ Contribution of wood burning to PM10 in London, 168 Fuller, G. et al Atmospheric Environment, 87-94 (2014)

It is difficult to conceive of alternatives to gas for industrial heat applications, so renewable gas is likely to be the only realistic decarbonisation option for much of our industrial heat usage.

In the context of preparing the business case for National Grid's 2015 bid for funding from Ofgem's Network Innovation Competition for a Commercial Demonstration plant to make biomethane from thermal sources (see below), National Grid's Energy Strategy and Policy Group were commissioned to independently quantify the benefits of renewable gas in the energy system, compared to a scenario without it. The benefits were found to be a £0.5 billion per year energy system cost saving in 2030 (for 37 TWh/a of renewable gas) rising to £3.9 billion per year in 2050 (for 100 TWh/a of renewable gas).¹⁷

NGGD has recently initiated a debate about the place of gas in the UK's future energy supplies and is publishing a series of documents intended to inform this debate, including one on the supply of renewable gas¹⁸. That publication noted that there is a consensus in the industry that UK sources of wastes and residues could generate 80 to 120 TWh/a of renewable gas, and so could meet around one third of future domestic gas demand.

Anaerobic digestion (AD) plants are already producing more than 2TWh/a of biomethane. However, conventional AD can only process some wastes, which limits the potential of the technology to around 20TWh according for an SKM Enviro report for DECC¹⁹. In order for biomethane to make a significant contribution to meeting heat demand it is necessary to develop technologies that can process all types of waste.

This has led NGGD to support the development of Bio Substitute Natural Gas (BioSNG): biomethane produced by the thermal conversion of mixed wastes and residues. We have been working with our partners Advanced Plasma Power and Progressive Energy since 2010 on the development and demonstration of this technology. The consortium has constructed a pilot plant that has demonstrated the technical, commercial and environmental feasibility of the technology and a commercial plant is now being built in Swindon. This will produce 22GWh/a of gas from local household residual waste. Further information about these projects can be found at <http://gogreengas.com/>

The new commercial BioSNG plant will commence operations in early 2018, and the intention is for this plant to lead to the development of large scale thermal biomethane production plants later in the decade. NGGD forecasts that by 2025, BioSNG will be a mature technology. At this point, given a favourable policy environment, the adoption of the technology could accelerate such that by 2030 over 50 large scale plants could be in operation, producing 37TWh/a of BioSNG.

Analysis by the BioSNG consortium partners has shown that, overall, the production of one MWh_{th} of biomethane will result in net negative carbon emissions of 103kgCO_{2eq} compared to emissions of 214kgCO_{2eq}/MWh_{th} for fossil gas. Therefore, overall savings will be 317kgCO_{2eq} per MWh_{th} of biomethane.

Once the BioSNG technology is mature it will produce gas from with the same price as fossil gas and provide consumers with heat for similar prices to those that they pay now.

In relation to the timing of decisions, the Government's Carbon Plan identifies the need to '*deliver between 83-165TWh of low carbon heat*' by 2030. The Renewable Heat Incentive delivered around 4.5TWh in 2015 and the latest RHI consultation document anticipated that the '*scheme will support 23TWh of renewable heat generation in 20/21*'. Therefore a step change is required to meet low carbon heat commitments.

NGGD believes that in view of the very large potential contribution that renewable gas could make to the decarbonisation of heat, **it is important to prioritise the allocation of waste and biomass resources to the production of renewable gas, and to make the decision to do this in the very near future, before such resources are locked into long term contracts for electricity generation.** There are many other ways of generating low or zero carbon electricity (e.g. nuclear, wind, or solar) but few readily-accessible

¹⁷ https://www.ofgem.gov.uk/sites/default/files/docs/national_grid_gas_distribution_-_commercial_biosng_demonstration_plant.pdf

(Appendix 2)

¹⁸ <http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas/>

¹⁹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48166/2711-SKM-enviros-report-rhi.pdf

alternatives for producing low carbon heat. In addition, the efficiency of energy conversion from waste or biomass to renewable gas (c. 65%) is much higher than the efficiency of electricity generation from waste or biomass (c.25% for conventional incineration plant or 35% for very large ex-coal steam turbine plant).

Role of Hydrogen and Carbon Capture and Storage

BioSNG has the potential to make a significant contribution to heating UK homes and businesses but will not be able to meet all of the UK's heat demand. It could provide 100TWh of gas which is a third of current domestic gas demand, but is ultimately limited by the availability of sustainable feedstocks. Heat pumps and heat network could fill some of the gap but in NNGD's view, in order to fully decarbonise heat it is essential to develop hydrogen production. The existing large scale method for hydrogen production is through steam methane reforming which can be combined with carbon capture and sequestration (SMR with CCS).

Hydrogen can be blended into the existing gas grid and is compatible with existing appliances at higher blends than currently permitted under the gas quality regulations. The NNGD HyDeploy²⁰ project will test the impact of increasing the hydrogen blend to 20% by volume on a real world gas network. This offers another route to reduce emissions and establish low carbon hydrogen production without wholesale conversion of the gas network.

Northern Gas Networks' H21 programme²¹ is examining the benefits and costs of complete conversion of the gas network to hydrogen on a street by street basis. This indicates that hydrogen conversion is viable given enough time and investment. The report estimates that the hydrogen produced by SMR with CCS will have a GHG footprint of 86kgCO_{2eq}/MWh_{th} representing a saving of around 60%. The report also estimates the total capital cost of converting and supplying the major conurbations in the UK, and capturing the CO₂ would be in the order of £50bn.

There are substantial synergies between BioSNG production and the conversion of the gas network to hydrogen. The technology used to produce BioSNG can be easily adapted to produce hydrogen or to produce a blend of hydrogen and BioSNG. BioSNG facilities can offer the flexibility to adapt to increasing levels of hydrogen as the network evolves. This provides a very cost effective and adaptable route to hydrogen production, and unlocks early adoption of hydrogen.

The GHG impact of BioSNG improves dramatically when it is combined with carbon sequestration. The BioSNG process creates a stream of relatively pure carbon dioxide that is suitable for sequestration. If infrastructure for storing carbon dioxide is developed the GHG savings of BioSNG increase by more than 50%. If a BioSNG facility using carbon sequestration is converted to biohydrogen production, even higher savings are achieved because all of the carbon in the feedstock is captured. The biogenic carbon dioxide captured from the atmosphere (which has previously been taken up by the biomass) is sequestered, creating genuinely negative carbon emissions.

Developing technologies with negative carbon emissions is essential in meeting 2050 climate change goals. The negative emissions will offset emissions from hydrogen produced by SMR with CCS and from other sectors that are hard to decarbonise such as aviation and farming. The imperative of this is shown very clearly by the Energy Technologies Institute (ETI) in their ESME Modelling in Figure 5

²⁰ https://www.ofgem.gov.uk/system/files/docs/2016/04/ng_ngn_hydeploy_isp.pdf

²¹ <http://www.northerngasnetworks.co.uk/wp-content/uploads/2016/07/H21-Report-Interactive-PDF-July-2016.pdf>

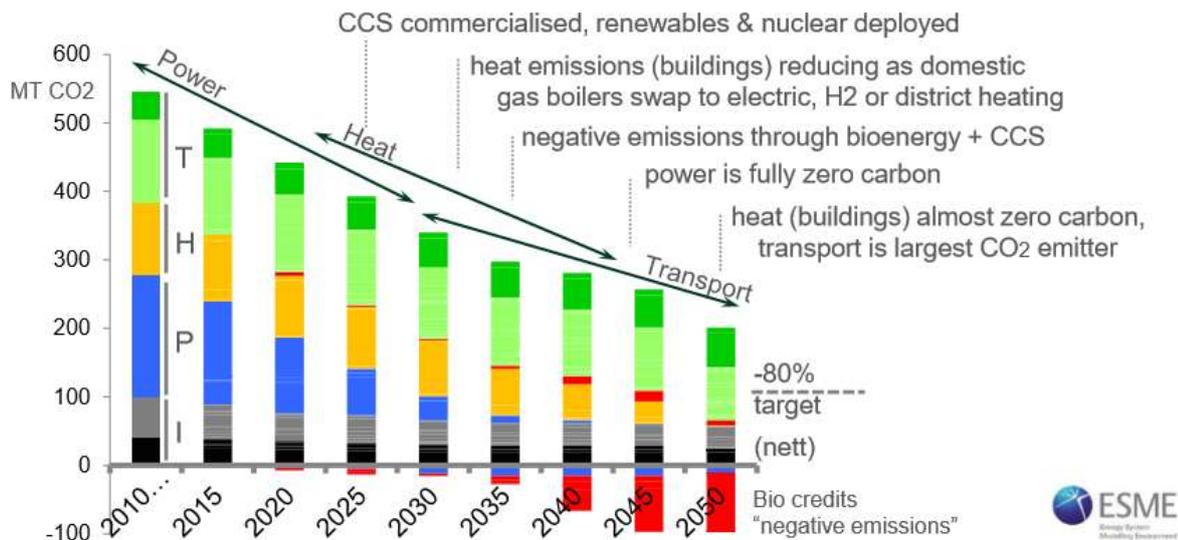


Figure 2: UK Energy system decarbonisation route-map to meet 2050 targets²²

NGGD believes that in view of the important contribution that hydrogen can play in decarbonising heat that it is important **the Government supports the introduction of technologies and infrastructure to enable carbon capture and sequestration** as recommending in the Oxburgh report²³. The incentives for production of low carbon heat should recognise and support the importance of hydrogen whether it comes from renewable sources or fossil sources combined with CCS technology. The Government should provide grants and other support for the development of hydrogen technologies.

Question 21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

The Low Carbon Vehicle Partnership's (LowCVP) methane infrastructure road map²⁴ predicts 190,000 gas fuelled HGV's and 17,000 buses by 2050.

The gas demand associated with that fuel requirement is c. 50TWh/yr. In 2013, the total UK gas demand was 850TWh/yr (including 294.2TWh/yr of domestic gas demand). Against a backdrop of reducing gas demand; the 2050 gas vehicle demand was only 6% of UK demand in 2013.

We believe the gas distribution network can easily support this level of increase in gas demand as a result of the uptake of lower carbon gas vehicles.

Our answers to questions 13, 14 and 15 also cover many issues relevant to this question.

Question 27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

NGGD believes that financial incentives are extremely important in the short term to develop a sustainable waste to energy industry, but that currently they are not correctly aligned between heat, transport and electricity outputs to produce outcomes that optimise least-cost carbon reduction.

Renewable Heat Incentive (RHI)

The RHI provides support to biomethane produced by AD and gasification technologies such as the BioSNG process. However, support drops off rapidly for facilities producing more than 40GWh/a of gas. This is an appropriate limit for AD, which works best in small facilities designed to use locally available agricultural

²² Heat and Energy Systems, Dr David Clarke FEng, Chief Executive ETI, Heat Catapult November 2016

²³ http://www.ccsassociation.org/index.php/download_file/view/1043/508/

²⁴ <http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas/>

feedstock, but it is too restrictive for BioSNG, which operates in an urban environment where waste volumes are higher.

DECC launched a consultation on reforms to the RHI in the spring of 2016. NGGD, the Renewable Energy Association, and range of engineering companies responded to ask for more focussed support for BioSNG with a separate RHI band providing 5.87p/kWh without any limits on scale.

BEIS published their response to the consultation on 14th December 2016. They agreed that BioSNG could increase the supply of green gas but rejected setting up a new band because of lack of evidence on costs and the risk of overcompensation.

NGGD and its partners in the BioSNG projects are engaging with waste companies to start development of large scale BioSNG plants. The completion of the first commercial plant in 2018 will be followed by facilities around ten times bigger, **but this will require appropriate support schemes in place.**

Renewable Transport Fuel Obligation (RTFO)

The RTFO is a further scheme that has the potential to incentivise waste to renewable fuel plants. The Department for Transport issued a consultation on changes to the RTFO on 29th November 2016.

In its response to the consultation, NGGD has stated that:

- The proposed changes are good for decarbonising transport and establishing a biofuels and low carbon transport industry that will create jobs, investment and exports.
- Biomethane is one of the best candidates for decarbonising heavy goods vehicles and buses and should be included in the development target.
- The buy-out price for development fuels should be set at a high level to provide strong incentives for this new technology.

Contracts for Difference (CfD) Scheme to support renewable electricity generation

NGGD has recently responded to BEIS's call for evidence on fuelled and geothermal technologies in the CfD scheme. In summary, we have suggested that so-called Advanced Conversion Technologies (ACTs) should no longer be supported by the CfD scheme but that ACT-based heat and fuels are appropriately supported. This is because the current ACT regime means that some projects are receiving a substantial subsidy for converting waste to electricity at efficiencies (<18%) lower than open market projects which operate with no support. This means that consumers are paying a subsidy for a worse carbon outcome; this is certainly not cost effective decarbonisation.

We suggest that removal of support for ACTs under the CfD regime should be undertaken in a co-ordinated way including enabling support for heat and fuels. This must focus on ensuring the future incentive regime for renewable heat provides the transitional support which was formerly delivered to AD, to allow gasification to deliver early commercial projects prior to being able to operate without support. Similar co-ordination is required with the Department for Transport on the Renewable Transport Fuel Obligation which is also currently under consultation.

Question 28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

A circular economy delivers effective resource utilisation. As noted previously, simply burning waste to generate electricity misses the opportunity which this bio-rich resource offers. Reforming the waste to a clean syngas, which can be used as a chemical precursor for production of fungible gas, fuels or chemicals, is an ideal form of molecular recycling.

Production of a clean syngas by gasification of waste also facilitates carbon capture using existing proven carbon dioxide separation technologies which have been operating for many decades. Conversion of a solid

to a gas or a liquid inevitably leads to excess bio-carbon which is rejected as bio-carbon dioxide. This forms the basis for the use of BioEnergy CCS (BECCS) which is recognised by both the Committee on Climate Change²⁵ and the ETI²⁶ as fundamental to meeting our 2050 targets. This approach already delivers captured bio-carbon dioxide today. For example production of methane from solid biomass leads to around half of the carbon separated as storage-ready carbon dioxide. This is already undertaken at all ~70 AD biomethane plants, some of which capture the carbon dioxide and sell it to industry. It will also be demonstrated at the NGGD supported BioSNG project at Swindon, where 5000 tonnes of carbon dioxide per annum will be sold to industry. In the future, this approach can be extended (simplified), with hydrogen produced as the energy vector with separation of all the carbon for storage.

The language used when referencing waste can be unhelpful: thinking of it as resource rather than waste may enable a more positive and constructive approach. It may also facilitate the cross departmental working that is critical to an effective circular economy. Waste must be considered as a valuable resource which needs to be managed efficiently, and within a framework which can recognise strategic priorities such as keeping people warm and our industry fuelled.

²⁵ https://www.theccc.org.uk/archive/aws2/Bioenergy/1463%20CCC_Bioenergy%20review_bookmarked_1.pdf

²⁶ <http://www.eti.co.uk/insights/the-evidence-for-deploying-bioenergy-with-ccs-beccs-in-the-uk>

Summary of Key Points from Our Response

One of the key investment questions facing our country in the coming decades is: How to decarbonise our heat and transport sectors.

- 1. Approximately two-thirds of residential and commercial energy consumption is met by natural gas (methane.) Gas provides 4/5 of total energy demand for heat at peak times. Reliable and safe gas supply is essential to the UK economy and domestic consumers.**
- 2. Over 80% of UK households use gas²⁷ and for the vulnerable and those in fuel poverty gas is significantly cheaper than coal, oil or electricity.**
3. To achieve the carbon reduction targets set out in the Climate Change Act 2008, 80% reduction from 1990 levels by 2050, significant investment will be required in Great Britain's energy infrastructure.
4. NNGD believes that the role that gas can play in both the short and long term should be considered carefully if we are to meet the demands of the energy trilemma. Maximising the value of the existing gas infrastructure has the greatest potential to support sustainable growth, both as a seed from which to grow new networks and as a conduit for sustainable gases.
5. Electricity is likely to be more expensive for consumers, may not meet future demand and may not achieve the targets for cutting carbon pollution. We believe that natural gas will play a crucial role as a bridging fuel as the energy system becomes carbon-free and innovative solutions developed that could use the existing gas networks such as biomethane or hydrogen.
6. The National Infrastructure Plan should incorporate natural capital into each of the main infrastructure sectors, following the mitigation hierarchy for managing impacts (avoid, minimise, restore, offset). An investment programme for natural capital should also explicitly feature in the National Infrastructure Plan.
7. The adoption of Ultra Low Emissions Zones (ULEZ) and Clean Air Zones across the major cities in the UK, alongside national policies to reduce emissions, will change current patterns for freight and buses by driving the adoption of more environmentally friendly vehicle technology such as compressed natural gas (CNG).
8. NNGD believes that financial incentives are extremely important in the short term to develop a sustainable waste to energy industry, but that currently they are not correctly aligned between heat, transport and electricity outputs to produce outcomes that optimise least-cost carbon reduction.

²⁷ <https://www.britishgas.co.uk/the-source/our-world-of-energy/energys-grand-journey/where-does-uk-gas-come-from>

National Infrastructure Assessment – Call for Evidence

Response from Dorset Local Enterprise Partnership

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of “highest value” should include benefits and costs, as far as possible taking a comprehensive view of both. “Long-term” refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

Please cross-reference with attached documents;

- 1. Dorset Rail Infrastructure map**
 - 2. Dorset Road Infrastructure map**
 - 3. Wessex North-South Connectivity study**
 - 4. Large Local Transport Majors application (A31-Poole Link)**
- Housing: Investment in major “place” regeneration of socially deprived areas to include accelerated new house building;
 - Road (External links) – Improvements to A31 between Ashley Heath and M27 (Southampton);
 - Road (External links) – major improvements to North-South route(s) accessing M4 via A350, providing significant benefits in closing productivity gap.
 - Road (External links) – improvements to A303/A358/A30/A37 to provide far better access to M5 from Dorset via Yeovil/Taunton.
 - Road (External links) – Provision of major new link road between Poole and A31, unlocking several thousand new homes;
 - Road: (Internal links) – Further dualing of A35 at key locations to ease significant congestion on E-W journeys across Dorset and into neighbouring counties
 - Rail: (External links) – Faster journey times between Bournemouth, Poole, Weymouth & London through significant track and signalling upgrades;
 - Rail: (External links) – greatly improve routes via Weymouth to Exeter, Taunton, Bristol, Swindon, Salisbury – Yeovil South Chord proposal is key.
 - Rail: (External links) – Weymouth to London via Yeovil. Redoubling of track between Wool and Morton. Power supply capacity improvements.
 - Rail: (Internal links) – ‘Dorset Metro’ – new and frequent cross-conurbation commuter train services, including new branch lines to Wimborne and Ferndown and potential for link to proposed Solent Metro;

- Rail: (Internal links) – a new station to serve Bournemouth University and Arts University Bournemouth campus.
- Rail: (Internal links) – creation of Dorset Innovation Park (Enterprise Zone) station, possibly involving relocation of nearby Wool station.
- Public/Low Carbon Transport (Internal Links) – Greater investment in sustainable travel – bus infrastructure, electric buses; cycling infrastructure; multi-purpose transport hubs;
- Public Transport: (Internal links) – creation of new transport interchange at Weymouth train station
- Transport: Air (External links) – Improve capacity and facilities at Bournemouth Airport with a view to increasing flights to and from key trading destinations to enhance export opportunities and the attraction of customers/visitors;
- Transport: Sea (External links) – Increase capacity and capability of Ports at Poole and Portland to enhance export opportunities and attraction of customers/visitors;
- Digital communications – early/quick adoption of 5G infrastructure to prepare for future ways of working and increase productivity

2. How should infrastructure most effectively contribute to the UK’s international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Cross reference with;

1. “A Strategic Economic Vision for Dorset”

The critical elements of successful world class economic regions should inform the prioritisation of investment in infrastructure in the UK and Dorset.

Dorset’s economy generally performs very well. There is very low unemployment¹ and a number of high-performing key sectors, especially financial, digital, creative and advanced manufacturing. However, there are issues with productivity and further growth being constrained by important infrastructure requirements.

The Dorset LEP “Strategic Economic Vision for Dorset” (Feb 2016), agreed and signed by all public sector partners, outlines the aspiration for Dorset to be Britain’s most sustainable core city region by 2033.

The relevant infrastructure elements to deliver the economic vision for Dorset are:-

1. High productivity economy – enabled by fit for purpose physical and digital infrastructure
2. Accessible to markets – good international, national and internal connectivity by road, rail, air and sea including increasing public transport use, reduction in travel times and the roll out of Ultrafast broadband and 5G infrastructure;

¹ Bournemouth has been identified as the fifth-fastest growing area for jobs in the UK over the past 10 years by Centre for Cities

3. A world class workforce – high quality universities and further education colleges providing courses and apprenticeships supporting key local sectors such as finance, digital/media and advance manufacturing;
4. Making the most of the natural environment – ensuring that the area provides a world class environment in which to do business and to attract new business and talent;
5. Provision of housing to facilitate growth – increasing the supply of all housing stock to help address affordability constraints on growth

Investment in infrastructure needs to be analytically and strategically applied to a mix of solutions across a wider range of regional areas to provide the optimum return on investment and contribution to the UK's international competitiveness.

Central infrastructure investment currently seems focused in too few regional areas and only on a handful of significant major (or political) projects, meaning that other areas with great potential for growth are not realising that potential. Investment could be more effectively dispersed across less large but nonetheless important enabling projects in order to unlock greater economic growth. In the recently published Green Paper 'Building our Industrial Strategy' government has acknowledged the need to *"better align central government infrastructure investment with local growth priorities"*.

Gateways for passengers, freight and data are very important for Dorset.

Bournemouth is one of the fastest growing digital/media economies in the country with excellent prospects for further growth. Availability of the latest technology and access to the fastest data transfer services is vital to supporting this growth and spreading the benefits across Dorset. The recent announcement by Ordnance Survey that it is to trial its 5G mapping software in Bournemouth recognises the importance of its potential and is typical of the high-tech investment that is needed if it is to compete on the world stage.

Dorset is home to a number of major financial institutions including JP Morgan which has its UK headquarters and international technology and operations situated in Bournemouth. Due to the international nature of these financial institutions it is vital that there are good quality international connections.

Dorset has numerous language schools and overseas student numbers have increased significantly over recent years with the exponential growth of Bournemouth University and the Arts University Bournemouth. Having effective international gateways to/from Dorset not only supports the schools and universities but brings considerable income into the local economy. Furthermore due to the attractiveness of the area many students often elect to remain in the town using their talents to not only support local businesses but also to establish new businesses.

Another key business sector is the tourism industry. Dorset has an exceptional natural environment, including the World Heritage Jurassic Coast. The area attracts millions of visitors each year, both from home and overseas bringing significant benefits to the economy.

In order to support current business sectors and future growth prospects and in order to make the most of potential international markets it is therefore vital that Bournemouth Airport and the Ports of Poole and Portland are able to provide connections to key international markets and customers.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

The quality of the local environment plays a vital role in the ability to attract customers and talent. Future urban infrastructure therefore needs to be designed around people, movement and place, reflecting the priority given to the most successful, attractive and inspiring towns and cities in the world.

In the post war era, too much emphasis has been placed upon function rather than place. Typical of this has been the overemphasis on the provision for cars which has led to unwelcoming major roads, blighting the urban landscape and severing communities. Whilst the strategic road infrastructure between and into and out of towns remains critical for economic success, there is the need to fundamentally reimagine our urban areas with the emphasis being on providing inspiring, attractive and sustainable places for people to live and move around.

Increasingly people are more aware of how their actions and choices impact upon the environment and therefore would actively seek out to live in places which support a more sustainable lifestyle. Dorset's age demographic is changing and the emerging younger generation can catalyse green economic growth in the area. Bournemouth is seeking to become one of the UK's leading 'green' cities and is looking to emulate other 'Green Economy Leaders' such as Vancouver, Stockholm and Copenhagen. For Copenhagen, the title of Green Economy Leader is expected to lead to more than 100,000 people migrating to the city by 2025.

To help attract growth, town and city centres need to have a very high quality public realm supported by sustainable, convenient, clean and attractive transport systems. In the future this would typically involve a mix between the provision of excellent walking and cycling facilities and a modern public transport system, possibly with electric buses, trains and/or trams.

Housing should also be designed with green credentials in mind and located to minimise the need to travel and therefore the need for additional infrastructure. Facilities and utilities need to be provided to new build housing to encourage remote working where possible. Business hubs should also be provided as part of new developments or within existing infrastructure so that employees of different businesses can set down and work remotely whilst still enjoying the interaction and sharing of ideas with others.

For those that do need to travel to work by car there is the need to provide much higher quality, attractive, multi-functional travel exchange hubs (rather than simple and uninviting park and ride sites). This would enable and encourage commuters to switch to more sustainable transport modes for their onward journeys into city and town centres.

Housing again needs to be designed with the need to attract talent in mind. Fast data communication hardware needs to be installed into new housing (for as long as hard wired networks are still required). Access to leisure is also a key requirement for most people therefore sustainable access to parks, shopping, sports facilities and entertainment also needs to be considered.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for demand to increase

when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

Transport demand management should broadly be characterised by two elements. Firstly the avoidance of the need to travel and secondly, if travel is necessary, the need to restrict travel by car.

Within Dorset's main conurbation of Bournemouth and Poole there is the potential to reduce demand significantly. In avoiding the need to travel, a typical intervention would be the encouragement of home or remote working. For this to be successful the right digital infrastructure needs to be in place and there would need to be a culture change facilitating greater take up amongst employers, who can often be resistant due to the perceived lack of control over remote working staff.

Reducing the demand for car travel presents considerable opportunities. Many people are willing to change their travel behaviour but the greatest barrier is the current lack of safe, convenient and affordable alternatives. Addressing this issue requires urgent attention and significant investment.

Where investment is made into alternative, sustainable transport and this leads to modal shift, surplus highway space may be reallocated to provide improved public realm, further sustainable travel networks or space for redevelopment, thereby helping to avoid any rebound effect.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Initially there is a need to identify what infrastructure is required both now and in the future. This assessment needs to be based upon both function and form i.e. does the asset serve an important purpose? Does the asset have any heritage/place making value? For those assets that pass this test generally it is more cost effective to carry out maintenance. However an assessment needs to be made as to whether continued maintenance of the asset is cost-effective or whether it should be replaced or whether a completely new and alternative asset should be provided.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

There is significant potential to improve collaboration between different client agencies that provide infrastructure. The absence of an overarching local infrastructure planning framework often means that agencies operate in isolation. The result can be the inefficient and uncoordinated provision of infrastructure, e.g. the location of a hospital or university facility with poor transport access will require additional and potentially avoidable investment in transport infrastructure.

The current local planning system neither has sufficient scope nor sufficient powers to ensure that all agencies work together to optimise key infrastructure investment. Consideration should therefore be given to the establishment of formal 'local

infrastructure bodies' which would require key agencies to identify, co-ordinate and plan future infrastructure helping to ensure that the right infrastructure is brought forward and is delivered as cost-effectively as possible. In the Green Paper 'Building our Industrial Strategy' government has acknowledged the need to create "... *the right institutions to bring together sectors and places*" and local infrastructure bodies could fulfil that role for infrastructure provision. These bodies could form part of an extended role for Local Enterprise Partnerships and/or in partnership with Combined Authorities and include expert representation typically from each of the following agencies: -

- Key local businesses;
- Political leaders;
- Local planning authorities;
- Urban designers;
- Local transport and highway authorities;
- Local clinical commissioning groups;
- Healthcare providers – GPs/Hospitals etc;
- Environmental bodies;
- Universities and FE Colleges;
- Education authorities/bodies;
- Network rail;
- Train operators;
- Bus and other public transport operators;
- Air and sea port operators;
- Energy providers;
- Water and waste water companies;
- Digital communications companies;
- Agriculture and fishing bodies;
- Waste management authorities;
- Flood risk authorities;
- Housing authorities/providers;
- Landowners;
- Housing developers;
- Other developers;
- Leisure providers;
- Contractors (e.g. Constructing Excellence)

Collaboration between key agencies is the most critical factor in delivering the right infrastructure effectively.

The use of competition can be applied to both client agencies and contractors building the assets. Whilst competition at the client level, e.g. energy companies and train operating companies, can be beneficial there is also concern that commercial interests (profit) have the potential to impede wider benefits. The creation of a 'local infrastructure body' with appropriate powers could help to mitigate this risk. In regard to contractors delivering the physical assets, provided that appropriate procurement options are followed competition is usually beneficial in securing better value for money.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

Current investment in road infrastructure is catered for through LTP and other DfT grant settlements. However other infrastructure, important for creating attractive places to live and work is not directly or adequately catered for. Typically, urban realm and regeneration schemes either have to be funded through developer contributions, which are becoming increasingly difficult to secure to the levels of funding required, or through local authorities’ own budgets which are already under considerable pressure. The identification of funding streams to support the development of both the built and natural environment would therefore be welcomed.

The creation of a funding/grant system that supports a broader infrastructure spectrum, rather than the current systems which primarily focuses on road construction, would be beneficial, and could help deliver the wider aspirations of potential ‘local infrastructure bodies’.

The introduction of longer-term, strategic funding opportunities would be extremely welcome. Too often funding opportunities are issued in very narrow timescales with shovel-readiness seemingly outscoring benefit cost ratios. Greater clarity/transparency on evaluation processes would be very welcome. Feedback on unsuccessful bids is usually very limited at best and does not offer any insight into how to improve future bids. The ability to bid for 10 year (or more) settlements would provide areas with far greater ability to deliver vital infrastructure and enable strategic partnership working as well as the opportunity to collaborate regionally to jointly fund major schemes that have historically been unachievable by local areas/authorities on their own.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

Raising capital for upfront funding of projects, particularly those requiring significant advance investment, is extremely difficult for local authorities. In some cases, upfront investment could be partially reimbursed through the charging of fares or fees or through the franchising of assets – e.g. the creation of a Dorset Metro rail system. However it should be borne in mind that benefits from assets are not always realised directly and even if a project may not be self-financing the wider economic and social benefits also need to be taken into account – e.g. increased tax revenue; reduced health or social care costs. When these indirect benefits are factored in the case for government intervention becomes much stronger.

At present local authorities would find it politically very challenging to introduce road – user charging to help fund projects as for many people there are not convenient alternative transport options in place. The provision of much better rail, cycling and bus infrastructure would make the case for road-charging considerably stronger and the income from this could then be used to offset some of the upfront infrastructure costs for these alternative modes.

The ability of local areas (e.g. through LEP, Combined Authority or 'local infrastructure body') to create rolling investment funds through e.g. use of devolved tax receipts (Stamp Duty, land charges) to enable pump priming of projects would be very useful.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

(Refer also to Q.6) The fundamental problem with current arrangements is that many key agents develop their future infrastructure plans in isolation which can lead to inadequate overall outcomes. A co-ordinated approach through a formal 'local infrastructure body' would address this problem and help to ensure that interdependencies are properly identified and catered for.

A formal local infrastructure body could also take on the explicit responsibility for ensuring resilience is accounted for in the design and construction of infrastructure as well as the ongoing management of resilience risk i.e. need for maintenance or other interventions.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

(Refer also to Q.6 and Q.9)

At present the planning system does not have sufficient scope, powers or resources to be able to fulfil governance effectively. In many respects the planning system can appear to be adversarial. Planners set planning rules and seek to obtain contributions from developers in order to provide the supporting infrastructure necessary to offset the impacts of the development, whereas developers seek to minimise any contributions in order to maximise returns on investment. The result is often a piecemeal, short term, reactive approach to the provision of infrastructure, rather than the strategic, co-ordinated approach that is required.

The provision of a formal local infrastructure body with wider powers and resources would help to address this issue, enabling strategic infrastructure to be properly planned in advance so that all parties are clear about what is required in terms of the infrastructure necessary to support any development. This upfront approach would make a significant contribution to 'fast-tracking' development through the planning system helping it to be delivered far more efficiently and on time.

Other measures that could be taken to speed up the delivery process would be increasing CPO powers over land which has no current intrinsic value.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Dorset's natural environment is a unique and major asset and makes a significant contribution to attracting businesses, customers and talent to the area. As well as the Jurassic Coast World Heritage Site, it also has wide areas of very important heathland

and wetland that is home to rare protected species, birds, flora and fauna. As a result many of these areas are subject to international environmental habitat designations.

It is therefore paramount that the provision of infrastructure should respect Dorset's natural environment, contributing towards its protection whilst enabling appropriate access for its enjoyment. This is clearly recognised in the Dorset LEP "Strategic Economic Vision" and the Natural Capital Investment Strategy produced by the Dorset Local Nature Partnership².

Access roads, car parks, visitor centres, disability friendly footpaths etc. all need to be carefully set out to strike the right balance between protection and access.

The Dorset coastline is particularly vulnerable to erosion. Coast protections and flood defence works can therefore help to protect the coastline as well as important habitats. However great care is required in the design to ensure that the infrastructure provided is sympathetic to the natural environment.

Roads, structures, renewable energy infrastructure, telecoms masts and pylons also all need to be sensitive to their setting within the landscape and should therefore be appropriately located.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: "credible" improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. "Tractable" improvements are those that can generate usable quantitative outputs. "Transparent" improvements are those that do not rely on 'black box' modelling and assumptions.

There is an urgent need to review cost-benefit analysis associated with infrastructure. The Growth Deal initiative has highlighted the inadequacy of current cost benefit analyses. For transport schemes designed to unlock employment land, the main economic benefit is treated as the saving in journey times rather than the considerable GVA generated from the creations of jobs. Current cost-benefit approaches can therefore lead to the wrong outcomes being measured, potentially leading to perverse outcomes with investment being directed into the wrong infrastructure. This issue has been partially recognised but a far better approach is needed.

Cost-benefit analyses should be targeted at a wider range of economic and quality of life 'building blocks' that will deliver the optimum outcomes and return on investment.

Greater focus therefore needs to be given to the ability of any scheme to deliver against key overarching outcomes such as: -

- Creation and protection of jobs;
 - construction of offices, business units, research/innovation centres; factories etc;
 - enhancement in agriculture and fishing facilities;
 - facilities to improve access to markets (local, national and international);

² https://www.dorsetlnp.org.uk/Natural_Capital_Investment_Strategy.html

- facilities to improve access to employment;
- Developing skills;
 - construction of university buildings; FE colleges, training centres; new schools etc;
 - facilities to improve access to education;
- Enhancing the built-environment;
 - construction of attractive public realm infrastructure in business, town, and neighbourhood centres;
 - construction of modern transport hubs;
 - regeneration initiatives;
 - creation of public open space and parks
- Healthier lifestyles;
 - construction of leisure, recreational and sports facilities,
 - creation of better walking and cycling environments;
 - facilities to improve access to leisure, recreation and sport;
- Improved Healthcare;
 - construction of hospital and healthcare facilities;
 - facilities to improve access to healthcare;
- Protection of the environment;
 - construction of sustainable travel networks e.g. rail, bus, cycling and walking;
 - provision of renewable energy;
 - Provision of flood and coastal defences.

Underpinning the above key outcomes is 'enabling infrastructure'. This enabling infrastructure should be assessed to the degree in which it contributes to the delivery of the above outcomes – rather than in its own right which currently can be a particular issue with road schemes. Typical enabling infrastructure may be considered to be: -

- Transport links (external and internal);
 - enhancement and construction of rail, road, bus, cycling and walking infrastructure;
 - enhancement of airports and sea ports.
- Utilities;
 - construction of water and waste water treatment facilities;
 - provision of affordable energy;
 - provision of digital and telecommunications hardware;
 - provision of waste management facilities
- Mineral extraction;
 - quarries, processing plants etc;

Few infrastructure schemes will contribute to all of these outcomes. It is therefore necessary to devise a cost-benefit mechanism that appropriately weighs the various outcomes so that differing schemes can be assessed and compared in terms of which deliver the best overall value for money. It may be difficult to develop credible, tractable or transparent cost-benefit analysis techniques capable of analysing and comparing the ability of differing schemes to deliver such outcomes, this should not be a reason for analysing simpler, alternative, non-critical outcomes. The focus should always remain on assessing the key outcomes, not the degree of difficulty involved in the assessment.

Greater consideration also needs to be given to post-project analysis. Post-project analyses are seldom properly carried out on infrastructure schemes and yet they are very important in answering two key questions;

- 1) Were the intended benefits/outcomes realised?
- 2) If the benefits/outcomes did not align with what was intended, what adjustments need to be made to future cost-benefit assessments?

Furthermore, evidence from post-project analyses has an important role in building a picture of what constitutes successful infrastructure interventions, to help inform future investment decisions. There would be a significant benefit in the NIC developing a national standard for cost-benefit analysis and post-project evaluation.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

The answer to is highly dependent upon where investment in transport infrastructure and technology is directed. Over the past sixty years the focus has been primarily on road building, which has inevitably led to the significant increase in car use. Similarly the future will be dictated by where transport investment is targeted.

Travel patterns and mode choice in the Dorset region have changed less than predicted over the past decade. Whilst inter-urban transport is likely to continue to be dominated by roads and cars to move people and freight around, land pressures within urban areas and the inability to continually widen roads, coupled with increasing congestion and air quality issues means a different transport regime is inevitable in our towns and cities. Infrastructure targeted at buses, rail, cycling and walking make much better use of available land and assets. With step changes also taking place in travel planning technology there is significant scope to improve sustainable travel making it far more attractive and easier to use. Therefore, with the right investment, in the future far more journeys will be undertaken by bus, rail, bike or on foot.

Growth of outward commuting is anticipated in Dorset as commercial premises are likely to be converted to residential via prior consent. Future development of brownfield sites will be principally residential rather than commercial. If the skills of new residents match the town centre job market, this will result in growth of short distance walking and cycling trips in town centres. If not, this will result in outward commuting which tends to be longer

distance trips to places more difficult to serve by sustainable transport. With the advance in technology, increasingly people will be electing to work from home, further reducing demands on the transport network. Currently daytime travel is dominated by peak hour commuter travel. Over the next 30 years there is likely to be a significant shift towards leisure travel and away from commuter travel. This will also deliver journey time benefits avoiding the need for any further major investment in road building for cars within urban areas.

With the provision of genuinely viable sustainable travel alternatives, demand for car use will be considerably less within towns and cities. This will be reinforced should car-use charging be introduced by which time most cars are likely to be electric, potentially autonomous vehicles.

Advances in autonomous vehicles raise the question of how traffic could be managed in the future. Coupled with advances in technology there is potential for both personal use and freight vehicles to be remotely 'orchestrated' to optimise journeys, although the advent of unforeseen incidents (e.g. potholes, severe and sudden weather events) and how to manage these represents significant difficulties. The number of people without driving licences is likely to grow as society ages and they will be a prime market for autonomous vehicles. Personal mobility is likely to increase; there will be a move to personal automated transport and the taxi and bus markets will change radically. Autonomous vehicles are likely to increase the total number of trips, as people make more trips; the vehicles will be shared and will therefore have more positioning trips/mileage. The demand for car parking on-street will diminish, but autonomous vehicles will still need parking space, which can be in remote locations, not prime town centre locations.

With its diverse population and geography, coupled with significant predicted growth, Dorset will inevitably see a greater demand on air and rail travel in future.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

Movement of people into and out of major urban areas

- Investment in new link road between Poole and A31 trunk road.
- Investment in 'Dorset Metro' commuter train service;
- Reopen key rail branch lines to Wimborne and Ferndown;

Movement of freight into and out of major urban areas

- Investment in new link road between Poole (including Port of Poole) and A31 trunk road;
- Investment in rail freight handling facilities.

Movement of people within major urban areas

- Investment in sustainable transport infrastructure for buses, rail metro, cycling and walking, including travel hubs;
- Investment in 'Dorset Metro' commuter train service;
- Investment in travel information technology.

Movement of freight within major urban areas

- Investment in sustainable transport infrastructure to reduce congestion and help free up internal strategic road network for freight.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

Given that large areas of Dorset are 100 miles from London, 80 Miles to Bristol and 80 miles to Exeter our rail connectivity is far below what is expected and needed. In fact current rail provision hinders economic growth. Inevitably rail is not the quickest method of transport within and outside of Dorset. This hinders the labour market and growth in productivity. Rail has the potential to increase housing supply within Dorset. Dorset LEP has worked with key local stakeholders to articulate the most important required changes to the rail network to address these issues (refer to Rail Infrastructure Map).

Mass transport, such as trains, subways and trams are efficient movers of people. Their ability to move large numbers of people along fixed routes will come under pressure from the convenience and end to end speeds of automated personal public transport provided by automated vehicles. This suggests that these modes need to modernise and achieve shorter journey times.

Network Rail's route studies are the current way to achieve this. The Wessex Route Study covers the period to 2043 and predicts a 40% increase in passenger demand in that timescale. The study suggests ways in which that growth can be accommodated. If the investment isn't forthcoming those additional trips will transfer to other modes, putting pressure on other modes and the transport network. The route study proposes a series of iterative increases in speeds and capacity, rather than a technological step change. Increasing rail capacity to and through Dorset particularly on routes to the east and the rail line to Bristol is an essential part of the transport mix required to facilitate the housing and employment targets. Historically, rail in the Dorset region has not received sufficient investment and there has been a trend to reduce capacity rather than increase it. The current focus on several high profile long-term schemes to provide new facilities, could easily reduce the amount of money available to continue investment in the existing network, which carries and will continue to carry the vast majority of rail passengers and freight. There also appears to be a skills shortage in specialist rail areas such as signalling, which is a substantial constraint on delivering projects and a lack of capacity in

the rail manufacturing sector, which also constrains the number of projects that can be progressed.

Movement of people outside of major urban areas

- Investment in infrastructure to reduce train journey times to London;
- Rail - greatly improve routes via Weymouth to Exeter, Taunton, Bristol, Swindon, and Salisbury.
- Rail – Weymouth to London via Yeovil. Redoubling of track between Wool and Morton. Power supply capacity improvements
- Investment in improving strategic road network – A31 trunk road between Ringwood and Southampton;
- Enhance facilities at Bournemouth Airport
- Enhance facilities at Port of Poole

Movement of freight into outside of major urban areas

- Investment in improving strategic road network
 - A31 trunk road between Ringwood and Southampton;
 - Road – major improvements to North-South route(s) accessing M4 via A350, providing significant benefits in closing productivity gap.
 - Road – improvements to A303/A358/A30/A37 to provide far better access to M5 from Dorset via Yeovil/Taunton.
 - Road – Provision of major new link road between Poole and A31 to create far better access to eastbound freight routes;
 - Road – Further dualing of A35 at key locations to greatly improve congestion and E-W journey times
- Investment in rail freight handling facilities.
- Enhance facilities at Bournemouth Airport
- Enhance facilities at Port of Poole

16. What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?

MaaS changes transport from an ownership model to a service model; this makes it easier to charge variable prices for the same journey, by differing time of day, levels of congestion etc. There is an equity argument where the value of a journey is simply converted to the ability to pay, rather than the need for the journey.

However if there are untaxed alternatives, then this would have the effect of making MaaS artificially less attractive and could well slow the take-up of MaaS services.

If autonomous vehicles really take-off in the study period, they are likely to prove very popular and inexpensive to the point where they are the predominant mode deployed to provide MaaS, so rather than optimising the mode to the particular trip, there will be a trend to a single mode provision

There is considerable scope to use 'mobility as a service' not only for road user charging but for helping people to access real-time public transport information and buy tickets online. A fully integrated travel information network has the potential to vastly change travel behaviour and digital Apps are already being developed with this capability.

Mobile technology has tremendous potential to reduce the amount of infrastructure necessary on street such as real-time bus travel information displays. The ability to use phones to geo-spatially track drivers has obvious cost-saving implications on delivering future road user charging regimes; however the greatest potential is with sustainable travel.

Digital communications:

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

Dorset is fully supportive of the NIC's Connected Future Report (Jan 2017)) and recommendations.

In addition to the 6 identified areas (1. Putting digital infrastructure at the heart of the UK's industrial strategy; 2. Motorways with mobile telecommunication networks fit for the future; 3. Rail passengers should have high capacity wireless connectivity; 4. Local government should actively facilitate the employment of mobile telecoms infrastructure; 5. Meaningful metrics on coverage; 6. Review the sharing of telecoms infrastructure 7. Regulatory review of mobile communications market) significant investment is needed in data and cloud infrastructure to enable a city region's (as Dorset aims to become) interoperability. A civic intelligence centre, similar to that of the [Mayor's Office of Data Analytics in New York](#), would enable all city region stakeholders to build capacity and capability to collect, analyse and visualise data across departments and fully realise the potential for a Smart City region. Business intelligence teams in local areas need investment in specific skill sets such as data analysts that will unlock the potential of how local data can be used to help inform authorities on how to cut costs, enabling them to become more efficient in their delivery of services, resulting in a data-driven approach to business decisions. Talent attraction into this area remains difficult as public sector employers are not competitive in terms of remuneration and the awareness of the opportunities within Councils is poor. This could be an area in which LEPs and/or Combined Authorities could provide a central, coordinated resource for local economic areas.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing "regime" refers to the current market, competition and planning frameworks. "Digital communications" includes both fixed and mobile connectivity.

Dorset is fully supportive the NIC's Connected Future Report and recommendations. With regard to 'Engaging Local Government as a partner' we would add for central

government to mandate the need for all fixed broadband service providers and MNO's to be fully transparent on where their existing networks are positioned and current coverage so we are able to have the most accurate view of existing infrastructure and connectivity and use this to inform future plans.

Drawing on case studies from Stokab and Bristol, Bournemouth has ambitions to own and commercialise ducting. This model should be replicated across Dorset. Support is needed from central government and knowledge sharing from key cities who have built this capability to develop this concept and investment to realise this ambition. The local authorities would then be able to manage their own network and provide mobile (5G and wifi) and fixed network coverage for residents, utilities and businesses.

Identifying pilot cities will be important to share knowledge and frameworks with other local authorities. Bournemouth is well placed to be a pilot for two important reasons. Firstly, the recent partnership with Ordnance Survey means by April it will already have a 3D model informing where 5G sensors should be positioned. Secondly it has the right mix of topography (urban, rural, and coastal) that is seen as critical to testing different deployment models. Dorset has several areas of considerable natural value, not least the Jurassic Coast, so we would seek to see how high quality design can minimise the visual impact of this kind of infrastructure on an area of outstanding natural beauty.

It would be a significant step change for each local authority (or combined authority) to employ a Chief Digital Officer, reporting to the CEO and overseeing the digital infrastructure, the digitalisation of local authority services and implementation of data strategy. This digital leadership role would drive significant cultural change across the local/combined authority business.

Energy:

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

There is very good evidence that the highest value solution for decarbonising heat use in the UK building stock is to reduce heating demand. For example, through setting high energy efficiency Passive House standards for new construction and to develop a financial support package for energy saving 'deep retrofits' to existing domestic properties and appropriate non-domestic buildings.

Although the UK Government cancelled the Code for Sustainable Homes target of net zero carbon new homes by 2016, the business case for support for Passive House standards is much stronger. Heating requirements are an integral element of building design and construction, whilst in many cases low carbon electricity can be supplied to new and existing properties at increasingly competitive prices by offsite generation through the electricity grid. The Passive House standard, which includes a maximum heat loss of 15kWh/m²/ year, was introduced in Germany 25 years ago.

The main advantages are reduced CO₂ emissions, very low energy bills for householders resulting in a reduction in fuel poverty and more income available in the local economy, a more comfortable internal atmosphere and opportunities for the manufacturing sector to develop new low energy building components such as windows, wall panels and ventilation systems.

Evidence from existing passive house developments in Dorset such as the Perryfields development in Portland have demonstrated construction costs of around £10,000 more than conventional construction costs, which is offset by lower running costs.

The UK's Building Research Establishment (bre) has detailed information about Passive House opportunities at <http://www.passivhaus.org.uk/standard.jsp?id=122> and there is increasing information on technologies for deep renovation based on passive house principles, e.g. see <http://europhit.eu/>

A strategic decision should be made by the National Infrastructure Commission to develop policies that would support all new housing in the UK to be built to Passive House standards by 2025- 2030 and as an interim measure offer support for training of architects and builders and a financial incentive for developers, such as a 50% grant towards architects fees for passive house design.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

It is encouraging that the National Infrastructure Commission has framed this question in line with the commitment in the 2008 Climate Change Act to reduce the UK greenhouse gas emissions 80% by 2050 compared to a 1990 baseline. Due to difficulties in full decarbonisation of the heat and transport sectors, achieving the target set out in the Act will require a zero carbon power sector by 2050, if not before.

It is noted that National Infrastructure Commission undertook an independent public opinion survey of national infrastructure priorities in 2015. The survey included responses from 2000 UK residents aged over 18 and was led by Copper Consultancy.

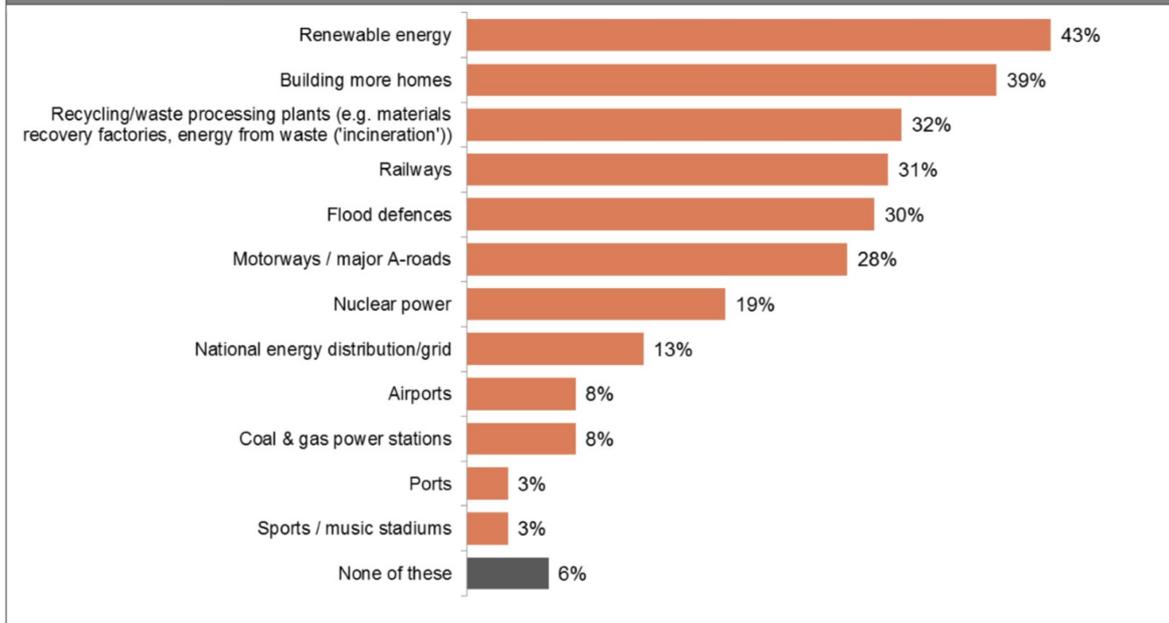
Independent survey of attitudes to infrastructure in Great Britain 2015

The results, summarized below, show that renewable energy infrastructure, with 43% support, was the highest public priority, higher than support for new nuclear power stations (19%) and much higher than for new coal and gas power stations (8%).

Figure 2 – National infrastructure priorities

Question: Which of these infrastructure types, if any, would be your investment priorities for the country? (Select up to 3)

Base: 2,000 GB adults aged 18+, June 2015



Similar consistent high levels of public support for renewable energy have also been evidenced through the DECC / BEIS Energy and Climate Change Public Attitudes Tracker e.g. see October 2016 data:

<https://www.gov.uk/government/statistics/public-attitudes-tracking-survey-wave-19>

As National Infrastructure support programmes are likely to be partly funded through public taxation there would appear to be a case for delivering the infrastructure that the public desires, subject to an objective economic and technical analysis and wider consideration of the national benefits.

Renewable energy infrastructure scores highly on all the above points. Renewable energy technology is mature and generated 25% of UK electricity supply in 2016 and 23% of global electricity production. According to the International Renewable Energy Agency IRENA, half of all new global energy generation capacity installed since 2012 has been renewable energy and 146 countries have policies to support renewables. The 2016 IRENA Power to Change report predicts that on current trends by 2015 electricity from utility scale solar power will decrease in cost by 59%, onshore wind energy by 26% and offshore wind energy by 35%. See:

<http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=2733>

These predictions are in line with the recent BEIS report on the Levelised Cost of Energy (LCOE) in 2025

<https://www.gov.uk/government/publications/beis-electricity-generation-costs-november-2016>

The key table in the report shows that for future UK energy projects expected to be commissioned in 2025, onshore wind and large scale solar generation will have lower levelised costs than the next generation of Combined Cycle Gas Turbine (CCGT).

A summary from the report shows continuing cost decreases for renewable energy:

Commissioning		2016		2020		2030	
		DECC 2013	This report	DECC 2013	This report	DECC 2013	This report
Large scale solar PV	High	116	94	98	80	73	73
	Central	108	80	92	67	69	60
	Low	101	71	86	59	65	52
Onshore wind >5MW UK	High	108	78	104	76	100	72
	Central	88	64	85	63	82	60
	Low	72	48	69	47	67	45
Offshore Wind Round 3	High	179	123	158	119	140	109
	Central	155	109	136	106	120	96
	Low	137	96	119	93	104	85

NB. Prices are in pence per kWh (at 2014 prices).

In comparison, new gas fired generation is estimated to have a LCOE of 8p/ kWh in 2025. Nuclear power has been offered a 35-year subsidy at 9.2p/ kWh at 2012 prices, index linked annually by the RPI. In addition, the long term costs and risks of nuclear decommissioning and waste storage are unknown, but are currently costing UK taxpayers over £2bn per year.

The UK renewable energy sector is badly in need of consistent long-term policy in order to provide investor confidence and lower capital costs for investments. It is disappointing that the recently published BEIS Industrial Strategy has not identified renewable energy as a priority for the UK's industrial strategy.

It is noted from paragraphs 1.2 and 1.3 of the National Infrastructure Assessment Call for Evidence that:

1.2 'The National Infrastructure Commission has been established to provide the government with impartial, expert advice on major long-term infrastructure challenges.

The government will provide the Commission with clear guidance by issuing a public remit letter, which will include a binding fiscal remit to ensure that the Commission's recommendations are affordable. While the government will set the Commission's remit (and the terms of reference for the in-depth studies that it undertakes), in all other respects it will have complete discretion to independently determine its work programme, methodology and recommendations, and the content of its reports and public statements.'

1.3 'The objectives of the National Infrastructure Commission are to: (i) support sustainable economic growth across all regions of the UK, (ii) improve competitiveness and (iii) improve quality of life.'

It is suggested that the National Infrastructure Commission uses the powers specified in paragraph 1.2 to recommend to the government that developing the UK's indigenous

renewable energy resources, including offshore renewable energy, will be the most appropriate means of achieving the objectives specified in paragraph 1.3 and represents the best value and most publicly acceptable means of achieving a zero carbon power sector by 2050.

The transformation could mirror and learn from similar energy transition programmes in France and Germany and would be complimentary to current policies relating to the roll out of smart meters and a smart decentralised grid. A suggested initial study would be as assessment of the maximum potential for renewable power generation to meet real time half-hourly electricity demand in the UK. Similar research for the German government, the Kombikraftwerk project lead by Emeritus Professor of Physics at Imperial College London, Prof Keith Barnham, provided evidence that 80% of German real-time electricity demand could be met from a mixture of wind energy and solar power, with 15% supplied by biogas power plants and 5% battery storage. There is evidence that perceived problems with the intermittency of a mix of renewable energy technologies have been exaggerated. The UK renewable energy sector has been held back by misinformation and inconsistent policies. An informed long-term strategic approach is urgently needed.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Government's stated objective of decarbonising the transport network by 2040, which falls within the timeline of this study, is welcomed. However this generates a whole series of issues associated with the demand for Electric Vehicle on the electricity grid, and intelligent management, as the predicted additional battery capacity of road vehicles will exceed the total existing capacity of the National Grid.

There needs to be a push to local energy generation, with additional PV generating capacity provided on building roofs, wind generation elsewhere (The Borough of Poole installed the first example in the UK of linking large scale PV generation to EV Charging). Research into PV road surfaces should be prioritised and funding mechanisms identified to install PV road surfaces as the technology moves from pilot demonstrators (reported in France) to the mainstream. As the sun always shines in Dorset, the south coast would be a good area to roll out this technology!

NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE

NATS DRAFT RESPONSE

NATS, the UK's leading provider of air navigation services, welcomes the opportunity to provide inputs into the development of the forthcoming National Infrastructure Assessment. We consider longer-term assessment of infrastructure needs to be vital to ensure the UK economy has the infrastructure it requires and allow for the correct planning and supporting legislative measures to be put in place.

We remain acutely aware that the environment in which we operate is continually changing and it is our challenge to develop and adapt to meet those changes. In particular there is a growing body of analysis relating to major long term trends ("Mega-trends") which point to a number of considerations for the transport sector.

Notable amongst these is the prediction that, in order to address the anticipated resource crunch caused by the rapid increase in global population (particularly in the middle classes), there is a trend towards increased urbanisation. Compact "mega-cities" like Singapore are seen as a part of the solution in a more resource-efficient future. Similar analysis done by ICAO suggests that there will be a complimentary increase in air traffic, the bulk of which will be along existing routes. To support this future "connectedness", aviation mega-hubs will develop, either at existing places (e.g. Heathrow) or new ones (e.g. Istanbul) – and they will be multi-runway, high intensity operations.

From a UK perspective, air traffic is set to continue to grow, reaching 3.1 million aircraft movements and 350 million passengers by 2030; the UK's airspace, the invisible pillar of national infrastructure, needs significant change today to manage this demand. Airspace change is complex and doesn't happen quickly, it takes a significant time to design and deploy and we are already behind schedule. It is therefore critical that the industry and Government now work together to deliver modernisation, moving from traditional ground-based beacons to modern satellite navigation, the capability for which already exists on modern aircraft.

Modernising airspace requires long term strategic decision making and we believe that there is significant merit in its inclusion in the assessment of the UK's national infrastructure.

The UK is at the forefront of aerospace technological development, and since 2005 UK airlines alone have introduced over 470 new aircraft into service, representing an investment of over \$49 billion whilst at the same time withdrawing their older and less efficient aircraft from their fleets. We now need to modernise our airspace to match this investment, this will have the potential to improve safety and increase efficiency and capacity whilst minimising the impact on the global environment.

Through better operating procedures which can be utilised with a modern airspace structure, there is a potential carbon saving to UK aviation by 2050 of between 9% and 14% and alongside the introduction of quieter aircraft ‘the potential to reduce UK aviation noise output by 2050 compared to 2010’ according to Sustainable Aviation.

Using modern technologies and improved procedures, aircraft can:

- Fly more directly and routes can be designed to avoid noise sensitive areas or provide a more equitable spread of noise as aircraft are not constrained by ground-based navigation aids.
- Make greater use of Continuous Descent and Climb operations which in turn reduces noise and CO2 emissions.
- Reduce the need for conventional orbital holding; instead aircraft can be readied for landing higher and thereby reduce noise and CO2 emissions. In essence, aircraft would be able to fly quieter and more efficient routes.

Modern airspace will also facilitate advances in technology where Air Traffic Control transitions from a tactical (on the day) to a pre planned operation, this will mean that aircraft will operate to plan, airports can then rely and structure their day to day operation to this plan with this predictability reducing costs for the whole industry.

All of the above will benefit the UK economy; airspace modernisation across Europe will deliver over £29bn to UK GDP and 116,000 jobs by 2035 (IATA,2016) whilst without it delays faced by passengers are likely to soar to 4 million minutes by 2030, up from 90,000 minutes in 2015 (NATS, 2015).

However, plans to modernise our airspace through the Future Airspace Strategy, have been delayed due to the Government’s decision to review of its airspace and noise policy due in large part to the negative reaction from some local communities who have been sensitised to aircraft noise by airspace trials. Short-term political need meant that Government reduced its support for modernisation due to these very vocal groups that dominated the public debate.

Airspace modernisation is a pillar of the CAA’s Future Airspace Strategy and of the UK’s infrastructure; it can support the economy and meet our environmental objectives. We believe the development of this invisible yet vital part of our infrastructure be included in the UK’s National Infrastructure Assessment to ensure it can continue provide the safe and effective connectivity the UK economy requires.

10th February 2017

Our ref – ACT



NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

E-Mail.: NIAEvidence@nic.gsi.gov.uk

Natural England
Suite D
Unex House
Bourges Boulevard
Peterborough
PE1 1NG

<telephone redacted>

<email redacted>

By EMAIL ONLY

Dear Sir / Madam

Re: National Infrastructure Assessment Call for Evidence

Please find enclosed Natural England's response to the current call for evidence for the National Infrastructure Assessment. If you would like to discuss any aspect of our response in more detail, please contact <name and email address redacted>, in the first instance.

Yours faithfully

<name redacted>
<position redacted>
Natural England

Consultation on the Call for Evidence for the National Infrastructure Assessment

Natural England's purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development. Natural England has responsibility for ensuring that England's unique natural environment including its flora and fauna, land and seascapes, geology and soils are protected and improved.

Natural England is a statutory consultee for all National Policy Statements (NPS) regarding Infrastructure (and their supporting environmental assessments (SEA/HRA)) and for all Nationally Significant Infrastructure Projects (NSIPs) (and their supporting environmental assessments (EIA/HRA)). We routinely advise on the delivery of Infrastructure projects and their impacts on the natural environment, working with Developers to identify strategic solutions to the delivery of infrastructure whilst achieving positive outcomes for the natural environment.

Green Infrastructure (GI) is a strategically planned and delivered network comprising the broadest range of high quality green spaces and other environmental features, including rivers, coast line, parks, woodland, etc.. It should be designed and managed as a multifunctional resource capable of delivering those ecological services and quality of life benefits required by the communities it serves and needed to underpin sustainability. GI is about putting the environment right at the centre of the planning process and producing a strategic and linked, multifunctional network of spaces with benefits for people and wildlife. It's also about underpinning the sustainability of a town or city, including making it resilient to the effects of climate change and enabling the conservation of biodiversity. To achieve this we strongly recommend that GI is factored into the strategy for the delivery of new infrastructure, and the assessments that will identify where new infrastructure is delivered.

We have responded to the consultation questions as set out in the paper, but our points can be summarised as:

- The delivery and enhancement of 'Green Infrastructure' is essential for the delivery and operation of infrastructure envisaged in the NIA. There exists a wide body of evidence of the successes that have been achieved where green infrastructure / ecosystem services approach have been used to inform the development process.
- Infrastructure Projects delivered through the NIA should demonstrate a commitment to achieving a 'net gain' for the natural environment, (including biodiversity, landscape, recreation, etc.) in order to contribute to the Governments aims as expressed in the 25 year Environment Plan.
- Natural Capital is a way of accounting and factoring in these benefits at the planning stage and that the NIA strategy should include natural capital as a guiding principle for considering the potential impacts / benefits of future infrastructure projects.
- Collaborative working between those planning and delivering infrastructure alongside those that will manage and live with their impacts is essential for the achievement of sustainable development. This will ensure that long term issues are addressed and multiple benefits can be achieved.

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

1. Investing in well-designed and maintained green infrastructure networks at national, regional and local scale will deliver increased resilience (both of communities and of 'hard' infrastructure), sustainable economic growth and improved health and well-being. Investing in enhanced natural capital and green infrastructure will help support inward investment, secure an enhanced return on investment and help increase productivity.
2. The London Infrastructure plan recognises the value of investing in GI in order to achieve the long term sustainable growth of the city. It promotes a GI network that will provide flood protection,

shade, biodiversity, cleaner air, a greener environment visually, pedestrian and cycling routes and space for recreation.

Evidence

- <https://www.london.gov.uk/WHAT-WE-DO/environment/environment-publications/green-infrastructure-task-force-report> see Natural Capital Investing in a Green Infrastructure for a Future City
- <https://www.gov.uk/government/publications/natural-capital-committee-research-investing-in-natural-capital> The Economic Case for Investing in Natural Capital in England - Final Report For the Natural Capital Committee 21 January 2015
- <https://www.gov.uk/government/publications/natural-capital-committees-fourth-state-of-natural-capital-report> Natural Capital Committee's fourth state of natural capital report
- <https://www.london.gov.uk/what-we-do/business-and-economy/better-infrastructure/london-infrastructure-plan-2050#acc-i-43211> see London 2050 Infrastructure Plan, Chapter 7.
- <http://ecosystemsknowledge.net/apply/local-economy/LEED> - Local Environment and Economic Development (LEED) Toolkit
- <http://www.vivideconomics.com/wp-content/uploads/2016/11/Briefing-The-value-of-Sheffields-parks.pdf>
- http://www.parliament.uk/documents/POST/postpn448_Urban-Green-Infrastructurereferences.pdf Houses of Parliament Parliamentary Office of Science and Technology – POSTNOTE Number 448 November 2013 'Urban Green Infrastructure'

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

3. Reliable, well-performing and resilient Infrastructure is essential to supporting international competitiveness. The resilience and performance of linear infrastructure can be enhanced depending upon whether the green infrastructure alongside or incorporated into them is well designed and maintained.

Evidence

- <http://publications.naturalengland.org.uk/publication/5752930789490688> Review of Literature: how transport's soft estate has enhanced green infrastructure, ecosystem services, and transport resilience in the EU (NECR169)
- https://www.ciria.org/News/blog/LINet_sets_out_the_benefits_of_green_infrastructure_to_enhance_infrastructure_resilience.aspx see *Maximising linear infrastructure resilience, environmental performance and return on investment*
- 4. Our natural capital and the existence of high quality green infrastructure also plays a key role in attracting tourism and inward investment through our international gateways.

Evidence

- <http://publications.naturalengland.org.uk/publication/6692039286587392> Microeconomic Evidence for the Benefits of Investment in the Environment 2 (MEBIE2) (NERR057) – see Chapter 3e: *Economic competitiveness - Tourism and recreation*
- <http://www.snh.gov.uk/docs/B732000.pdf> Valuing Nature Based Tourism in Scotland

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

5. The planning and design of infrastructure is key to enabling it to make a positive contribution to the natural environment. Planning of new infrastructure should seek to avoid environmental impacts by considering spatial aspects such as location, context, place etc. Understanding the context and setting for new infrastructure is essential, and within this context seeking to conserve and enhance culture, heritage and natural capital, wherever possible having an ambition for net environmental gain. It should use and re-use materials sustainably and avoid a high carbon and energy footprint.
6. Good design should also allow for future adaptation and technological advances. Alongside this designing for future management and maintenance is essential – what will this structure and its environs look like and how will it be managed in 20/50/100 years' time, is a key consideration.
7. Green infrastructure can make a major contribution to the attractiveness of a place to live and work within. Cities with a strong network of GI will be more attractive to a modern mobile professional workforce, furthermore the efficient functioning of GI is essential to the wellbeing of those that reside within a settlement, both in terms of protection from extreme events (heat, floods) and general health (recreational potential, tranquillity, etc.).
8. Infrastructure investment should deliver a 'net environmental gain', ensuring that the natural environment is in a better state after the creation of the infrastructure, than before, helping to realise the biggest natural capital return on the investment. Investment in green infrastructure would deliver;
 - Quality of place;
 - Health and wellbeing;
 - Environmental resilience.
9. Investing in well-designed and maintained Green Infrastructure will deliver the ecosystem services that businesses and communities depend on and thus build local Natural Capital. In terms of housing, green infrastructure should be incorporated in such a way as to:
 - Ensure places are adapted to cope with the impacts of expected climate change;
 - Deliver green spaces that are accessible, natural and deliver a range of functions;
 - Ensure that development and growth can be brought forward sustainably;
 - Support communities and businesses by delivering the ecosystem services they depend on;
 - Support the improvement and maintenance of high levels of health and wellbeing;
 - Manage natural hazards such as flood risks;
 - Help to improve air quality where required;
 - Address diffuse pollution of terrestrial waters and reduce pollution inputs to the marine environment to help maintain the quality of our coasts and seas;
 - Support and enhance our biodiversity and deliver functional ecosystems and ecological networks.

Evidence

- The Highways England Design Panel and HS2 Design Panel are exploring the contribution that good design can make to the success of infrastructure projects. There is potential to extend this concept to other infrastructure and to establish design principles and processes that help to embed place-responsive design.
- <https://www.gov.uk/government/publications/natural-capital-committee-research-investing-in-natural-capital> The Economic Case for Investing in Natural Capital in England - Final Report For the Natural Capital Committee 21 January 2015
- https://www.landscapeinstitute.org/wp-content/uploads/2016/03/Green-Infrastructure_an-integrated-approach-to-land-use.pdf Green Infrastructure: An integrated approach to land use
- http://publications.arup.com/publications/c/cities_alive Cities Alive: Rethinking Green Infrastructure
- <http://publications.naturalengland.org.uk/publication/6692039286587392> Microeconomic Evidence for the Benefits of Investment in the Environment 2 (MEBIE2) (NERR057)

- <http://www.ukgbc.org/resources/publication/uk-gbc-task-group-report-demystifying-green-infrastructure> UK Green Building Council: Demystifying Green Infrastructure
 - <https://www.evidence.nhs.uk/Search?q=Cost+benefit+analysis+urban+green+space> reports on costs and benefits for health outcomes of green infrastructure
 - http://ec.europa.eu/environment/water/flood_risk/better_options.htm Flood risk prevention options
 - <http://www.wsp-pb.com/Globaln/UK/WSPPB%20Biodiversity%20whitepaper.pdf> BIODIVERSITY NET GAIN – A new role for infrastructure and development in improving Britain’s wildlife.
10. Multi-disciplinary and collaborative approaches to the design and development of infrastructure are likely to deliver assets that provide the widest range of benefits. The Linear Infrastructure Network (LINet) demonstrates how a collaboration between industry, contractors and environmental organisations can help secure resilience and environmental performance win-wins.
- https://www.ciria.org/News/blog/LINet_sets_out_the_benefits_of_green_infrastructure_to_enhance_infrastructure_resilience.aspx see *Maximising linear infrastructure resilience, environmental performance and return on investment*
 - <http://www2.nationalgrid.com/UK/In-your-area/Visual-Impact-Provision/> National Grid’s Visual Impact Provision Project is an example which addresses ways of improving landscape character.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

11. No comment.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

12. The Government’s Natural Capital Committee emphasises that efforts should be placed on securing and enhancing the maximum natural capital value from infrastructure, with considerations of value for money factoring in the whole life costs to avoid short-sighted and short-term interventions that cost more in the long-run. An example is the cost differential over the whole life of traditional urban drainage techniques versus sustainable urban drainage (SUDs). Existing deficits in natural capital should be addressed through investment in new, multi-functional green infrastructure that seek to deliver an environmental ‘net gain’ whilst existing green infrastructure assets should be maintained and enhanced. To secure the best return on investment it is essential to have a good understanding of local needs and the effects of proposed developments on ecosystem services.

Evidence

- <http://www.susdrain.org/resources/ciria-guidance.html> for evidence etc. on SUDs including costings
- <http://publications.naturalengland.org.uk/publication/6692039286587392> Microeconomic Evidence for the Benefits of Investment in the Environment 2 (MEBIE2) (NERR057)
- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/444322/future-cities-green-infrastructure-health.pdf Cities, Green Infrastructure and Health
- <https://www.evidence.nhs.uk/Search?q=Cost+benefit+analysis+urban+green+space> reports on costs and benefits for health outcomes of green infrastructure

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

13. The supply of infrastructure services are often interdependent in terms of their reliance and management of natural resources. For instance, transport infrastructure has significant impacts on where waste water is created and needs to be treated. Provision of clean water will determine where new infrastructure is required e.g. flood defences, transport, digital communications, etc. The land take and severance caused by new infrastructure (particularly linear infrastructure) will impact on the functioning natural environment. Greater collaboration and consideration of multiple impacts in the planning of infrastructure can demonstrate where solutions can achieve multiple benefits both for the delivery and operation of the infrastructure and the natural environment.
14. We have submitted the following case studies as examples of where collaboration in the supply of infrastructure services has achieved multiple outcomes that benefit suppliers, users and developers of new infrastructure, whilst meeting the Government's environmental aims and commitments.

Evidence

- **River Mease – Catchment-based, Strategic approach** to tackling phosphorus and increased flow identified from Sewage Treatment Works (STW) outflows. Individual housing applications that contributed to increases in STW outflow were being refused due to an increase in pollution in the River Mease and reduced likelihood of meeting conservation objectives for this Special Area of Conservation (SAC). A strategic approach to exploring phosphorus removal and flow reduction/control measures was required. The River Mease Partnership, which includes the local authorities and Severn Trent Water in the catchment, was formed to help implement a Developer Contribution Scheme (DCS). The DCS enabled individual proposals to provide a proportionate contribution to a fund that helped implement research and technology required to protect the River Mease's water quality and flow whilst supporting development needs. More information on the DCS can be found at <http://www.rivermease.co.uk/improving-the-river/developer-contributions-scheme-2/>
- **River Clun – nutrient management approach: joining air and water considerations** – The River Clun is designated as a Special Area of Conservation (SAC) due to the presence of the rare freshwater pearl mussel which is sensitive to increases in nitrogen compounds in the river. Any proposal that increased airborne or water-related nitrogen was potentially refused consent due to the risk of impacts on the River Clun. This cost individual applicants time and money whilst making it difficult to balance development needs. Natural England worked with Shropshire Council to gather evidence about nitrogen sources and to liaise with farmers in the Clun catchment to decide on potential solutions. As a result, Shropshire Council has published [guidelines for assessment at planning](#) and farmers have agreed to this strategic approach which minimises nutrient loading in the Clun. This approach includes reducing fertiliser application on fields adjacent to the Clun if an increase in aerial nitrogen (especially ammonia) is expected through expansion of housing or increase in slurry store/lagoon size.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered? Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

15. Projects should maximise resource efficiency by delivering the maximum range of ecosystem service benefits. One mechanism to support this outcome would be for projects to adopt a 'net gain' approach to delivery, whereby they seek to deliver a net increase in environmental outcomes benefitting people and nature. This in turn would serve to increase natural capital value over time. Currently, there is often no financial benefit to those who enhance ecosystem service provision. We consider that support could be given for Payment for Ecosystem Services (PES) initiatives, through infrastructure developments.
16. New sustainable and long-term funding mechanisms are emerging which have the potential to provide significant new and long-term resource for green infrastructure asset enhancement and maintenance. The adoption of 'net gain' approaches¹ to development provides one mechanism to

¹ E.g. The Defra Biodiversity offsetting metric <https://www.gov.uk/government/collections/biodiversity-offsetting>

secure long-term financial resource for green infrastructure maintenance. Green bonds could also provide another potential revenue stream. The maintenance of green infrastructure assets is critical if they are to perform well and deliver the optimum benefits.

17. The Highways England Environment Designated Fund is a good example of how public funding has been used in innovative ways. The £300m fund, which represents less than 0.01% of the overall budget for the strategic road network for the period 2015-2021, has been used to secure capital works that enhance the environmental performance of the network. The fund has enabled the active engagement of partners in delivering Highways England Key Performance Indicators (KPIs), such as the biodiversity KPI. Contributions have been levered in from partner organisations, and this has helped to secure additional funding from others such as Heritage Lottery Funding for key projects, enabling delivery of considerably wider benefits beyond the boundary of the highways estate. This partnership approach demonstrates the benefits of a collaborative approach for all.

Evidence

- <https://www.gov.uk/government/publications/payments-for-ecosystem-services-pes-best-practice-guide> Payment for Ecosystem Services – Best practice guide
- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf National Planning Policy Framework – see paras 9, 109 and 152
- <http://www.wsp-pb.com/Global/UK/WSPPB%20Biodiversity%20whitepaper.pdf> BIODIVERSITY NET GAIN – A new role for infrastructure and development in improving Britain’s wildlife.
- <http://www.icmagroup.org/Regulatory-Policy-and-Market-Practice/green-bonds/green-bond-principles/> Green Bond Principles
- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441300/N150146_-_Highways_England_Biodiversity_Plan3lo.pdf Highways England Environment Fund for Biodiversity

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets? Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

18. No comment.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

19. There is strong inter-dependent relationship between infrastructure and the natural environment and this is often not recognised in design, planning and management of infrastructure assets. Extreme weather events associated with climate change in recent years have brought this to the forefront of our minds, with flooding causing significant disruption for example to transport networks resulting in closure of roads and rail lines, increased risk of landslip and earthworks failure, failure of equipment due to inundation of water, bridge scour and other impacts that affect the operation of the networks. These impacts have been identified by infrastructure developers in recent climate change adaptation reports². Our response to Q11 expands on these points and highlights how these relationships and inter-dependencies should be taken into consideration.

20. Based on Natural England’s experience of working with major infrastructure companies such as Highways England, Network Rail, HS2, National Grid, water companies and airports, and our

² Network Rail Climate Change Adaptation Plan 2015 <http://www.networkrail.co.uk/publications/weather-and-climate-change-resilience/>

engagement in relevant cross-sector groups such as the Linear Infrastructure Network (LINet) chaired by National Grid, Highways England's Design Panel and Natural England's Developer Industry Group, we recommend that that infrastructure takes account of the following issues and opportunities to most effectively contribute to protecting and enhancing the natural environment:

21. In this context it will be important for the National Infrastructure Commission to take account of evidence and expert opinion from environmental professionals. We would recommend that experts from the environment sector, including ecologists and landscape architects, are represented on expert panels and roundtables. This will be the key to enabling the inter-dependencies between infrastructure and the natural environment to be fully understood.
22. Further information on the methods that can be applied to increase resilience in infrastructure, are included in our response to Q11.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

23. Natural England engages with the planning system for nationally significant infrastructure (Town Planning Act 2008) and other infrastructure developments (Town & Country Planning Act 1990) as a statutory consultee. We consider that the planning system must seek to achieve a clear strategy for the delivery of infrastructure in a way that adds to natural capital and provides an overall net-gain for nature (including biodiversity, landscape and access).
24. The decline in UK biodiversity identified in the Lawton Review: Making Space for Nature (2010), should be addressed through a strategy of providing more, bigger, better and joined up sites for nature. We consider that the delivery of infrastructure through the planning system will be better achieved if strategic improvements to the natural environment are considered as part of the infrastructure planning process. Direct site impacts which cannot be effectively avoided or mitigated, could then be compensated or offset through an agreed 'infrastructure plan' for the environment. A strategy that considered the 'green infrastructure' of the country should look at the full range of benefits and how these can be delivered (including new habitat creation but also payments for the delivery of ecosystem services that new infrastructure provides, or that is provided elsewhere, enabling new infrastructure to achieve a 'net-gain'). We consider that this would speed up the delivery of infrastructure projects and provide a clear direction for improvements that new infrastructure projects could make.

Evidence

- <http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf> Making Space for Nature: The Lawton Review (2010)
- <http://www.humbournature.co.uk/about/> Humber Nature Partnership: An example of new infrastructure development being collaboratively delivered within a protected habitat.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

25. Infrastructure investment should focus on providing well-designed and maintained infrastructure assets that deliver sustainable economic growth, enhance natural capital, increase resilience and improve health and well-being. Investing in existing or new GI (in areas of natural capital deficit) will significantly contribute to protecting and enhancing the natural environment, whilst enabling new infrastructure. The biggest natural capital return on this investment will be achieved where GI assets are managed as part of existing or new GI networks. GI assets and networks provide important habitats and also assist species move across the landscape and adapt to climate change.
26. Green infrastructure alongside or incorporated into existing or new 'grey' infrastructure assets provides significant benefits to the natural environment (in terms of habitats for species) as wider ecosystem service benefits.
27. We consider that all infrastructure projects should follow the mitigation hierarchy (Avoid, Mitigate,

Offset, Compensate) and also commit to deliver environmental 'net gain' to ensure they most effectively protect and enhance the natural environment. A number of major infrastructure projects and developers have committed to delivering net gain including Network Rail Infrastructure Projects, Highways England and Berkeley Strategic Land.

28. Specifically we consider that the following approaches should be endorsed in the planning and delivery of infrastructure, in order that the natural environment can be enhanced:

- Embedding and mainstreaming the use of green infrastructure (GI) as a tool for enhancing the resilience to climate change and reducing the whole life costs of infrastructure assets, and to maximise biodiversity and ecosystem service benefits. This will be particularly important for linear infrastructure assets which traverse a variety of landscapes and have the potential to contribute to ecological corridors but also to fragment important habitats. Incorporating the full spectrum of GI, including the use of hard design features that have ecological and/or ecosystem service benefits in situations where these are appropriate. Incorporation of GI into new infrastructure assets must be done in a way that allows for cost effective management and maintenance beyond construction and into the operational period. GI can help to mitigate impacts of development and maximise opportunities presented by it: from improved air quality, low carbon fuel cropping, wildlife corridors to access to recreational space that positively impacts on quality of life and human wellbeing.
- Targeting investment in GI at places where the highest value return on the investment can be achieved (in terms of enhanced ecosystem service delivery). For example where GI enhancements would deliver long term enhancements to local Natural Capital; develop improved community resilience; contribute to achieving local economic objectives; improve the sustainability of development and overall Quality of Life for communities living and working alongside infrastructure assets.
- Incorporating thinking on Natural Capital and Ecosystems Approach, building on the work of the [Natural Capital Committee](#)³ and the National Ecosystems Assessment⁴. Taking a Natural Capital approach will enable the environment to deliver the improved ecosystem services that infrastructure, communities and businesses depend on.
- Recognising the contribution that the UK's protected landscapes (National Parks and Areas of Outstanding Natural Beauty) and nationally and internationally designated sites for nature conservation make to defining a sense of place and the importance of place-based design that reflects local character and contributes to attractive places to live, do business and invest in.
- Ensuring consideration of the health and well-being needs of local communities and making sure that the UK's GI is recognised for the contribution to health and well-being (both physical and mental) that it can make.
- Understanding the cross boundary environmental issues facing different areas including those derived from the impacts of ecosystem service flows between urban and rural areas.

Evidence

- https://www.landscapeinstitute.org/wp-content/uploads/2016/03/Green-Infrastructure_an-integrated-approach-to-land-use.pdf Green Infrastructure: An integrated approach to land use
- http://publications.arup.com/publications/c/cities_alive Cities Alive: Rethinking Green Infrastructure

³ Various reports under the [Natural Capital Committee](#)

⁴ UK National Ecosystem Assessment 2011 <http://uknea.unep-wcmc.org/>

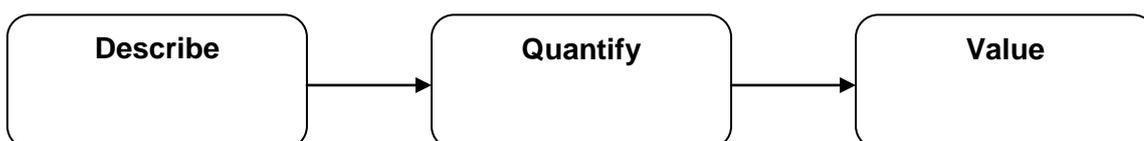
- <http://publications.naturalengland.org.uk/publication/6692039286587392> Microeconomic Evidence for the Benefits of Investment in the Environment 2 (MEBIE2) (NERR057)
- <http://www.ukgbc.org/resources/publication/uk-gbc-task-group-report-demystifying-green-infrastructure> UK Green Building Council: Demystifying Green Infrastructure
- <http://webarchive.nationalarchives.gov.uk/20130402151656/http://archive.defra.gov.uk/environment/biodiversity/documents/201009space-for-nature.pdf> Making Space for Nature: A review of England's Wildlife Sites and Ecological Network
- <http://www.railengineer.uk/2014/08/22/biodiversity/> Network Rail Infrastructure Projects Net Biodiversity Gain
- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441300/N150146_-_Highways_England_Biodiversity_Plan3lo.pdf Highways England - Our plan to protect and increase biodiversity
- <https://www.berkeleygroup.co.uk/sustainability/environmental-sustainability> Berkeley Group and Net Gain

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

29. We consider that there are two main areas where improvements should be made to cost-benefit analysis techniques. Firstly, we support the Natural Capital Committee’s (NCC’s) view that **natural capital⁵ as a concept should be fully incorporated into cost benefit analysis (CBA) techniques⁶**. As the NCC states, this should be the case for all projects that impact on the environment, regardless of whether the environment is the main purpose of the project. Properly accounting for the environment is as important for an analysis of concrete infrastructure as it is of green infrastructure. This will not only improve the credibility of analysis by better accounting for all impacts but also transparency by demonstrating the impacts of infrastructure projects on the environment. Additionally, natural capital aims to consider impacts at a wider level than CBA has tended to. The piecemeal nature of CBA has led to environmental impacts being dismissed as insignificant whilst overall stocks of natural capital decline. A more strategic approach to the consideration of natural capital, considering the effects of all infrastructure requirements will better account for environmental impacts, whilst also better identifying how the environment can contribute to wide-scale solutions.

30. Secondly, **greater emphasis needs to be paid to the assessment of expected environmental and social effects**. Valuation should follow a three-step process:



⁵ The Natural Capital Committee (NCC) has defined natural capital as “the elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions”

⁶Improving Cost Benefit Analysis Guidance, A report to the Natural Capital Committee, <https://www.gov.uk/government/publications/natural-capital-committee-research-improving-cost-benefit-analysis-guidance>

31. Too often, though, analysis focuses overly on this final step without firstly understanding the actual impacts of the project(s). One consequence of this is that the monetary valuations placed on environmental changes are inaccurate if the underlying environmental and/or social change is not properly understood.
32. A further, important, consequence of this is that the analysis concentrates on aspects we can monetise, rather than where best value can be delivered. Where environmental opportunities, solutions or consequences are important but difficult to monetise it is vital that they are incorporated into decision-making, rather than being ignored simply because it is difficult to value them. Further consideration of how to bring these important, but non-monetised, costs and benefits into decision-making alongside monetary values would be a significant improvement to current cost-benefit techniques.

Evidence

33. **Environmental valuation guidance** - There are a number of pieces of guidance that could assist in improving consistency in approach. We recommend the following reports and toolkits as useful pieces of evidence:
 - <http://publications.naturalengland.org.uk/publication/6692039286587392> Microeconomic Evidence for the Benefits of Investment in the Environment 2 (MEBIE2), Natural England
 - <http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completeted=0&ProjectID=19514#Description> Environmental Value Look-up (EVL) Tool, eftec for defra
 - <http://publications.naturalengland.org.uk/publication/5890643062685696> Ecosystem Services Transfer Toolkit, University of York and Natural England
 - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69192/pb12852-eco-valuing-071205.pdf An introductory guide to valuing ecosystem services, defra
 - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182376/vt-guidelines.pdf Valuing Environmental Impacts: Practical Guidelines for the Use of Value Transfer in Policy and Project Appraisal, eftec for defra

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

34. The Department for Transport (2015) forecasts⁷ a 19% to 55% growth in traffic between 2010 and 2040, with the size of that growth depending on three uncertainties in road demand - the number and types of journeys that people make, the effect of rising incomes on car ownership and car use, and future trends in income growth and fuel prices.
35. The substantial, 60% growth in GB rail travel⁸ between 1995 and 2007 is thought to be the result of more people starting to travel by train, rather than existing rail users travelling more, with rail mileage growing most rapidly for business purposes.
36. New infrastructure is likely to be needed to address this anticipated growth in travel. Network Rail has commitments in Control period 5 and 6 to electrification of many of its mainline routes. HS2 phase one is expected to be completed by 2026. Highways England has commitments to over 100 major schemes in its first Roads Investment Strategy (RIS) and further development is expected in RIS2 (to 2025).
37. There will be significant impacts and opportunities for the natural environment from transport

⁷ DfT Road Traffic Forecasts 2015

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf

⁸ On the Move: making sense of car and train travel trends in Britain <http://orr.gov.uk/publications/reports/car-and-train-travel-trends-in-britain>

infrastructure development of this scale. As a statutory consultee, Natural England advises on all major transport infrastructure schemes, facilitating early engagement through our Discretionary Advice Service.

38. Both Network Rail Infrastructure Projects and Highways England have commitments to biodiversity net gain, with HS2 having a commitment to no net loss in biodiversity.
- Highways England's Roads Investment Strategy commits them to delivering No Net Loss in biodiversity by 2020 and Biodiversity Net Gain by 2040
 - Network Rail's Infrastructure Projects have set the target of "a measurable net positive contribution towards biodiversity in the UK" by March 2019.
39. New technologies are likely to change travel patterns and could bring about changes to the impacts of transport infrastructure development. For roads, technological changes such as low emissions vehicles which have the potential to reduce the air quality impacts that roads have on local communities and the natural environment.⁹
40. Platooning, connected and autonomous vehicles have the potential to allow road space to be utilised more efficiently, reduce emissions and be safer places. They could also change the way we engage with transport and prompt us to rethink our car ownership and usage. This could impact on the way that roads are designed, reducing the need for signage and helping to minimise roadside clutter so that roads are better integrated into the surrounding landscape - something of keen interest to the Highways England Design Panel.

Evidence

- https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/411471/road-traffic-forecasts-2015.pdf DfT Road Traffic Forecasts 2015
- <http://orr.gov.uk/publications/reports/car-and-train-travel-trends-in-britain> On the Move: making sense of car and train travel trends in Britain

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

41. See response to Q15.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

42. We have covered questions 14 and 15 together below:

43. Transport corridors are often the gateway to places where people live and work – be they villages, towns or cities. Any transport investment that connects people and places needs to consider the user experience, including non-motorised users. The importance of the design and management of the green infrastructure alongside road and rail networks is important for defining sense of place and can contribute significantly to the aesthetic for 'beautiful roads'¹⁰.
44. Green infrastructure alongside road and rail assets provides important ecological connectivity and wider ecosystem services, such as air and water quality management, pollination and biomass, as well as forming part of the bigger, better more and joined up vision for ecological connectivity set out

⁹ The ecological effects of road pollution from road transport: an updated review
<http://publications.naturalengland.org.uk/publication/6212190873845760>

¹⁰ <https://www.gov.uk/government/speeches/beautiful-roads> Rt Hon John Hayes MP vision

in the Lawton¹¹ Review. Investment in the design and ongoing management of this green infrastructure can help the transport networks to function more effectively and operate more safely.

45. Through the Green Transport Corridors Initiative¹², Natural England has been working with Network Rail and Highways England to look at how the green infrastructure alongside road and rail lines, as well as the land adjacent to, and upstream of, major infrastructure can be used as a tool for enhancing their resilience to climate change, safety and performance, and reducing the whole life costs, as well as delivering biodiversity and ecosystem service benefits.

46. This approach could help to reduce significant risks to infrastructure such as of flooding, where the work has identified that there is significant scope to look at the use of natural flood risk management approaches on a catchment-scale to reduce the impacts on linear infrastructure.

Evidence

47. The paragraphs below set out the contribution that investment in the design and management of green infrastructure alongside road and rail assets can have on their resilience and operation:

Safety

- In 2013/14 there were 1,500 incidents of trees falling on Network Rail lines.¹³ One third of these fallen trees were hit by trains. Well designed and managed green infrastructure can reduce tree and leaf fall realising improved safety and performance and a safer environment for staff/contractors when working on or at the lineside.
- Reduction in deer and other mammal induced collisions and accidents.
- Green street furniture is increasingly being used alongside hard infrastructure as a security measure, acting as barriers at rail stations, airports and prominent visitor destinations.

Asset Resilience and Performance

48. Well managed vegetation can improve access for inspections, maintenance, repairs and emergency access to services. Vegetation can help protect and defend under-lying hard assets, extending its life and optimising its performance:

- Natural flood risk management on a catchment scale and use of vegetated sustainable drainage systems on the adjacent land, and on the transport network can reduce the risk of surface water flooding and the associated safety risks;
- The right vegetation can increase bank stability, preventing landslip. In 2015-16 Network Rail earthworks risk had risen 63% compared to the previous year¹⁴;
- <http://www.treeconomics.co.uk/wp-content/uploads/Area-1-iTree-Report.pdf> In Devon/Cornwall, Kier Highways calculate the 300,000 trees on the estate prevent 76,000 cubic metres of run-off per year;
- In Scotland capital costs of traditional drainage were more than double the capital costs of SUDS, annual maintenance costs were 20 – 25% cheaper and SUDS is around half the cost over a 60 year life span¹⁵;

Reputation with Customers/Neighbours

¹¹ Making Space for Nature, 2010 <https://www.gov.uk/government/news/making-space-for-nature-a-review-of-englands-wildlife-sites-published-today>

¹² Natural England NEWP 32 Transport Green Corridors Options Appraisal and Opportunity Mapping 2014, <http://publications.naturalengland.org.uk/publication/5485064148221952>

¹³ <http://www.networkrail.co.uk/community-relations/trees-and-plants/>

¹⁴ Network Rail Monitor Period 8-13 2015-16, ORR, July 2016

¹⁵ Duffy, Jefferies et al. 2008

49. Vegetation management issues account for the highest number of complaints to Network Rail - almost 25,000 complaints per annum. Complaint reduction and better customer and community relations would be significantly reduced if GI were well designed and managed.
- 1.69 billion passenger rail journeys¹⁶ were made in Great Britain in 2015/16. For people travelling by rail every day, the rail-side vegetation and the views it frames into the wider countryside can be their main daily contact with nature.
 - Improved aesthetic that reflects sense of place and allows road and rail corridors to serve as attractive gateways to business and tourist destinations, and provide a better user experience for passengers, both on network and at customer interface areas eg stations and motorway service areas.
 - Greened linear features help to connect communities and enhance local economy for tourism. HS2 is incorporating 16 green bridges into its network.

Wider Benefits for Society and Quality of Life

- Vegetation can remove air and water pollutants and reduce noise pollution thereby protecting ecosystems and neighbourhoods.
- Vegetation stores and sequesters large amounts of carbon, helping to offset the 48.4 grams of CO₂ emitted per rail passenger km¹⁷.
- Benefits for farmers: flowering plants along these corridors provide food for the pollinators that are vital for agriculture.
- Wildlife connectivity, contributing to Lawton's principles of 'Bigger, better, more and joined up' spaces for nature¹⁸.
- Kings Cross: Transformation of 67 acres of disused sidings between St Pancras and Kings Cross Station alongside the new Eurostar station has created natural habitat for birds, butterflies, amphibians and a rich variety of plant life.
- <http://www.treeconomics.co.uk/wp-content/uploads/Area-1-iTree-Report.pdf> Devon/Cornwall: 300,000 trees on the strategic road estate are estimated to remove 29 tonnes pollution per year and store over 22,000 tonnes of carbon

Spending to save

- Network Rail estimate that the impact of vegetation on train performance costs the UK economy £100m annually¹⁹. Spending on management will help to save on performance costs.
- Reduction in whole life asset costs through regular interventions to retain early successional plants such as grasses, preventing growth of woody vegetation,
- Simplified estate management that can be undertaken regularly without disruption to services.

Generating income and reducing waste

¹⁶ Passenger Rail Usage 2015-16 Q4 Statistical Release http://orr.gov.uk/data/assets/pdf_file/0015/22056/passenger-rail-usage-2015-16-q4.pdf

¹⁷ Rail infrastructure, assets and environment 2014-15 Annual Statistical Release http://orr.gov.uk/data/assets/pdf_file/0007/19537/rail-infrastructure-assets-and-environment-2014-15.pdf

¹⁸ Making space for nature: a review of England's wildlife sites, 2010

¹⁹ <http://www.networkrail.co.uk/community-relations/trees-and-plants/>

- Biomass harvesting for income and energy generation and reducing waste. Network Rail and Highways England conservatively estimate a potential biomass revenue forgone over 25 years of more than £90million and a renewable energy source for three cities the size of Leeds for a year.
- Lincolnshire (2016): Preliminary results from a large scale road verge harvesting trial indicate that it may be possible to cover the operational management costs with the revenue from anaerobic digestion (AD) generation of biogas from harvested roadside grass cuttings.
- Denmark (2014): From harvest, collection, transport, storage and digestion of roadside vegetation the energy return on invested energy (EROEI) was found to range from 2.17 to 2.88.(for 18,000ha of annual harvestable area based on 1.3m width).²⁰

16. What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?

50. No comment.

Digital communications:

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

51. No comment.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing “regime” refers to the current market, competition and planning frameworks. “Digital communications” includes both fixed and mobile connectivity.

52. No comment

Energy:

53. We have no specific comments to make in regard to the questions posed on energy, however our response to the cross-cutting issues section is relevant to the choices to be made when delivering energy infrastructure.

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

54. No comment.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

55. No comment

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

56. No comment.

²⁰ Bioenergy production from roadside grass: A case study of the feasibility of using roadside grass for biogas production in Denmark, A.K.P. Meyer, E.A. Ehimen, J.B. Holm-Nielsen, Resources, Conservation and Recycling (2014) 124–133

Water and wastewater (drainage and sewerage):

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: “demand” includes domestic, commercial, power generation and other major sources of demand.

Future resilience in determining new infrastructure demands on environmental capacity

57. In drawing resources from the environment such as water, or in requiring the environment to absorb future waste (in, e.g., domestic or industry discharges) infrastructure development competes with the requirements from other parts of the system including biodiversity (which needs for example adequate river flows or water levels for ecosystem hydrological functioning, and water quality to support a range of freshwater and marine biological processes) and with other polluting or resource-requiring human activities.

58. When the needs of future infrastructure are estimated, the future needs both of vulnerable or dependent ecosystems and of competing human activities under future scenarios of (e.g. climate change) and of changing demands for land use for (e.g. food production) must be taken into account. This matters especially where the capacity of the water treatment systems is needed to cope with similar types of pollutants from different sources. In the case of nutrients such as Nitrogen and Phosphate, which are the main drivers for declines in habitat quality in many freshwater and coastal ecosystems including designated sites, both diffuse agricultural and point sources (sewerage systems) are important. The capacity for agriculture to reduce nutrient (and other pollutants) losses to the environment via measures to tackle diffuse agriculture pollution to the extent needed to meet environmental targets is still far from clear, though measures are underway (e.g. catchment sensitive farming, diffuse pollution measures under agri-environment schemes and regulation).

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

Identifying customer beneficiaries

59. In relation to water services and sewerage infrastructure provisions, the beneficiaries from investment in a given location may include stakeholders who are not themselves the customers of the relevant water supply / service company. For example, environmental improvements resulting from investment in sewerage treatment (e.g. bathing waters improvements, or improved biological status of water bodies) benefit visitors as well as the local customers / bill-payers. Such beneficiaries are difficult to take into account in evaluations of willingness to pay targeted at the more strictly defined customers. This broader sense of customer beneficiary should be taken into account in evaluating environmental risks as well as evaluating the range of options in managing those risks from new infrastructure development.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

60. The perceived “headroom” for new infrastructure development will need to take into account limitations in the ability to manage down diffuse agricultural emissions (and those from other sources) into the future if environmental quality is to be restored over the long-term.

61. Where situations arise like that above, it is sensible to manage overall nutrient budgets (emissions from various sources) at the catchment level. This would imply taking into account the specific requirements of receiving waters (which may vary within a catchment according to, e.g., habitat or species vulnerability, or designation status) and the proportional contribution, now and in the future, from different sectors operating within the catchment in order that the most resilient and cost effective measures can be taken to addressing the different sectoral (including national infrastructure) contributions. The use of existing catchment level stakeholder processes (such as Catchment Based Approach partnerships) would be valuable in building in stakeholder support as

well as drawing in local knowledge in determining how further environmental capacity is to be managed).

Evidence

- <https://www.gov.uk/government/publications/water-framework-directive-compliance-assessment-review> Example of a Water Framework Compliance Assessment Review for HS2
- <https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters> Water Framework Directive Assessments: Coastal and Estuarine Waters
- <https://www.gov.uk/guidance/catchment-sensitive-farming-reduce-agricultural-water-pollution> Catchment Sensitive Farming: Reducing Agricultural Water Pollution
- <https://www.catchmentbasedapproach.org/> Catchment Based Approach partnerships

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

62. Natural England's responsibilities are focussed on the natural environment rather than flood risk to people and property. Our interests are therefore in ensuring that in determining a suitable level of flood resilience that natural environment issues are addressed. There are two specific points that we would wish to make:

- While much can be done to address current and future flood risks through traditional forms of flood defence and the deployment of natural flood management measures there remain flood risk challenges that need to be addressed, at least in part, through the land use planning system. These primarily relate to the location of assets, be they infrastructure, homes or businesses, that cannot be protected in situ because either it is unsustainable to do so (e.g. low lying assets threatened by sea level rise) or because if they were protected flood risk would be increased elsewhere (e.g. man-made bottlenecks in river corridors in urban areas). We believe that the importance of planning based solutions to securing a more sustainable approach to flood resilience is often neglected and, if used more widely, would provide greater security for national infrastructure and conserve and enhance the natural environment.
- There are significant areas of nationally and internationally important wildlife habitats in coastal flood plains protected by seawalls. In the long term we recognise that it will be unsustainable to conserve many of these in-situ. We have been working closely with a variety of partners to address this issue over the last 20 years and have developed good practice examples including providing compensatory habitat elsewhere and lowering sea defences, so that although the frequency of inundations is increased, the seawalls remain undamaged and flood waters can be quickly evacuated.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

63. We believe that natural flood management (NFM) has a key role to play alongside traditional forms of flood defence and planning based solutions in reducing flood risk. Natural England has recently reviewed the evidence for NFM (report to Natural England Board December 2016) and concluded that it has an important role to play if used in the right place and in the right way.

64. Its key value is in helping to reduce flood risk in locations where traditional forms of flood defence are not justified; in doing so it can deliver a wide range of ecosystem services including substantial benefits to biodiversity. On the downside it is challenging to deploy over large catchments.

Solid waste:

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

65. No comment

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

66. The classification of a materials (eg whether a material is classified as a ‘waste’ or ‘biomass crop’ etc) and the permits required, can pose barriers to the development of a circular economy. An example is the permits needed for the use of verge arisings (e.g. grass clippings etc.) in anaerobic digesters. There is currently no waste code for grass arisings from roads and this impacts on permitting. If these materials were clearly categorised then it would be easier and simpler to obtain the correct permits and the material could be utilised as a fuel creating a circular economy where infrastructure providers have an incentive to manage their estates to achieve multiple benefits.



NATIONAL ASSOCIATION OF WASTE DISPOSAL OFFICERS

National Association of Waste Disposal Officers
(NAWDO)

This matter is being dealt with
by: [name redacted]
[title redacted]

Direct Dial: [number redacted]
Email: [e-mail redacted]

Date: 10th February 2017

NAWDO Response to Call for Evidence on the Development of the National Infrastructure Assessment.

The National Association of Waste Disposal Authorities (NAWDO) would like to take the opportunity to comment on the National Infrastructure Commission call for evidence to provide input into the development of its National Infrastructure Assessment specifically in regard to questions on solid waste.

The National Association of Waste Disposal Officers (NAWDO) is the primary network for senior waste managers working for Waste Disposal Authorities in England and Wales. Membership of NAWDO comprises over 100 representatives from all types of statutory Waste Disposal Authorities including: London Boroughs, Metropolitan, Unitary and County Councils.

This is a joint response on behalf of all of our members, but it does not prohibit individual authority members from submitting separate responses.

Whilst we try to ensure that this response represents a consensus view; there may be specific instances within it where individual authorities do not feel that their view is wholly consistent with that included in this document.

NAWDO welcomes the opportunity to present its views via this consultation response and hope you find our response helpful. We are happy to provide further comments or clarification.

Solid waste

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Since its introduction in 1996, Landfill Tax has been an effective financial incentive in diverting waste away from landfill disposal. The £8.00 per tonne per annum escalator was changed in 2014 to an annual RPI increase and this increase should remain in place as it continues to encourage diversion from landfill, although not always by innovative means which can be costly.



NATIONAL ASSOCIATION OF WASTE DISPOSAL OFFICERS

As a direct consequence there has been an increase in recycling rates, however the sometimes volatile nature of the recycle markets, and in some areas the lack of local infrastructure to cost effectively collect and process recyclable materials, can be limiting.

A comprehensive long term strategy to create clear policy and regulation for waste prevention, re-use and recycling would be beneficial. This should include all business sectors and encompass full producer responsibility which ensures that the cost of collection and treatment is funded, which will drive the business sector to rethink how it operates and will effectively reduce the amount of waste produced due to the financial incentive to do so. For example, designing out waste, by designing in reusability, recyclability and light-weighting will result in a reduction in the overall quantity of waste produced. Where these form part of primary thinking, it should follow that infrastructure throughout the Country must be adequate to fulfil the demand in all areas.

A minimum recycled content requirement in packaging will also help to stimulate and stabilise markets. In addition, a commitment to redistribute some of the substantial PRN receipts and HMT receipts for Landfill Tax, back to Unitary and Waste Disposal Authorities to invest in the infrastructure required for their local/regional areas could result in a significant increase in the amount of waste re-used and/or recycled.

When married to the growth agendas of councils across the UK, this can be viewed as essential to the delivery of, and the ongoing support services for that growth.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

To establish and accomplish a circular economy, strong leadership from policy makers is needed which ensures that the principles are embedded across all levels of government, and that those principles are championed in a positive and effective way.

To enable sensible and well informed decisions to be made, the availability of accurate information is essential. Whilst Local Authority Collected Municipal Waste is recorded through the Waste Data Flow System by Local Authorities, this is not the case for other business sectors leading to inaccurate data availability. A system of recording accurate data for all sectors needs to be established to ensure that sound decisions are taken on the locations of infrastructure to maximise re-use and recycling.

Whilst it is accepted that waste cannot be completely eradicated, it is essential that viewing it as a resource is adopted. This approach needs to be adopted at inception



NATIONAL ASSOCIATION OF WASTE DISPOSAL OFFICERS

of an idea to enable waste to be designed out wherever possible, and where impossible to do that, to ensure that the lifetime and end of life use is fully understood and forms part of the overall design. This must be a co-ordinated country wide understanding. Currently there is little incentive for designers and manufacturers to consider this, unless specifically required to do so by their clients.

Substantial investment is needed to see the principles of the circular economy implemented and succeed across all sectors. As commented above, full producer responsibility which ensures that the cost of collection and treatment is funded will drive all sectors to rethink their approach to waste and, coupled with a commitment to redistribute a large portion of the substantial PRN receipts and HMT receipts for Landfill Tax back to Unitary and Waste Disposal Authorities to invest in the infrastructure, it will naturally drive the principles of a circular economy.

It is hoped that all these comments prove helpful; if however you have any comments or queries please contact myself in the first instance.

[name redacted]

[title redacted]

[organisation redacted]

[number redacted]

[e-mail redacted]

Consultation Response



National Infrastructure Assessment – Call for Evidence

North East England Chamber of Commerce Response

Introduction

The North East England Chamber of Commerce is the region's leading business membership organisation and one of the largest chambers of commerce in the country. We represent more than 3,000 businesses from across Northumberland, Tyne & Wear, the Tees Valley and County Durham. Our members include businesses of all sizes – from SMEs to multi-national organisations – and from across all sectors.

The region's infrastructure needs rank highly among the concerns of our members, with the North East's transport, energy and digital infrastructure seen as key to helping the region reach its potential.

These issues form the backbone of our [Chamber Manifesto 2017](#), which sets out the areas we will campaign on for the year on behalf of the business community of North East England. We also recently set out our [transport infrastructure investment priorities](#), highlighting the region's requirements across road, rail, air and sea transport.

This response will summarise our members' views on the region's infrastructure requirements by addressing the relevant questions in the National Infrastructure Assessment Call for Evidence document.

Cross-Cutting Issues

1) What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Each and every infrastructure investment should help move the region towards unlocking its economic potential, however there are two key gateway infrastructure projects in the region which have the potential to unlock long term growth and regeneration in their parts of the North East, at Newcastle Central Station and Darlington Station.

Ambitious plans for Newcastle Central Station will see accessibility improved, platform capacity increased to prepare the station for High Speed Rail, and a new southern entrance, opening up an entire section of the city – the historic Stephenson Quarter and neighbouring Forth Yards – to regeneration. Newcastle Central is a gateway to the north of the region, acting as the primary link between Tyne and Wear and the rest of the country via the East Coast Mainline.

Similarly, Darlington Station acts as the gateway to the Tees Valley. For that part of the region to flourish, Darlington Station requires redevelopment and realignment, to allow greater capacity for trains to pass through and prepare the station for High Speed Rail, while preserving a key access point to Middlesbrough and Teesport.

2) How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

North East England is a region with a global outlook and is the UK's leading export region. To maintain this successful global foothold in an increasingly competitive environment, the region needs investment both on a local and a national level.

The Government's commitment to expand London's Heathrow Airport is a welcome one, securing the region's current links via Newcastle International Airport to the UK's international hub, and opening up the potential for a new



link between Heathrow and Durham Tees Valley Airport. However, now the expansion of runway capacity is out to consultation, it is important the project continues to gather support and continues to move along the process towards delivery as quickly as possible.

To ensure that the region continues to benefit from the excellent connectivity it currently enjoys, and with the room for growth, it is important that surface access to our ports and airports is improved. This includes improvements in road access across the region, and ensuring the correct loading gauge and capacity for rail lines is available linking Teesport and Port of Tyne to logistics centres across the country.

12) What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

The Chamber is currently engaged in a project working with members to understand some of the issues they face around public procurement, and identify ways in which current approaches could be improved to achieve better outcomes.

This work is at an early stage, but we would urge the National Infrastructure Commission to look closely at ways to include a more extensive range of measures in the cost-benefit analysis. Efforts should be made to ensure the full impact of a scheme – on local jobs, on societal inclusion and on local growth – are included in analysis, and that the potential for largescale, nationally significant investment to transform a region.

Rebalancing the economy, delivering an industrial strategy and enabling the northern powerhouse will require an ambitious programme from government, and one which goes beyond the current capability of the public procurement and project assessment processes, to understand aspiration and unlock potential in regions like North East England.

Transport

14) What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

In addition to the projects already outlined, the region has one key ask to improve the reliability of its transport networks – new rolling stock for the Tyne & Wear Metro.

The current Metro fleet is approaching 40 years old, and has operated since the service opened. It is beyond the end of its operational life, and reliability issues mean that without a new fleet, the Metro will not be able to expand and improve the service to meet the growing needs of Newcastle, Gateshead, North Tyneside, South Tyneside and Sunderland.

Expansion plans, linked to the delivery of new trains, include extending the network onto the national rail system, potentially linking currently isolated parts of Northumberland and Co. Durham in particular to the system and to the East Coast Mainline. New trains, new signalling and new routes will help unlock additional freight paths across the region, better linking Co. Durham and Port of Tyne in particular with the East Coast Mainline.

The Tyne & Wear Metro is a tremendous asset for the region, but needs substantial investment in order to continue to play this vital role in the regional economy.



15) What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

North East England is in a unique position within the UK, with strong existing links to London and Edinburgh, and strong international links via our ports and airports.

Where the region's connectivity must improve is in strengthening links with our neighbours in the north.

Improvements are needed on the East Coast Mainline, not only to enable planned improvements to passenger services, but also to relieve bottlenecks and open up new freight paths. Estimates by the Consortium of East Coast Mainline Authorities suggest improvements to the East Coast Mainline will be worth £12.2m a year in increased GDP thanks to better links between the North East and London, and £12m a year in increased GDP from better links between the North East and Scotland.

Improvements to the existing national rail network in North East England are also vital to allow HS2 trains to run on and into the region before high speed track arrives, adding additional capacity and opening up links to new connections across the country.

The timely delivery of HS2, and its swift progression into North East England, should be viewed as part of improving connectivity to the region's neighbours, including to across the Pennines. Providing these links, via the A66 and A69 on the road, and also via trans-Pennine rail services, will play a significant role in enabling the north of England as a whole to achieve its aims for economic growth and sectoral development.

Digital Communications

18) Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Digital connectivity is crucial to North East England, as a region with a diverse geography combining the rural and urban and with many areas still struggling with broadband access. The region needs continued support, both for the roll out of existing fibre broadband technology and for the delivery of the next generation of digital communication technologies like 5G.

The current schemes for superfast broadband rollout across North East England have set ambitious targets for the number of households they hope to reach. The nature of the region's geography however, makes it likely that some more remote parts of the region will remain isolated unless alternative methods are found. The example of iNorthumberland, who have used microwave radio to reach isolated settlements – those which are too far from existing fibre to be connected directly – points the way for the use of alternatives to provide the connectivity the region needs.

Energy

20) What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

As set out by the work of IPPR's Northern Energy Taskforce, the North – including North East England – has long been at the forefront of energy generation in the UK, and has the natural assets, skilled workforce and industrial expertise to remain so. Not only is North East England a leader in the renewables sector, it also enjoys the



presence of many energy-intensive industries, whose competitiveness is linked to the cost and reliability of their energy supply.

Efforts should be made to support industrial investment in new technologies around energy generation – including industrial Carbon Capture and Storage – and help reduce costs for high-intensity users and pave the way for a zero carbon power sector in the future. This must include long term certainty around the energy sector, offering clear sight for investors as they plan and deliver schemes over the medium to long term.

This certainty of policy would unlock private investment across the sector, allowing the region to continue to play that role at the centre of the UK's energy generation, drawing on and developing our expertise in advanced manufacturing, subsea oil and gas, and renewable energy.

[name redacted]

[email address redacted]

[job title redacted]

North East England Chamber of Commerce

February 2017



[name redacted]
Network Rail The
Quadrant Elder
Gate Milton
Keynes
Buckinghamshire
MK9 1EN

10th February 2017

Network Rail response to the National Infrastructure Commission's consultation on the National Infrastructure Assessment: 'Call for evidence'

Network Rail Infrastructure Ltd. welcomes the opportunity to contribute to the National Infrastructure Commission (NIC) 'call for evidence' consultation on their forthcoming National Infrastructure Assessment (NIA). Network Rail is the owner and operator of the rail network in Great Britain, and is responsible for its safe operation, maintenance, renewal and enhancement.

As established in previous consultations to the NIC, Network Rail recognises the objectives of the NIA as complementary to its own vision to deliver a railway which will support a thriving, sustainable economy and improved quality of life. Although this response provides a high level view to the questions provided, for further detailed development of the NIA we would welcome bilateral engagement with the NIC on any, or all, of our responses.

The key points of Network Rail's response are:

- Rail infrastructure serves a vital role in the UK's economy and society, connecting new, and strengthening existing, markets for passenger and freight users.
- The current network faces considerable capacity and performance challenges in a number of areas. Significant investment is required to satisfy both current rail infrastructure challenges and meet the growth in demand in the long-term.
- Network rail has a planning pipeline for long-term investments over the timescale of the NIA. Long-term planning is done in collaboration with the rail industry through an established Long Term Planning Process (LTPP). Current emerging opportunities for long-term investment include:
 - The Digital Railway programme.
 - Brighton Mainline, South West Mainline, and station capacity improvements.
 - Further pipeline developments from the LTPP route studies.
 - Long term transformational enhancement schemes such as Northern Powerhouse Rail, HS2, and East-West Rail.
- Any enhancement or expansion of rail infrastructure should be planned alongside other infrastructure changes to ensure the maximum benefits can be delivered.
- Network Rail is exploring new methods of funding and financing to improve efficiency of infrastructure delivery.
- Network Rail welcomes collaboration and competition, where appropriate, to provide best value to its funders and users.
- There are opportunities for the NIC to assist in several areas for benefit of cross-sector infrastructure planning: for example, investigating interdependencies and resilience, and by reviewing effectiveness of planning systems and consents approval.
- Network Rail believes, however, that care should be taken not to undermine the independence of sectoral regulators, and that recognition should be provided to the unique characteristics of each infrastructure industry.

Cross-cutting Issues

Q1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Network Rail is a national organisation which owns and operates the majority of the rail network across Great Britain. Although the rail infrastructure serves a vital role in supporting long-term sustainable growth across the UK's cities and regions, it faces considerable capacity and performance challenges in several locations. To meet these challenges, Network Rail is committed to plan for the future role of the railway in the UK economy. It undertakes planning through the Industry established Long Term Planning Process (LTPP), and further development of specific interventions through a progressive 'pipeline' in order to present effective investment options for funders.

The contribution of rail to the British economy is increasingly recognised. Rail infrastructure can provide connectivity to open up new, and strengthen existing, markets for passengers and freight across the country. A study produced for the Rail Delivery Group in 2014 reported that the rail industry in Great Britain, and its supply chain, employ around 212,000 people and generate £9.3bn of gross value added (GVA) per year¹. Furthermore, the sector provides benefits worth up to £13bn a year to its passengers and freight users, and enhances the productive potential of the economy by up to £10.2bn per year.

In delivering these benefits, Great Britain has one of the fastest growing railways in Europe and the second most intensively used². Demand has grown significantly in the past two decades bringing both benefits and challenges. In London, in 2015, rail delivered on average over 580,000 commuters into the central business district during the morning peak each weekday with around 5.8% of these passengers in excess of capacity³. As a consequence of this capacity challenge, the performance of the network is not achieving the required levels and user experience of service can drop.

In the next 25 years passenger demand is yet expected to double, and freight markets are faced with modal shift to predominantly intermodal traffic. These demands will not be met within the capacity of the existing infrastructure network. If further capacity is not provided, then it will significantly constrain the ability of the network to meet demand for rail infrastructure services, and further lead the rail network to become a constraint on the future economic growth of the national economy.

In planning to meet demand effectively, Network Rail works with rail industry to produce the LTPP⁴. This is an industry established process which takes a network wide perspective in providing strategic options for investment in the railway. As the process is embedded, and broadly aligned with the timescales of the NIC, it is recommended that the NIA utilise the outputs of the LTPP as an integral 'building block' for long term planning. The LTPP comprises a set of documents and activities that:

- Address the demands that are likely to be placed on Britain's rail network over the next 30 years (to 2043).
- Capture stakeholder aspirations to develop new train services in the light of continuing rail investments.
- Present investment choices for funders to accommodate demand and future aspirations.

The LTPP proposes ways in which train services and infrastructure enhancement could develop over the longer term to 2043, and provides an evidence base for near-term investment in the next Control Period (CP6) from 2019 – 2024. Due to the uncertainties of a 30-year planning horizon, the LTPP is an iterative process. Future planning cycles enable an updated view to take into account the changing context and requirements of the industry and economy. The LTPP acts as a key input to the industry's ongoing discussions with funders concerning the future outputs, investment choices and funding requirements for the railway.

The LTPP consists of a number of essential elements:

- **Market Studies**⁵. These forecast future rail demand, and develop conditional outputs for future rail services. These outputs are based on stakeholders' views of how rail services can support delivery of the industry's strategic goals.
- **Cross-Boundary Analysis**⁶. This analysis considers options for services that run across multiple routes, providing consistent assumptions across Route Studies.
- **Route Studies**⁷. These develop options for future services and identify options for investment in the rail network for each of Network Rail's devolved routes. Options are based on the conditional outputs and demand forecasts from the Market Studies, and are assessed against industry appraisal criteria to provide choices for funders.

Acknowledging the consultation's note that "considerations of 'highest value' should include benefits and costs, as far as possible taking a comprehensive view of both", Network Rail incorporates value consideration and appraisal at several stages through the LTPP and 'pipeline' scheme development. The use of a 'conditional output' importantly recognises that outputs from the market studies, such as increasing frequency of service, are conditional upon affordability and a value for money (VfM) business case being determined.

The LTPP route studies offer the best way to understand long-term options for investment across the rail network. As each route study is aligned to route geography, the requirements of a variety of rail markets serving a 'city or region' can be located within the relevant study produced. However, although the LTPP identifies options for funders to invest in the rail network, to produce a deliverable project or programme these options must pass through a 'pipeline' of further development. As further introduced in Q10, this pipeline is being adopted as a progressive process for funders to invest in the railway, and to improve governance of projects and programmes

Current investments emerging in this pipeline to address the growing capacity and performance challenges on the network, and improve connectivity, include opportunities of:

Digital Railway⁸ – Other travel modes, such as Aviation and the London Underground, already benefit through use of Digital Control systems. Through deployment of digital railway signalling, it is possible that several currently congested routes would have capacity released for more efficient use on the existing network. Alongside this, Digital Railway traffic management systems have the possibility to provide performance benefits through efficient monitoring and control of rail infrastructure systems.

Investment in key rail capacity 'hotspots' – As introduced, the current rail network faces immediate challenges if growth persists on existing infrastructure. Notably, capacity is required on several economically vital routes into London. Mirroring the expected benefits of the forthcoming Elizabeth line (Crossrail), a North-East to South-West Crossrail 2 would provide additional connectivity to markets in central London and relieve capacity on existing lines⁹. Investment in economically vital lines into urban areas, such as the congested South-West Mainline and Brighton Mainline to London, would also release capacity and provide performance improvement.

Investment in key stations – In addition to capacity pressures on rail infrastructure, investment will be required in key stations to ensure they can provide safe and effective means to change trains, interchange with other transport modes, and provide access to local economies, when passenger footfall increases place pressure on existing station provision. Birmingham New Street is a recent example of the transformational opportunities such investment can provide¹⁰.

Investment in key freight corridors - As identified in the Freight Network Study¹¹, developing capacity and capability along a core arterial, nationally cohesive freight network would allow the rail network to reflect forecast growth in intermodal rail traffic between key nodal sites such as Ports and regional distribution centres.

Investment in supporting interregional connectivity – HS2 will revolutionise rail travel, by providing very fast connectivity between London, Birmingham and the Midlands, and Manchester and Leeds in the North¹². Opportunities to integrate benefits of HS2 with the existing rail network, such as a 'Midlands Hub', could further increase regional connectivity¹³. Beyond this, other major programmes are promoted by potential funders and local partnerships. A 'Northern Powerhouse Rail' providing fast and frequent interurban travel between the northern cities has been promoted by Transport for the North (TfN) to assist in delivering the economic potential of cities in the north of England¹⁴. Similarly, delivery of a completed 'East-West Rail' could connect high-value and knowledge based industries with housing growth across an area promoted as 'England's Economic Heartland'¹⁵.

Q2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight, and data in ensuring this?

One of the wider goals identified in the market studies for transport, and for rail markets to assist in meeting, is to enable economic growth⁵ – a benefit contingent upon increased competitiveness.

Although each rail market has different capabilities to assist in meeting this wider goal, broadly rail infrastructure can most effectively contribute to the UK's competitiveness through four ways:

Firstly, rail infrastructure can improve **connectivity** to open up new, and strengthen existing, markets across the country. Improving the journey time, frequency, and network of rail connections can all contribute to a more competitive economy for labour, housing, goods, ideas, leisure, and customers. Resultant outcomes, such as increased agglomeration economies and access to labour markets, also have the potential to assist in 're-balancing' the competitiveness of regions within the UK¹⁶.

International gateways increasingly depend upon rail infrastructure connectivity for access into, and out of, British markets along identifiable 'corridors'. The freight market is shifting to intermodal traffic, resulting in reliance upon connectivity along strategic corridors between vital nodal sites such as deep sea ports and distribution centres⁵. For services and leisure markets, corridors of connectivity are required between centres of economic activity and airports. Maximising the benefit of airport rail links can be provided through improved connectivity to urban transport modes, and business districts through 'gateway' stations.

Secondly, rail infrastructure can provide sufficient **capacity** for economically productive activities. On point-to-point mobility, rail can transport relatively large volumes of people and goods efficiently with a competitive journey time. Demand for rail transport is high on the majority of routes, and has been growing consistently since 1994¹⁷. In most rail markets, even in pessimistic scenarios, growth looks to continue. Where this growth can't be accommodated, it provides a constraint on the competitive benefits provided by connectivity. Already, freight transport is limited by capacity constraints on a number of key corridors between markets and international gateways. For passengers, a constraint on capacity can limit access to business and labour markets, and vastly decrease satisfaction with service. Capacity improvements can meet existing demand, and increase competitiveness by opening up infrastructure to increased economic benefit.

Thirdly, improvement of **performance** allows goods and people to flow across the country effectively. Delays and poor reliability negatively impact competitiveness through perceptions of uncertain end-to-end journey times, difficulty of connectivity to markets, and poorer quality of life for travellers. For goods markets especially, competitiveness is extremely sensitive to journey time. As such, pressure on operators' reliability will likely increase. Improvements in resilience and reliability can then provide confidence in economic delivery, and could provide a boost to UK competitiveness.

Lastly, development of new technologies and talent could allow the UK to export **expertise and skills**. The UK has a relative advantage in a number of areas associated with infrastructure delivery and management – for example, digital signalling and train control¹⁸. By providing a basis for increased exports, this expertise could benefit the UK economy through job and skills creation.

Q3. How should infrastructure be designed, planned, and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

As infrastructure projects and programmes are taken through a 'pipeline' of design, planning, and delivery, the best way to assess and deliver the benefits of better places to live and work is to collaborate effectively with a variety of stakeholders – such as funders, business groups, local authorities, operating companies, and user groups. Through collaborative and joint working, a variety of contingent developments such as housing may additionally be identified and considered.

In planning and design, Network Rail's LTPP process is strongly collaborative at all levels of study. In Market Studies, future demand and requirements (expressed as 'conditional outputs') of the rail network is built upon stakeholders' views, and thorough review of how rail services can support delivery of the market's strategic goals. In Route Studies, when options are developed for geographically aligned routes they are assessed against the identified market study outputs, funder and stakeholder criteria, and an early assessment of value for money. At this early stage of project design and planning, stakeholder collaboration and strategic review increases the chances of effective delivery of railway infrastructure strategic outcomes and benefits.

Likewise, where contingent developments such as housing are dependent upon infrastructures, early collaboration and integration is key to successful delivery of ultimate benefits. For example, large housing developments can deliver benefits of better living and working if they are situated near a station. However, with capacity on many routes often low, early collaboration is essential to ensure that any new station proposal is the correct transport strategy without detriment to overall rail service and wider regional quality of living and working¹⁹. Indeed, a mixture of transport means to undertake 'last mile' mobility need to be integrated with existing hubs to deliver benefits more effectively.

Early stage planning and design could arguably be further improved to focus upon 'better places to live and work' through increasing consideration of social value planning and wider benefits in the appraisal of options. Wider benefits such as community improvement, jobs creation, and social value can be difficult to capture in an economically aligned business case. Expansion upon this point is provided in response to question 12.

Q4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Demand for rail infrastructure services has increased consistently in recent years, and is set to continue under any forecast scenario⁵. Where demand is seen to outstrip capacity, the LTPP works to identify options to address them. Notwithstanding required infrastructure enhancements of varying scales, in a capital and capacity constrained environment, demand management can provide additional tools to alleviate or redistribute some demand for the benefit of increased efficient use of an existing network.

On a sectoral level, long-term demand for transportation may be managed by efficient planned use of infrastructure modes for different markets. A freight train, for example, is capable of conveying the equivalent of approximately 60 lorry loads²⁰. Over long distances, this can reduce congestion on the road network, emissions into the environment, and maximise economic benefit from connectivity. On a national scale, the ORR notes that in 2013/14 rail transported an equivalent of 1.78 billion lorry kms²¹. Management of demand at this level is contingent upon competitive benefits to the market and capacity, and effective planning policy; for example, the ability for goods to be delivered efficiently requires planned nodal warehouse sites and investment in the Strategic Railfreight Network.

On an industry level, demand may be managed through micro-economics strategies of regulating access of operators to the network, and of ticket pricing to the consumer – both of which are beyond the scope of Network Rail’s duties to the rail network²². For the former, changes to access charges are determined by the ORR, and done so on basis of cost recovery. However, changes of access charge to reflect a value of capacity may present large commercially sensitive challenges with limited benefits, including potential to ‘price off’ valuable traffic from rail infrastructure such as freight, at detriment to wider benefits such as increasing environmental emissions and road congestion. For the latter, tickets are already split into peak and off-peak fares around service demand trends during the ‘working week’, and by regulated and unregulated structures. To further improve service to passengers, an action plan for information on rail fares & ticketing was released jointly by the DfT, RDG, and Transport focus setting out clear and agreed steps between the Government, Industry and consumer groups to help passengers find and choose the best ticket for their journey²³.

On an infrastructure level, day-to-day demand spikes and recovery from incidents can be managed through improved traffic management technologies and performance strategies. For example, one element of the Digital Railway programme is deployment of a traffic management system which could assist signallers and operators to more efficiently manage increased levels of train service on the infrastructure⁸.

Q5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Network Rail is committed to effective asset management to a safe and reliable standard, both for the construction of new assets and the maintenance of existing assets. As such, where planning for new assets takes place it should take into account existing asset maintenance on a minimum whole life costing basis. The latest update to Network Rail’s Asset Management policy was issued in 2014, compliant with ISO 55000 standards²⁴.

Any activity on assets should be directed to support statutory and customer requirements. In the case of infrastructure, this normally means delivering safe, reliable assets that have capacity and functionality when the customer requires them. With these requirements in mind, a balance can be struck between ensuring that the established capability of existing infrastructure is retained (where it remains key to customer requirement), and investment to offer new and improved capabilities, providing expanded services to existing and new customers.

To determine an effective balance, life cycle ‘asset management’ analysis is required. This involves use of decision supporting tools to confirm how risks to service levels change with different patterns of investment of maintenance and improvement. These tools need to reflect cost, performance, and risk relationships over time for both a discrete asset, and a portfolio of assets. These methodologies are sensitive to long term patterns of degradation; for example, often a short term reduction in maintenance may only reveal itself as risks to service reliability in the medium term. For this reason it is essential that the degradation models that are used within the lifecycle tools are created from historical records of change and are peer reviewed / independently verified to confirm that tools are valid and that uncertainty within the analysis is understood.

Instead of provisioning a balance, tools can provide options and choices to funders. These will offer differing short and long term patterns of investment, maintenance and improvement scenarios, and the consequential impact on short and longer-term patterns of performance and risk. Often, the best time to improve an asset is when it is up for renewal. For example, on the digital railway programme, where demand for additional train service capacity or enhanced performance exists, a targeted approach could be aligned with the need for asset renewals so that there is an overall minimisation of both the value of assets which must be replaced, and the level of disruption to service provision for end users.

It is with such evidence, that an informed judgment can be taken on balance between maintenance and construction of new assets – one that won’t create any unintended or perverse consequence, and one that can be aligned with funding constraints and market capacity, which can be essential to support medium-term sustainability within the supply chain.

Q6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Network Rail recognises that collaboration and competition in different areas of the supply of infrastructure services, when effectively applied, can deliver a variety of benefits.

Already one of the most liberalised rail sectors in the EU, the GB rail market has train operation provided by franchised competitors for passenger services and private companies for freight services²⁵. To further improve infrastructure activities and operation, Network Rail further recognises the benefits of collaborating with train operators in an increasing number of ‘railway alliances’. These can be undertaken through a number of models, such as the joint management of ScotRail and Network Rail Scotland²⁶, with ultimate aim of providing enhanced service and value to users and funders.

In project delivery of rail infrastructure, Network Rail additionally welcomes increased contestability. Indeed, railway renewals and enhancements are already provisioned through market competitions in order to increase efficiency of delivery. To investigate barriers preventing further alternative project delivery models on the British rail network, Network Rail's CEO has tasked [name redacted] to conduct an independent review²⁷.

For long-term innovative technological enhancement, the Digital Railway programme is currently collaborating closely with the supply chain through early contractor involvement (ECI)²⁸. ECI aims to maximise supplier buy-in from an early stage to drive down costs and ensure alignment of supplier capability with the emerging needs of a digital railway. Diverse workstreams such as new technology business case development, collaborative cost reduction, optimisation of commercial structural and operational arrangements, and the joint development of technical specifications all provide examples of opportunities of collaboration in the supply of a new infrastructure service.

Successful collaboration and competition in the identified areas of infrastructure service provision identified generally depend upon a number of factors. The provision of a correct benefit-sharing model for relevant parties and tools to support sectoral strengths, correct apportionment of risk, implementation of a robust joint management system, and the selection of partners based upon strategic goals, capability, and value potential are all required to deliver the benefits.

With regards to collaboration and competition in the sector, relevant sectoral regulators have unique sets of duties as legislated by parliament. It is noted that there was consideration of making economic regulators have regard to recommendations provided by the NIC²⁹. Network Rail believes care should be taken not to undermine the independence of sectoral regulators, and that recognition should be provided to the unique characteristics of each infrastructure industry where a uniform policy may provide a variety of outcomes in a commercially sensitive sector. Therefore clarity on the statutory status of the NIC in this scenario would be welcomed.

Q7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The delivery of rail infrastructure services, for which Network Rail is responsible, is currently largely funded from Government. Policy could aid in a number of areas to improve rail infrastructure service delivery, including examples in assisting possible changes to funding origin, the process by which funding is gathered, and structure of funding provision.

With regards to how railway enhancements are paid for, there is increasing desire to see contribution from third parties and ultimate beneficiaries. For established third party investors, coordination and collaboration between industry and government partners would increase attractiveness of a business case for investment in various projects. In areas surrounding new infrastructure enhancements, beneficiaries of the enhancements, such as property developers, should be expected to help pay for the investments. For example, this could be through methods such as 'section 106' and the community infrastructure levy. Other beneficiaries could also potentially provide indirect funding if primary legislation provided targeted tax (such as on properties and businesses set to benefit) powers to local authorities.

Network Rail generally receives much of its funding through 5-year 'control periods', with funding provided for delivery of agreed outputs. The control period model, however, doesn't always provide an efficient model for complex longer-term strategies and enhancements such as digital railway and HS2 enablement as their programme lifecycles span beyond one single control period. Network Rail is instead moving its enhancements model towards a progressive funding model – with funding of enhancements agreed outside the periodic review process. Cross-border projects also require an approach which recognises the beneficiaries of investments. For example, clear agreement on priorities and responsibilities of funding between Scottish and central Government would allow for efficient investment in any cross-border rail infrastructure projects.

Q8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Funding and financing are terms which are sometimes used interchangeably. For rail infrastructure, funding refers to enhancements that are paid for 'upfront' with cash whereas financing refers to enhancements being paid for through borrowing money.

Existing models developed both in other sectors and rail that could be used include the PPP/PFI approach; concession arrangements the structures used in rolling stock procurement, property-related models (e.g. Northern Line Extension), regulatory licensed models (Thames Tideway, Oftos), models for delivering and financing construction (such as Evergreen) or joint ventures.

Possible sources of incremental value through use of private sector capital may include:

- optimised costs through more effective whole-life asset management;
- effective risk transfer, robust cost control and operational efficiencies;
- benchmarking of differing procurement strategies;
- innovative delivery approaches (for example, pricing and mitigating disruption more efficiently);

- better alignment of interests between Network Rail, its train operator customers and contractors and deliverers; and
- current availability of private sector capital at a historically low cost.

Generally, however, the cost of private sector finance will be higher than the public sector cost of capital faced by Network Rail. Therefore, the use of private sector capital will create incremental VfM if the efficiency, performance gains, and the risk transferred outweigh the extra cost of finance.

Network Rail is actively considering raising private sector finance where appropriate at project levels, but conditions for effective financing are likely drawn from a combination of external and internal conditions.

Potential issues

- **Industry engagement and support** on the mixed delivery approach to new investment models, and how they will be regulated and managed within the industry's implementation plan
- **The availability of funds looking to invest in infrastructure.** There is a range of sources depending upon different schemes. A pipeline of appropriately structured deals could potentially either offer a self-generating revenue stream for investors and/or which provide opportunities for efficiency and innovation.
- **Interface issues.** However these could be seen as more of an issue to manage effectively rather than a problem per se. Often, many of the developers are also Network Rail contractors and have experience of working on the rail themselves or working with construction companies who do. Behind them is a group of investors who are less risk averse and more likely to consider construction risk.
- **Clarity of the revenue model.** It will be necessary to structure availability or usage payments to the project deliverers based on the availability and performance of their assets. Many schemes may not be fully self-funding, meaning that funders may need to consider how it allocates its long-term support to privately financed assets, including some projects which may have some element of other funding as well as generating project income.
- **Protection for investors.** Infrastructure assets are, in general, not freely transferable and financial security cannot be exercised by removing rail assets. The primary protection for investors is the essential nature of assets' outputs, but investors could remain exposed to changes in Government policy (including the duties of regulators) which can affect revenues and/ or costs.
- It is assumed that the **principles of the existing Track Access regime** are not undermined by a greater volume of projects financed with private sector capital. System capacity will continue to be sold to operators by Network Rail as system operator; project promoters will potentially bear risk on the outputs of the assets they deliver, but not on wider system outputs (which they could not effectively control and to attempt to transfer this risk to them would be poor value for money). The exception to these assumptions might be a concession under which a whole region of network is to be recapitalised by the private sector which takes over as a network owner and operator.

Internal/delivery conditions:

- **Testing the Value for Money case.** It is important to choose which of the wide range of projects are more suitable for private investors, with mind that social and environmental benefits are challenging to monetise for and available for repayment to private sector project parties.
- **The railway operational environment (including interface complexity)** may make investment less suitable in some cases. Effective risk transfer (hence value for money) is predicated on giving the relevant party the risks they are best placed to manage.
- There must be **confidence that the project will be delivered**, or that the procurement will lead to a transaction. Lengthy, expensive and uncertain procurement processes should be avoided, as these impose unacceptable cost and risk on bidding parties. The current average time from OJEU to Close is more than four years.
- **Payment mechanisms.** Preference for payment mechanisms that reward asset performance (controllable by the investor) over those that transfer usage risk (e.g. track access charges and compensation payments) with a general investor preference for financing approaches that avoid demand risk.

Q9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

There are a variety of interdependencies which arise between infrastructure sectors, some of which have been identified by the NIC for investigation, which can provide uncertain and varied risks to service provision. Increased collaboration and visibility between sectors, alongside effective integration of 'resilience' in planning, asset management, and operations, can help identify and mitigate these risks. Across infrastructure, however, there is no generally agreed definition of 'resilience', and this can challenge benefits from collaboration. For example, levels of resilience can be interpreted in other sectors as levels of reliability, and resilience can be hard to assess and model within business cases for enhancement. As such, this could be an area of future research for the NIC to undertake.

On a strategic level, long-term consideration for interdependence and resilience could be built into planning through engagement between contingent system operators, regulators, government organisations and stakeholders in different sectors and supply chains. For example, working with key stakeholders such as Highways England, National Grid, MI5, and the Environment Agency could allow for information sharing and the development of strategies cognizant with identified interdependencies and risks in areas as diverse as climate change, environmental management, energy policy, and security incidents etc.

On an asset level, resilience can be provided through whole life costing effective design and implementation. Features such as standardisation, modularisation of equipment, remote monitoring and diagnostics can be designed into assets to increase reliability and resilience. Although initial capital costs may be higher, a whole life costing model captures the economic benefit of resilience over time through reduced economic impact of failures within a transport system. Sharing information between sectors could further improve accuracy of costing models and strengthen cases for investment.

On an operational level, standardised traffic management and driver advisory systems (such as those provided by Digital Railway investment) could increase resilience to delays and provide increased accuracy to timetable planning. In addition to continual performance improvement within rail industry with traffic management, collaborative working with other transport operators can produce resilient operational strategies where interdependent risks arise. For example, a failure of a transport mode – such as a major road incident - may significantly increase pressure upon rail transport along a geographically similar route.

Q10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The planning processes of Network Rail's Enhancement Programme 2014-2019 were recently the subject of review by [name redacted]³⁰. In response, Network Rail and the Department for Transport issued a memorandum of understanding outlining a process for improving the joint delivery of infrastructure projects³¹. The issues highlighted, and processes put in place, could provide lessons learnt for wider how infrastructure planning and governance is conducted with a variety of funders.

Additional governance has been put in place to assist in the timely and efficient delivery of works, and to recognise that projects and programmes in early development are highly immature. Network Rail now aims to develop a pipeline of projects to be put through a series of joint decision points, so that funding is committed progressively and the value for money of delivered outputs is tested at key points in development. Funding should only be committed to progress to the subsequent joint decision point, to ensure clarity of cost and outcome expectations. Through this process, it is envisioned that at each stage planning faces discipline to investigate an increasing clarity of scope, outputs, outcomes, and benefits, as well as decreasing risk to funding and timely delivery.

The delivery of infrastructure, particularly rail, is dependent upon securing a range of necessary consents and permissions, including planning, land acquisition, but also environmental or listed building consents. Over the years Government has provided new tools for the delivery of multi-consenting schemes – such as Transport and Works Act (TWA), Development Consent Order (DCO's) or Hybrid Bills (such as HS2). It would be opportune for the NIC to review the effectiveness of such regimes, particularly TWA and DCO, and to make recommendations for best practice to be shared across the sectors or for improvements to be made. DCO's, for example, were established in the 2008 Planning Act and whilst the time taken for formal decision making period is prescribed, the front loading requirements mean that periods of 2-3 years are required before the scheme is formally submitted. A review may reveal and suggest opportunities to streamline this, increasing the efficiency of delivery.

Continued review of processes and planning strategies on a variety of levels is required to ensure that supporting processes are effective, and that infrastructure developments have line of sight to national, regional, and local goals. If timelines and strategies of delivery for contingent projects and programmes (such as infrastructure developments and local authority zoned housing) are not properly aligned, then it can lead to frustration of stakeholders and delays to benefits. Collaborative working and transparency through such processes can provide opportunities of continuous improvement and likelihood of efficient delivery on time.

Q11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Network Rail recognises the impact rail infrastructure can have on the natural environment, and believes that sustainable development and improving environmental performance is essential to being a responsible and successful organisation³². Through recognition of the impact of infrastructure on the environment, effective collaboration with partner organisations, and working to build sustainability principles in business management and project development, it is possible for rail infrastructure to protect and enhance the natural environment without detriment to service provision.

Existing rail infrastructures and assets do not always have space available to dedicate to the enhancement of the natural environment, but have potential for consolidation of the many species which currently inhabit them. For example, embankments and land alongside railways can sometimes act as a series of fenced off habitats. However, difficulty arises when

the primary use of this land, safe railway operation, requires clearance or interference with these environmental benefits. As such, proper planning and an understanding of estate and ecological management are required to provide both transport and environmental benefits. By working collaboratively with partner organisations, environmental data could be gathered and built into national datasets on habitats and species within railway land. This information can be used to inform effective ecological management, further improved by sharing data and best practice through partner organisations such as the Linear Infrastructure Network (LINet)³³.

Collaboration and inclusion of sustainability principles can additionally minimise the disruption of providing new rail infrastructure. Through effective planning, project resource use and asset design could lead to long-term efficiency benefits and a reduction in waste and pollution. In addition, major rail investments in the existing network such as the Great Western route modernisation, or in new networks such as HS2, are often required to enhance natural environments such as involvement in biodiversity 'net gain' trials. As such schemes are often 'pioneering', it is vital that learnings are shared with other operating and delivery organisations to provide industry and sectoral best practice on effective design and delivery of infrastructure around the natural environment.

Q12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable, and transparent?

Although specific techniques can always be improved, the most significant issues that call for improvement are arguably broader than the question provided.

First, cost-benefit analysis should be more widely acknowledged for what it is: one of the key things that inform a business case and thus decision-making, but not the only one. There are few, if any, major investments for which cost-benefit analysis is likely to accurately quantify, let alone value, all the relevant considerations. Ironically, appraisal guidance itself often recognises this, stressing the importance of qualitative considerations in the overall decision. In practice, however, an arguably disproportionate amount of effort is sometimes put into the quantitative cost-benefit analysis.

Second, cost-benefit analysis – and planning and decision-making in general – needs to be more clearly objective led. Current cost-benefit analysis, for example as set out by the HMT Green Book³⁴ and DfT Transport Appraisal Guidance (WebTAG)³⁵, uses welfare benefits (for example, the value of savings in travel time) as its key measure. However, maximising welfare benefits is not always the sole or even main objective of decision-makers. Economic growth, rebalancing the economy and deficit reduction – to take three examples – are not the same thing as welfare benefits; and the investments that would be most effective at achieving these objectives are not necessarily the same as those that would maximise a traditional Benefit / Cost Ratio. It is important that business cases consider the extent to which the investments are likely to achieve the desired objectives, even if this is difficult to quantify precisely, rather than the extent to which they meet objectives which are easier to measure but are not the primary goal of decision makers.

Third, current cost-benefit analysis is based on assessing the proposed investment in isolation. For example, transport appraisal compares the world with and the world without the proposed transport investment, with all other things being equal. However, transport investments are increasingly being planned as part of wider development strategies that include multiple investments in transport, housing and other infrastructure, as well as non-infrastructure investments such as in skills and training. Assessing each investment in isolation will not necessarily give a fair assessment of the overall strategy.

These considerations suggest that the most valuable improvements to cost-benefit analysis – at least in respect of major investments that aim to have significant effects on the economy – would be increased emphasis on the narrative explaining how proposed investments are expected to achieve their objectives, and guidance on the nature of the supporting evidence that should be provided.

Finally, it is not clear how best to value resilience of systems. This is becoming a more important objective, particularly following a number of extreme weather events in recent years and the prospect of increased risk due to climate change (although resilience is not limited to weather issues). However, there is little quantitative evidence of the effects of system failures (e.g. impact on the economy), and hence of the value of avoiding them in future. As mentioned in Q9, research in this area would be beneficial.

Transport

Q13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

As part of the LTPP, Network Rail issued four Market Studies to set out how demand is expected to change over the subsequent 30 years in the Long Distance, London & South-East, Regional Urban, and Freight rail markets⁵.

Growth in rail travel markets, or indeed any mode, is dependent on a number of changing factors and trends: macro- economics such as employment and economic activity, micro-economics such as travel costs and competition, demographics of population

and age, consumer tastes and perceptions, and the supply of travel opportunities such as modal generalised journey times can all affect travel pattern changes.

In addition to these factors influencing demand, change in rail markets is framed within four scenarios combining economic performance with social and environmental planning, which includes national technological capability: prospering in global stability, prospering in isolation, struggling in global turmoil, and struggling in isolation.

Travel between modes, and between different markets of rail transport, could vary depending on a combination of these factors. However, even in the poorest scenario, rail transport still displays positive demand. This may be due to entrenched trends of increases in population and urbanisation, which are favourable trends to the use of rail as they increase demand for modes of transportation that move large numbers of people between, and around, urban areas efficiently. Indeed, the most likely scenarios indicate that rail passenger transport demand will double again over the next 30 years.

For rail freight transport, a rapid structural change in the commodity base has been prompted by change in generational policy and globalisation of steel manufacturing. Despite this, overall demand is growing, mostly from intermodal traffic between deep sea ports. Indeed, in 2014 the RDG reported that 1 in 4 containers entering the UK were received by rail freight³⁶. Future growth in this sector is likely to follow this trend, but is notably sensitive to modal competitiveness and capacity.

Major new technologies of note emerging in the UK rail sector include those which enhance national and regional infrastructure capability (such as High Speed Rail and Digital Railway signalling), and those which enhance transport service provision (such as 'Smart Ticketing' and digital communications technologies). The former should build upon rail's established economic benefits with technologies providing opportunities of enhanced inter-regional connectivity, increased capacity on congested routes, and better operational performance. The latter may allow for increased user experience and productivity, as passengers can prospectively integrate journey planning, efficiently purchase travel, and work on the move with high-speed internet connectivity³⁷.

Technologies of note emerging in other sectors include the possible development of new transport modes, such as Autonomous Vehicles (AVs) along road networks. If technology develops to maturity where AVs can operate safely at high speed in a coordinated manner, it could arguably provide large benefits and advantages to road transport. However, rail may still maintain an advantage with the efficiency it transports large volumes of passengers. Indeed, AVs could be regarded less as a competitive threat, but as a complimentary means to plan for – for example, station planning and development could integrate AVs as an additional transport mode in a customer's journey.

While modelling forecasts are useful to long-term planning processes, caution is urged with regard to accuracy of predictions over timeframes as extensive as 30 years.

Q14. What are the highest value transport investments to allow people and freight to get into, out of, and around major urban areas?

In the response to Q1, Network Rail's LTPP was introduced as an established process through which high-value investments in rail infrastructure are identified over a planning horizon aligned to the forthcoming NIA. Whereas Q1 offered a national snapshot, rail infrastructure has particular opportunities and challenges in delivering high value transport within an urban context. It should be noted, however, that railway planning takes a holistic approach to the mixed markets urban rail infrastructure serves, with route studies identifying solutions which provide a variety of benefits. An 'urban scheme', such as the examples listed below, will often serve both commuter or metro style service, and long distance high speed services requiring access to inner city stations. With this in mind, although the limits of Q14 and Q15 are useful to consider challenges and opportunities to rail infrastructure in different geographies, any potential investments will likely provide wider benefits.

Cities are important centres of national economic activity. As urbanisation has progressed, and the national industry base has shifted to services, the importance of major urban areas to the British economy has increased. Often high-value and knowledge-based sectors are located in cities providing competitive labour markets and growth. The capital, London, has such industries on an internationally competitive scale that it can be classified as a 'world city'³⁸. Furthermore, this worldcity is expected to also reach the classification of a 'megacity' in 2030, as population is projected to reach 10 million persons³⁹. This trend of urbanisation and service sector productivity can be observed in several of the UK's major urban areas, although it is notable that growth in London has been much higher. Continued growth, and the general competitiveness of urban areas, can be supported by connectivity to a variety of markets – for example, labour can be efficiently connected from areas of available housing to centres of employment, leisure and business services can access a wider number of customers, and goods can be imported and exported.

Rail offers an efficient means to provide connectivity for major urban areas. As cities grow, rail can generally offer advantage for flows of commuter and leisure markets serving principal urban centres if journey times, frequencies of service, and costs are competitive over the distances served. Train services can then provide an efficient means of point-to-point travel, transporting high volumes of people and goods into central locations of economic activity. This can provide secondary benefits of relieving

congestion on road networks, and reducing emissions through train travel's relatively low carbon emissions⁴⁰. This is especially notable for freight; the large consumer population of a city provides large demand for goods which, if transported entirely by HGVs, can congest key road arteries. Efficient supply chains could then be supported through integrated nodal railfreight sites. Indeed, urban travel is often intermodal, and further connectivity across an urban area can be promoted through integration with other modes such as metro, bus, trams, or bicycle sharing to complete the 'last mile' from train station to destination. Indeed, a trend to 'mobility as a service', supported by such innovations as integrated ticketing, smart cards, and digital applications, can increase efficient transport by integrating the benefits of a rail service into a user's personal journey.

Investment in the rail network is required to provide capacity for sustained demand. Although long-term demand forecasts are not without uncertainty, it is unlikely rail's advantages will be eroded. Both the 'Regional Urban' market study of the 13 largest regional urban centres in the UK⁴¹, and the 'London & South East' market study⁴², predict urban rail growth in every scenario. In London, in 2015, rail delivered on average over 580,000 commuters into the central business district during the morning peak each weekday with around 5.8% of these passengers in excess of capacity⁴³. Without further investment in capacity, the benefits of connectivity will be eroded and rail could act as a constraint to regional and national long-term growth.

Digital Railway offers potential for urban transport in several locations, with core technologies to enable more efficient transportation of people and goods in and out of major urban areas. The adoption of ETCS could allow trains to run safely closer together on existing infrastructure, providing capacity for increased passenger services on busy routes. For freight, this capacity could be provided to freight paths and ETCS could allow for more efficient braking and acceleration curves. These benefits are further increased when combined with the other main technology of traffic management which can aid signallers' and controllers' decision making on busy vital lines. For major urban areas, this means that passenger and freight services could be more reliable and delay response more effective. Both a future digital railway, and current day to day operations, will be underpinned by the Network Rail Telecoms (NRT) national fixed and wireless network. However, further investment is required to improve today's constrained telecommunications infrastructure to one which will enable the future service requirements in a transformed, digitally enabled railway, delivering vital improvements in capacity, performance, safety, security, and a customer experience. There are a number of investment options that could drive the development and delivery of an accessible national, open, digital platform that meets the needs of the future digital railway those of service providers, train operating companies, and mobile network operators whose services traverse a rail corridor.

In London, the scale of both the capacity and performance challenge requires immediate significant infrastructure investment. Mirroring the benefits delivered by the opening of the Elizabeth Line (Crossrail), the NIC have notably endorsed Crossrail 2 as a new artery effectively connecting areas of North-East and South-West London to the job and leisure markets of the centre⁴⁴. Secondly, this new line could relieve capacity on existing congested routes into busy terminals such as Waterloo and Liverpool Street further supporting the economic potential of the London city region. Additional investment in congested commuter routes, such as the South West Mainline and Brighton Mainline, would also assist in relieving capacity for areas of need. Both routes already face significant crowding and performance issues, constraining the economic benefits delivered by commuter markets and significantly lowering user satisfaction.

In addition to enhancing rail infrastructure, the ability of key stations to provide safe capacity for pedestrian traffic and serve as effective 'gateway' hubs for business districts and urban transport will need to be addressed. The success of recent enhancements to Birmingham New Street serves as an example of how investment can increase capacity for passenger movement and provide an attractive means to interchange and enter a city for leisure and business⁴⁵. For London, key station capacity schemes for investment might include hotspots such as the major interchange at Clapham Junction, and terminus at London Liverpool Street. To serve an increasingly intermodal transport market in urban areas, enhancement and design of future stations will have to be built with effective exchange and interfaces in mind as passengers pass from rail to means such as walking, bicycles, buses, cars, or even autonomous vehicles.

Q15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

In addition to supporting the economies of single urban areas, rail infrastructure additionally provides essential connectivity between the country's regions and urban areas. Alongside investments within urban areas introduced in Q14, several strategies are emerging for valuable investments in regional and interregional rail infrastructure to support long-term sustainable growth.

Connectivity between Great Britain's regions and principal cities of Scotland, the North, Midlands and London is primarily provided by two electrified high speed routes: the ECML and WCML. Both routes carry a mixture of traffic including long distance high speed passenger traffic, and significant portions of cross-country, cross-pennine, and national freight traffic. Both routes, and supporting lines, have a number of capacity constraints reflecting their intensive use and economic reliance. Over the next five years, significant enhancements of the rail network will be completed to increase capacity. However, it is considered that with limited options to increase capacity (e.g. train lengthening), interventions will only be sufficient to meet demand until approximately the mid-2020s⁴⁶.

The very-fast interregional services of HS2, between London, and the principal cities and regions of Birmingham and the Midlands, and Manchester and Leeds in the North, will provide a significant expansion in capacity and connectivity. Without HS2, WCML service will be unable to meet the demands placed on it by passengers, freight, or the economy. When phase 2 is expected to open in 2033, new infrastructure could provide up to 18 trains per hour at speeds of up to 225mph providing significant capacity and connectivity benefits⁴⁷. By providing investment to effectively integrate HS2 into regional rail networks, the benefits of this increased capacity and connectivity could be maximized to further assist in boosting regional growth across areas such as the North and Midlands. Additionally, HS2 will provide links to international gateways through access at key locations of a possible 'UK Central' development around Birmingham International Airport⁴⁸, and a further interchange at Manchester Airport.

Partnerships have formed to promote the role of transport connectivity in regional economic growth. For example, Midlands Connect is a partnership of local authorities and LEPs to argue that long-term sustainable growth potential of the Midlands – termed the 'Midlands Engine' – can be facilitated by further investment in connectivity across the region, notably by effectively integrating HS2⁴⁹. Due to a central location, existing regional economic capabilities, such as manufacturing and logistics, benefit from access to other regions for business. Investments in regional connectivity, such as a 'Midlands Rail Hub' identified in the local Network Rail route study⁵⁰, could make best use of the benefits provided from HS2 and assist in alleviating the local capacity constraints in the commuter and regional interurban markets.

Similarly, Transport for the North (TfN) and the NIC have reported that investment in rail infrastructure in the North of England would support the growth potential of a 'Northern Powerhouse'⁵¹. Currently a productivity gap exists whereby Northern GVA per capita has been consistently 25% below the UK average, with sub-optimal transport links and investment having been identified as main factors driving this gap⁵². Although several infrastructure developments are underway in northern cities, significant future growth of passenger numbers is forecast to continue. In order to meet further growth, and assist in delivering connectivity to support regional growth, a 'Northern Powerhouse Rail' is an emerging strategy of a network delivering fast frequent interurban rail transport between the principal northern cities and key international gateways, such as Manchester Airport and the Ports of Immingham and Liverpool⁵³.

In other examples, the NIC has already highlighted the benefits of new east-west transport links in the Cambridge – Milton Keynes – Oxford corridor⁵⁴. Supported by local partnerships, such as the East-West Rail consortium and 'England's Economic Heartland'⁵⁵, the connectivity of an effective transport corridor would maximise the potential of the existing knowledge-intensive clusters, protect the environment, and provide access between these competitive labour markets and areas of housing development.

For freight, the investments in connectivity identified often provide contingent benefits for goods transport. For example, the construction of HS2 could release capacity on the congested WCML for vital north-south traffic, and investment in a Northern Powerhouse Rail network would provide improved transport between the principal northern cities. However, the majority of freight traffic is transported along corridors of a strategic freight network identified in the Network Rail Freight route study⁵⁶. Investment in key capacity constraints and nodal sites such as Ports, Airports, and rail connected distribution centres around this network will be essential to support the economic growth of industries which depend upon it.

Q16. What opportunities does 'mobility as a service' create for road service charging? How would this affect road usage?

Network Rail doesn't have means to respond on this topic.

Digital Communications, Energy, Water & Wastewater, Flood risk management, and Solid waste

Network Rail manages and operates a variety of infrastructures and assets which evidently interface with the above areas of input to the NIC's NIA. In Digital Communications, for example, Network Rail's Digital Railway programme may interface and draw benefit from changing digital infrastructures, and operations depend upon an established telecommunications network. Energy can see interfaces with increased demand from Network Rail's electrification programmes, asset management of rail infrastructure can interface with flood risk management in floodplain areas, and delivery of large projects requires effective solid waste management, to give further examples.

Network Rail will continue to contribute to the NIC's research, and will welcome opportunities for bilateral cooperation on long term planning and investments where appropriate. Alongside this submission, responses will be provided to the discussion papers on The Impact of technological change on future Infrastructure supply and demand⁵⁷, and Population change and Demography⁵⁸ with further relevant detail.

-
- ¹ Oxera and Rail Delivery Group, What is the contribution of rail to the UK economy?, 2014: <http://www.oxera.com/getmedia/802a4979-8371-4063-ad24-8a81ed6c8f82/Contribution-of-rail-to-the-UK-economy-140714.pdf.aspx?ext=.pdf>
- ² European Commission, Fifth report on monitoring development of the rail market, 2016: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0780&from=EN>
- ³ Department for Transport, Rail passenger numbers and crowding on weekdays in major cities in England and Wales (2015), 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541587/rail-passengers-crowding-2015.pdf
- ⁴ Network Rail, Long-term planning, , 2016: <https://www.networkrail.co.uk/running-the-railway/long-term-planning/>
- ⁵ See Market studies for Freight, Long Distance, Regional Urban, and London & South East at: <https://www.networkrail.co.uk/running-the-railway/long-term-planning/>
- ⁶ See Cross-Boundary Analysis at: <https://www.networkrail.co.uk/running-the-railway/long-term-planning/>
- ⁷ See Route Studies at: <https://www.networkrail.co.uk/running-the-railway/long-term-planning/>
- ⁸ Digital Railway, Digital Rail and the National Infrastructure Commission, 2016: <http://digitalrailway.co.uk/wp-content/uploads/2015/11/NIC-Factsheet.pdf>
- ⁹ National Infrastructure Commission, Transport for a World City, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/506633/Transport_for_a_world_city_-_100316.pdf
- ¹⁰ Network Rail, Birmingham New Street improvements, 2015: <https://www.networkrail.co.uk/running-the-railway/our-routes/lnw/birmingham-new-street-improvements/>
- ¹¹ Freight Network Study (draft), Network Rail, 2016: <https://www.networkrail.co.uk/wp-content/uploads/2016/11/Freight-Network-Study-Draft-for-Consultation.pdf>
- ¹² HS2 and Department for Transport, The strategic case for HS2, 2013: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/260525/strategic-case.pdf
- ¹³ Midlands Connect, Emerging Strategy: Executive Summary, 2016: https://www.midlandsconnect.uk/media/1078/mc_emerging_strategy_executive_summary_121216.pdf
- ¹⁴ Transport for the North, Northern Transport Strategy: Spring 2016 update, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505705/northern-transport-strategy-spring-2016.pdf
- ¹⁵ National Infrastructure Commission, Cambridge – Milton Keynes – Oxford corridor: Interim report, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/569867/Cambridge-Milton_Keynes-Oxford_interim_report.pdf
- ¹⁶ , HM Government and Transport for the North, The Northern Powerhouse: One Agenda, One Economy, One North, 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427339/the-northern-powerhouse-tagged.pdf
- ¹⁷ Rail Executive, Rail trends factsheet, 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487497/rail-trends-factsheet-2015.pdf
- ¹⁸ Rail Supply Group, Fast track to the future: a strategy for productivity and growth in the UK rail supply chain, 2016: <http://www.railsupplygroup.org/wp-content/uploads/2016/01/RSG-Brochure-Jan-2016.pdf>
- ¹⁹ Network Rail, Investment in Stations: A guide for promoters and developers, 2014: <http://archive.nr.co.uk/browse%20documents/rus%20documents/route%20utilisation%20strategies/network/working%20group%20%20-%20stations/investmentinstations.pdf>
- ²⁰ Network Rail, Value and Importance of Rail Freight, 2010: http://www.networkrail.co.uk/wp-content/uploads/2016/11/9083_Value-of-Freight.pdf
- ²¹ ORR, Freight Rail Usage: 2015-16 Q2 Statistical Release, 2015: http://orr.gov.uk/_data/assets/pdf_file/0007/19888/freight-rail-usage-2015-16-quarter-2.pdf
- ²² ORR, Network Licence granted to Network Rail Infrastructure Ltd.: As of April 2014, 2014: http://orr.gov.uk/_data/assets/pdf_file/0012/3063/netwrk_licence.pdf
- ²³ Department for Transport, Rail Delivery Group, and Transport Focus, Action Plan for Information on Rail Fares & Ticketing, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579850/action-plan-for-information-on-rail-fares-and-ticketing.pdf

-
- ²⁴ Network Rail, Asset Management Policy, 2014: <http://www.networkrail.co.uk/wp-content/uploads/2016/11/Asset-Management-Policy2.pdf>
- ²⁵ European Parliament, Liberalisation of passenger rail services: situation in different member states, 2016: <http://www.europarl.europa.eu/resources/library/media/20160420RES24185/20160420RES24185.pdf>
- ²⁶ See 'Scotland' at: <https://www.networkrail.co.uk/running-the-railway/our-routes/scotland/>
- ²⁷ Network Rail, Hansford Review 2016: <https://www.networkrail.co.uk/industry-commercial-partners/hansford-review/>
- ²⁸ Digital Railway, Early Contractor Involvement Report: Delivering Digital Train Control Technology Efficiently, 2016: <http://digitalrailway.co.uk/wp-content/uploads/2016/12/Early-Contractor-Involvement-Report-Dec-16.pdf>
- ²⁹ National Infrastructure Commission, National Infrastructure Commission: response to the consultation, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/523951/national_infrastructure_commission_consultation_response_web.pdf
- ³⁰ Department for Transport, Report of the Bowe Review into the planning of Network Rail's Enhancements Programme 2014 – 2019, 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/479560/bowe-review.pdf
- ³¹ Department for Transport and Network Rail, Memorandum of Understanding between Department for Transport and Network Rail on rail enhancements, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/509545/mou-dft-network-rail-rail-enhancements.pdf
- ³² Network Rail, Environment Policy, 2015: <http://www.networkrail.co.uk/wp-content/uploads/2016/11/Network-Rail-Environment-Policy.pdf>
- ³³ See Green Infrastructure Partnership: <http://gip-uk.org/>
- ³⁴ Her Majesty's Treasury, Green Book, 2013 (updated 2016): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf
- ³⁵ See Transport analysis guidance: WebTAG, (last updated 2016): <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>
- ³⁶ Rail Delivery Group, Keeping the lights on and traffic moving, 2014: http://www.raildeliverygroup.com/files/Publications/2014-05_keeping_the_lights_on.pdf
- ³⁷ National Infrastructure Commission, Connected Future, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/577906/CONNECTED_FUTURE_ACCESSIBLE.pdf
- ³⁸ See Globalisation and world cities research network: <http://www.lboro.ac.uk/gawc/index.html>
- ³⁹ Office of National Statistics, Subnational population projections for England: 2014-based projections, 2016: <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/subnationalpopulationprojectionsforengland/2014basedprojections/pdf>
- ⁴⁰ Rail Delivery Group, Freight Britain, 2015: http://www.raildeliverygroup.com/files/Publications/2015-02_freight_britain.pdf
- ⁴¹ Network Rail, Regional Urban Market Study, 2013: <https://www.networkrail.co.uk/wp-content/uploads/2016/11/Regional-urban-market-study-2013-1.pdf>
- ⁴² Network Rail, London and South East Market Study, 2013: <https://www.networkrail.co.uk/wp-content/uploads/2016/11/London-and-South-East-market-study-1.pdf>
- ⁴³ Ibid. – See note 3.
- ⁴⁴ Ibid. – See note 9.
- ⁴⁵ Ibid. – See note 10.
- ⁴⁶ Ibid. – See notes 5,6,7.
- ⁴⁷ Ibid. – See note 12.
- ⁴⁸ See UKCentral: <https://www.investinukcentral.com/>
- ⁴⁹ Ibid. – See note 13.
- ⁵⁰ Ibid. – See 'West Midlands & Chilterns Route Study' in note 7.

⁵¹ National Infrastructure Commission, High Speed North: A National Infrastructure Commission Report, 2016:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/507791/High_Speed_North.pdf

⁵² Transport for the North, SQW Ltd. And Cambridge Econometrics, Northern Powerhouse Independent Economic Review: Core Messages, 2016: <http://www.transportfornorth.com/wp-content/uploads/NPIER-Core-Messages.pdf>

⁵³ Ibid. – See note 14.

⁵⁴ Ibid. – See note 15.

⁵⁵ See England's Economic Heartland: <http://www.englandseconomicheartland.com/pages/our-priorities.aspx>

⁵⁶ Ibid. See note 7.

⁵⁷ National Infrastructure Commission, The impact of technological change on future infrastructure supply and demand, 2016:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/576151/The_impact_of_technological_change_on_future_infrastructure_supply_and_demand.pdf

⁵⁸ National Infrastructure Commission, The impact of population change and demography on future infrastructure demand, 2016:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/576151/The_impact_of_technological_change_on_future_infrastructure_supply_and_demand.pdf

National Infrastructure Commission consultation

The National Flood Forum

The National Flood Forum is a national charity that supports and represents flood risk communities. It helps people to take control of the flood risk in their lives by:

1. Helping people to prepare for flooding
2. Helping them to recover their lives when they have been flooded
3. Working with government and other organisations to put flood risk communities at the heart of policy making and operational delivery

Impact of flooding

The impact of flooding is normally calculated in the direct costs; the additional costs to local authorities (such as through the Belwin formula), insurance claims, damages to agriculture and to business. More recently, society has begun to recognise non-market impacts, but these are largely unrecorded, are under recorded or are only recorded in terms of the costs to the delivery of the services they affect. The examples below are illustrative; the two references are two new documents that you may not be aware of and are relevant:

1. Health – PHE 2017 Thomas David Waite, Katerina Chaintarli, Charles R. Beck, Angie Bone, Richard Amlôt, Sari Kovats, Mark Reacher, Ben Armstrong, Giovanni Leonardi, G. James Rubin and Isabel Oliver The English national cohort study of flooding and health: cross-sectional analysis of mental health outcomes at year one, BMC Public Health
2. Education – Lancaster University
3. Employment
4. Secondary impacts on businesses Economic Impact Assessment of the Boxing Day Floods (2015) on SMEs in the Borough of Calderdale University of Leeds
 1. Community economic resilience
 2. Environment
 3. Food supply chain
 4. Costs of maintaining critical infrastructure systems (assets and interdependencies)

However, as many people testify, recovering from flooding puts people's lives on hold and often causes long term damage to individuals' and communities life chances. The ongoing trauma that we deal with in the National Flood Forum affects many thousands of lives.

Therefore, the costs of flooding to society are rather greater than we record.

The UK Climate Change Risk Assessment 2017 projects that the risk of flooding is likely to get worse. Without an adaptive, focussed, cross societal response the

[Phone number redacted]

impact on people's lives, on businesses' viability and critical infrastructure resilience are likely to increase significantly.

Flooding is an infrastructure issue

The National Infrastructure Commission is right to consider flood risk management as critical infrastructure. However, it is particularly complex as managing the risk is dependent upon the actions of many organisations, businesses and people. A few examples follow:

1. Assets are in multiple ownership and number many thousands in any area
2. Maintenance of assets is a major concern and failings in this area are almost always implicated in every flooding event. Detailed management of local assets such as drains, road gullies, culverts and walls is required to maximise their efficacy and to ensure that they work when most needed. Local knowledge from within communities is often critically important and is often not recognised
3. Natural processes and their management are at the core of flooding (and drought issues) at each point from where rain falls on the ground to the sea, slowing and speeding water at different points and times in a flooding incident, storing water at the right moment and in the right place and ensuring that water flows do not synchronise where rivers meet This includes agricultural land management, river management and maintenance, as well as managing water through urban spaces
4. The planning system and its delivery plays a major and central role in long term prevention of flood risk. To misquote a recent report by the Town and Country Planning Association, *Planning for the climate challenge? understanding the performance of english local plans* - We couldn't have planned it better if we tried to make it flood. This also reflects the feedback that we get back from many communities that proposals for development are frequently a major cause of worry because they fail to take account of flooding properly and rarely incorporate the knowledge and skills held by people in the locality. In the light of this we held a national conference on 1 February on the theme of *Are we planning to flood? The very strong retort was that we are.* A major review is required both of whether we have the right policies in place and whether the system is delivering the outcomes that we expect. Are we delivering development that will be resilient in 30 years time? At the moment we have almost no evidence that this is the case and it seems a fundamental point if critical infrastructure is to be developed and secured for the future. There is no point in investing in assets if this is negated through inappropriate development elsewhere.
5. People and communities lie at the heart of flooding. They are the ones who suffer if flooding occurs or if their services are lost. They are often the ones who have the local knowledge and skills that need to be combined with

[Phone number redacted]

technical expertise to deliver practical results and they are usually the ones who are listened to least of all and rarely involved. This needs to change.

Level of ambition

There are no published targets for flood risk management about what we are trying to achieve, unlike many sectors, such education, health, water quality, etc. However, Flood Re, the measure to improve affordability of household insurance, set up under the Water Act 2015 has a sunset clause requiring that the market returns to risk reflective pricing by 2039, with intermediate transition points and plans along the way. In reality this means that we do have a statutory target requiring us to ensure that people can get affordable insurance on the open market by 2039.

An ambition of a similar nature is required for critical infrastructure.

This has consequences on how we approach flood risk management.

National Strategy needed

A national strategy is needed in order to attain a national ambition; otherwise there is little chance of focussing on what is needed, where and when, and which combination of partners needs to deliver it.

There are several considerations:

1. The strategy needs to focus on what is needed for the long term, what should be avoided to avoid later regrets, what strategic actions are required to ensure that future costs are reduced and what needs to be done when.
2. It needs to be adaptive, with a series of operational plans ensuring delivery
3. It must go much wider than the Defra and Environment Agency remit. Most of the areas of activity that can make a really significant difference lie in other areas of responsibility, notably planning, housing, transport, business and economy, Health and Wellbeing. Therefore, the plan must encompass all of these and other sectors. It must be owned across Government.

To be effective, more localised strategic plans are required at catchment and place level that cover the same considerations as the national plan. This is not the same as current Lead Local Flood Authority Strategic Flood Risk Management Plans, which are too narrow in focus and are often led by rather junior staff. These plans need to be director or chief Executive led, involving the relevant partners at senior level. It is:

1. How many homes, and businesses, will struggle to obtain property insurance at risk reflective pricing, what will current plans deliver (and when), what is the gap and what needs to be done strategically to meet the gap across the full range of sectors.

[Phone number redacted]

2. What standards do we need for assets and the linkages between them; these could be operational targets for example, how can these best be achieved strategically through actions of all sectors and what is it important to deliver and when?

All of this equates to a long term strategic and adaptive approach.

[Name redacted]

[Job title redacted]

10th February 2017



NHBC Submission: National Infrastructure Assessment Call for Evidence, 10th February 2017

- 1.1 NHBC's submission focuses on the cross-cutting issue of infrastructure and housing and how we can support the development of an evidenced-based National Infrastructure Assessment (NIA).
- 1.2 NHBC is the UK's leading standard-setting body and provider of warranty and insurance for new homes. Our purpose is to work with the house-building industry to raise the standards of new homes and to provide protection for homebuyers in the form of Buildmark warranty and insurance. Established in 1936, NHBC is the home warranty provider of choice, currently insuring over 1.6 million homes, with a market share of approximately 80%.

Provision of housing data

- 1.3 We welcome the development of the NIA, which will assess the infrastructure system as a whole using robust evidence. To support the development of the NIA, NHBC is able to offer access to our statistics, which are a unique source of detailed up-to-date information on new home construction and the house-building industry. The figures relate to new homes registered with NHBC for its 10-year warranty, which covers around 80% of all new homes built in the UK. NHBC figures are available well ahead of Government figures and as such, we represent the only source of up-to-date information on new home registrations, starts and completions.
- 1.4 NHBC is currently supporting the Housing & Finance Institute (HFI) with data on new builds to support their work in examining how infrastructure networks can open up housing development. Our data demonstrates information on, for example, the lag between initial 'site notification' and starts in the South East region, which has seen some of the strongest housing growth in the last few years.

Support to infrastructure providers

- 1.5 Furthermore, NHBC is supporting infrastructure providers such as Openreach to increase the speed of delivery of high-speed broadband infrastructure to new homes in a variety of ways, including:
 - 1.5.1 Providing Openreach with a platform to communicate with senior technical staff at large and medium sized house builders via NHBC 'Building for Tomorrow' seminars around the UK;
 - 1.5.2 Carrying out quarterly customer satisfaction surveys of owners of new homes to understand their experience of broadband provision, to help Openreach improve their customer experience;
 - 1.5.3 Promoting surveys to builders and developers to understand their experience of dealing with broadband providers;
 - 1.5.4 Communicating improvements and changes to processes for broadband delivery in new homes;
 - 1.5.5 Using NHBC site registration data to identify new developments to enable broadband providers to plan future digital infrastructure better.

National Infrastructure Assessment Call for Evidence

February 2017

Executive Summary

Blueprint for Water is a unique coalition of environmental, water efficiency, fisheries and angling organisations and a campaign of Wildlife and Countryside Link. Blueprint is calling for the Government and its agencies to set out the necessary steps to achieve “sustainable water” by 2021.

We welcome the opportunity to respond to the National Infrastructure Commission’s (NIC) call for evidence on the National Infrastructure Assessment (NIA). We highlight the importance of building resilience into the system and ensuring that impacts on the environment are minimised. This requires careful consideration of the various options available and taking an ecosystems approach to decision making. We urge the NIC to integrate natural infrastructure, where possible, into the design of strategic infrastructure projects from the outset and promote opportunities for retrofitting natural infrastructure into existing assets. These are small but significant ways of bolstering our resilience to the challenges of climate change and population growth.

In addition to integrating natural infrastructure, there is a strong case for habitat creation and restoration to deliver our infrastructure needs. For example, managed realignment projects to protect against flooding; creation of farm ponds to reduce water demand from agriculture; and large scale urban green and blue space development, to reduce pressure on our sewerage systems. Such options also deliver other benefits including health and well-being, reduced urban heat island effect, improved water quality and enhanced biodiversity, which more traditional infrastructure lacks.

Please see our answers to specific questions below:

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

Demand management is currently underutilised within the water sector. Innovation in this area is low, and encouraging innovation could make great improvements.

Greater demand management could be driven through the development of a wide package of measures through the next Price Review (PR) process. This needs buy in from, and to be facilitated



Wildlife and Countryside Link
89 Albert Embankment
London
SE1 7TP

T: 020 7820 8600
E: enquiry@wcl.org.uk
W: www.wcl.org.uk

‘Wildlife and Countryside Link is a unique coalition of voluntary organisations concerned with the conservation and protection of wildlife and the countryside.’

Chair: Dr Hazel Norman Director: Dr Elaine King
A company limited by guarantee in England & Wales
Company No. 3889519
Registered Charity No. 1107460

by, Government and Ofwat, to encourage such measures before resorting to large supply side preferences. Packages of measures should include a combination education measures for the general public to better understand issues around water scarcity, smart metering, as well as social and environmental tariffs. Initially, we would welcome a number of in depth pilots. These pilots need to be set up and monitored for a number of years, not only 6 months. This will help inform further Price Review processes and address issues such as uncertainty. Universal metering and, in particular a wider role out of smart meters, would assist water companies in better understanding the actual scale of leakage within assets. The sustainable economic level of leakage (SELL) is not helpful in driving leakage reduction, as water companies are able to do the minimum required, rather than drive distinction.

However, it is not just water companies who are responsible for reducing water demand. Industry and the general public need to better understand that water is a finite resource and needs to be managed sustainably. It is important for all stakeholders to take responsibility for demand reduction and there are efficiencies to be made within various industries and the retail sector. Regarding the former, there is currently little incentive for efficiency, as water is inexpensive and abstraction licenses allow, in most situations, the amount that companies need. Regarding the latter, there is concern that the new competition market may in fact reduce efficiency in this sector rather than drive it, as it is likely to drive prices even lower.

Irrigated agriculture is one of the biggest users of water globally. Management practices that increase efficiency in irrigation methods can greatly increase the availability of water for other human and environmental uses. Of all sectoral water demands, climate change will affect the irrigation sector most strongly¹. It is areas in the UK with greatest risk of water scarcity, which have the greatest agricultural demand for water. To date, little has been done to incentivise demand change in agricultural water use, but there is potential for substantial savings to be made.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

It is important that in an effort to increase infrastructure (and housing) development and reduce the time taken for delivery, there should not be short cuts around quality or analysis of need and impact. Good quality infrastructure, where it is most needed and where it has been designed to minimise impact on the environment, will last longer and have greater use.

We urge caution that the checks and balances in place to ensure good quality are not weakened. It is vital that whilst ensuring efficient and prompt delivery of infrastructure, environmental safeguards remain.

¹ https://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch3s3-5-1.html



Delivering natural infrastructure

Current national and local policy does not provide clear governance arrangements around sustainable drainage systems (SuDS), whilst it promotes SuDS in large developments. Without clear direction and responsibility for delivering, adopting and maintaining SuDS leads to long discussions between developers and planning authorities around SuDS options.

In addition, Highways Authorities can have a contradictory approach to developers, and local authority proposed SuDS schemes, leading to further delay. Highways Authorities have no legal driver to adopt SuDS and have an automatic right for run-off to be released direct into water courses, regardless of quality. This conflicts with work being done to improve water quality under the Water Framework Directive by water companies, local authorities and others. If water run-off from highways was required to pass through SuDS in new development, it could help improve quality and reduce SuDS design issues and drainage in a new development. In turn, this would facilitate development and agreement over drainage systems,.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Those delivering infrastructure systems should include ecological expertise from the project outset, designing for multiple benefits, including maintenance planning. The Wildfowl & Wetlands Trust, in partnership with RSPB, have [published guidance](#) on designing SuDS for multiple benefits which can be useful for anyone working on this topic. It is not enough to assume biodiversity benefits from green infrastructure. To benefit wildlife and the environment, the type of the system, as well as how that system is designed and managed is paramount. For example, a simple sedum green roof offers less biodiversity benefit compared to those with more diverse vegetation.

The importance of protecting existing high value habitats and species should be considered for any project. Remnant natural habitat is usually more diverse than newly created habitat. There are two important factors to this: understanding where important areas for biodiversity are which shouldn't have infrastructure built on them, and retaining pre-development habitat within a development site, where possible.

Natural infrastructure should also be integrated into the design of more traditional infrastructure and retrofitted into maintenance and renovation projects. Additionally, it is important to consider whether a natural infrastructure approach could meet the objective, as opposed to hard infrastructure or using a combination of both.



Wildlife and Countryside Link
89 Albert Embankment
London
SE1 7TP

T: 020 7820 8600
E: enquiry@wcl.org.uk
W: www.wcl.org.uk

'Wildlife and Countryside Link is a unique coalition of voluntary organisations concerned with the conservation and protection of wildlife and the countryside.'

Chair: Dr Hazel Norman Director: Dr Elaine King
A company limited by guarantee in England & Wales
Company No. 3889519
Registered Charity No. 1107460

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

The Natural Capital Committee, in their third report, recommended that the National Infrastructure Plan should incorporate natural capital into each of the main infrastructure sectors, following the mitigation hierarchy for managing impacts (avoid, minimise, restore, offset). An investment programme for natural capital should also explicitly feature in the National Infrastructure Plan. Within a natural capital approach, social and environmental costs and benefits, including non-financial, are accounted for within decision making.

Natural infrastructure can offer a great value-for-money approach, if accounted for properly. The discount rate applied to cost benefit analysis must be quite low - considerably closer to zero than the Treasury’s Green Book value. A low discount rate does not simply highlight environmental impacts; it increases the relative importance of the future, compared to the present. Many large scale infrastructure projects are very long-lasting, with expected economic lifetimes spanning many decades, such as airports or nuclear power plants. It is vital that a precautionary approach is taken towards environmental harm and a low discount rate is applied to help prevent this future risk.

Reframing the question – for example, asking “What is the least-cost strategy for reducing congestion on a highway by a given amount?” rather than limiting the analysis to the status quo vs. one preferred alternative may yield a different solution². In particular, natural infrastructure options should be considered as alternatives wherever possible.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

Evidence indicates that campaigns to tackle water demand could be used to reduce the daily peak demand patterns, which reduces the pressure on network pumping energy costs during peak use times. Additionally, water companies could use demand-side strategies to also achieve efficiencies in

² Ackerman, F. (2008) Critique of Cost-Benefit Analysis, and Alternative Approaches to Decision-Making, Friends of the Earth.



the distribution of urban water (e.g. reduced energy for pumping in pressurised water system, pipe augmentation deferrals, peak energy demands)³.

However, we also pose the question, if we are looking at zero carbon, why not water efficiency as well?

22. *What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?*

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

Within the UK water is not valued appropriately. In both domestic and industry sectors water continues to be treated as a low-value and unlimited resource.

The Water UK [Water resources long-term planning framework](#) looked at the resilience of long term water supplies, concluding that significant effort and investment was needed to ensure droughts did not impact on consumers, businesses and the freshwater environment. One of the most effective tools they identified to boost resilience is rigorous demand management, through household metering.

Currently, only half of the households in the country pay for water based on the amount they use. The percentage of metered households needs to increase significantly if we are to empower consumers to control their own water bills, and incentivise water efficiency. Under current legislation, water meters cannot be introduced on a universal basis in large parts of the country, even when it is clear that these systems could go a long way to securing long term resilience of regional and national water supplies. **Water companies should be able to introduce universal metering** if, after consultation with customers through the existing Water Resources Management Plan and Business Plan processes, it is found to be the most affordable option for customers overall, as well as being the best option for water resources management and resilience. High users who would find increased bills difficult to pay could be supported using social tariffs.

The NIC is encouraged to refer to Waterwise's recent [water efficiency strategy](#) document for further ideas and case studies around demand management.

Regarding supply options, there are environmental risks to be considered on a case by case basis, which should be taken into account during decision making in order to minimise environmental risk and damage. Before large supply options are given approval, it should be clear how demand options

³ Beala, C.D., Gurung, T.R., Stewart, R.A. (2016) Demand-side management for supply-side efficiency: Modeling tailored strategies for reducing peak residential water demand, *Sustainable Production and Consumption*, 6: 1-11



and leakage reductions have been optimised and considered. One simple option would be to ensure all new houses are built to energy and water efficient standards.

To increase resilience, we should have a package of options, but we also need to ensure that cumulative supply options do not cause environmental degradation, as well as considering the merits and risks of each individual option.

There is currently no join up between water resources, waste water management and flood management. A joined up, holistic approach at a catchment scale is needed, as suggested in Q24. By slowing the flow throughout a catchment, the environment will have a greater resilience to drying out in times of low precipitation, which ultimately will slow down our lead in to drought scenarios.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

Long term waste water plans

Water companies are required to produce long term (at least 25 year) Water Resource Management Plans, to ensure that water supply systems are sufficient to meet future demand and resilient to climate change and other pressures. We believe that this process has delivered a step-change and fostered a forward looking, collaborative and innovative approach to ensure the needs of people and the environment are met in relation to water supplies. A similar process for wastewater is essential to address the outstanding and significant problem of sewage pollution in rivers and streams. The Government should require **water companies to produce, consult on and publish statutory long term wastewater management plans that secure the delivery of resilient wastewater services.**

Manage water more holistically

A more holistic approach between water supply, waste water and flood management is essential. The 2013 National Policy Statement for waste water states that demand management measures could achieve a reduction in sewer and treatment capacity required for England of greater than 1 billion litres per day⁴.

Currently, developers have an automatic right to connect new development to the sewerage system, even if that system is at capacity. As a minimum, sewerage companies should be statutory consultees in designing new developments, and the automatic right to connect should be removed. This will allow sewerage companies to have better control over sewerage capacity. Additionally, as

⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69505/pb13709-waste-water-nps.pdf



mentioned above, reducing water demand can help to alleviate pressure on the sewerage system. As such, new water efficient homes, commercial developments and infrastructure could help ensure our sewerage system is able to cope with an increasing population. Small changes to existing infrastructure and considering the role of natural infrastructure within new design can help address diffuse pollution problems, reducing pressures on the system.

A network of sustainable drainage systems

Reducing surface water run off could substantially reduce pressure on the sewerage system. SuDS should be designed into new developments from the outset. Together with a suitable retrofit programme, SuDS will provide a buffer to future challenges. SuDS need a strategic, rather than simply opportunistic, approach looking at where they could be best applied. Therefore, an opportunity mapping exercise should be undertaken in our major urban areas (at the very least). This can identify where SuDS would be best placed from a geological and surface water flood risk perspective, but also connecting them to current green space as well as joining up or creating stepping stones between habitats. How such a network of SuDS could work within a wider catchment approach, should also be investigated.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

We fully endorse this question and believe that a catchment approach to water management, integrating management of supply, waste water and flood risk, is hugely important. The question of how this could be managed is an important one.

Whilst it is widely recognised that the catchment is the ideal scale in which to undertake and integrate water management activities to achieve more for less (see Defra 2013 [Catchment Based Approach](#) or Dieter Helm, 2015, [Water Catchments](#)), it can be argued that, to date, we have failed to make it happen, and certainly to make it happen effectively. This failure has been recognised by the water sector, which has increasingly attempted to intervene on behalf of their customers, at a catchment scale, to address a range of issues such as pollution and flooding.

We recommend the following:

- **Better integration of both governance and planning around water management at a catchment scale.** Potentially through having fewer organisations responsible for water management and through less but better joined up plans at a catchment scale.
- **A stronger regulatory baseline** that is adequately enforced by regulators to tackle inappropriate and illegal activities within a catchment such as agricultural pollution.
- **Better targeting of funding so that it can, and does, deliver multiple benefits and addresses problems at source, rather than dealing with consequences.** For example, funding sources



Wildlife and Countryside Link
89 Albert Embankment
London
SE1 7TP

T: 020 7820 8600
E: enquiry@wcl.org.uk
W: www.wcl.org.uk

‘Wildlife and Countryside Link is a unique coalition of voluntary organisations concerned with the conservation and protection of wildlife and the countryside.’

Chair: Dr Hazel Norman Director: Dr Elaine King
A company limited by guarantee in England & Wales
Company No. 3889519
Registered Charity No. 1107460

and rules that preferentially promote solutions such as better land management; delivers flood attenuation water quality and biodiversity benefits at source, rather than separate funding streams that deal with consequences, including providing enhanced water treatment or ever higher flood walls.

- **Greater partnership working at a catchment scale.** Involving local communities and stakeholders in planning, decision making and delivery. Building on the existing catchment partnerships.

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

Many attendants at the recent NIC workshop on flood risk management suggested that the Government should aspire to deliver a set level of resilience to future flooding. In practice, this may be difficult to achieve without a significant shift away from current policy, which is to deliver the maximum flood benefit from a defined budget, to one where the level of resilience is defined and budget and policy are set to meet that standard. However, we welcome the shift from a sole focus on flood defence, to a broader view that recognises the importance of making communities, businesses and infrastructure more resilient to flooding.

Although it is widely recognised that universal flood defence is not attainable, there seems little recognition that not all floods are equally damaging. Indeed, many of our most important wildlife sites are associated with and thrive from regular, shallow winter floods and have been farmed for many generations. Failures to make adequate distinction between protecting homes and essential infrastructure, and investing in agricultural land drainage, can result in suboptimal decisions being made about where public investment in flood risk management should be directed. Communities are often not given the information necessary to make informed choices. There is value in understanding international projects on similar issues; such as the Netherlands [‘Room for the River’](#) programme, where farm buildings have been relocated to higher ground in recognition that fields will periodically flood. Allowing for such approaches and other natural flood management measures can help our communities buffer the effects of climate change.

We understand that river maintenance is needed in some circumstances to improve conveyance around critical pinch points, yet much discussion continues to react to a call for river maintenance. Instead there is a need for a wider debate about ensuring land use planning sufficiently manages water during and after extreme rainfall events. This principle is fundamental to the Room for the River programme in the Netherlands, as well as the [Blue Green City](#) principles in the UK. The Government will have to make difficult decisions around where to invest in defence, where to provide support in improving resilience, and where to remove or step back defences, however, natural flood management and habitat creation such as floodplain marshes and managed realignment can help increase resilience and longevity of defences.



Wildlife and Countryside Link
89 Albert Embankment
London
SE1 7TP

T: 020 7820 8600
E: enquiry@wcl.org.uk
W: www.wcl.org.uk

‘Wildlife and Countryside Link is a unique coalition of voluntary organisations concerned with the conservation and protection of wildlife and the countryside.’

Chair: Dr Hazel Norman Director: Dr Elaine King
A company limited by guarantee in England & Wales
Company No. 3889519
Registered Charity No. 1107460

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: “innovative technologies and practices” can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

The evidence for the effectiveness of natural flood management is growing and our ability to incorporate it into our approach to reduce flood risk will also increase (see <https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk-a-research-and-development-framework>).

Reconnecting rivers with their floodplains, new washlands and coastal habitats, stepping back embankments and incorporating green and blue infrastructure in urban areas to take flood water are all forms of natural flood management. However, we know that these methods work and they will be critical in order to avoid the worst impacts of future floods.

There is a growing body of evidence that upstream measures can be very effective at preventing flooding. However this effect depends on a complex array of factors, including the size of the catchment, topography, geology, soil type and critically, the duration and magnitude of the rainfall event. Specific interventions, such as installing in-stream features to stretch the storm hydrograph and reduce its peak, must be carried out in the right place and in sufficient quantity, if they are to be effective. These schemes will prove invaluable in certain catchments, when sufficient thought can be put to design, location and maintenance. Inclusion of such measures in agri-environment schemes would need to be strategically targeted to be effective and would need to be designed to deliver biodiversity benefits to ensure flood management does not come at a cost to the environment.

Significant gains could be delivered by preventing damaging practice and recognising the role of land use change in slowing flows into streams and rivers. The creation of new native woodland and scrub, the restoration of blanket bogs and rivers and creating salt marsh and mudflats through managed realignment can contribute to flood management objectives alongside restoring biodiversity, sequestering carbon and improving water quality. As they deliver a wide range of benefits, there are many organisations and landowners interested in contributing towards building a shared evidence base, delivering projects and supporting ongoing costs.

Additionally, more could be accomplished by removing perverse incentives which result in increased flood risk through damaging land management. Measures to conserve our soils, such as prohibiting the growth of high risk crops such as maize on vulnerable slopes, maintaining broad hedgerows and buffer strips, could contribute to reducing flood risk, slowing the rate at which water flows off of hillsides and preventing the silting up of watercourses.



Wildlife and Countryside Link
89 Albert Embankment
London
SE1 7TP

T: 020 7820 8600
E: enquiry@wcl.org.uk
W: www.wcl.org.uk

‘Wildlife and Countryside Link is a unique coalition of voluntary organisations concerned with the conservation and protection of wildlife and the countryside.’

Chair: Dr Hazel Norman Director: Dr Elaine King
A company limited by guarantee in England & Wales
Company No. 3889519
Registered Charity No. 1107460

We consider the best outcomes will arise from a catchment approach to considering flood risk and using a combined suite of measures. These should include but not restricted to: upstream measures (designed to 'slow the flow' of water), downstream measures, (designed to make 'room for the river' and increase capacity to store flood water), coastal measures such as managed realignment where appropriate, together with measures in the urban environment such as SuDS and other green and blue infrastructure, traditional hard defences where necessary and improved land management.

This response is supported by the following organisations:

- Amphibian and Reptile Conservation
- Angling Trust
- RSPB
- Salmon and Trout Conservation
- Wildfowl & Wetlands Trust
- Woodland Trust



Wildlife and Countryside Link
89 Albert Embankment
London
SE1 7TP

T: 020 7820 8600
E: enquiry@wcl.org.uk
W: www.wcl.org.uk

'Wildlife and Countryside Link is a unique coalition of voluntary organisations concerned with the conservation and protection of wildlife and the countryside.'

Chair: Dr Hazel Norman Director: Dr Elaine King
A company limited by guarantee in England & Wales
Company No. 3889519
Registered Charity No. 1107460

National Infrastructure Assessment / call for evidence.

4. QUESTIONS

Water and wastewater (drainage and sewerage):

22) What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Submissions of evidence should be no longer than 20 sides of A4 paper and should be emailed to NIAEvidence@nic.gsi.gov.uk. 5.3

Please provide submissions and evidence by Friday 10 February 2017.

Addressing the difference between supply and demand for (drinking) water.

Reading reports from the water industry it appears they are more interested in big schemes to increase the water supply. For example new reservoirs, or a national water grid.

The other side is to look at reducing demand. This is unpopular within the water industry as, on metered properties, which is being encouraged, it will result in reducing income. Although Ofwat has offered to compensate water companies for loss of income from water efficiency measures, it is highly likely that reducing domestic consumption will, eventually, result in a loss of income for the water companies.

An easy way to reduce demand is to use rainwater harvesting. At the moment water companies collect water from aquifers, rivers and reservoirs, which they then filter and add chemicals to, to ensure that it is high quality drinking water. Then they pump it back to our homes where 30% is flushed down the toilet. Some is used to water the garden or wash the car!

How about we collect the rainwater that falls on the roof of our homes, collect it, filter it, store it and then flush it down the toilet? This could save up to 30% of domestic drinking water consumption.

Adding a water butt with a pump (solar powered) could save an extra 7% by using rainwater to water the garden and wash the car.

One water company says it does not consider rainwater harvesting as a viable resource as "it doesn't work in a drought". Neither will their system as they will install standpipes. Rainwater harvesting will reduce droughts, by leaving more water in reservoirs and aquifers.

Managing the water that falls on the roof of houses will happen, the only question is when?

The technology, using solar power, is already available. It is easy to store 2,000 litres of rainwater domestically for non-potable use.

This would add to the SuDS sustainable drainage systems as the storage could be emptied some time in advance of a major rain event, either locally, by the home occupier, or remotely by the water company, to enable the 2,000 litre storage to be refilled by the first downpour of a large rainfall event. Home owners could have an “app” which had details of their stored rainwater.

This would help reduce flooding as part of a local SuDS system.

The tools to reduce the domestic consumption of drinking water is available now. See www.flushrain.co.uk

Water companies must be encouraged by tax relief and investment allowances to bear the cost with only small, less than 1%, increases in charges to customers.



National Infrastructure Planning Association

National Infrastructure Assessment: Call for Evidence

NIPA: National Infrastructure Planning Association

1. The National Infrastructure Planning Association (NIPA) was launched in November 2010 with the aim of bringing together individuals and organisations involved in the planning and authorisation of major infrastructure projects. Our principal focus is the planning and authorisation regime for nationally significant infrastructure projects introduced by the Planning Act 2008.
2. NIPA was created to develop and disseminate learning and best practice for both promoters and those affected by proposed projects. Our membership of around 500 provides a forum for those with an interest in the planning and authorisation of national infrastructure projects in the UK, particularly those brought forward within the framework of the Planning Act 2008. In summary, we:
 - advocate and promote an effective, accountable, efficient, fair and inclusive system for the planning and authorisation of national infrastructure projects and act as a single voice for those involved in national infrastructure planning and authorisation;
 - participate in debate on the practice and future of national infrastructure planning and act as a consultee on proposed changes to national infrastructure planning and authorisation regimes and other relevant consultations; and
 - improve knowledge, skills, understanding and engagement and so provide learning and education opportunities on national infrastructure planning, develop, share and champion best practice in national infrastructure planning.
3. The efficiency of delivering projects through the planning process, and the effectiveness of subsequent project delivery is therefore of particular interest to NIPA. Our response only deals with question 10, as that is the only one about the planning process.

Response to Question 10: *What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?*

NIPA Insights Research Project

4. In February 2016, discussion amongst NIPA Members indicated that there was a concern amongst many stakeholders in the Planning Act regime about:
 - the level of detail which some major infrastructure projects were being asked to assess and then be scrutinised against at examination, as well as
 - the limits on flexibility in the specification for some major infrastructure projects within the resulting Development Consent Order.
5. As a result, NIPA prepared a brief for a research project to look at these issues, and instructed UCL Bartlett School of Planning as the research team. The title of the research study which was launched in August 2016 was: **Does the Planning Act process deliver the certainty and flexibility necessary to attract investment, permit innovation during the design and construction process, and support cost effective infrastructure delivery – whilst providing appropriate protection for affected landowners and communities?**

6. **Context:** The context for the study is the creation of the Planning Act Regime in 2008. This was a reaction to the long and tortuous processes for consenting major infrastructure projects, epitomised by the Heathrow Terminal 5 Public Inquiry. The Planning Act created a regime for the examination and approval of major infrastructure projects, with a system of National Policy Statements providing national policy backing for the need case, and strict timescales for the examination and determination of each project.
7. The primary trade off required to achieve this time bound process relates to the pre-application process, and the need to ensure that the proposal being put forward for acceptance was complete and unlikely to need to change during the examination and determination processes. This requirement has led to a significant increase in pre-application timescales and costs.
8. The regime has been amended and updated several times over the intervening years, but the essential structure of the process has remained intact. There has been some recognition that some changes are inevitably necessary during the examination process in more recent changes to the regime, and this has been facilitated by the transition of oversight for the regime from the independent Infrastructure Planning Commission, to the Planning Inspectorate with the final decision being made by the relevant Secretary of State.
9. However, there is a perception amongst many stakeholders that the level of detail which is required during the preparation of the application, and which is required to be scrutinised during the decision-making process, has continued to increase. Many participants in the DCO process have highlighted this as an issue of concern, for a range of reasons, for example:
 - The sheer cost of preparing a detailed design for a scheme before it secures an in-principle consent;
 - Highly complex, technically dense and long documents being prepared which are costly, and impenetrable by the lay person wishing to engage with the process;
 - A focus on detail at examination which does little to improve the quality of decision making, or in the event of a consent, the quality of the resulting project;
 - Highly constrained requirements and S106 obligations tend to over complicate the process of discharge of requirements/ obligations for both promoter and regulator; and
 - Over specified projects tend to restrict innovation and technological development during the design and construction process, limiting future opportunities for reducing costs, and improving environmental and community protection in the final project.
10. **The Project:** The membership of NIPA is drawn from a wide spectrum of stakeholders in the DCO process, but is very aware that the views expressed above may not represent those of the wider stakeholder group. The NIPA Insights Research project therefore set out to take an academic-led research approach with the following objectives:
 - To collate evidence and industry views about the **issues** – identified as being the level of detail required in assessment, application, examination and consent of/for national infrastructure projects; versus the **impacts** - of current practice on the quality of the process for all stakeholders, the impact of current practice on the quality of decision-making, and on the quality of resultant schemes, including their delivery.

- To objectively identify the principal issues and impacts based on evidence and industry views, based on a strong cross industry conversation about this issue;
 - To identify practical recommendations which can support a move towards an optimum balance between detail, flexibility, process, decision-making and project outcomes for the planning and authorisation of national infrastructure projects;
11. The issues of detail vs flexibility in the planning and authorisation of national infrastructure projects are relevant to many of the existing authorisation procedures in the UK. However, for the purposes of this piece of work, the focus is on the planning and authorisation of national infrastructure projects through the Planning Act process.
12. **Approach:** The approach adopted to NIPA's research has been as follows:
- **Stage 1A:** Desktop review of the issues to determine current policy and practice. Issues to include level of detail in EIA and DCO application generally, examination practice, and in the DCO itself; and impacts for the project in terms of flexibility, scope for innovation, cost, construction and operational effects.
 - **Stage 1B:** Consultation with stakeholders based on an interview and focus group pro forma approach, to determine their experiences and consequences for projects of which they have experience. Stakeholders included Government Departments, Promoters, Advisers, Contractors, Local Authorities, Statutory Consultees, and Community Representatives.
 - **Preliminary Report** on the principal issues and impacts, (eg social & economic effects, skills and capacity within each stakeholder group, as well as risk, cost and programme for project outcomes), arising from the desktop review and stakeholder consultation. Consideration was also given to any differences between industry sectors within the scope of Nationally Significant Infrastructure Projects as defined in the Planning Act, including commercial and business schemes.
 - **Stage 2:** Engagement with stakeholders about the findings of the Preliminary Report, including the principal issues and impacts identified and preliminary recommendations. This will include meetings with Statutory Consultees, Promoters, Practitioners and with DCLG and PINS explore opportunities and constraints to future changes in policy or practice, and potential changes which could lead to a more optimal balance between detail, flexibility and project outcomes.
 - **Final Report** to summarise evidence to investigate and inform principal issues and impacts identified, summarise stakeholder views following consultation, and identify recommendations aimed at achieving an optimum balance between detail, flexibility, process, decision-making and project outcomes.
13. **The study has now reached the halfway point, with the production of the Preliminary Report. This response provides a summary of the preliminary findings and recommendations.**

Preliminary Findings

14. As this study has progressed, responses from stakeholders have suggested that the critical focus of this work should be to identify ways in which the Planning Act process, on which the delivery of much national infrastructure will depend, can produce projects **which optimise the balance between detail and flexibility so as to define major infrastructure projects that can be delivered cost effectively and efficiently**, whilst continuing to meet their social, environmental and economic objectives, and protect the interests of interested stakeholders and communities.
15. The study has found that most participants in the Planning Act process believe that it is generally operating effectively, and that the incremental improvements made to the process over the years have been beneficial. However, the study has also uncovered a range of evidence about unnecessary detail being considered during the planning stages of projects, and about project flexibility being constrained through Development Consent Orders, both leading to inefficiencies and additional cost in delivering major infrastructure projects.
16. **Detail of Assessment:** There seem to be a wide range of reasons for detail being assessed and specified too early during the Planning Act process, and that this is driven by a range of different actors involved, including promoters, local communities, local authorities, statutory consultees, and examining authorities. Our research suggests that some of the drivers of detail include:
 - perceptions and requirements of environmental regulation and requirements for assessment;
 - provision for the rights of affected landowners through the process of compulsory purchase;
 - a desire amongst local stakeholders, communities and statutory consultees to understand more about the impacts of the proposed scheme or its construction; and
 - a risk averse approach by promoters, their advisors and examining authorities to increase the robustness of consents, often as a result of risk of Judicial Review.
17. Conversely, there is also evidence that there are circumstances when detail of assessment and consent are perfectly reasonable, particularly when there are particularly constrained sites, or issues of important environmental sensitivity.
18. **Flexibility of Consent:** There is also a wide range of reasons why flexibility appears to be constrained within Development Consent Orders, including:
 - A perceived need to understand the nature of a scheme to provide greater certainty to local communities about the design and future operation of a scheme;
 - A perceived need to understand the impacts of a scheme to ensure that local communities, local authorities, and statutory consultees understand the nature of the mitigation requirements;
 - a lack of confidence from local communities, local authorities and statutory consultees about the processes that will follow to refine the detail during the implementation process;
 - a lack of knowledge about the construction techniques available, particularly amongst those stakeholders who are not regularly engaged in the process; and

- a perceived need to tie down compulsory purchase requirements, and therefore provide greater certainty for land owners.
19. However, the need for greater flexibility in project design and consent arises for a range of different reasons, and this is dependent on project type, sector, and location, for example to:
- provide for future changes that might take place because of uncertainty about future construction methodology;
 - allow for alternative scheme options that might be required by regulators, project funders or investors;
 - to accommodate potential technological change over very long delivery periods; and
 - to avoid time-consuming and expensive post consent changes to Development Consent Orders.
20. Conversely, some projects are achieving a good level of flexibility in their Development Consent Orders, and there is evidence that this can also lead to better outcomes for landowners, local authorities, local communities, statutory consultees and the environment. The attainment of this flexibility does – reasonably – require greater detail to be assessed in order to be able to define a wider envelope in which the project can be progressed, but this seems to be an accepted consequence of seeking greater flexibility for project delivery.
21. There is, however, a risk that too much flexibility can make schemes harder to assess, and provide mitigation for, as well as creating a risk of slowing down implementation because of the complexity of providing the level of flexibility sought, and delivering it through project development and discharge of requirements. A balance therefore has to be sought.

Towards Some Preliminary Recommendations

22. As discussed above, this study suggests that there are reasonable reasons for seeking flexibility in Development Consent Orders, and that it is reasonable for this to be justified and judged on a ‘case by case’ basis, with an appropriate level of detail being required to test a range of potential options and identify the reasonable worst case. Evidence suggests that this is well understood and accepted by some, and that this is necessary to ensure that the needs of efficient and effective project delivery is balanced against the need to protect the interests of landowners, communities and the environment.
23. However, the risk of Judicial Review and the need for certainty is a key driver for many, and the criticality of achieving a consent often creates perverse incentives in the system. **Achieving a Development Consent has therefore, for many, become an end in itself, and this can reduce the focus on what is needed to deliver the project effectively.** This is not good for efficient and effective project delivery.
24. The wide range of evidence considered in this study so far suggests that there is no ‘one size fits all’ solution to this issue. However, there seems to be an opportunity to refocus the planning process to include greater consideration of deliverability issues, and the flexibility and detail required to deliver this through into the project delivery phase.
25. The preliminary recommendations therefore seek to put the Planning Act process in the wider context of project delivery by establishing **a greater focus on the need for project delivery all the**

way through the planning, design, engagement and consenting processes. A range of small changes in process or behaviour, by all actors in the regime, are proposed. Together, these changes are aimed at increasing the confidence in creating project flexibility through the Development Consent, and that this can take place satisfactorily alongside the need to project the interests of stakeholders. Four broad areas for recommendations have been identified.

26. **Legislation, Policy and Guidance:** There would appear to be an opportunity to address the issues of detail, flexibility and deliverability in the drafting of National Policy Statements. Many of the current NPSs are approaching the time at which they will need to be updated, and this could be addressed through this process, perhaps with the National Infrastructure Commission taking a role of providing evidence about any particular sectoral requirements.
27. There is also the potential to address these issues more cohesively through guidance. The issues of detail, flexibility and deliverability are dealt with patchily across current DCLG Guidance and PINS Advice Notes, and there may be benefit of drawing this together into one place to establish greater focus on these issues through the DCO process.
28. There have been many consultees to this work who have suggested that the current process for non-material amendments could usefully have a statutory timescale. Current experience suggests that there is a risk that this process can take a long time, and be very costly in terms of delays during the design and delivery process, and this creates a perverse incentive in the system to avoid the process altogether, and accept avoidable cost increases on the project. A more user friendly resolution to non-material amendments would, it is suggested, avoid this.
29. **The DCO Application, Examination and Consent:** Often, the issue is seen as being about how to create an appropriate level of flexibility in the Development Consent Order. However, there are a number of examples of flexibility being provided within an Order; of greater relevance therefore are the stages of the process leading up to the approval of the Order which have a defining influence on how it is drafted, and the process thereafter leading towards implementation. It is therefore important that any recommendations flowing from this work considers all aspects of the process of the planning process.
30. A point often raised is the extensive nature of application documentation, covering a range of assessments and evidence of engagement. This study suggests that it is hard to get away from this because of the large scale and complex nature of many of the projects, although there is no doubt scope for clearer, more consider reporting and accessibility to be provided. Our research supports the view that many of the tools and techniques required to deliver more cost effective, deliverable major infrastructure projects are already available, but that these are not employed consistently across the industry.
31. The question raised therefore is whether or not the engagement, assessment and examination of projects can address these issues more directly, demonstrating how the need for flexibility and detail has been resolved through engagement, design development and assessment of the project, addressing the need for effective and efficient delivery, as well as protection of the interests of local communities and the environment.
32. Where the need for resolution of detail is not required at the DCO stage, and it is possible to make provision for decisions to be taken at later project stages, the study finds that there is a differing range of practice in the drafting of DCOs. The study has identified that it is possible for provision to be reasonably made through discharge of requirements to resolve matters of detail, **and** for this to be good for project promoters, local authorities, land owners and affected communities alike.

Greater consistency and awareness of alternative mechanisms to achieve this, and the benefits this can lead to, is considered necessary.

Project Management and Delivery

33. There is evidence that the priorities of promoters to achieve robust consents leads to contract arrangements for promoters' teams to be incentivised on attainment of the consent, and not on the cost effectiveness or deliverability of the resulting scheme. This seems to encourage a risk averse culture which tends towards detail and limited flexibility. Consideration might be given to alternative arrangements.
34. The study suggests that there is potential to improve deliverability and constructability by appointing a project manager/ management team which oversees the project through planning and delivery, and in particular through the handover period between consent and construction contracts. This would improve the transfer of information about what is proposed in terms of flexibility, and why, to the design and construction team – who are otherwise on a steep learning curve at the beginning of the delivery process.
35. The study also suggests that the engagement of construction partners or advice in the early planning and design development stages of projects would better inform their requirements for flexibility and reduce requests for detail further into the process.

Training and Dissemination

36. Regular promoters in the system are now clearly learning lessons about how to improve project flexibility and deliverability through the Planning Act process, however, the evidence suggests that those who are less regularly exposed to the system are not benefiting from the lesson learned. A process of dissemination, beyond the high level information available through conferences and the like, particularly targeted at key sections of the stakeholder group, would seem to be a sensible idea.
37. In particular, greater dissemination of case studies which show both the methods to deliver greater flexibility, and the potential for benefits to accrue to promoters, consultees and affected communities would help to increase confidence in the use of requirements which allow further detail to be agreed at later stages of projects, when more information is available about design, construction process, and technology. This suggests that there is a need for more rigorous post project monitoring and evaluation.

Preliminary Recommendations

38. The preliminary recommendations of this study are described above. Our next steps are to test these recommendations with stakeholders more fully to make an assessment of their potential feasibility and usefulness in terms of improving project delivery. This will lead to a series of final recommendations, and a proposed action plan setting out how it is proposed to take them forward.
39. NIPA would be very keen to engage with the National Infrastructure Commission during the completion of this work, as it seems very likely that it will provide many useful suggestions which answer the question it has asked. The final report will be provided in due course.

- network infrastructure can be designed, planned and delivered to create better places to live and work by minimising the impact through effective collaboration of works, and where appropriate, providing upfront funding to facilitate early installation of utility corridors.
- **Superfast Broadband** – Multi-billion pound investment programmes are being undertaken to deliver Government's commitment to provide superfast broadband coverage to 95% of the UK by the end of this year.
 - **Low Carbon Vehicles / Electrification of Cars (Question 21)** – Delivering the Government's objectives for electrification of vehicles requires multiple charging points and will also require reinforcement of electricity networks to meet additional demand.
 - **Low Carbon Heat** – The Government's Renewable Heat Incentive (RHI) is designed to decarbonise heat by encouraging the installation of air / ground source heat pumps and other renewable technologies for existing homes. Whilst the uptake of these technologies is currently small, it is growing steadily, and if Government decide to extend the RHI post 2020, uptake could increase quickly, resulting in increased street works. Additionally, should the Government choose to incentivise the electrification of heat (currently only 7% of UK homes use electric heating), then this would require additional capacity and upgrades to electricity network infrastructure.

NJUG welcomes the Commission's recognition of some of the cross-cutting issues that could affect the cost and delivery of the UK's infrastructure needs, and would particularly highlight:

- **Alignment of Funding Cycles (Question 7)** – Currently, local authorities are subject to annual funding rounds for their road investment planning, whereas utilities' investment programmes are typically agreed with their economic regulators for 5-8 year periods. Local authorities have all the necessary powers to manage utility street works effectively, however **closer alignment of local authority and utility funding cycles would enable greater long-term co-ordination of works, benefitting the UK and local economies.**
- **Earlier Sight of Planned Major Development / Infrastructure (Questions 9 and 10)** – To ensure efficient delivery of utility services or their diversion, early engagement with utilities is vital. Currently, there is no requirement to consult with utilities until a major infrastructure project or housing developer wishes to request a price for diversion or connection, often near the end of a development.
- However, NJUG's experience shows that there are significant benefits to be gained from **early consultation with utilities by primary infrastructure or housing developers** – providing greater opportunity to design diversions or connections and co-ordinate works in advance, leading to reduced delays and costs and avoiding excavating newly laid or resurfaced roads, thereby reducing disruption to the surrounding community.
- **Clarity** – It is also imperative that major infrastructure or housing developers provide accurate information on the design of their project (route / utility requirements etc.) This to enables accurate estimates and designs to be provided, so as to reduce delays and costs.
- **Increasing Capacity** – Housing, commercial and transport infrastructure growth will lead to increased demand for electricity, gas, water and communications. As well as street works in the immediate vicinity, increasing the capacity in utility networks can often lead to remote reinforcement away from a main development, and so early consultation with utilities at planning application or consent stage is vital.
- **Resources and Skills** – The street works sector is already struggling to recruit sufficient experienced and qualified operatives and supervisors who can undertake safe and high quality street works. As the scale of infrastructure construction rises this will only increase.
- **Minimising Road Occupation** – In the context of more people², more traffic³, more housing and infrastructure building, and increasing road maintenance and utility network investment,

² The Office for National Statistics' central population projection is of 77.5 million people in 2050. Source: 'The impact of population change and demography on future infrastructure demand', National Infrastructure Commission, December 2016.

³ The Department for Transport estimate that traffic will increase by 43% between 2010 and 2040. Source: Road Transport Forecasts 2013. Available here: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/212474/road-transport-forecasts-2013.pdf

National Joint Utilities Group
4th Floor
69 Wilson Street
London EC2A 2BB
info@njug.org.uk
www.njug.org.uk
020 3397 3315

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London EC3M 8UD

Sent by email: NIAEvidence@nic.gsi.gov.uk

6th February 2017

Dear Sir / Madam

NJUG Response to the National Infrastructure Assessment Call for Evidence

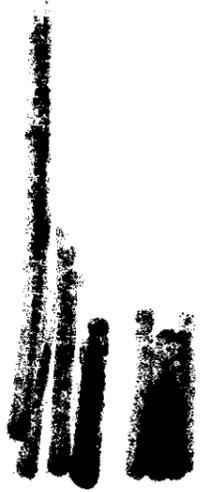
The National Joint Utilities Group Ltd. is the UK's only cross-sector trade association focusing solely on road and street works matters, covering gas, electricity, water, sewage and communications. NJUG represents 56 utility companies and contractors, and 18 specialist sub-contractors who provide equipment, materials and services supporting street works activities. Together they make a major contribution to the delivery of the Government's recently published Industrial Strategy, through multi-billion utility investment programmes to deliver safe, secure and reliable utility services that underpin the UK and local economies.

Whilst we recognise that the current scope of the National Infrastructure Assessment (NIA) does not specifically focus on the delivery of utility network infrastructure investment, much of which involves street works, we wanted to emphasise the role of street works in supporting and facilitating Government's objectives, and the interdependencies between delivery of the infrastructure included within the NIA scope, and utility infrastructure investment.

The Commission recognises some of these interdependencies in its response to the NIA Process and Methodology Consultation Response, but it is important to highlight the sheer scale of street works¹ necessary to deliver the UK's wider infrastructure needs, including:

- **Diversion of apparatus and supply of utility services for major infrastructure** - Connecting or diverting pipes, cables and ducts to facilitate the delivery of major transport and urban regeneration projects e.g. Crossrail; HS2 etc., and providing gas, electricity, water and communications supplies during construction and ongoing operation.
- **Commercial Development and Housing Growth (Question 3)** – We are pleased that the Commission has confirmed its intention to consider the interactions between infrastructure and housing in the context of the Government's commitment to substantial housing growth. This, alongside significant commercial development, will require connection of new utility services and some reinforcement of networks to provide additional capacity. The Ebbsfleet Garden City and Heineken Project examples listed below show positive ways of how utility

¹ In 2014/15 the number of street works in England and Wales was 1.37m and the cost of undertaking those works in the street was £1.6 billion – PA Consulting Delivering a Step Change in NJUG Information Independent Report



yet little increase in the capacity of local roads, if the UK is to avoid becoming gridlocked, **it is vital that everyone works together to minimise road occupation through innovation and even greater collaboration of works.**

- There are many ways to improve the efficiency of undertaking road and street works to deliver the key services / infrastructure that underpin the UK economy. NJUG and our members are:
 - Promoting innovative techniques and materials including Roadmender⁴, the Street Works Compliance Mobile App⁵, Coring and Vacuum techniques⁶, National Grid's keyhole technology⁷ and Southern Gas Networks' remote control robot^{8,1}
 - Collaborating street works to reduce the duration of works – including the Bristol Code of Conduct⁹ and London Communal Entry Chambers Initiative¹⁰ amongst others.
 - Working with Staffordshire County Council and Future Cities Catapult to support the Heineken Project, which includes a street works hub where utility and authority staff can co-locate to jointly plan street and road works. Future Cities Catapult are also producing an economic white paper identifying key benefits of collaborative works and barriers and potential solutions to their delivery.
 - Working with the Infrastructure and Projects Authority and the Ebbfleet Development Corporation to deliver efficient utility services across the Ebbfleet Garden City, via utility corridors and effective forward planning. This innovative project has included the forward funding of core utility infrastructure corridors to enable co-ordinated installation of key utility apparatus prior to developers being able to ask for connections for individual developments, thus reducing the time and costs of works. We hope that such an approach will be mirrored for the recently announced new Government-backed garden cities.
- **Future of Street Works Strategy** – In addition, NJUG will this year launch the 'Future of Street Works Strategy' which will bring together a broad range of stakeholders and interest groups to comprehensively examine the future of street works and provide the Government with a future vision of the sector, as well as suggested policy measures that the Government could enact to benefit to the industry and wider society as a whole.
- **Policy Stability** – For NJUG and our members to contribute to the right solutions for the UK's economy and communities through the above initiatives and more, **a period of policy stability is necessary to enable a continued focus on driving up standards and minimising road occupation through even greater collaboration and innovation.**

NJUG appreciates the opportunity to respond to this Call for Evidence and would welcome the opportunity to meet with the Commission to discuss the above points further.

Yours faithfully





⁴ NJUG Case Study on Roadmender, Winner of the 2015 NJUG Innovation Award: <http://www.njug.org.uk/wp-content/uploads/CASE-STUDY-NUMBER-86-Roadmender1.pdf>

⁵ NJUG Case Study on the Street Works Compliance Mobile App, Winner of the 2014 NJUG Innovation Award: <http://www.njug.org.uk/wp-content/uploads/CASE-STUDY-79-Army-United-Utilities-Innovation-Award.pdf>

⁶ NJUG Case Study on Coring and Vacuuming Excavation Techniques: http://www.njug.org.uk/wp-content/uploads/2_Coring_Vacuuming.pdf

⁷ Further details available here: <http://nationalgridconnecting.com/national-grids-gas-distribution-innovation-team-cited-as-game-changer-in-utility-week-magazine/>

⁸ Further details available here: <https://www.sgn.co.uk/innovation-NJA/Innovation-NJA-Repair-Projects/>

⁹ NJUG Case Study on the Bristol Code of Conduct, Winner of the 2014 NJUG Minimise Disruption Award: <http://www.njug.org.uk/wp-content/uploads/CASE-STUDY-76-Bristol-Code-of-Conduct-2014-Minimise-Disruption-Award-Miner.pdf>

¹⁰ NJUG Case Study on the London Communal Entry Chambers Initiative, Winner of the 2013 NJUG Minimise Disruption Award: <http://www.njug.org.uk/wp-content/uploads/CASE-STUDY-71-City-of-London-Corporation-Communal-Entry-Chambers-Early-Installation-Initiative.pdf>

& UHDWLYH 'LJLWDO LV RQH RI 1RUIRWN, Norfolk, Norwich, Great Yarmouth, King's Lynn, Cromwell, Dereham, Thetford, Wells, and other towns in the county.

support and enable the digital economy in rural areas? Companies in Norfolk are at forefront of developing new technologies and need the required ICT infrastructure to carry on their work and to attract new business. A similar situation exists for our financial/professional services. Norfolk has a strong manufacturing sector and investment in ICT infrastructure for roads would improve the movement of goods.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

More national research is required on how to improve efficiencies and reduce the cost to maintain infrastructure. Maintenance/operational costs should also be factored into business cases so this element of cost can be planned for. The government should investigate sources of funding for maintenance costs, ways to reduce maintenance costs and ways to increase investment in new assets.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Infrastructure needs to be funded and in place upfront to release housing and ultimately create better communities. Norfolk County Council has paid for the delivery of infrastructure upfront at one of our largest housing site in Thetford and will recoup the costs from the developer. The Government needs to ensure mechanisms are in place for this front loading of infrastructure so the public sector can confidently invest in infrastructure to unlock growth. Utilities companies should be required to collaborate with local planning authorities to ensure infrastructure is provided in an efficient way. There should be longer term strategic planning for utilities such as the power that will be generated by the offshore wind farms in Norfolk and suppliers should be encouraged to collaborate for the most efficient provision of infrastructure. The government should encourage more innovative solutions that are not so capital intensive and the private sector should be given more opportunities/capacity to problem-solve.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The current system is not efficient and a long term funding stream needs to be provided to give certainty to borrowing which would provide local authorities confidence to invest.

8. Are there circumstances where projects that can be funded will not be financed?

Land banking is a problem for Norfolk where land has been bought at peak values leading to viability issues for development and infrastructure investment decreases as a result. The marketplace in Norfolk is different to much of the southeast and the private sector needs to be made accountable for the upfront investment to support growth.

Land in Norfolk for development schemes should be seen as a long term investment with any increase in value spread overtime as opposed to one upfront sum, having to pay this large upfront sum can lead to viability issues. I I W K H F X U U H Q W P D U N H W Z R U N H C any need for interventions.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Once a planning permission is approved this is not the end of the planning system's role as there are often post-approval infrastructure issues for new development. Government needs to facilitate infrastructure provision by identifying infrastructure gaps or blockages and provide mechanisms to overcome these issues.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Infrastructure should use natural processes and offer a multifunctional approach to help meet infrastructure and wider social needs. E.g. grey water re-use and SUDS for black water cleansing. SUDS can aesthetically and ecologically improve the environment, providing greenspaces for the public to enjoy, responding to the health agenda.

Access to the countryside and green corridors for movement of fauna should be considered in transport infrastructure projects. These considerations will ensure the robustness of our environment and allow people to access the wider countryside more easily, offering wider health and well-being benefits.

Growth should contribute to the local green infrastructure network and be designed to integrate and enhance the commute and recreational pedestrian / cycle network. Ecological corridors should not necessarily be treated as a separate entity, with mitigation, integration and enhancements to the network on and off-site being provided as integral parts of any project to deliver net gains for biodiversity; responding to the NPPF, climate change and emissions targets to contribute to a healthier environment and lifestyles.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

The appraisal does not allow one to easily factor-in wider economic benefits likely to arise from the intervention, such as GVA uplift, or (acceleration of) housing and jobs growth. Increasingly transport schemes are being developed and delivered to bring forward the economic growth rather than deliver transport benefits per se. The appraisal and the calculation of benefit to cost ratio needs to be able to take account of this.

Current appraisal of transport schemes places undue emphasis on the value of small time savings. At present time savings insignificant to users can be valued very highly in the appraisal where there are significant numbers of users who would have a time saving.

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

The New Anglia Local Transport Board is working on a transport strategy for Norfolk and Suffolk; the New Anglia area. This is developing a range of future economic scenarios looking 30-40 years hence. For each scenario the work will set out how transport systems should evolve, be innovatively developed, or change organically, to reflect the different ways that economic activity might be carried out in the future; and how transport might best support the desired economic scenarios. The work to date has identified that there are a number of drivers of change in travel patterns including: changes in the way that the

economy works; demographic and social change; and technological change. These can be influenced by policy directives or legislation.

In New Anglia the Strategic Economic Plan identifies a number of economic sectors. The work on the transport strategy is examining likely future changes in travel patterns arising from major changes within the economic sectors; or to support development of the sectors. Although this work has yet to be completed some changes, and their drivers, arising from this and the other drivers listed above might be:

- x Reduction of numbers of people working in offices: due to technology allowing for more dispersed / home working; cost of maintaining the office space;
- x On-demand production or delivery: 3D at-home printing allowing people to avoid trips to shops for basic items; items not being held bulk in-store or warehouses, but produced / manufactured as and when they are demanded (e.g. books being printed and dispatched as a result of an order); a growing expectation from consumers that items will be delivered next-day
- x Logistics sector, first and last-mile changes: Imported goods no longer being delivered to distribution centres, but instead sorted at dockside and dispatched directly to local stores;
- x Demographic change: Society is generally ageing. Evidence shows that older people make fewer journeys. These journeys are also likely to be outside of the times of peak travel demand. Evidence is also showing that fewer young people are learning to drive. If there continues to be a concentration within urban centres such patterns might become increasingly strong. Also, the model of car ownership and travel consumption generally is changing. People are increasingly moving towards the need it whether this be at different times of the day there will be a shift in the travel patterns

Technological change in transport will also affect travel directly, including:

- x Increasing use of automation in vehicles, ultimately leading to autonomous vehicles
- x Advances in fuel technology

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

It is likely that urban centres would benefit most from high capacity public transport systems, most likely tram, metro or rail systems. It is vital that these local systems connect not only the high value, economically strategic employment sites, but also to major transport hubs in the centres, typified by national rail stations or international airports, as well as to the residential and retail areas. However, high value economic returns are most likely through connecting the business districts together either locally or via the national and international networks.

Norfolk recognises that investment in transport infrastructure outside of our boundary can unlock growth for the county; this is particularly relevant for Ely North Junction where a major enhancement of rail infrastructure is essential. Ely is a major constraint for Norfolk in terms of passenger service connections to London, Cambridge, Stansted Airport and beyond and for freight services out of Felixstowe Port. Improvement in the Ely area will allow additional frequency passenger trains and additional freight movements.

Work within Norfolk indicates that –especially given the planned levels of growth –Norwich has a population that could support a tram system; and such a system could add significant added value to the UK economy by boosting employment sites and opportunities in the county, and –if it were connected to Norwich International Airport –significantly add to the value of a regional airport with international connections as well as one that serves the Great Yarmouth, are probably not sufficiently large enough to support tram systems. Both however would benefit from investment into the heavy rail network so that more frequent services and better quality services could be provided.

Within Great Yarmouth the county council has received investment from government to progress work on the Great Yarmouth Third River Crossing. This lifting bridge would connect the South Denes Enterprise Zone and the port to the trunk road network and significantly improve connections to the southern tip of the Great Yarmouth peninsula, reducing traffic through the town centre. Major, high-value investments such as this require government support where the business case can demonstrate economic benefits (jobs growth, productivity, etc. « Well as transport benefits.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Investment into the heavy rail network, and the strategic (trunk) and major local road network are required. Heavy rail needs to provide fast, frequent and reliable services that have the capacity to accommodate the demands from users. Services need to be –at the minimum – every half hour, even on the services connecting the smaller market towns.

The strategic road network needs to be complete dual carriageway with grade separation. Smart networks need to be implemented to provide drivers with information and, in the busiest areas, to control traffic flow through variable speed limits or other traffic management measures. Increasingly, the networks will need to provide the technology to enable the

Within Norfolk, the highest value investments required are:

- x Investment into the Norwich to London rail line to provide fast, reliable services that offer adequate capacity. 90 minute journeys are planned, but investment needs to build on this to ensure that all journeys have a maximum running time of 90 minutes. Additional services need to be provided at the southern end of the line to accommodate the growing commuter market into London. This requires major infrastructure investment.
- x East West Rail: east west connections into and across East Anglia are very poor. East West Rail, connecting Ipswich and Norwich to Oxford and the south west via Cambridge, needs to be implemented at the earliest possible opportunity.
- x A47 upgrades: This road, providing the main strategic road route across northern East Anglia to connect to the Midlands and the north of England and Scotland, is poor. It is a mixture of single and dual carriageway. Journey times are long and unreliable. Whilst a number of major upgrades, including dualling, are planned, much of the road will remain to single carriageway standard.

The roll-out of technology to allow for management of networks, and information to drivers is essential. This includes the provision of up to date travel information directly available to SDVVHQJHUV DQG FDU XVHUV WKURXJK PRELOH QHWZRUNV information systems, rather than via sign gantries, or real-time public transport information). Across Norfolk the lack of alternatives for the strategic road and rail networks means that there is a vital requirement for better management and information, yet the trunk road network in particular has no real time management or information provision.

16. What opportunities GRHV μPRELOLW\ DV D VHUYLFH† FUHDWH IRU
How would this affect road usage?

Mobility as a service will, essentially, charge consumers for travel. This charge will depend on a number of factors including mode of travel, time of day, and quality of the experience (e.g. vehicle quality). It would be relatively easy for the digital infrastructure (required for the ERNLQJ V\ VWHP YHKLFOH WUDFNLQJ HWF « WREH EXLO overall charge to go back to government or towards the infrastructure provider (the local KLJKZD\ DXWKRULW\ 7KDW LV μURDG XVHU FKDUJLQJ† FR travel for the consumer. Moreover, the road user charging element could easily be varied to take account of factors such as overall demand for travel at certain times of day, congestion on the networks, where the journey takes place, or the types of infrastructure used (e.g. motorway or local road), or for pollution.

For the charge to affect road usage it would need to be transparent. That is, the consumer would need to be able to compare the different options ±as noted above ±to be able to make an informed choice about how to travel, or the time of travel.

Norfolk understands this concept of mobility but how does this system work in a predominantly rural county such as Norfolk? Car ownership is unavoidably high and the proposals such as charging road users would not provide suitable solutions for our county.
: KDW LV WKH JRYHUQPHQW † sva seWde D Wrel Jeds? U PRELOLW

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long -term technology trends)? When would decisions need to be made?

Fixed line infrastructure has undergone a step change since the start of the Broadband Delivery UK (BDUK) deployments in 2013; with access to Superfast coverage (24Mbp+) expected to reach 95% of properties by the end of 2017, and further increases after that. Having reached this level of penetration, with the most expensive element of the infrastructure in place (civil engineering elements e.g. thousands of kilometres of ducted fibre) the active electronic components within the infrastructure which determine speeds available will continue to evolve and drive available speeds up. It can be expected that this will take place via the commercial sector.

However, large disparity still exists in mobile coverage. To achieve the benefits from the Internet of Things and beyond, there needs to be universal access to each new Generation of mobile infrastructure as it becomes available. Currently as each new Generation emerges, because it relies almost entirely on commercial investment, understandably

densely populated areas with existing mast infrastructure gain access whilst less populated rural areas with less mast infrastructure lag further and further behind.

5G is not here yet, but with the addition of embedded IT sensors, the functionality of EXLOGLQJV YHKLFOHV DQG RWKHU SK\VLFDQ DVVHWV FDQ are not to be islands of isolation they need to be enabled to share data, allowing things to be sensed, changed and enacted remotely. Although some of this can be achieved via fixed line infrastructure, in many cases connectivity will need to be via non fixed line infrastructure.

This ability to integrate the physical and virtual world will transform the way we do business, live our lives and interact with the world around us, resulting in better public services, improved efficiency across all aspects of our lives, and deliver economic benefit. In practical terms, the Internet of Things will allow a range of activities that support these objectives, including:

- x Intelligent buildings
- x Smart energy management and remote control of household appliances, providing convenience and saving money for residents and businesses
- x Assistive technologies to allow people to stay at home for longer as can wider e-Care opportunities
- x Intelligent vehicles
- x Emergency vehicles informing action and sharing real time data with others
- x Allowing public transport to be targeted both learning from past activity and enacting FKDQJHV ZKQDUMH stand, avoiding traffic jams
- x Intelligent devices
- x Allowing scarce specialist resources such as medical consultants to be available in a range of locations without having to physically be there
- x Monitoring implants e.g. for heart conditions, so that problems can be identified early and managed
- x Devices to sense people in their homes ±KDV DQ ROGHU SHUVRQ¶V GDLC FKDQJHG L H WKH\ KDYHQ¶W RSHQHGWKH IULGJH DOC
- x Assist in search and rescue
- x Intelligent traffic management based on real time information
- x Biochip response devices that transmit data on current events, e.g. for floods, or DQLPDQV¶ KHDQWK VXFK DV PRQLWRULQJ YLWDO V LJQ
- x Broadcast messaging, particularly when dealing with emergency situations

Many of the technologies needed to undertake the type of activities listed above are already proven, but the necessary network infrastructure is not universally in place to support them, particularly mobile networks in rural areas.

In common with Fixed Line infrastructure, the expensive elements and those which take time to implement tend to be the civil engineering based assets e.g. masts, power provision etc. Once a mast is available, as the next Generation of mobile technology becomes available it can be provided. If there is no mast infrastructure it is a much more difficult and expensive task. Therefore the deployment of sufficient mast sites to provide extensive geographical coverage is vital and should be implemented as soon as possible. The Government should consider investment in new mast sites, albeit requiring these sites to be available to all operators and needing to overcome State Aid restrictions.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Digital connectivity should be seen as an essential utility that facilitates and enables the digital economy. The digital economy is a key sector for Norfolk and will have an impact on every business in the county from the financial and business sector to agriculture. Norfolk has ambitious plans for its digital economy and as it is unlikely Norfolk will receive the level of hard or physical infrastructure other areas will have it is of even greater importance that we have the digital infrastructure in place for our digital economy to prosper and grow as planned.

³ 'L J L W D O F R P P X Q L F D W L R Q V ' L Q F O X G H V E R W K I L [H G e d Q G P R

Line infrastructure is often possible in the Highway, and as such it avoids the complexity and expense of securing private way-leaves to implement infrastructure. The infrastructure tends to be smaller and less intrusive than mobile infrastructure; it also tends to serve people close to the actual infrastructure and therefore causes less overall concern for residents. Critically, public subsidy has created a step change in the deployment of fixed line infrastructure. Mobile signals tend to depend on mast infrastructure in the right locations, to allow mobile operators to site their equipment. For improvements to happen, mobile operators will need to add equipment to current masts, and in some cases install new masts, and if this does not happen cove U D J H Z R Q ¶ W L P S U R Y H

During 2016, the Government consulted on reforms to the planning regime to support the mobile industry in the rapid rollout of 4G technology. The proposed reforms include the ability to erect larger structures and increase the size of existing ones, lifting the restrictions on the number of antennae allowed on certain structures and lifting a variety of restrictions on smaller structures.

The Government is also reforming the Electronic Communications Code (ECC). The reformed ECC will make major reforms to the rights that communications providers have to access land. This will ensure property owners will be fairly compensated for use of their land, but also explicitly acknowledge the economic value for all of society created from investment in digital infrastructure. In this respect, it will put digital communications infrastructure on a similar regime to utilities like electricity and water.

New rights to upgrade and share infrastructure will allow future generations of technology to be quickly rolled out as it becomes commercially viable. There will also be administrative changes to court processes to allow for improved dispute resolution, ensuring that disagreements between communications providers and landowners do not hold up investment and create uncertainty. These rights should mean that as each new mobile Generation is released it will be rolled out across existing infrastructure, however it is unlikely to make rural locations commercially viable for the implementation of new mast sites and therefore the Government should consider investment in new mast sites, albeit requiring these sites to be available to all operators.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

As outlined below and throughout this response renewable energy and particularly offshore wind is an incredibly important sector for Norfolk. A considerable amount of the offshore wind projects will be making landfall in Norfolk, this impact is significant and can be unwelcomed so we need to ensure Norfolk also gains from these projects. Our economic strategy outlines established key growth locations such as the A11 Tech Corridor, which have already received considerable investment but still suffer from power supply issues.

As suggested below the government needs to provide a strategy or mechanism to fill these gaps which would then fuel growth.

Strategic Assessment - Way forward

The following recommendations are made to the NIC with regard to offshore wind Energy and Grid connection issues:

Firstly there needs to be a strategic approach at a National Level governing how offshore not adequately address the long term supply and delivery of electricity to the end user. It is also inefficient in terms of infrastructure required on the ground with the lack of strategic join up between future OFTOs i.e. many cable routes and grid connection points instead of an integrated approach benefiting from economies of scale and moreover being less environmentally damaging as well as causing less disruption to local resident and businesses;

Secondly There probably needs to be legislation put in place making it a mandatory requirement to any energy producer to consider sharing existing or planned infrastructure where there are two or more developers bringing forward projects in broadly the same time horizon.

Thirdly Allow existing and future Offshore Transmission Operators (OFTOs), which have a connection to the National Grid to also connect to the local transmission networks i.e. direct to the Distribution Network Operators (DNO). This would assist in over-coming local deficiencies in the electricity transmission network as outlined above.

The offshore wind energy sector has the potential to make a significant contribution to the supply mix, which will include energy from other sources such as oil, gas and nuclear. The benefits of exploiting wind energy, particularly offshore, is that it is renewable and can be There are currently 8 operational and consented offshore windfarms off the Norfolk coast under Rounds 1 and 2 of the wind energy licencing programme (see table 1 below). These projects have the potential to supply over 2 million households electricity from these eight projects comes ashore either in Norfolk or Lincolnshire.

Table 1 - Round 1 and 2 offshore wind energy projects off the Norfolk Coast

Wind farm	No of Turbines and total capacity (MW)	Height of Turbines Metres	Distance off Coast (KM)	Number of Homes - Supplied	Status
1. Scroby Sands	30 (60)	92	3	40,000	Operational
2. Lynn	27 (97)	N/A	18	65,000	Operational
3. Inner Dowsing	27(97)	N/A	23	65,000	Operational
4. Sheringham Shoal	88(317)	172	17	220,000	Operational
5. Lincs	75(270)	170	18	150,000	Operational
6. Dudgeon Shoal	187 (402)	190	32	410,000	Approved Construction Started
7. Race Bank	91 (573)	180	27	400,000	Approved Construction Started
8. Triton Knoll	288 (900)	220	48	800,000	Approved not started
Total	813 (2,716)			2,150,000	

In addition to these Round 1 & 2 projects there are a series of Round 3 projects off the Norfolk and Suffolk Coast, which comprise the following:

Table 2 - Round 3 Offshore wind energy projects off the Norfolk Coast

Wind farm	No of Turbines and total capacity (MW)	Height of Turbines Metres	Distance off Coast (KM)	Number of Homes - Supplied	Status
1. East Anglia One	102 (714)	-	43km	500,000	Approved Construction Started
2. East Anglia Three	172 (1,200)	145	79km	850,000	At planning stage
3. East Anglia Two	TBC (800)	TBC	31km	-	Pre-planning
5.Norfolk Vanguard	TBC (1,800)	TBC	47km	1,300,000	Pre-planning
6.Norfolk Boreas	TBC (1,800)	-	54km	1,300,000	Pre-planning

Total	274 (6,314)		-	3,950,000	
-------	-------------	--	---	-----------	--

Norfolk will provide the landfall and grid connection points for projects 5 (Vanguard) and 6 further 2.6 million households (3.6 GW). Both these offshore projects will be progressed as Nationally Significant Infrastructure Projects (NSIPs) and will ultimately be determined by the Secretary of State. The Vanguard project is likely to be determined around late 2019, with the Boreas project being determined the following year.

Infrastructure Implications for Norfolk

The social and economic benefits arising from those offshore proposals making landfall in Norfolk are potentially significant in terms of extra business for local companies and attracting inward investment that could lead to jobs created in:

- x Manufacturing of key Components (e.g. blades; gear-box; tower assembly);
- x Assembling and constructing the turbines and various major components;
- x Logistical support, surveying and other forms of offshore support;
- x Other lower tier supply chain companies to support any of the above
- x On-going operations and maintenance (O&M) (port related). It is hoped that more bases to support this activity will be established locally that will have at least a 25 year time frame, to add to those already established by Sheringham Shoal and Dudgeon for example;

Much of the opportunity around offshore wind is enabled by the ports of both Great Yarmouth and Lowestoft. They are already seen as the major energy support focus for the Southern North Sea and one of England's However, it is the deep water facilities of East Port Outer Harbour that is attracting most interest from potential investors related to the renewable energy sector, although the river port and Lowestoft port will have key roles to play as well, especially supporting O&M. The port of Wells has already shown the benefits that can be derived from offshore wind, which it is hoped will be repeated once further investment takes place off the North Norfolk Coast.

There are, however, wider issues of grid connection which need a nationally strategic overview / plan to ensure:

- x that the local transmission network operators (operating below 400 kV) in Norfolk are able to benefit from the offshore power supply; and
- x the electricity connects to the National Grid efficiently.

Grid Connection Issues

Local Transmission Network - Norfolk

Within Norfolk the Distribution Network Operator (DNO) is UK Power Networks which provides electricity to homes and businesses across the County at 132 kV and below. Given the nature of Norfolk as a large rural County, the electricity transmission network across the County varies significantly with some urban and built up areas having reasonable supply, but with major deficits in others, along with several more remote rural areas all struggling to cater for growth. Among those areas of the County with supply issues are:

(a) The A11 (T) corridor, from Colney (where the Norwich Research Park is located) through Hethel, Wymondham, Attleborough, Snetterton, and on to Thetford. This is the Norfolk section of the Cambridge Norwich Tech Corridor, where much of the other technology is projected to be. As well as localised issues, there is a need for a fundamental upgrade at the Norwich Main substation, which was part of the 2015-2023 programme but so far there are no plans to instigate this.

(b) Parts of North Norfolk to the north of North Walsham.

These gaps in the transmission network (see map attached) are creating difficulties for local businesses and attracting inward investment into the County.

National Grid - Offshore Wind Connection

The offshore wind energy sector, as referred to above, will have a significant impact on Norfolk as many of the projects will make landfall in the County and connect to the National Grid (400 kV) network. Connection to the Grid will involve cable routes being buried between the respective landfall points up to where they connect to the grid.

The most significant projects to connect to the grid in Norfolk are:

- (a) Dudgeon Wind Farm to connect to the Grid at Necton;
- (b) Vanguard Wind Farm to connect to the Grid at Necton;
- (c) Boreas Wind Farm - to connect to the Grid at Necton; and
- (d) Hornsea Project Three to connect to the Grid at Norwich Main.

(See grid map with substations identified).

While the Dudgeon scheme has full planning consent both for the offshore and onshore elements, including approval for connection to the grid involving a new sub-station, the remaining projects are the subject of planning approval through the NSIP process.

The County Council has been in close contact throughout the pre-application process with the applicants (Vattenfall and DONG Energy) of the above projects (yet to be approved). The County Council has also met up with National Grid to discuss grid connection issues.

The County Council has raised with the two applicants whether there is any opportunity for:

- (a) Sharing some of the onshore infrastructure, such as landfall points; cables routes; and grid connection points;
- (b) Providing electricity to those parts of the County where there are local transmission shortfalls e.g. A11 corridor and around North Walsham.

These discussions are on-going with the respective applicants and National Grid, but initial response would suggest that:

- (a) Sharing onshore infrastructure may prove difficult as National Grid have different locations. These grid offers have been accepted by the two applicants. Planning involved;
- (b) Achieved according to the National Grid as the onshore cables from the wind

farms will belong to a future Offshore Transmission Operator (OFTO). In such circumstances, where the main connection point for the OFTO system is at a transmission substation (National Grid), the regulatory arrangements governing OFTO infrastructure do not provide for secondary interconnection between the OFTO system and a local distribution network operator (DNO)(i.e. UK Power Networks).

27. Are financial and regulatory incentives correctly aligned to provide sufficient long term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

The landfill tax is the primary driver for finding alternative recycling and disposal options but it does not necessarily encourage innovation. Cost is a key driver for local authorities and this does not always promote supporting innovation.

Additionally funding is not available to Local Authorities in order to pay to drive materials up the waste hierarchy. For example, the cost of separating and recycling some bulky items exceeds the cost of disposal when considering transportation and treatment. Commercial waste infrastructure seems to be particularly lacking in this area and there doesn't seem to be any regulatory or financial drivers to provide it. Infrastructure provision for long term treatment capacity often has long payback periods and uncertainty in obtaining planning and the high costs associated with providing the infrastructure can be a barrier to development of new facilities.

Data is crucial to managing waste holistically. Industry should provide data in the same way that Local Authorities do through Waste Disposal Facilities, which would allow waste to be treated the same, irrespective of its source.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

A circular economy is a growing focus for EU legislation and is one in which we keep resources in use for as long as possible, extract the maximum value from them whilst in use, then recover and regenerate products and materials at the end of each service life.

Supporting the circular economy maintains the value of the materials and energy used in products in the value chain for the optimal duration and by minimising waste and resource use. This can promote competitiveness, innovation, a high level of protection for humans and the environment, and bring with it major economic benefits, thus contributing to growth and job creation. It can also provide consumers with more durable and innovative products that provide monetary savings and an increased quality of life. The development of innovative solutions and new markets also need to be supported as a key element of the circular economy.

Barriers to the circular economy include the scale of change and number of stakeholders
LQYROYHG ZKR PD\ KDYH GLIIHULQJ LQWHUSUHWDWLRQV R
a long term approach is needed and this can be difficult when set within a financial context where, for example, local authorities need to make savings.

North East Combined Authority response to National Infrastructure Assessment call for evidence. [Name redacted][email redacted][telephone redacted].

Room 144
Civic Centre
Barras Bridge
Newcastle upon Tyne
NE1 8QH

National Infrastructure Commission
1 Horse Guards Road
London
SW1A 2HQ

Phone:

Email:

www.northeastca.gov.uk

Date 10th February 2017

Dear Lord Adonis,

National Infrastructure Commission call for evidence

The North East Combined Authority (NECA) welcomes the opportunity to respond to the National Infrastructure Commission's call for evidence. Our response to the questions posed by the Commission is attached and we would be happy to provide further information or to answer any questions you may have.

Yours sincerely,

Leader of Newcastle City Council
Transport Portfolio Holder for the North East Combined Authority

North East Combined Authority Response to the National Infrastructure Commission Call for Evidence

The NECA consists of the seven local authorities of Durham County Council, Gateshead Council, Newcastle City Council, North Tyneside Council, Northumberland County Council, South Tyneside Council and Sunderland City Council. The Combined Authority reinforces and strengthens existing partnership arrangements to collectively drive forward change and enable economic growth across an area of almost 2 million people. Maintaining and improving an integrated transport network that supports economic growth and enhances the mobility of residents, visitors and businesses is a key goal of the Authority.

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

There has been a historic lack of investment in transport infrastructure in the north of England. This has resulted in lengthy, infrequent and unreliable journey times for city to city travel, which is a constraint to productivity, jobs, and housing growth. In economic terms, cities in the north of England are performing well individually but they are not realising their full potential partly as a result of this poor connectivity to other cities in the north and elsewhere^{1 2 3}.

Where investments are made, it should be the case that these are created as part of an integrated transport system where possible. Users view the transport system as a whole, crossing multiple modes and boundaries, rather than separate sets and investments should reflect this.

In terms of transport infrastructure investments, these can be broadly split by mode:

Rail

The East Coast Mainline (ECML) is an extremely important rail route to NECA and to the nation as a whole and we are full members of the East Coast Mainline Authorities group (ECMA). Investments to improve capacity on the ECML along the route, but particularly north of York, have been identified as essential through multiple processes, including by Network Rail, local authorities, operating companies^{4 5 6 7} and Transport for the North (TfN)⁸. The current two-tracking north of Northallerton represents a constraint on both inter-city capacity (linking the North East to Leeds and Manchester city-regions in the North and to the economic centre of London) and intra-regional capacity, restricting the ability to increase the quantum of regional services, limiting local labour markets.

¹ *Cities Growth Commission* Unleashing Metro Growth (2014)

² *IPPR North* Rhetoric to reality: a business agenda for the northern powerhouse, (2015)

³ *Transport for the North* Northern Transport Strategy, Spring Report (2016)

⁴ *JMP Consultants* Sunderland: Rail Connectivity Improvements Study (2014)

⁵ *JMP Consultants* Prospectus for Investment in the East Coast Mainline (2014)

⁶ *Office of Rail and Road* Applications for Access on the East Coast Main Line (2015)

⁷ *Network Rail* East Coast Main Line Capacity Options Report (2014)

⁸ *Transport for the North* The Northern Powerhouse: One Agenda, One Economy, One North (2015)

Further, it is expected that there will be future restrictions on the ability to assign freight paths on the route due to high demand for passenger services operating at high speed. As a result, the growth of freight and logistics within the region faces future constraints, and some freight may switch to the highway network, with attendant negative consequences.

A cost-effective and short-term measure would begin with provision of passing loops for freight services north of Northallerton, as identified in CP5 and the Hendy Review. However, this does not represent a long-term solution to match anticipated growth, which is estimated at 144% for passengers up to 2043⁹ and 13.2% annually for key biomass traffic or 11.9% for domestic intermodal up to 2043¹⁰. The best way to match both estimated growth and the ambitions for the corridor would entail four-tracking the route between Northallerton and Newcastle and investigating capacity enhancements on the line north of Newcastle up to the Scottish border.

However, considerations for improvements should not be limited to simply four-tracking along the existing route. There are other ways to grow capacity along the ECML corridor and allow for greater resilience and further development. NECA supports investigating the re-opening of the Leamside line, linking the ECML to Pelaw via Leamside and Fencehouses. The benefits from re-opening of this line have been noted in work by Network Rail, Local Development Plans, the North East LEP's Strategic Economic Plan and in TfN's 'Northern Powerhouse Rail' workstream. The initial benefits of reopening this line have been examined¹¹ and it would represent an investment in transport infrastructure in the region which would serve multiple functions. Not only would it significantly increase capacity on the corridor and allow for the development of more local and regional services, it would also increase resilience to disruption on the ECML which frequently isolates the North East from the rest of England.

The NECA also believes that improvements to other rail lines in the region are vital in continuing to support economic growth. In terms of existing passenger routes, the Bishop Auckland, Durham Coast and Tyne Valley Lines all have great potential to drive economic growth and support local connectivity, whilst improvements to the latter two routes would also enhance the resilience of the ECML. The Durham Coast Line links six of the largest areas in Durham. Sunderland and the Tees Valley and is a strategic asset for the region which has not historically received appropriate levels of investment.

The NECA is supporting improvements to these lines through Rail North, including development of a new station at Horden. The NECA also strongly supports a scheme led by Sunderland City Council to redevelop Sunderland station which, in its present state, is acting as a deterrent to economic growth when it should be acting as a stimulus.

⁹ *Network Rail, Long Distance Market Study (2013)*

¹⁰ *Network Rail, Freight Network Study (2016)*

¹¹ *AECOM Conditional Output Statement for Reintroducing Rail Services Between Newcastle and Northallerton (2014)*

A new railway station at Cramlington in South East Northumberland has been identified as an opportunity to facilitate growth in the town and take advantage of the opportunities presented to the town by its location on the strategically important ECML. This would involve re-siting the current station to a location closer to an important and growing interchange with a large catchment and more able to provide effective interchange with other transport modes.

Some of the strongest potential for sustainable growth comes from unlocking growth in areas which are currently not well connected by rail to large employment areas. In the North East, we strongly support reopening the Ashington, Blyth and Tyne line to passenger traffic. This has the potential to support up to 280,000 return journeys per year for the 150,000 residents along the corridor and halve public transport journey times from the densely populated area of South East Northumberland to Newcastle City Centre¹². This would contribute to the sustainable economic growth of an area with ambitious plans for growth of over 200 hectares of strategic employment land and 12,840 houses¹³.

High Speed Rail

As highlighted above, improvements to the ECML corridor are essential to the economic well-being of the North East and its contribution to the national economy. However, these improvements are unlikely to be sufficient to cope with forecast demand, both passenger and freight, and deliver the growth we seek in the long-term (defined in the Call for Evidence as up to 2050). Therefore, if these long term travel requirements are to be met, the existing commitment to deliver High Speed 2 needs to be developed further, in conjunction with local authorities.

Working as part of Northern Powerhouse Rail, with Rail North, we support a link from HS2 phase 2b to the East Coast Main Line. This is planned at Church Fenton. Linking HS2 phase 2b from Leeds to the East Coast Main Line will function to provide £44bn of GDP up to 2093¹⁴.

In 2016 HS2 Ltd published its report "Broad options for upgraded and high speed railways to the north of England and Scotland"¹⁵ which explored options to:

- improve journey times from Edinburgh and Glasgow to cities further south, including options that could reduce journey times to London to 3 hours or under
- provide additional passenger and freight capacity where it is projected that future demand will not otherwise be met

NECA advocates an Eastern route for HS2 Scotland, whether by a completely new route or upgrades to the existing ECML. The Eastern Route is ideal compared to the

¹² AECOM Ashington-Newcastle Rail Link: Update of Scheme Business Case (2014); Jacobs Ashington Blyth & Tyne GRIP 2 study (2016); Northumberland County Council Ashington Blyth & Tyne Line report to Cabinet (2016)

¹³ Northumberland County Council Local Plan Core Strategy Pre-Submission Draft (2015), incorporating the South East Northumberland Delivery area

¹⁴ HS2 Ltd High Speed 2 phase 2b Strategic Outline Business Case Economic Case (2016)

¹⁵ HS2 Ltd [Broad options for upgraded and high speed railways to the North of England and Scotland](#) (2016)

Western Route as it connects large existing centres of population more effectively, with fewer environmental constraints.

When HS2 phase 2b is delivered, stations need to be ready for the demands placed upon them by this additional capacity. Newcastle Station has been identified as a future pinch-point by Network Rail¹⁶ and there is a need to make it ready for HS2 services and increase capacity.

Light rail

The Metro system connects the key centres of population in Tyne and Wear. Many employment sites are accessible by Metro, either directly or via interchange. Universities and Further Education Colleges can be easily accessed by Metro, along with many retail facilities, hospitals, GP surgeries and clinics. Metro is readily accessible¹⁷ to 350,000 individuals. Passenger surveys¹⁸ suggest that approximately one quarter of the Tyne and Wear population (297,600 i.e. 27% of 1.1m) uses Metro, with many Metro stations serving as interchanges with other modes of public transport, mainly local bus services but also taxi, national and local rail services and also air transportation.

This connectivity is important to allow people to access employment opportunities, to travel for leisure purposes or for education and training. The economic importance of these links is recognised by the North East Local Enterprise Partnership's (NELEP) Strategic Economic Plan (SEP).

The Metro and Local Rail Strategy sets out proposals to expand, improve and integrate local rail and Metro services. This is fundamentally important for the economic growth plans of the North East, and is reflected in the Transport Manifesto and SEP. Metro extensions have the potential to improve the economy of the North East and to be better integrated with our local rail network as well as serving areas of housing and business growth. With the timescale of this Commission covering a period up to 2050, these extensions may go beyond those already identified in the Metro and Local Rail Strategy. The vision for the strategy is "An integrated, modern and sustainable Metro and local rail network for the NECA region that supports the local economy, environment and society". In order to take Metro into the future by developing Metro and local rail services together to enable the North East to thrive economically and socially, the objectives are:

- To provide Metro and local rail services that are reliable, accessible and comfortable with high levels of customer satisfaction, within available resources;
- To grow the Metro and local rail network and their modal share as part of an integrated public transport network; and
- To achieve value for money.

¹⁶ Office of Rail and Road and Network Rail [ECML 2020 Capacity – Timetable Assessment Report](#)

¹⁷ Defined as living within 800m of a Metro station

¹⁸ Nexus Business Intelligence patronage figures, adjusted for the frequency of Metro travel

In addition to this, Nexus is seeking funding and investment for a new fleet of Metrocars as the current 90-car fleet was built in the late 1970's and many components are life expired. A new fleet of Metrocars will provide improved reliability, journey time benefits and a better passenger experience.

Cities and their hinterlands within the NECA region would significantly benefit from investment in a new Tyne and Wear Metro fleet, which could be dual voltage and inter-operable with the local rail network. This would rejuvenate and revitalise a system by replacing a fleet which has served since the inception of the Metro in 1980. Viewed over the life of the trains, this would represent a cost-effective investment, particularly when compared to a do-minimum alternative. This would allow a more flexible and comprehensive local rail network that creates new journey opportunities for the region.

Connectivity to major employment, rail and airport hubs is integral to securing job growth and productivity not simply between but also within city-regions. In this respect, investments in expansion of light rail and metro systems can be complementary to larger inter-city investments, which can represent the 'hubs' of a 'hub and spoke' model. Correspondingly, expansion of the Metro system would represent one of the highest value infrastructure investments in the region and in the North more widely.

Highways

NECA supports the delivery of schemes identified and committed to within the current Road Investment Strategy (RIS) to 2020 and beyond in the North East. These schemes are integral to managing growth on the Strategic Road Network in the future and to addressing current, longstanding congestion issues. It is important that where funding has been secured for works, such as improvements on the A1 between Scotswood and North Brunton or A19 improvements at Testos and Downhill Lane, timely delivery is ensured to enable the benefits to be secured as early as possible.

It is the ambition of NECA to achieve an upgrade of the A1 to provide continuous dual carriageway standard between London and the Scottish Border and we believe this should be a priority as it addresses identified weaknesses in city-to-city connectivity and inter-regional connectivity. We welcome commitments made by the Government as part of the RIS, City Deals and through other mechanisms to address existing capacity issues.

The A19 Corridor and A1 Western Bypass are integral to passenger and freight movements in and through the region, including for access to regional ports.

The A19 is vital to both city-to-city (the Tees Valley to Tyne & Wear) and enterprise (industrial to international gateway) connectivity. NECA welcomes current Highways England (HE) investment on key links such as the Testos and Silverlink junctions. Future investment along this corridor must be prioritised in order to unlock further enterprise growth such as that planned for the International Advanced Manufacturing Park (IAMP).

The A1 Western Bypass has already been recognised as nationally important and NECA support the current RIS programmes. However, in order to unlock additional

capacity, further investment must be made a priority within the region and form a significant part of RIS2 to continue to unlock growth and drive productivity.

The NECA has consistently supported the case for investment in the A66 and A69 to improve connectivity between this region and North-West England. We welcome the improvements announced in the Autumn Statement but note that, as part of the Transport for the North programme, studies are continuing into the benefits of further upgrading TransPennine routes.

While delivering the above improvements is essential, there will still likely be future capacity issues on our network. In particular, this applies to capacity across our major rivers. We are looking to work with partners, particularly Highways England, to explore this issue.

Where improvements to the Strategic Road Network are prioritised, this must be done with consideration of the impacts this will have on the associated local road network. The interface between the two must be considered holistically to ensure the greatest possible support of growth from any intervention. This should also be a consideration with regard to asset management as well as new infrastructure.

Active Travel

Investment in cycling and active travel is among the most cost-effective forms of infrastructure investment^{19 20}. The relative proximity of the North East's towns and cities means cycling infrastructure is well placed to replace car journeys for shorter trips. By removing many car based local commuter journeys, particularly on the Strategic Road Network, cycling infrastructure supports the efficient functioning of highway infrastructure in general. Air quality issues are becoming a major concern for the future health and wellbeing of our region. We are clear that investment in Active Travel, together with our ongoing work to improve public transport and promote low-emission vehicles, will help improve our quality of life as well as our economy.

NECA would expect investment in the strategic road network to include cycling infrastructure improvements, including cycle routes along road corridors as well as reducing severance at interchanges. This will complement investment at a local level through local resources and the Government's forthcoming Cycling and Walking Investment Strategy.

The North East Independent Economic Review noted that ensuring consistent investment in cycling facilities was required to secure continuous improvement to the quality of the built environment, community life and public health and thereby retain the skills needed to deliver the economic strategy.

Technology

The NECA is strongly in favour of low-emission vehicle technology, and the international expertise of the region in this sector is emphasised within our Strategic Economic Plan (SEP). We believe that it should be a priority to future-proof the

¹⁹ Raje, F., Department for Transport [The Value of Cycling](#) (2015)

²⁰ Cabinet Office Strategy Unit [An Analysis of Urban Transport](#) (2009)

Northern road network so that it is capable of supporting the next generation of vehicles. We have incorporated this aspiration into our bid to OLEV as part of the Go Ultra Low City Scheme opportunity, emphasising the region's role at the forefront of Low Emission Vehicle adoption.

There are further additional technology opportunities which can complement and enhance transport investments. With increases in both the number of people with flexible working patterns and an increasing recognition of the importance of being productive while travelling, the provision of fast and reliable 4G coverage across the transport network is a priority. When allied to Wi-Fi at public transport nodes and on vehicles, this can dramatically improve the productivity benefits of investment although this is not currently picked up in appraisal practices.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Two of the ways in which international competitiveness can be addressed are to improve access to and from international gateways (such as ports and airports) but also to improve connectivity within the country for freight and passengers. The NECA believe that both aspects need to be tackled equally to improve competitiveness.

While the North East has a well-developed freight and logistics industry, lifting 88 million tonnes per year by road²¹ we are hampered by the lack of a Strategic Rail Freight Interchange (SRFI), providing the facilities to enable large volumes of freight to be transferred to and from road vehicles and freight trains. The provision of Rail Freight Interchanges is a national government objective and the National Planning Statement (NPS) on National Networks²² is clear about the need for new Strategic Rail Freight Interchanges (SRFIs) across the regions to boost economic growth. The NPS stresses that rail freight interchanges are required 'particularly in areas poorly served by facilities at present' and that new SRFIs 'are likely to attract substantial business, generally new to rail'. The NECA has therefore identified the need for an SRFI as a goal in our Transport Manifesto and also in our submissions to the Transport for the North Freight and Logistics workstream.

NECA welcomes the National Infrastructure Commission's focus on the long-term future international needs of the region. As the only region in the UK with a positive balance of trade and over £13bn of annual exports across the globe, international connectivity is at the heart of the economic strategy of the NECA.

Our ports serve dual roles as key international gateways for not only goods but people. We have seen strong growth, particularly in the cruise sector, an industry with growth potential²³. As a region, we have the second largest municipal Port in the UK at

²¹ Department for Transport Road Freight Statistics (2016)

²² Department for Transport [National Policy Statement on National Networks](#) (2014)

²³ 43 cruises visited the region in 2016 – this included the Disney Magic vessel and the Koningsdam, the largest cruise ship to berth at a Northumbrian Quay. 60 cruise ships are expected to visit the Port of Tyne in 2017

Sunderland, which has grown 64% in just 3 years²⁴ and the Port of Tyne contributes £710m in GVA to our economy annually²⁵. Exports and imports from our ports amount to more than 10,000,000 tonnes per year and are integral to our regional exports that amount to more than £12bn a year. Ensuring that ports in the UK are not only more accessible for freight movements but for the movement of people by improving surface access will improve the UK's international competitiveness.

The NECA would welcome improved surface access to Newcastle International Airport which, due to its location, has a unique catchment area. Improved surface access is likely to increase the attractiveness of the airport to both passengers and airlines with a view to improving international connectivity. Improved surface access can also widen the catchment area by bringing more people to within two hours journey time of the area which has the potential to increase demand for services. Airlines may choose to address this demand through increasing the frequency of new routes and introducing new services. In particular we would welcome improvements to the A696 and its junctions associated with the A1 in order to accommodate forecast growth at the airport. These measures will enhance the North East's connections to international markets and will contribute to our ability to compete in the global marketplace.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

The NECA supports the government's wish to see new development centred on brownfield sites as these are likely to be close to existing town and city centres and current transport routes. Where new housing or business developments take place outside these locations, it is essential that these are permeable, encouraging rather than deterring sustainable travel modes, and that, by use of the Community Infrastructure Levy where applicable, they are underpinned by investment in suitable transport links, including bus services and infrastructure, cycling and walking routes.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

The North East Combined Authority recently responded to a Transport Select Committee on urban congestion²⁶ and we support measures which enable demand management, particularly in the urban areas where it is most appropriate. Demand management may not be appropriate for all areas and should be part of an overall package of integrated transport where appropriate.

Being able to guide people and influence behaviour change is a key aspect of addressing congestion in urban areas where there are feasible transport alternatives. In central Newcastle, measures have recently been introduced to try to remove cars from the core of the city centre and create more space for public transport, cycling and

²⁴ Department for Transport Port Freight Statistics PORT0101

²⁵ Port of Tyne Annual Report (2015)

²⁶ Transport Select Committee [Urban Congestion Inquiry](#) (2016)

walking. These schemes can result in less congested roads in the city centre and encourage car users to think about alternative travel options.

The NECA recognises the contribution sustainable travel can make to congestion reduction and our Go Smarter programme for Tyne and Wear, Durham and Northumberland encourages everyone to think about changing their behaviour to use more sustainable ways of travelling on their daily journeys to work and school. Previous research has indicated that this can have a meaningful impact, with schools targeted for intervention experiencing declines in car trips and increases in walking and cycling.²⁷

Changing travel behaviour to more sustainable modes of transport can cut congestion, tackle poor air quality, improve health and ultimately help improve our economy. The Go Smarter to Work business engagement programme focuses on key employment sites served by the A1 Western Bypass and A19 corridors, and motivates employers and their staff to travel more sustainably. Schools Go Smarter encourages pupils and their parents to travel more actively on their daily journeys to school, helping to keep young people fitter and healthier, and reducing congestion around the school gates and local areas. Go Smarter can also help people gain greater access into employment and training.

When there are attractive active travel options, this can help reduce future demand on networks by encouraging modal shift and help sustain the travel time and congestion benefits of investment over longer periods.

The NECA believes that, addressed in the right way, disruption and congestion can provide an opportunity to encourage sustainable travel. Go Smarter's Make the Switch²⁸ campaign seizes the opportunity to leverage the frustration felt by motorists held up in traffic congestion caused by major road improvement schemes that are happening across the area as a 'hook' or opportunity to encourage behaviour change to make the switch to more sustainable modes of transport.

The Go Smarter programme aligns with the DfT's draft Cycling and Walking Investment Strategy which states that increased cycling and walking improves health, enhances air quality and eases congestion. The NECA acknowledges that the draft strategy aims to deliver benefits through increased cycling and walking. However, we are concerned at the lack of funding allocated to delivering on the ambition.

Current national appraisal and assurance frameworks present challenges when developing innovative cycling, walking and public transport infrastructure in congested urban areas. As user benefits and travel time are such a great proportion of the benefits of urban transport schemes, investments which aim to reduce and reallocate road space away from motor vehicles often do not meet Cost-Benefit thresholds despite very positive air quality, health and environmental impacts. In spite of their

²⁷ *Go Smarter* Monitoring data (2015) Using data up to 2014 proportion of car trips in intervention schools declined from 34% to 30%; whereas car use increased by a similar level in control schools, from 32% to 36%. Walking mode share declined from 54% to 48% in control schools throughout the period while the proportion increased slightly in intervention schools from 55% to 56%. Cycling mode share increased slightly by 2% in intervention schools whereas it remained roughly similar in control schools.

²⁸ [Go Smarter Make the Switch](#) (2016)

widespread use there remains very limited empirical evidence to support the emphasis given to cost/benefit calculations in transport appraisal.

Safety of road users, particularly cyclists and pedestrians, needs to be a key consideration when determining proposals to ease congestion and a balanced package of measures will help to achieve this.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The role of Tyne and Wear Metro is fundamentally important to the economy and people of Tyne and Wear. It connects key centres of population allowing access to employment opportunities, to travel for leisure purposes or for education and training. Following, the acceptance of Nexus' business case by government in 2007, the DfT granted Nexus significant capital funding to undertake the Asset Renewal Programme which, when combined with a 10% local contribution amounts to around £352 million spread over 11 years. This has meant that life expired assets have been renewed and replaced. This includes track, overhead lines, lifts, escalators and refurbishment of the current Metro Rolling Stock. This investment has improved the operational performance of the system's infrastructure across a number of factors.

In recognising the importance of renewals and maintenance, Nexus had developed ambitions plans to continue the long term approach to capital funding, through an Outline Business Case submission to the DfT.

As well as the plans for Metro renewal, the North East has an ambitious programme to construct a new generation of transport infrastructure in the region. However, this should be balanced with commensurate investment in revenue funding.

Prizing capital investment at the expense of revenue²⁹ could lead to perverse incentives for local authorities to build new infrastructure at the expense of maintaining their existing assets. In order to better balance this, revenue funding made available to local authorities to provide activities such as maintenance and planning should be increased.

Recent work from the Urban Transport Group indicates that increasing maintenance funding could provide returns of £6.50 for every £1 invested³⁰ and TRL suggested that cuts in road maintenance budgets could result in wider costs to the economy of between £1.50 and £2 for every £1 saved³¹. This has been backed up by the National Audit Office, which has called for long-term certainty in funding of road maintenance³². This should also be backed by more balanced investment in maintenance between the strategic and local road networks. The Highways England Network has a spend of £111,000 per km per year, while Local Authority B, C and U roads only spend £7,000

²⁹ Urban Transport Group [The Revenue-Capital Mismatch](#) (2015)

³⁰ Urban Transport Group [A Bumpy Ride: The Funding and Economics of Highways Maintenance on local roads in the English City Regions](#) (2015)

³¹ TRL for Transport Scotland, National Roads Maintenance Review (2012)

³² National Audit Office, [Maintaining strategic infrastructure: roads](#) (2014)

per km per year³³. While these are different types of road, these gaps should be narrowed.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

One of the primary barriers to efficient transport funding is a preponderance of competition-based funding. While this may have some merit in allowing a more flexible approach from central government in terms of project selection, on the ground at a local level it produces challenges in terms of project selection and delivery. This means that it is challenging to bring forward projects which fall outside traditional 5 year funding envelopes or are at a very early stage and there is a bias toward 'shovel ready' projects, which may not be the most optimal to achieve long-term benefits.

As noted under Question 5, the preponderance of capital funding over revenue based funding means that there are significant challenges for authorities to deliver infrastructure services efficiently. The lack of revenue funding can mean that longer term priorities are not addressed efficiently.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

This response can be broadly split into two points, one on the devolution of existing powers and another on alterations to the planning and governance structure.

The NECA is supportive of the principle of the government's proposals for devolution of powers, which if developed appropriately, will have significant benefits for delivery of areas such as transport and housing in all devolved areas. Devolution of powers would mean that a long term programme of activity can be planned, rather than dealing with schemes on an ad hoc basis, therefore enabling projects with transformational impacts to be properly planned, appraised and delivered.

Transport for the North (TfN) is establishing unique governance arrangements to enhance its role as the voice of the North on Transport, bringing together representatives for the whole of the North through Combined Authorities and Local Enterprise Partnerships with an independent chair.

An embedding of the governance of TfN in its constituent transport authorities provides for the ability to better align strategic priorities both inter and intra-regionally. When allied to long-term planning and appraisal this presents the most effective governance to deliver transformative infrastructure.

In terms of alterations to the planning and governance structure, NECA is a transport authority rather than a highway authority and does not currently believe highway authority powers would be appropriate over the large spatial area of the region.

³³ See 30

However, there are potential alterations to the planning and governance structure which would help ensure that infrastructure is delivered efficiently.

NECA believes in delivering not merely transformational infrastructure, but public transport service delivery in the North and has pursued innovative governance and management solutions to enhance long term planning and outcomes for stakeholders. In terms of rail, it is anticipated that the North East Rail Management Unit, involving the North East Combined Authority, Tees Valley, Cumbria, and North Yorkshire, will be integral to our ambitions to deliver a step change in quality for rail users in the North and support this model of more localised service delivery. This partnership, which includes train operators, is the first of its kind and will be helping the authorities in the North East ensure that new franchises truly deliver their ambitious upgrades for the regions trains.³⁴

The NECA would like to see full implementation of the 2004 Traffic Management Act which would equip local authorities with the powers to enforce and issue penalties for moving traffic offences such as blocking yellow box junctions, ignoring one-way systems and banned turns. The Local Government Association notes that ‘gaps in council powers at even the most prosaic level hamper attempts to manage transport as a whole.’

As stated by the Local Government Association in their response to the Bus Services Bill, enforcement by local authorities will help to improve traffic flow at congestion hotspots and improve journey times. The NECA believes that full implementation of the Traffic Management Act would significantly enhance traffic flows in urban areas and therefore encourages government to fully implement the Act. This improved traffic flow would prevent the need for significantly more expensive infrastructure investment. It is disappointing to see that the Department for Transport does not currently wish to endorse this.³⁵

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Contemporary cost-benefit techniques are frequently critiqued within^{36 37 38 39} and outside the transport industry⁴⁰. NECA welcomes the DfT, and government more widely, being open to the review of their analysis and methodologies and has been supportive of the Understanding and Valuing Impacts of Transport Investment (UVITI) programme at the DfT. This has included partnership working with the Urban Transport group on a joint response to the recent DfT consultation on changes to wider economic impact assessment and on values of time.⁴¹

³⁴ *Nexus* [North East passengers to benefit from rail deal](#) (2016)

³⁵ *Transport Network* [Exclusive: Government refuses to move on moving traffic violations](#) (2017)

³⁶ Prof. David Metz, *The Myth of Travel Time Saving*, *Transport Reviews* Vol 28. No.3, p321-336 (2008)

³⁷ Dr Rachel Aldred, *British Cycling*, *Benefits of Investing in Cycling* (2014)

³⁸ *Passenger Transport Executive Group/Urban Transport Group* [Response to Department for Transport WebTAG consultation](#) (2010),

³⁹ *Sintropher/University College London* [The Problematic application of CBA in transport appraisal](#) (2015)

⁴⁰ As summarised in *Steer Davies Gleave*, [Is there a crisis in transport appraisal?](#) (2011), *What Works Centre Evidence Reviews: Transport* (2015)

⁴¹ *Urban Transport Group* [Response to Value of Time Consultation](#) (2016)

However, there are a number of further changes which would make the system credible and transparent, reducing its appearance as a 'black box' and ultimately increasing public trust in the appraisal process.

These are:-

- Current DfT guidance assumes that there is 100% displacement of employment from transport schemes, unless they are additive at a national level⁴². We would question this, particularly in the context of Foreign Direct Investment (FDI). The North East has an extremely strong record in FDI, competing to win contracts internationally. When global businesses choose to locate in the North East, they are frequently not choosing against other parts of the UK (as assumed in current guidance) but against the wider world.
- As noted in our response to question 3, we are committed to making better places to live and work in the region. Part of this has been done through successful urban regeneration and improvement projects such as Newcastle Station Portico⁴³ funded through the Regional Growth Fund. However, the current appraisal system does not allow us to capture the land value increases caused by these improvement schemes and consequently there are challenges in terms of their appraisal. A more open appraisal system would better capture these benefits
- The current appraisal system struggles with appraisal of highway and public transport maintenance schemes. As noted in our response to Question 5, with declining revenue budgets, highway maintenance is more and more being addressed through competitive bid funding. However, to put these schemes up against capital improvement projects puts other schemes at a disadvantage. Ultimately, the solution to this is to increase revenue budgets available to local authorities.
- It can often be challenging to present a positive cost-benefit analysis case for public transport projects, particularly ones which extend into areas experiencing significant deprivation. This is despite such projects meeting many of central and local government's wider policy objectives. Social and Distributional Impacts are currently accounted for in transport guidance, but should play a far greater role in infrastructure appraisal, even for national-scale projects.

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

This is an exciting time for transport. Travel demand has varied considerably over the past 50 years and technological developments mean that changes are likely to continue apace over next 33 years. We believe that the North East is well placed to be at the forefront of new technologies and adaptation to change.

However, we must be clear that transport does not always lead development. When planning transport infrastructure for the long term, we should consider the future locations of development and the sorts of places in which we want to live. This means

⁴² Department for Transport [Understanding and Valuing Impacts of Transport Investment: Updating Wider Economic Impacts Guidance](#), (2016)

⁴³ Ryder Architecture, [Newcastle Central Station](#) (2014)

that at all stages in the transport planning process we should consider future locations, future development and the travel patterns which emerge from this.

NECA anticipates the following changes in travel patterns between now and 2050, resulting from the impact of new technologies and other trends:

1. Continuation of the trend away from traditional “Monday to Friday 9 to 5” working patterns, with technology enabling more homeworking, flexible working, video conferencing, dispersed employment locations and part-time working⁴⁴
2. A readiness among younger people, especially in urban areas, to consider alternatives to the car, where these are supported by an adequate public transport, cycling and walking network. This has led to a fall in mileage travelled by these people⁴⁵
3. Increased online shopping and banking, with consequent rise in delivery van traffic and reduced off-peak home to city centre or retail development travel demand⁴⁶
4. An increasingly older population, resulting in : fewer work-related trips ; much greater focus on travel to health facilities ; more leisure journeys ; higher expectations of independent mobility ; increased need for appropriately designed infrastructure and services including door-to-door transport provision⁴⁷
5. Increased expectations of the quality of public transport in terms of speed, reliability punctuality, comfort, seamless ticketing and comprehensive technology-based information before, during and after a journey ⁴⁸
6. The potential for new technologies, such as driverless cars, to change the way in which we approach car ownership, mobility and the user of our time while travelling⁴⁹

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

The NECA contains major urban areas of Tyneside and Wearside and supports a number of transport investments which will allow people and freight to move more freely in and around these areas. The NECA Transport Manifesto outlines our position on major investments in our region⁵⁰ and sets out our key themes and guiding principles for transport. This builds upon our Strategic Economic Plan⁵¹, which set out our region’s ambition for investment that would enable more and better jobs.

⁴⁴ There is a large body of work on this literature. Some relevant publications are: *Department for Transport, National Travel Survey* (2015); *Gordon Stokes Has Car Use Per Person Peaked?* Transport Statistics User Group (2012);

⁴⁵ *Transport for London Travel In London 9* (2016)

⁴⁶ *Department for Transport Road Use Statistics Great Britain* (2016)

⁴⁷ *International Longevity Centre The Future of Transport in an Aging Society* (2015); *Shergold et al., Future Mobility in an Aging Society: Where are we heading?*, *Journal of Transport and Health*, Vol 2. No.1, p86-94 (2015)

⁴⁸ *Transport Focus, Smart Ticketing in the north: What do passengers think?* (2016); *Passenger Focus, The Future of Transport* (2012)

⁴⁹ *Department for Transport, Driverless Vehicles: Impacts on Traffic Flow* (2016)

⁵⁰ *North East Combined Authority, Transport Manifesto* (2016)

⁵¹ *North East Local Enterprise Partnership, Strategic Economic Plan* (2014)

Some of the highest value investment in urban transport can come from complementary investment in traffic management and control. In the North East, Tyne and Wear and Durham have Urban Traffic Management and Control (UTMC) systems which provide notice of disruption, help us to manage major events and enable the smooth flow of traffic through connected traffic signals. Research⁵² indicates that further investment in these systems can deliver high value for money, with UTMC services providing £60m of network benefits over a decade. These systems also provide an ideal testbed for future research projects to better understand the impact of transport investment. In Tyne and Wear, the UTMC Centre is working with Newcastle University and other partners as part of the Newcastle Urban Observatory and Compass4D projects⁵³ which will deliver significant benefits to the city.

The benefit cost ratio of cycle schemes can be as much as 20:1⁵⁴. Findings from Cycle Demonstration Towns have found that for every £1 invested in cycle measures, the value of decreased mortality was £2.59. When considering infrastructure costs alone, it was found that a piece of cycle infrastructure costing £1 million, only requires an extra 109 people each year to become regular cyclists for payback when considering the benefits to health, congestion and pollution⁵⁵. Enabling greater use of these active modes will also lead to reduced levels of congestion, fewer Greenhouse Gas emissions, lower noise levels and improved air quality.

To maximise their benefits both walking and cycling provision must be fully integrated with the road and public transport networks. Moreover, although cycling has been declining in much of the country prior to changes in government policy, there are still places where it has retained a significant modal share of journeys, such as Oxford and Cambridge, and there are cities in Europe like Copenhagen and Stockholm that have successfully increased cycle use to even greater levels, more than a third of journeys to work, and are frequently rated highly for quality of life and liveability.

In dense urban areas which suffer from motor traffic congestion, cycling is an ideal solution which can allow for rapid commuting between different parts of the city, and this is ideal for assisting in the benefits of agglomeration. There is a growing use of cycling in many congested cities for not only cycling for the movement of people, but also for the rapid movement of goods as well, for larger packages using adapted bicycles such as cargo bicycles. The efficiency gains from switching from motorised transport to pedal powered transport in congested urban areas are enormous.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

The NECA has the largest rural footprint of any Combined Authority area and contains large rural areas of Durham, Northumberland and Gateshead. Rural transport

⁵² ITS UK, [Intelligent Transport Systems and their benefits](#) (2016); AECOM NECA UTMC Review (2016); Kolosz, B. Extending cost-benefit analysis for the sustainability impact of inter-urban Intelligent Transport Systems, Environmental Impact Assessment Review, Vol 50. p167-177 (2015)

⁵³ [Compass 4D Newcastle's 'talking' traffic lights could cut congestion](#) (2015)

⁵⁴ Sustrans Economic Appraisal of Local Walking and Cycling Routes (2005)

⁵⁵ Department for Transport, Valuing Increased Cycling in the Demonstration Towns (2009)

presents different issues to that in single urban areas and it can be difficult for it to secure equal funding opportunities. This is highlighted in our recent Transport Manifesto and Strategic Economic Plan, as noted in our response to Question 14.

In more rural areas, it is important for capital investment to be matched by revenue spending which can help support the provision of services that are vital lifelines to communities. While these investments may perform less well on traditional Value for Money metrics they are crucial to sustaining the vitality of these areas. This includes not only improving rural to rural connectivity but also rural to urban connectivity, enabling more people to get around without relying on private car travel.

In terms of connecting multiple urban areas and regions, as noted in Question 10, the Combined Authority and its constituent authorities is a member of a sub-national transport body, Transport for the North. This body will, through its Strategic Transport Plan, identify the highest value transport investments to deliver economic growth across the urban and rural areas of the North of England.

Response to the NIC Call for Evidence, North East Combined Transport Activists' Roundtable (NECTAR)

Introduction

NECTAR is one of a network of Transport Activists' Roundtables working together with the Campaign for Better Transport and similar national bodies that share the core aim to promote sustainable transport. It covers the North East of England from the North Sea coast to the Pennines and from Scotland to North Yorkshire. It is an open, voluntary, umbrella body, established to provide a forum in which the many organisations with an interest in sustainable transport in all its forms can develop a co-ordinated view on contemporary transport issues. NECTAR provides opportunity for the exchange of news, studies and information and provides a voice for dialogue with government, transport providers, transport users and similar bodies concerned with transport and related policy and practice locally, nationally and internationally.

Membership of NECTAR is open to organisations which:

- o support the use of sustainable transport and sustainable changes to the transport infrastructure.
- o broadly support integrated transport and land use policies which reduce the need to travel
- o promote better provision for public transport, walking and cycling.
- o seek to minimise any negative environmental or social impacts of transport, whilst maximising accessibility, safety, good health and quality of life for all.

Responses

Cross-cutting issues: 1. Highest value infrastructure investments

Sustainable development should take environmental and social objectives into consideration, rather than focusing solely or mainly on the sustainability of economic growth. With regard to transport, it is important to consider the environmental impacts of major schemes, such as air and noise pollution, land take, severance, and carbon emissions.

We consider the following projects to be the most important for the future of a sustainable transport system in the North East. They are described in detail in Appendix 1.

- a) Expansion of the Tyne & Wear Metro system as described in the Metro Strategy 2030.
- b) Reopening of the railway line from Ferryhill to Pelaw (21 miles) utilising the former Leamside track bed.
- c) Upgrade of the Stillington (Ferryhill - Stockton) freight only line (circa 10 miles) to passenger train standard.
- d) Creation of strategic radial cycle routes in Newcastle-upon-Tyne, the region's most significant employment hub.
- e) Ashington, Blyth and Tyne railway line reopening

Other important projects in the area are:

- f) A new rail halt at Horden, Peterlee (supported by the North East LEP)
- g) A new station at Ferryhill
- h) A new station at Team Valley
- i) Newburn – Blaydon footbridge

2. Contribution of infrastructure to international competitiveness.

The priority should be international welcome – ensuring transition between international arrivals and regional transport networks, particularly with regard to passenger transit to regional

destinations. As well as ports and airports, a priority should be the East Coast link to Eurostar services; it reflects the importance for the North East of St Pancras International station as a gateway to/from Europe.

3. Planning and designing infrastructure to create better places to live and work.

The most important thing is to ensure that infrastructure is considered at all stages of the development process. The aims should be, firstly, to reduce the need to travel; secondly, to prioritise more environmentally sustainable and space-efficient modes, establishing a hierarchy of users - from top to bottom, pedestrians, then cyclists, then public transport users, then private car users.

At the strategic level:

- planning for growth in locations with existing good public transport routes, or with routes nearby that could be extended to new developments - particularly passenger transit.
- Assuming higher densities in order to generate more compact cities that can be more easily served by transport infrastructure and which create shorter journeys to facilities and services, amenable to active travel and the development of efficient public transport services. (Metro identifies low population density as one of the constraints on its efficiency.)

At development level:

- Design to ensure characteristics which facilitate use of sustainable transport modes: density, legibility, interconnectivity, and safe and segregated pedestrian and cycle routes.
- Reducing the need to travel by incorporating adequate and accessible facilities and services.

4. Potential for demand management, recognising behavioural constraints and rebound effects.

Demand management for road space should prioritise users higher up in the hierarchy of users, as described above. Demand for road space by users of motorised transport can be managed by:

- temporal distribution: seeking incentives for peak spreading, such as flexible working hours, extension of retail hours, and cheaper off-peak travel and parking.
- modal distribution: encouraging cycling and walking by better, safer and segregated cycle and pedestrian infrastructure and parking; encouraging use of public transport by better and more efficient transport planning. 2/3 of car trips are less than 5k, so many of these could be made by cycle; but without safe cycling infrastructure, modal shift won't happen.

Attempting to spread demand spatially is not an environmentally sustainable option. More dispersed origins and destinations mean that a greater amount of pollution is spread over a wider area and that it is harder to service the network by public transport – whereas a centripetal network based upon local hubs facilitates simpler and more viable public transport networks. However, reducing the need to travel, so that facilities and services can be accessed locally, is viable.

It is possible that demand management could result in a different equilibrium, where better cycling, walking and public transport facilities might free up road capacity only for it to be filled again by motorists. However, the level of congestion at which this equilibrium settles would be lower than if no genuine choice exists and people are forced to drive through the inadequacy of other modes. Mechanisms to dissuade car use could also be used, such as constraints on particular types of vehicle (particularly the most polluting), increased parking charges, and traffic management that did not prioritise vehicular access in town centres.

5. Balancing maintenance and repair with the construction of new assets.

At present, decades of under-investment in cycle and pedestrian networks in the North-East of England, and the absence of a good regional rail network except in Tyne and Wear, means that in some places there is little to maintain. The priority, therefore, has to be bringing facilities for non-car modes up to an acceptable level, while restricting expenditure on roads to repair, maintenance and safety enhancements. (Road maintenance is as important for cyclists as for motorised vehicles, since cyclists will always have to use roads in some situations.)

6. Opportunities to improve the role of competition or collaboration.

Experience has shown that public transport services cannot be delivered efficiently by the private sector. This means that private operators focus on the most profitable routes, limiting the potential for cross-subsidy of socially necessary but unprofitable ones – so that these must be funded publicly - and causing congestion, especially where multiple operators compete along overlapping routes. It also reduces the ability for co-operation between operators and across modes in matters such as alignment of timetables, creation of interchange points, and through ticketing. A return to central planning of public transport is needed to deliver a functional and credible service. In this respect the Bus Services Bill, with its emphasis on franchising and partnership working, is welcomed, although its bar on local authority-owned bus companies seems to be a manifestation of blinkered ideology.

7. Desirable changes in funding policies

Funding policy should take into account environmental and social objectives, and cost-benefit analyses should resist monetising of drivers' time as a proxy for economic growth, as discussed below. Funding decisions should be strongly influenced by the need to cut carbon emissions and reduce air pollution. Long-term certainty of funding is required (as opposed to a feast-or-famine style of allocating funding). Specifically with regard to rail infrastructure, measures are needed to ensure that Network Rail responds positively to proposals rather than wishing that they'd go away.

8. Circumstances where projects that can be funded will not be financed.

Proposals that would increase carbon emissions or air pollution should not be financed even if they already have funding.

9. Ensuring resilience against the risks arising from increasing interdependence across sectors.

The first priority has to be increased resilience of the component parts, followed by improved collaboration and communications between sectors.

10. Desirable changes to planning and infrastructure governance.

Better co-operation is needed between the LTP and Local Plan development process. They should really be planned together in authorities where the same area is covered by both, so that an interlinked strategy is created, in which development planning always takes account of the need to provide infrastructure and takes up the opportunities presented by new transport infrastructure, and where transport planning takes into account likely increases in population and industry and is able to influence their location. Where the spatial scope of the LTP differs from that of the Local Plan, collaborative working is likely to be more difficult and complex. Unfortunately, we seem to be moving in the wrong direction here: transport is to be planned at a combined authority level, and land use development by local authorities.

Specifically with regard to rail improvement projects, we understand that difficulties have been encountered through both Network Rail's GRIP process, which sometimes proves to be expensive and lengthy, and its apparent shortage of technical staff with relevant expertise.

The early stages of the GRIP process essentially involve Network Rail charging the sponsoring client for a study to confirm the client's intentions. Thus the process seems to be trying to impose an internal project management process onto an external commercial environment. This gives the impression that there is no inherent desire within Network Rail to grow the network.

Besides this, there is a tendency for Network Rail to add in functionality that is not required for the immediate project. That may be the appropriate thing to do from the point of view of the wider rail network, but the extra functionality should not need to be funded by the local project sponsor. We suggest Network Rail should have their own capital improvement funds to invest in such cases.

In summary, Network Rail have no competitor, and little apparent appetite to "win" the business or to keep the price to within reasonable levels that the project sponsor can justify. It should be possible to deliver projects much quicker and more cheaply than the current arrangements allow.

11. Contribution of infrastructure to protecting and enhancing the natural environment?

The global environment can be best protected by fostering the deep cuts in carbon emissions which are required by the Paris Agreement. In transport terms, this should be done by focusing on reducing the impact of motorised transport by encouraging and facilitating modal shift.

Measures to reduce car use and, hence, carbon emissions, should also reduce the local impact of transport upon the natural environment. Regulatory measures such as fostering innovation and efficiency are also needed to reduce use of the most polluting vehicles.

The local natural and built environment can best be protected by reducing the land-take of transport infrastructure. Again, this can best be done via a shift away from the private car and by resisting demands for new roads and car parks, taking due note of the low occupancy of cars, generally averaging around 1.2 occupants per car in peak time journeys (DfT data).

In rural areas, demand for increased tourism is now saturating many car parks. A strategic review of locations, shuttle arrangements etc at key tourist nodes might usefully be carried out.

12. Desirable improvements to cost-benefit analysis techniques.

Changes are needed to the way in which the costs and benefits of road projects are assessed. At present, drivers' time is monetised, so that the delays experienced by motorists within a given country or region are interpreted as an economic cost which the area has to bear. This hypothetical cost is used in order to justify schemes to speed up motorists' journeys. However, the evidence for an inverse correlation between congestion and economic growth is patchy. That's not really very surprising; more economically successful places attract more travellers, and therefore have more congestion; you could argue that congestion causes economic growth, although this would probably have the causal mechanism the wrong way round.

It is sometimes assumed that quicker travelling frees up people to spend more time being economically productive. This may not be the case. Sometimes it simply facilitates longer commutes. Monetising of drivers' time is particularly problematic where a very small delay affects a large number of motorists. The cumulative cost of the delay is assumed to be very large, even though the impact upon any road user's quality of life or economic potential will be negligible.

So monetising of drivers' time is a poor way to assess the costs and benefits of road schemes. It also has significant negative effects in terms of the way funding is allocated. It is used to justify road-building schemes which may not, in actual fact, have broader economic benefits, and which may have significant impacts in terms of land-take and induced demand, as more people find it

convenient to use clearer roads, and faster journeys facilitate increased commuting distances. All of this has negative consequences in terms of local air pollution and carbon emissions. Conversely, there needs to be a stronger emphasis on monetising the indirect costs of motorised transport. While there have been changes to WebTAG over the years, we do not believe that air pollution and carbon emissions, issues that government is now obliged to address in a significantly shorter timeframe than it wanted, feature as prominently as they should.

Transport: 13. Changes in travel patterns between now and 2050.

The development of autonomous vehicles will have both positive and negative consequences. Negative consequences will include: a reduction in driver jobs ; potentially, an increase in the total number of motorised vehicles, as on-demand vehicles become cheaper, and are able to be driven by anyone - and hence an increase in land-take, carbon emissions, severance, noise, etc. Positive consequences could include: more efficient use of vehicles through the use of “mobility as service” ; uptake of autonomous vehicles by those currently unable to drive, thus conferring additional freedoms.

Increasing carbon emissions and climate change are likely to have the following consequences: increased levies on carbon emissions and hence, an increase in the costs of driving (although cars are also likely to become more efficient) and a squeeze on the costs versus benefits of buses and light rail; warmer weather facilitating more cycling and walking; direct impacts of climate change and volatility upon transport infrastructure, such as melting, buckling or flooding.

If trends continue, the number of journeys may not rise very much, or may change (more home-working, more click-and-collect shopping, changing recreational journeys) but journeys on average are becoming longer – meaning greater carbon emissions and their consequences.

There will be an increased requirement to address air pollution, particularly in major cities, and reduce carbon emissions. Policy-makers should seek to reduce demand for travel and to prioritise transport modes higher up the hierarchy of users, as described above. There will also be a need to increase the electrification of motorised transport (rail, bus and car).

14. Highest value transport investments around major urban areas.

In the NECTAR view, this has to be the investments that facilitate the transit of the greatest number of people for the lowest possible cost - not just financially, but in terms of land-take, carbon emissions, and other environmental impacts. Recent judgements on the legality of the Government’s action on air pollution, and findings about the impact of air pollution on physical and mental health, indicate the need to prioritise less polluting modes wherever possible. Hence NECTAR suggests that, in the area, extensions to the Tyne and Wear Metro system and their connectivity with other transport networks are likely to be the highest-value investments.

15. Highest value transport investments outside a single urban area.

Rail links, as described above and in Appendix 1.

16. Opportunities and effects of ‘mobility as a service’ for road user charging.

Establishing the concept of ‘mobility as a service’ facilitates the recognition of the real costs of provision, eg of motoring. Currently motoring costs are normally hidden behind road subsidies, standing charges etc. Motorists notoriously perceive motoring costs to be synonymous with fuel costs when comparing costs with other modes. However, when claiming expenses, the maximum HMRC permitted charge (4 to 5 times higher) suddenly is recognised!

Appendix 1: Description and justification for strategic projects

Descriptions of the projects

Project a) Tyne and Wear Metro improvements as described in the Metro Strategy 2030

This project is described elsewhere and is supported by NECA. It is therefore not discussed in detail here, but we reiterate our support for it as a strategic project with the potential to make a significant social and economic contribution, and support environmentally sustainable transport.

<http://www.nexus.org.uk/sites/default/files/Metro%20Strategy%20Background%20document.pdf>

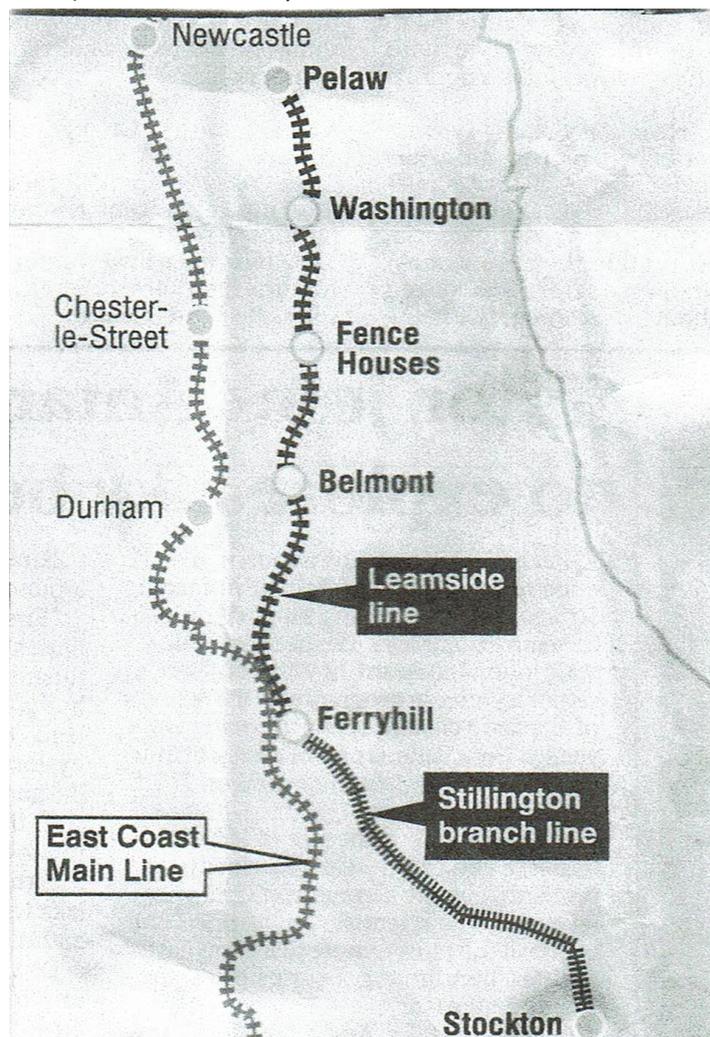
Project b): Construction of a railway from Pelaw to Ferryhill utilising the former Leamside track bed.

1: Project Title

Construction of Leamside Railway Line

2: Location

The Leamside track bed runs largely unimpeded from Pelaw (near Gateshead) via Washington, Penshaw and Belmont to Tursdale Junction at Ferryhill on the East Coast Main Line (ECML). The total length is 21 miles. At Pelaw there is ready access to both the Middlesbrough to Newcastle (Durham Coast) line and to the Tyne & Wear Metro.



3: What the project entails – its scope and its vision

The Leamside project requires the construction of a double track, electrified (25kv) railway from Pelaw in Tyne and Wear to Ferryhill, County Durham. Passenger stations would be required to serve Washington (pop 55,000), a Park and Ride facility created at Penshaw, an interchange station at Belmont (three miles from Durham City) and at Ferryhill. The route would be suitable for freight trains, for a local Newcastle-Middlesbrough service (via Ferryhill and an upgraded Stillington line); and as a diversionary route for long distance passenger trains.

The line would galvanise local rail travel within the relevant catchment area, create enhanced public transport connectivity, act as a driver of economic regeneration and improve quality of life. It could provide freight services to Nissan and to the national warehousing centre at Washington.

The project is endorsed by Durham County Council (DCC), Newcastle City Council, North East LEP, Nexus (operators of Tyne & Wear Metro), local MPs, Transport for the North (TfN) and Rail North.

4: History

Until 1872 when the present ECML was opened, Leamside was part of the primary route from Newcastle to London. Thereafter it was used for freight and for local passenger services, which ceased in 1962. Leamside was closed after the ECML was electrified in 1991. In 1995 DCC drafted (unfunded) proposals for a passenger service over Leamside in the County Durham Structure Plan. In 1999 Railtrack announced that it intended to re-open Leamside. The aims were to alleviate forecast capacity constraints and separate freight trains from high speed passenger ones between Newcastle and Northallerton. Project completion was estimated for 2004. Funding for the construction of new stations at Washington and Belmont was secured - the latter to include a Park and Ride interchange facility - and a new station at Ferryhill was proposed. Preliminary work commenced late 2001, but ceased the following year when Railtrack went into receivership. However, DCC reiterated its hopes for the line in its Local Transport Plan (LTP2) published in 2006. In 2006, key Leamside players commissioned Faber Maunsell to produce a feasibility study to assess the line's potential, which reported at the end of 2007 and favoured reopening. A report (in 2009) by the Association of Train Operators (ATOC) pointed to Washington as one of the largest centres of population in Britain without a rail link. By implication ATOC supported Leamside reinstatement. During 2012/13 the track was lifted by Network Rail and all disposable items removed due to serious vandalism and deterioration - on the understanding that the route would remain unimpeded. DCC, NELEP and Nexus remain committed to reinstatement. In 2016 HS2 Limited investigated the construction of a new bypass line to the east of Durham city utilising the Leamside track bed, in order to cater for the arrival of the dedicated high speed line at Leeds post-2033.

5: Economic Benefits

The Faber Maunsell Study of 2007 demonstrated that Leamside could bring substantial economic benefits to present and future employers along the route in terms of access to freight flows and in increasing the size of the labour pool able to commute by rail. The combined population of the city regions of Tyne and Wear and Tees Valley (Middlesbrough) – 1.42 million – is the fourth largest urban area in the UK. Trains could run between Middlesbrough and Newcastle in less than one hour and also serve Washington.

6: Impact on employment and education

Besides increasing access to employment opportunities, the passenger service would broaden choice of and access to colleges of education, an especially important factor in the lives of young people.

7: Mobility and Housing

New key journey opportunities would be created by the line in its catchment area enhancing travel mobility enormously. Leamside could also unlock the potential of adjacent development sites,

housing and commercial, which have poor access by road, or which lend themselves to innovative spatial planning designs, based upon minimal use of the private car.

8: Operational advantages to the wider rail network and aspects of resilience

Besides offering opportunities for the creation of a much needed local passenger service and enabling freight trains to keep clear of the Newcastle to Ferryhill section of the ECML, Leamside would provide an excellent diversionary route for long distance passenger trains during periods of disruption. At present any closure of the ECML between Newcastle and Ferryhill requires an inconvenient and expensive bus replacement, since the alternative (Durham) Coast route can only cope with one of the five long distance trains per hour that currently operate on this section. This same section contains three major viaducts as well as a number of embankments. In the event of significant failures involving any of these structures, especially over a lengthy period, the train operators would have to 'shut up shop' between Newcastle and Darlington since in reality there is no viable diversionary route.

9: Contribution to joined up transport

Leamside offers easy access to the Metro at Heworth with destinations including Newcastle International Airport. Heworth is also a large bus interchange point and boasts a park and ride facility. At Belmont, Leamside would link up with the Durham City park and ride bus services that operate from the Belmont Interchange located a short distance from Junction 62 of the A1(M). Construction of a significant park and ride facility where Leamside crosses the A182 near Penshaw should be possible and would provide an alternative mode of travel for the many car commuters making for Newcastle and Durham. Assuming the Metro would be extended from South Hylton to Penshaw and link with Leamside there, new rail access into Sunderland would be established.

10: Impact on car usage

Leamside is expected to encourage a significant modal shift from car to train, notably during traditional peak periods, along the A1(M) corridor between Durham and Newcastle, between Washington and the A1 Western By-Pass, and between Ferryhill and Middlesbrough area with some shift as well on the A19 between Houghton-le-Spring and Newcastle.

11: Impact on Air Quality and Carbon Emissions

Any modal switch from cars that can be achieved will clearly have a positive effect on both air quality and on carbon emissions.

12: Contribution to International Gateways.

Not only will a reopened Leamside route provide good access to Newcastle International Airport via Heworth (see section 9), but if the wish of Nexus to operate dual voltage and bi-mode trains over both the existing Metro lines and heavy rail ones is fulfilled, then through running between the likes of Hartlepool and the Airport become possible. There is the opportunity to create a passenger train service in and around the Tyne and Wear Metro system which would otherwise not be possible. Leamside also opens up the prospect of more rail traffic running to and from the Port of Tyne which is already well established as an international gateway point in the North East.

13: Project Financing

Funding will be sought from national/central sources with some assistance possibly available from the Government's local growth fund.

14: Impact on Quality of Life

Quality of life enhancements will arise from increasing employment and educational opportunities, economic rejuvenation of the area, better public transport to hospitals and leisure facilities and improved health as a consequence of better air quality.

Project c) Upgrade of Ferryhill to Stockton freight only line to passenger train standard

1 Project title:

Quicker Tees-Tyne Rail Services

2 Location:

The project involves the section of freight-only track between Norton South Junction (north of Stockton-on-Tees railway station) and Ferryhill south junction (where this line joins the East Coast main line between Darlington and Durham). It is just over 10 miles in length.

3 Scheme History:

Passenger services ceased along this section on March 31, 1952, when its three local stations (Sedgefield, Stillington, and Redmarshall) closed. The line itself, however, did not close, as freight services have been routed along it from that day to this. From time to time, it has been used for main-line long-distance passenger trains when the 'normal' route through Darlington was being maintained and/or repaired, usually at weekends.

Occasional efforts were made, by British Rail, to introduce a direct Middlesbrough - Durham - Newcastle passenger service, but they never succeeded. Arriva Northern's desire to introduce something similar, as one of the "Northern Connect" group of semi-fast passenger services, is the latest bid to speed up Tees-Tyne rail travel.

4, 5 Likely Economic Benefits (including access to employment, tourism, and higher education):

Three background factors affect any meaningful estimate of these. They are:-

(a) The Tees Valley Combined Authority spans the 27-mile distance between Darlington and Saltburn, including Stockton and Middlesbrough (11 miles and 15 miles eastward respectively). The nearest main line train services are accessed at Darlington. No other comparable area of (post)industrial Britain is treated like this - Stoke-on-Trent, 15 miles east of Crewe, has its own twice-hourly London expresses (from Manchester), and Nottingham, 16 miles east of Derby, has a similarly-generous range of direct through trains to and from London. So why not Tees-siders?

(b) In 1992, British Rail extended their Transpennine network northwards and eastwards to Thornaby and Middlesbrough, whose populations could now reach York, Leeds and Manchester by through semi-fast trains without touching Darlington or changing trains. This service has been outstandingly successful, often overcrowded on Saturdays all the year round.

(c) Three rail routes connect the two conurbations.

(i) the 47-mile Coast line via Hartlepool and Sunderland, whose trains take 78 minutes from Middlesbrough to Newcastle. These are often hopelessly overcrowded, especially on Saturdays, leaving intending passengers behind from as far south as Hartlepool itself:

(ii) the Middlesbrough-Darlington-Durham-Newcastle line, 51 miles in all, whose few remaining local all-stations trains need some 70 minutes northbound and 66 south:

(iii) the Middlesbrough - Stockton - Norton - Stillington - Ferryhill - Durham - Newcastle line, just under 42 miles - on which no passenger trains run at all!

So if passenger services begin on the Stockton-Ferryhill route, they will save over 20 minutes each way between the two conurbations, as an overall Middlesbrough-Newcastle time of 55 minutes is possible, even with the present 50mph speed-limit on the freight-only section. Such trains will help to relieve overcrowding on the Coast line more or less from the day they begin, in that those in Middlesbrough, Thornaby or Stockton wanting to go to Newcastle will no longer need to use Coast line trains to do this. Nor will they need to divert via Darlington. This route also transforms intermediate journey-times, especially that from Stockton to Durham.

Durham university established an outpost in Stockton some years ago, and an express bus service (X12) connects the two; but it takes at least 48 minutes, even if there is no traffic delay in and around Durham. This would compare with a 28-minute booking, start to stop, even before any track refurbishment occurred. Quite apart from the time-reductions, of course, a restored rail service via Stockton-Ferryhill brings an entirely new, hassle-free way for all in and around Tees-side to visit Durham as a tourist attraction. If a new station is built at Ferryhill itself, as advocated by another project in this series, the value of the Stockton route as a way to employment in Tees-side is added to that of the main line to Newcastle for all who live within range of Ferryhill.

6 Housing development possibilities:

As this project does not, at least in its earliest stages, involve any new station-building, little effect can be guessed at, unless the potential of an enlarged station at Stockton is exploited so that some main-line services between York and Newcastle are routed via Stockton rather than Darlington. Stockton, with 190,000 inhabitants, should arguably be prioritised over Darlington, with 105,000.

7 Operational advantages for the railway:

Background factor (a) above, headings 4 and 5, is evidently leading the Tees Valley Combined Authority to prescribe ambitious but unnecessary expansion of facilities at Darlington Bank Top - for a station handling fewer trains on its through lines than Northallerton. The gross imbalance of provision, when compared with population distribution, means that Stockton, with so much spare capacity thanks to its currently vestigial one-short-train-per-hour each way, can readily cope with some York-Newcastle express services, to the overwhelming benefit of all in the borough. Journey time to and from York can reduce to just over 40 minutes (depending on intermediate stops) just as it will to Newcastle via the Ferryhill line.

First Transpennine's additional trains from York to Newcastle, extensions of its Manchester Airport service, are prime candidates for just such a diversion via Stockton and the line to Ferryhill. Their maximum speed is lower than those of any other of the mainline operators, so, by omitting Darlington in favour of Stockton, they ease incipient congestion along the main line and, at the same time, radically improve the quality of train service through Stockton itself.

7, 8 HS2 potential, and joined-up transport possibilities:

There does not seem much scope for this, thanks to the scattered nature of bus stop and bus station distribution in the central areas of Tees-side boroughs in general, but, if the whole Northallerton-Stockton-Ferryhill line were upgraded for speeds up to 90mph throughout, and electrified in the process, the case for enlarging Stockton's station could include custom-built bus interchanges at each end of it - off Bishopton Road, already served by several local buses, to the south and off the A177 to the north, where much apparently unused land seems suitable for park-and-ride use. More still could be made of Stockton's potential as Tees-side's main rail-head for an eventual HS2.

9, 10, 11 Sustainability, reduced car usage, and air quality:

Inasmuch as an improved train service via Stockton, even if still diesel-powered, removes motorised journeys to and from Darlington station, their absence will improve air-quality and reduce car use over the 11 miles separating Darlington Bank Top from Stockton. The more varied and numerous the destinations served by main-line trains calling at Stockton, the greater the level of overall reduction. Electrification of the lines through Stockton would reduce local air pollution.

12, 16 Resilience and the quality of people's lives:

This line has formed a diversionary facility for decades - yet, although it offers much shorter journey-times between Stockton and Newcastle than does the Coast route, publicity for it has been poor.

Project d) Newcastle 9 + 2 Strategic Cycle Routes

1: Project Title

Newcastle 9 + 2 Strategic Cycle Routes

2: Location

The strategic cycle route network as identified in the 2011 Newcastle City Council document, “Delivering Cycling Improvements in Newcastle: A ten year strategy” consists of seven radial routes. These routes will lead from the city centre to the following destinations: Newburn, West Denton, Great Park, Gosforth, Longbenton, Benfield and Walker. However, the Newcastle Cycle Campaign identify a need for two additional radial cycle routes – to Woolsington and Haddrick’s Mill – and two circular strategic routes, one inner route around the city centre and one outer route linking inner suburbs.

3: Scheme History

The first phase of the scheme (CCAF1) was funded in 2013 with £5.7m of funding from the DfT’s Cycle City Ambition Fund. The second phase of funding was granted in 2015 and will consist of £10.6m over the period to April 2018. The Newcastle Cycling Campaign would like to see a 30-year plan, developing and expanding a comprehensive network throughout the city, which is integrated with new housing and employment development.

4: Economic Benefits and Tourism

Improved cycle networks within the city, linking it to its suburbs, will improve the city’s tourism offer by: a) linking in to the Metro system and Newcastle Central railway station bringing international visitors from the Port of Tyne, Newcastle Airport, and Eurostar services via St Pancras and the East Coast Main Line b) providing a better quality and cleaner city centre environment c) providing opportunities for cycle tours of the city and its suburbs.

By providing another good alternative to the private car, the programme should reduce congestion and thus make journey times by all modes more predictable.

5: Impact on Employment and Education

By linking Newcastle’s concentric suburbs with its city centre, this programme will improve access to the region’s most important employment centre, the two universities, and other city centre educational institutions. Reducing travel costs by facilitating a healthy and low-cost means of transport should help to remove barriers to participation both in employment and education. In subsequent years, a comprehensive network of cycle routes throughout the city should improve access to employment and education sites throughout the city.

6: Mobility and Housing

A priority for Newcastle Cycling Campaign’s additional (Woolsington and Haddricks Mill) routes will be to link in to new housing development to the north-east of the existing conurbation and in the Jesmond area. This should help to reduce the transport impact of the proposed housing development and to give new residents genuine choice in terms of transport modes.

7: Contribution to Joined up Transport

The proposed radial routes will link in to the city centre transport hub, integrating a convenient and safe cycling system with public transport (bus and rail) services, and, via them, to international transport routes.

8: Contribution to Sustainability

The project will contribute towards the three “pillars” of sustainability as follows:

Economic contribution: the project will ease congestion by bringing about modal shift. Delays will be reduced and journey times by all transport modes will be made more predictable, thus reducing

unforeseen time losses to business. The city's tourism industry will benefit from a cleaner and more pleasant city centre environment.

Environmental contribution: the project will reduce air pollution and carbon emissions by encouraging a shift to less polluting modes. The physical environment of the city centre and its suburbs will be made more pleasant by improvements to the public realm.

Social contribution: residents will benefit from a cleaner and more pleasant city environment. Residents will have an increased choice of safe and convenient means of accessing the city centre, which will help to reduce barriers to employment and education. Residents' health will be improved by encouraging active travel and by reducing air pollution.

9: Impact on Car Use

Currently, 2/3 of car journeys are under 5km. Many of these journeys could potentially be taken by cycle, but evidence indicates that an absence of safe and convenient cycle routes dissuades people, particularly women, from cycling. This project will help to give people a genuine choice in travel modes and therefore bring about modal shift from cars to cycles.

10: Impact on Air Quality and Carbon Emissions

Air pollution and carbon emissions will be reduced by bringing about modal shift to less polluting modes.

11: Impact on Rail Resilience

Links to regional and national rail services from Newcastle Central Station will help to support rail services.

12: Contribution to International Gateways

The project will provide good-quality links to the Metro system and Newcastle Central railway station bringing international visitors from the Port of Tyne, Newcastle Airport, and Eurostar services via St Pancras and the East Coast Main Line.

13: Project Financing

The project has already received two instalments of funding: £5.7m in 2013 and £10.6m in 2015. To bring about a citywide transformation, we estimate that some £50m will be needed, with a proper budget beyond that for improvements.

14: Project Downsides

None identified

15: Impact on Quality of Life

Residents will benefit from a cleaner and more pleasant city environment. Residents will have an increased choice of safe and convenient means of accessing the city centre, which will help to reduce barriers to employment and education. Residents' health will be improved by encouraging active travel and by reducing air pollution.

Project e) Ashington, Blyth and Tyne reopening

1: Project Title

Ashington Blyth & Tyne Rail Re-opening

2: Location

The rail route connects Newcastle with Ashington in South East Northumberland, plus intermediate stations at Manors (to be confirmed), Northumberland Park (for connection to Tyne & Wear Metro), Seghill, Seaton Delaval, Newsham for Blyth, Bebside, and Bedlington. Beyond Ashington, the route continues to Woodhorn; a station here would act as a Park & Ride and serve the adjacent Museum of Mining and Northumberland Life. Newcastle and Manors are existing stations. Both platforms at Ashington and one at Bedlington remain in situ. In addition to the core route proposed for initial re-opening, the line has several further branches including a) Bedlington to Morpeth (working line for freight and diversionary services), b) West Sleekburn / Marchey's House to North Blyth (working freight line to Port of Blyth), c) Woodhorn to Newbiggin d) Newsham to Blyth Coast Main Line east of Ulgham village.

3: Scheme History

The route is part of a working freight network and still carries occasional passenger trains on emergency diversionary routes or excursion charters. Re-opening of the core route as described at Section 2 is now being progressed by Northumberland County Council, who are close to Commissioning the GRIP 3 Study with Network Rail. NCC are not, however, proposing a station at Seghill; SENRUG therefore request passive provision be made for this to be opened subsequently.

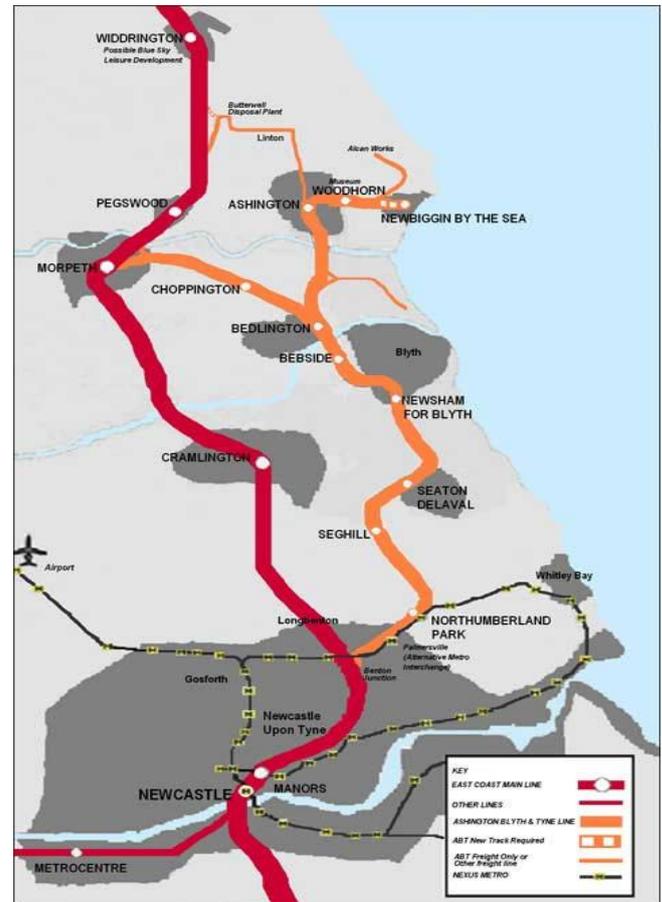
4: Economic Benefits and Tourism

The area to be served, South East Northumberland, experiences a high degree of economic deprivation. The line would connect it to an area of opportunity (Newcastle) – providing access to employment for existing residents, and increasing the attractiveness of the area to commuters to Newcastle, bringing more spending money into the local economy. Woodhorn Station would serve the Museum of Mining and Northumberland Life (one of Northumberland's premier tourist attractions) and Seaton Delaval station would be close to the National Trust's Delaval Hall.

5: Impact on Employment and Education

The line would create access to employment from Ashington, Bedlington and Blyth to opportunities at Cobalt Business Park (served by Northumberland Park station) and Newcastle, as well as to a wider range of places served on the Metro and wider rail network. It creates a direct transport link from South East Northumberland to the University of Northumberland campus at Manors Station.

Town and e) Ashington to Butterwell Junction on the East .



6: Mobility & Housing

The re-opening would support further housing development in South East Northumberland, currently hindered by lack of public transport infrastructure. It also creates access to the national rail network from Newcastle (buses from South East Northumberland do not serve Newcastle station). Woodhorn station also serves Wansbeck General Hospital and Seaton Delaval station would become the nearest station to the brand-new Northumberland Specialist Emergency Care Hospital at Cramlington and it is envisaged would be linked by a bus shuttle service.

7: Operational Advantages to Wider Rail Network

The line is also a freight route serving Port of Blyth and Lynemouth Power Station (currently being converted to Biomass). The route as far as Bedlington coupled with the Bedlington – Morpeth north branch is already used as an emergency diversionary route for intercity services and freight between Newcastle and Scotland. This section of the route is included within the design specification for the new Hitachi IEP trains. The Ashington – Butterwell Junction branch coupled with the addition of a north-to-east connection at Butterwell, has the potential to be used as a much larger diversionary and alternative route to the East Coast Main Line between Benton and Butterwell Junctions, taking freight off this section of the ECML and allowing more passenger services between Newcastle and Edinburgh and thus London and Edinburgh.

8: Contribution to Joined Up Transport

The route offers interconnection with the Metro at Northumberland Park and Newcastle, and provides access to Newcastle Station. Buses from Northumberland do not serve Newcastle Station, making public transport access to the wider range of services available from Newcastle difficult.

9: Contribution to Sustainability

No specific input

10: Impact on Car Usage.

The re-opening is expected to reduce car usage on the main north-south A1 and A189-A19 corridors, as commuting to work by rail becomes feasible.

11: Impact on Air Quality and Carbon Emissions

By increasing the rail capacity between Newcastle and Edinburgh (see Section 7), more of the London – Edinburgh passenger market can be transferred from air to rail.

12: Impact on Rail Resilience

The re-opening of the route coupled with subsequent double tracking of the single-track sections, and electrification, creates a significant alternative route to the East Coast Main Line between Benton and Butterwell Junctions as described in Section 7.

13: Contribution to International Gateways

The freight route to Port of Blyth will be enhanced by upgrading the core AB&T route for passenger services. There would be passenger access to Newcastle Airport via the Metro interchange at Northumberland Park, coupled with future aspirations to run Metro services direct from the Coast branch to Airport.

14: Project Financing

NCC are the sponsoring local authority and will seek contributions from regional and national funds.

15: Project Downsides

None

16 Impact on Quality of Life

Quality of life is improved by increasing employment opportunities, economic regeneration of the area, better public transport to hospitals and improved health due to improvements in air quality.

Project f), New Rail Halt at Horden

This project is described elsewhere and is supported by NECA. It is therefore not discussed in detail here, but we reiterate our support for it as a strategic project with the potential to make a significant social and economic contribution, and support environmentally sustainable transport.

<http://www.durham.gov.uk/article/7707/Proposal-for-a-new-railway-station-at-Horden>

Project g) A new station at Ferryhill

1: Project Title

Ferryhill Proposed New Rail Station

2: Location

Ferryhill is a town in County Durham population 11,656 and is a rail junction between the East Coast Main Line and the branch line to Stockton on Tees. It is twelve rail miles from the towns of Stockton and Darlington and ten miles from Durham City.

3: Scheme History

Ferryhill railway station closed in 1967 and was demolished. The rail tracks in the Ferryhill area were rationalised and realigned in 1971 to provide higher line speeds, in 1990 the lines were electrified with overhead catenary.

A lot of employment was provided by coal mines in the area, these had all closed by 1968.

Alternative employment was provided by industrial estates in the locality but some people now work further afield.

There is scope to provide a new station at Ferryhill north of the road over bridge, which links Bishop Middleham with Ferryhill, known locally as Lough House Bank railway bridge.

Who would use this station? Within a four mile radius of the proposed station there are a number of towns and villages that have no rail provision, so it would make sense for them to use the new Ferryhill station. These settlements include Spennymoor, Middlestone Moor, Kirk Merrington, Tudhoe, Chilton, Cornforth, Bishop Middleham, Mainsforth and Sedgfield. From the population census of 2011, the total number of persons living within 4 miles of the proposed station is in the order of 45,000.

Which trains would serve the new station? Northern trains are to provide a new hourly connect service between Middlesbrough Newcastle and Carlisle, hopefully by the use of the rail route between Stockton and Ferryhill with suggested new platforms being provided on the slow lines at Ferryhill.

In addition to this, platforms should be provided on the main lines. These could comprise a new northbound platform and an island platform to serve both southbound mainline and the northbound line from Stockton. The platforms could be accessed by ramps with a slope of 1 in 20 from the north side of the existing bridge with an adjacent car park.

The main line service could be provided by the TPEX Manchester Airport to Newcastle service. This will be hourly from summer 2019 when new 5 car Hitachi 802 rolling stock is introduced.

Ferryhill station also has a number of bus services passing the site. For example service number 8 hourly frequency Darlington to Spennymoor, service 35A Bishop Auckland to Kirk Merrington evenings, service 56 Bishop Auckland to Durham half hourly, service 113 Sedgfield to Ferryhill hourly.

4: Economic Benefits and Tourism

Ferryhill and adjacent communities are former coal mining areas of County Durham and as such now experience a high degree of economic deprivation.

By providing a rail station at Ferryhill it would make travel to employment areas much easier and quicker, for example Darlington and Durham could be 10 minutes journey time. Newcastle could be reached in 25 minutes.

People may wish to come to Ferryhill to visit its weekly market. There are several walks in the area including former magnesium limestone quarries which are rich in flora and fauna. Thrislington national nature reserve is nearby and is the most valuable wildlife site on County Durham's magnesium limestone.

5: Impact on Employment and Education

A new station at Ferryhill would enable students to travel to Darlington College and Teeside university annex, which are both situated next to Darlington station. People could commute from Ferryhill to Durham and Newcastle where there are more job opportunities.

6: Mobility and Housing

The provision of a station at Ferryhill would stimulate house building in the area and improve the sustainability of the town.

7: Operational Advantages to Wider Rail Network

The station would provide new rail journey opportunities to Teeside and Tyneside and quicker journey times than present between these locations.

8: Contribution to Joined up Transport

As stated in section 3 there are 4 bus service that pass the station site plus there more services available by changing in Ferryhill town centre.

9: Contribution to Sustainability

No specific input

10: Impact on car Use

A new station at Ferryhill would remove the need to drive to either Durham or Darlington station to access rail services, thus reduce car usage on the A167 road.

11: Impact on Air Quality and Carbon Emissions

This will reduce in the A167 corridor between Darlington and Durham as people could drive to the new station at Ferryhill or use the existing bus services if convenient.

12: Impact on Rail Resilience

If a passenger service is routed from Ferryhill to Stockton then the line speed of this section of track needs to be raised from the present 50mph. This would benefit any planned diverted trains by speeding them up over this section of the track and impacting less on the timetable.

13: Contribution to International Gateways

No specific input

14: Project Financing

Money may be available from the new stations fund and or the local authority.

15: Project Downsides

None

16: Impact on Quality of Life

Quality of life is improved by increasing employment and learning opportunities, economic regeneration of the area, better public transport to hospitals and improved health due to improvements in air quality.

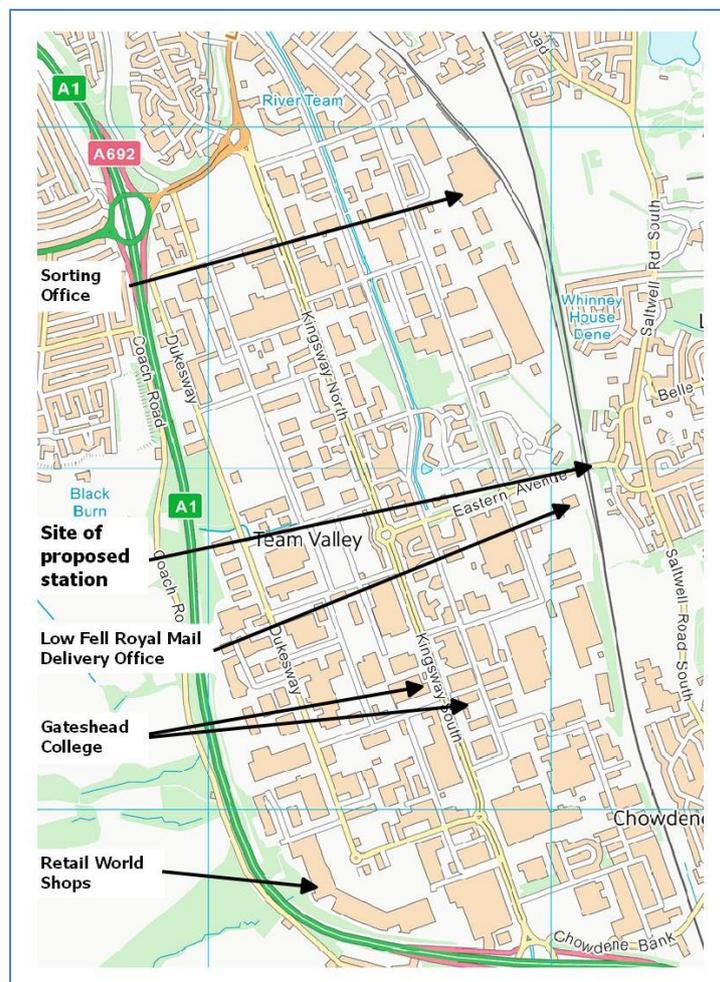
h) Station for Team Valley Trading Estate, Gateshead

1. Project Title:

Station for Team Valley Trading Estate, Gateshead

2. Location (see accompanying map):

Ordnance Survey grid reference NZ251600, site of old Low Fell station (closed 1952, now demolished), where Eastern Avenue passes over East Coast Main Line. The Team Valley Trading Estate (the Trading Estate) is a flat area measuring approximately three miles by three quarters of a mile. It contains a retail area called "Retail World" consisting of several large shops around a large car park, two departments of Gateshead College, the main regional Royal Mail sorting office, the letter delivery office for Low Fell postcodes and many factories and warehouses. These places are spread over a large area which is separated from the rest of the town by the East Coast Main Line. Over the railway line there are very few road or footpath crossings which makes it difficult to get here without a car both from outside Gateshead and even from within most of the town. It is easy to cycle on the Trading Estate (except Kingsway where traffic is fast moving) but difficult to cycle away from the estate because the valley has steep sides.



4, 5. Likely economic benefits and employment opportunities:

There are already many employers at the Trading Estate but for many people, access is very difficult without a car. Cars and buses can be held up in traffic on roads approaching the Trading Estate such as the A1 Western bypass and the Tyne crossings from Newcastle. Not every employer has a big enough car park and some of the roads within the Trading Estate are partially obstructed by parked cars. For job seekers, especially those without a car, there is a disincentive against seeking or

accepting employment here, particularly if it is low paid. Access by rail and linked buses would make commuting a reasonable prospect from north of Newcastle and from Durham.

6, 7. Mobility within the catchment area:

This station would directly serve the east side of the Trading Estate and the west of Low Fell, and a greater area if suitable bus links were provided. At present, the nearest railway station is at Newcastle, more than two miles away across the river Tyne. The nearest local railway station is Gateshead, on the Tyne and Wear Metro system, which is some 2km away from Team Valley at its nearest point. All road routes across the Tyne become congested at peak times. A railway station here would make journeys to the rest of the region, southbound journeys especially, much easier. If linking bus services were provided, it would become easier to reach this part of the Trading Estate from much of Gateshead. This should prove useful for those who need to visit their local letter delivery office, which is located adjacent to where the station would be, with no existing bus access.

8. Joined up transport (see accompanying map):

At present, no buses run on Eastern Avenue. They run north to south on Saltwell Road South, 200 yards to the east, and on Kingsway, 500 yards to the west. It would be physically possible to run buses from Kingsway via Eastern Avenue up to the A167 Durham Road and beyond. There are so few places where one can cross the East Coast Main Line, even on foot, that a bus route on this road should prove useful not only for reaching the station but also for travelling from Gateshead to the Trading Estate.

9, 10, 11. Car use and air quality:

The primary intention of the proposed station is to reduce car use within its catchment area. This should improve air quality both by reducing the number of motorised vehicles and by reducing the time which remaining vehicles spend in traffic queues with the engine idling. The Team Valley is flat at the bottom but the sides are steep. The ability to arrive and depart by train will enable more people to cycle in the valley without a strenuous return journey.

15. Downsides:

To be effective, the station would have to be a transport hub well served by buses reaching all parts of the TVTE, and providing good east to west links with places not reached by rail (including Low Fell, inner Gateshead and Birtley). The bus operators would have to co-operate. It is highly likely that most of the passengers would be too young to be eligible for free travel so fare income would probably be good.

Conclusion:

This station represents a fairly 'low-key' project, but in our opinion it would be enormously effective. It is difficult to believe that an industrial complex of the magnitude of the TVTE has remained 'rail less' for so long.

Project i) Newburn – Blaydon Foot/ Cycle Bridge

1. Project Title:

Newburn – Blaydon Foot/ Cycle Bridge

2. Location

In between Newburn Riverside and Blaydon, taking in the railway and bus stations.

3. Scheme History

The scheme was discussed within the 2005 report to Government Office North East, ONE North East, ANEC and the North East Assembly, “North East Prioritisation Framework” as an “emerging” scheme. At this point it was expected to cost £6m. The scheme featured in Regional Funding Allocation documents at the same time, with an expected price tag of £5-£10m. By the time ONE and NEA produced their final submission to government in Jan 2006, the scheme had apparently been reduced in status to one of the “current emerging schemes that could contribute towards delivering priority outcomes”.

The scheme then survived at least until the publication of the RSS in July 2008 where it is described in Section 3, part 3.302, Table 4 Page 181 as: New cross Tyne access to Newburn Riverside from Blaydon Station (Proposed Blaydon Newburn Pedestrian/Cycle bridge for investigation jointly by Newcastle City and Gateshead Councils).

ONE was abolished, along with other regional development agencies, in 2010; this, together with the financial crash of 2007-8, probably contributed to the slowdown in business development at Newburn Riverside, where ONE had been based.

In 2015, the undeveloped portion of the site was re-allocated for housing development in the Newcastle/Gateshead Core Strategy. This changes the likely usership of a bridge at this point: rather than being used by people working at Newburn Riverside and commuting to it via Blaydon, a bridge to be built alongside housing development on the Riverside would cater for residents accessing facilities and services in Blaydon, and commuting to Newcastle by rail from Blaydon.

4. Economic benefits and 5. Employment and education

The proposal could help residents on Newburn Riverside, Newburn and Lemington access employment in Newcastle via rail services from Blaydon. It could also help residents in Blaydon access employment on Newburn Riverside and Newburn Industrial Estate; the area currently has significant employment but poor public transport links. The scheme would also improve access to Blaydon station from the adjacent industrial area.

6. Mobility within the catchment area, 7. Operational advantages to wider network and 8. Joined-up transport

The timetable at Blaydon railway station saw a major improvement in December 2013, which has been rewarded by significant extra patronage. Improving links to the station and making it more accessible should result in greater use, and we would hope to see this reflected in the December 2017 timetable when there will be two trains per hour between Newcastle and Carlisle.

A cycle-accessible footbridge would provide an additional link in the network of good-quality cycle routes to the west of Newcastle, including Keelman’s Way and Hadrian’s Cycleway. It would provide access to rail services for residents of Newburn, Lemington and nearby settlements, which are within a few kilometres of Newburn Riverside. The scheme would also provide a better and more user-friendly link between bus and train services in Blaydon.

9. Sustainability, 10. Impact on car use, 11. Impact on Air Quality and Carbon Emissions

The scheme would provide access to local rail services for residents from Newburn, Lemington and Newburn Riverside, and adjacent suburbs, provide better linkages between bus and rail services in

Blaydon, and augment the existing pedestrian and cycle network in the area. This would provide a viable alternative to the private car for residents and employees on Newburn Riverside, where public transport services are poor, and would improve the convenience and attractiveness of non-car modes for residents in the other nearby settlements and suburbs.

12. Impact on Rail Resilience

The scheme could increase the viability of rail services at Blaydon by increasing its potential catchment to include nearby settlements and suburbs on the north bank of the river.

13. International gateways

No specific contribution.

14. Finance

The cost of the scheme was estimated at £6m in 2005 and £5-10m in 2006

15. Downsides

None.

16. Quality of Life

The scheme would link Newburn and Lemington with facilities and services in Blaydon, improve links from Blaydon railway station to the bus station and shopping centre, and provide step-free access to the eastbound platform at Blaydon. It would therefore increase local residents' access to facilities and services, and bring separated communities closer together.

A well-designed bridge at this location could also be an asset to the local landscape and townscape.

THE NATIONAL INFRASTRUCTURE ASSESSEMENT – CALL FOR EVIDENCE

This consultation response is made on behalf of Northampton Rail Users Group (NRUG).

NRUG campaign on behalf of rail users in Northampton, and through maintaining a high profile of the key issues for our members and other users, resulting in service improvements from Northampton to both London Euston and Birmingham New Street, the new Northampton railway station built, and, through proper use of the consultation channels, a good response for Northampton in the current refranchising round.

The over-arching response of our group to this call for evidence was the need for a good strategy for rail and rail freight, including the proper integration of freight with passenger traffic. Particular emphasis was put on not having a series of stop-gaps and short term measures presented as strategy in an industry that takes decades to expand effectively.

In principle we have limited our replies rail, as given in our response to the questions below.

13. How will travel pattern change between now and 2050? What will be the impact of the adoption of new technologies?

Note: travel patterns include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

Concerning the introduction of new technologies this is very much looking into the “crystal ball”. However, our observations are that the change in working patterns, centralising jobs into the large urban areas and cities, particularly in the south east, and increased consumer spending on leisure travel, has to date resulted in greater needs for transport. There has been no net reduction through working at home and other such concepts that the information revolution was at one time said to bring. In fact, despite the rapid growth of new technologies, and the recession, rail passenger growth has been very strong over the past decade. Therefore, unless there is a major change in the way business operates, and decreased centralisation, particularly to the south east, we do not see any change to the current pattern.

Further, at local level, it is the case that small town local factories have gone, and employment is replaced by larger scale facilities in urban areas, again increasing the needs for transport. A similar pattern arises for health care and hospitals. The days of walking to the local factory are gone. In many ways the ability of IT to distribute jobs around the country, especially in financial services and administration, has been there for many years, but employers (including the public sector) choose not to do it.

Therefore we conclude that technology is not the driver, other employment and economic factors are driving a consistent growth in travel. However, we think that the current trend for longer distance commutes will continue, both as a function of house pricing and centralisation of business activity.

As regards freight, we think freight patterns are likely to be distorted by the nomination of rail freight interchanges as nationally important infrastructure, which coupled with the problems developers report with the planning system, is encouraging the application for facilities for

warehousing on rail connected sites that are not the best solution for rail or road capacity. In that context a proper strategy for freight is required, not a series of stop gaps.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: high value transport investments, in this context include those that enable agglomeration economies – the increase in productivity in firms locating close to one another.

Our only comment here is that as local economies stratify, and lose diversity, the need to travel to the places where similar activities are located increases as people travel further to work as their jobs relocate.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

There is a tension here between longer distances between set points that make rail the best option, and the need for local distribution of goods and movement of people. Rail is very good for moving vast numbers effectively between 2 locations, people or freight. However, since many rail journeys start and end with a journey to and from the station by car in rural areas or public transport in cities, there are local interactions. These usually pan out for passenger traffic due to the nature of commuting into the big cities, though commuter stations handling '000s or 10s of '000s per day put strain on local roads.

The case for freight needs much more careful consideration, as a policy of putting things onto rail entails by nature truck journeys to and from the rail head, which can considerably increase local road use, and if rail is used only for a short distance, increase truck traffic rather than decrease it. The effects on roads of rail freight are complex – it decreases long distance motorway freight, but increases local truck journeys. Multiple handling can also be expensive.

Co-location of manufacturing and rail freight is probably a good strategy.

See also our reply to 14 above.

16. What opportunities does “mobility as a service” create for road user charging? How would this affect road usage?

NRUG's only comment here is that town congestion charging should not add to the cost for commuters already facing heavy annual fares for going to work and parking at the station. This is a foreseeable rebound effect. People should not be forced out of their jobs by mobility pricing, unless such pricing is accompanied by a major restructure to enable them to work closer to home.

Further, our rural economies will suffer if too much is taken off those who live there in the name of mobility or congestion measures.

NRUG has been asked to campaign for low cost season tickets by care workers and other low paid people going to London. Capacity pricing has the rebound effect of making London too expensive for low paid health care workers, social care workers etc. If this is repeated on local roads the conditions for a backlash may be very high.

Cross cutting issues and Energy

The "Energy" section does not address this, but question 4 in "cross cutting issues touches on it:

NRUG would be concerned if demand management for energy forms a "double whammy" with demand management on rail capacity through peak fares, and even more concerned if road pricing turned that into a triple hit.

Lord Adonis
Chairman
National Infrastructure Commission
1 Horse Guards Road
London
SW1A 2HQ

10 February 2017

Dear Lord Adonis,

I am writing to respond to your call for evidence, to introduce Northern Gas Networks to you, and to highlight the work we are doing to help unlock the potential of the Northern energy economy.

By way of introducing Northern Gas Networks (NGN), we deliver gas to 2.7 million homes and businesses in the North of England. We employ over 2,000 people and generate on average around £330 million for the region's economy every year. We will be investing £1 billion to upgrade and replace our region's metal gas pipes with plastic equivalents by 2021, these pipes have a life span of 50 -70 years. With this continued investment we will have a gas network that will transport low cost, sustainable and low carbon gas for decades to come.

I would like to draw to your attention to work we have recently undertaken with KPMG to demonstrate the current and potential value of the Northern economy, specifically the energy economy.

I'd like to take this opportunity to share with you several notable conclusions from the report.

- The Northern Energy Economy is already making a substantial contribution towards the economic growth of the region. From 1997 to 2014 the North accounted for 23% of total UK economic value for the electricity, gas, steam and air conditioning supply sector. Indeed, the North West, the North East and Yorkshire and the Humber contributes to £3.5bn in GVA per year in the energy sector.
- Players in the region - from businesses to world class universities - are leading the way in developing transformative low-carbon technologies of the future, such as hydrogen networks. The region already plays a leadership role in areas including smart grids, decarbonised gas, offshore wind and transport.
- The North is well positioned to act as an 'energy champion' for the UK. There is potential for energy to increase GVA growth by £2.3bn by 2050 by building on existing strengths and exploiting opportunities in smart power, decarbonised gas and transport.

We are convinced that the development of the region is key to the future industrial success of the UK. We are therefore hugely supportive of the work the NIC is doing to support sustainable economic growth in the North and will be supporting your work where we can, beginning with our response to the National Infrastructure Assessment call for evidence:

1 What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Ongoing investment in the Gas Network in the UK already contributes a significant element to both the local and national economy through the strong economic multiplier effect this type of investment provides. In addition investment in programmes such as the Iron Mains Replacement Programme contributes significantly to the reduction in UK carbon emissions through reductions in the release of Methane to atmosphere through leakage from an ageing pipeline infrastructure. These significant shorter term benefits also play a role in allowing the gas network to play a key role in the transition to a low carbon economy in the medium term. But also provide policy makers with an economically viable component of a multi-vector energy system in the long term to 2050 and beyond.

Management of growth in a sustainable, secure and affordable way to 2050 and beyond will represent both a significant challenge and an opportunity. Currently, over 80% of peak energy demand is delivered by the gas grid and, with the UK population forecast to increase by 22% by 2050, energy demand is also likely to continue to move upwards. Although some interventions may mitigate the growth in demand (for example, improved building efficiency and the potential opportunities presented by linking smart metering technologies with reactive appliances and controls in the home) the challenge remains large if we want to keep our homes and businesses lit and warm in a safe, secure and affordable way whilst decarbonising our emissions as required by the Climate Change Act and the Paris Agreement.

Progress is being made to reduce carbon emissions from the electricity generation sector with the increase in renewables and the commissioning of new nuclear power; however, as mentioned above, at peak periods electricity supplies less than one-fifth of the country's total energy needs. Even if sufficient generating capacity could be built between now and 2050 (which is highly unlikely), the electricity transmission and distribution network would be completely incapable of transporting the required amount of energy.

Even though natural gas is the least carbon-intense fossil fuel, a key infrastructure investment for future sustainability would therefore be one that allowed for the reduction or elimination of carbon emitted due to the burning of gas. Hydrogen emits no carbon at the point of use and work is already underway, as part of Northern Gas Networks' and National Grid Gas' Hydeploy project, to examine the possibility of increasing the proportion of hydrogen in mains gas to up to as much as 20%. NGN has also recently produced the H21 Leeds City Gate report which demonstrates the feasibility and process to completely convert the Leeds gas supply network to 100% hydrogen. To deliver long-term sustainable growth it is essential that such initiatives have the support of industry, the regulators as well as local & central government.

Investment in and around research and development of alternative low carbon uses for this type of infrastructure can also provide a significant stimulus to economic growth. But also provide an opportunity to identify areas of international competitiveness for the UK

economy in the adoption and roll-out of new technologies and processes centred on the re-purposing of exiting energy/heat infrastructure.

2. How should infrastructure most effectively contribute to the UK's international competitiveness?

Continued access to efficient, safe, reliable and sustainable infrastructure that supports customers' heat and energy requirement must play a key role in ensuring that businesses and the wider economy remain competitive in the international marketplace.

However, the transition to a low carbon economy also presents significant opportunities for the UK to take a lead in the development of new technologies that give a significant 'first-mover' advantage. Investment in and around research and development of alternative low carbon uses for this type of infrastructure can also provide a significant stimulus to economic growth. But also provide an opportunity to identify areas of international competitiveness for the UK economy in the adoption and roll-out of new technologies and processes centred on the re-purposing of exiting energy/heat infrastructure.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Effective asset management principles applied to a broader economic scenario can help identify the business case for maintenance/repair of existing assets or the development of new/additional infrastructure.

As indicated in the IMRP example above, opportunities exist to identify short, medium and long term benefits cases for investment in new infrastructure that address not only the current use of a particular infrastructure but also identify the role it can play in transitioning towards an alternative scenario and/or actively play a role in a particular energy future.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Funding/financing of investment in new/additional infrastructure can be impacted significantly by the associated risk profile of that investment and the availability and cost of access to funding for that level of risk.

The UK has been successful in providing significant and efficient levels of investment in infrastructure (Electricity, Gas, Water & Telecoms) in the UK through stable, low-risk regulatory frameworks. This type of framework should be considered in appropriate circumstances as an effective way of addressing access to low risk, low cost finance where this is believed to be a blocker to the timely and efficient development of infrastructure.

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Heat accounts for around 40% of UK energy demand (split approximately 60/40 between domestic and industrial/commercial respectively). If by 'value' we mean 'cost' then electrification of heat would be significantly higher cost (to factors of 10) than decarbonising the gas network and there are fundamental questions unanswered as to whether it would be technically possible. Moreover if electrification of heat was required it would involve generating vast amounts of clean electricity, which the UK already needs to do to displace oil in transport and currently electrical use. To put the scale of that

challenge into context, that would be the equivalent to building around 40 Hinckley point C size nuclear power stations.

Electrification of heat would also require fundamental changes to over 80% of UK households which currently use gas in addition to rebuilding of the electrical grid to allow transportation of this vast quantity of additional energy. Inter-seasonal storage would not be possible in an electric grid which would prevent this being practically and/or economically viable. A more realistic, cost effective and customer focused direction for heat would be to incrementally convert the UK gas networks to hydrogen as detailed in the H21 report. Additionally many industrial and commercial heat applications do not have an electrical alternative so a decarbonised gas grid with hydrogen has the potential to cover all users. Decisions must be made in the early 20s in order to give enough time to build the infrastructure incrementally to achieve decarbonisation targets in line with the Climate Change Act.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

Currently electrical consumption accounts for around 20% of energy in the UK. A zero carbon power sector in 2050 would be heavily supported by a zero carbon hydrogen gas network and would be transporting more of the UKs end use requirement (maybe up to 40/50%). The hydrogen gas network would likely be providing the fuel for centralised power generation but also supporting decentralised power generation with micro CHP in the home removing 10% losses from the electrical distribution system. The power grid would also be supplied by growing renewable generation capacity and additional nuclear capacity. The electricity distribution grids would have undergone significant reinforcement and rebuilding to support both existing electrical demand and significant amounts of additional demand for electrical use for transport. The electricity network would be operating alongside the hydrogen gas grid taking advantage of system coupling opportunities between these two complementary energy vectors.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Transportation currently accounts for around 40% of UK energy use and is almost entirely based on oil. Low carbon vehicles will be required to move away from oil and will likely be fuelled by a combination of gas (either methane and/or hydrogen) and electricity (which will only be low carbon if we have decarbonised the supply). To support and explore this potential NGN is partnering with Leeds City Council to construct a natural gas filling station which will initially be used to refuel the council’s waste disposal fleet. In order to fully displace oil significant additional energy production capacity will be required to meet the demand in the form of both gas (potentially hydrogen via steam methane reformers) and electricity. Additionally significant reinforcement of the electricity grid (transmission and distribution) will be required and extensive gas fuelling stations and electrical charging stations will need to be built. In reality, in order to meet the challenge, a combination of electrical vehicles (more likely in the domestic market) and gas vehicle in both the domestic and industrial markets (refuse trucks, HGVs, vans etc) will be required. The opportunity to utilise the UKs gas network for hydrogen would resolve any energy storage issues as gas can be stored indefinitely and managed to meet huge swings in demand as it does today.

26. What are the merits and limitations of natural flood management schemes and

innovative technologies and practices in reducing flood risk?

The impact of the Climate Change on the physical environment is a growing risk for infrastructure providers. The appropriate or efficient response to managing or mitigating these risks for existing infrastructure is, in many cases, multi-party. Without cooperation in addressing these risks, it could be envisaged that there may be multiple responses to the same risk with the potential for inefficient or over-investment.

'Up-stream' or 'natural' solutions to the impacts of climate change and flooding on the physical environment can be an effective and efficient way of managing these risks. However, this can only be confirmed when compared directly with the alternative investment or operational responses that manage the impact on infrastructure. There is therefore a requirement to ensure there is an effective means by which these comparisons can take place and how 'optimal' solutions can be identified and funded potentially across multiple agencies and industries.

Longer-term, it is clear that these impacts of climate change will need to become an important consideration in planning for investments in new infrastructure

May I draw your attention to three reports; the previously mentioned Energising the North, report, H21 Leeds City Gate and 2050 Future Energy Scenarios, which I hope you read with interest: <http://www.northerngasnetworks.co.uk/ngn-and-you/document-library/gearing-up-for-the-future>

It is our hope that the findings of the above reports and our direct response to your questions provide substantial evidence to help support the NIC in delivering a decarbonised energy sector.

I would be delighted to provide any further information for you and your team on Northern Gas Networks strategic priorities regarding delivering clean, secure, low cost energy for our customers. Please do let me know if this is of interest.

Yours sincerely,

[name redacted]

[job title redacted]

Northern Gas Networks

[telephone number redacted]

[email redacted]



Northern Powergrid's response to the National Infrastructure Assessment Call for Evidence

Key Points

- **Moving towards 2050, networks are taking an increasingly central role in the energy system** due to the change in the generation mix, the growth in distributed energy, and the need to cost-effectively balance competing policy drivers and facilitate innovative approaches.
- **Electricity networks can be key enablers of growth, but maintaining resilience is critical to this.**
 - Managing the interdependencies between various parts of the energy supply chain, but also between different types of infrastructure is key to maintain or bolster the resilience of the energy system while allowing for innovation and change.
 - We need to consciously manage cross-network issues to ensure that investment builds resilience and mitigates against over-interdependence between systems.
- **DNOs have a critical role in supporting the roll-out of electric vehicles and they could provide a route for the rapid initial roll-out of a national network of charging infrastructure.**
- The Energy System is undergoing many changes and the future shape of the system is not clear. **Government has a clear role in ensuring that this transition is orderly:**
 - We believe that **particular weight should be given to innovations in the system that create flexibility, or those that create option value** – prioritising decisions (to either act or defer) that have low-or no-regret associated with them.
 - The broad structure of roles and responsibilities in the UK energy system works well, and the challenge is to allow for innovation, and flexibility at both national and local level, without introducing unnecessary risks and undermining investment in the sector.
 - **Ofgem needs to be a proactive regulator**, but it must also open and predictable; **we welcome the publication of its Regulatory Stances document¹.**
- Both third party and network companies should be allowed to deploy and operate distributed energy resources (like storage) - these types of asset could be vital tools in managing networks and network companies should be given some space to innovate.
 - **The *de-minimis* thresholds in the distribution licences could be calibrated to permit DNOs to take controlled but valuable steps towards becoming distribution system operators (DSOs)**, in doing so 'priming the pump' for technological and commercial innovations.
 - There needs to be a re-think of the funding routes available to support a 'whole energy system' approach for innovation projects widening the focus from the current 'network only' innovation. **Government should allow DNOs to be active players in networks innovation without crowding out third parties.**

¹ <https://www.ofgem.gov.uk/publications-and-updates/ofgems-regulatory-stances>

Overview

1. We welcome the Commission's call for evidence on the UK's infrastructure needs. The work is highly relevant to the recent call for evidence that we provided to the Department of Business, Energy and Industrial Strategy (BEIS) and Ofgem on a smart, flexible energy system². Many of the themes we raise here are explored in more detail in our response to that call for evidence³.
2. Further, we recognise a further important linkage – to the Government's green paper on the Industrial Strategy⁴. We are currently reviewing our response to that consultation along with our stakeholders.
3. Our submission is to be read in a wider context than simply Northern Powergrid as a distribution network operator (DNO). Our parent group has an appetite for further investment in energy infrastructure if the investment conditions are right.
4. We recognise that the National Infrastructure Commission (NIC) has already expressed an opinion on the future of energy infrastructure in the Smart Power report⁵, published in March 2016. We take the opportunity to return to some of the themes raised there in this response.

Northern Powergrid

5. Northern Powergrid is a wholly-owned subsidiary of Berkshire Hathaway Energy, one of the world's largest energy companies. Berkshire Hathaway Energy is an international group made up of integrated power companies; electricity transmission and distribution network companies and gas pipeline operators.
6. In the UK, Northern Powergrid runs the electricity distribution network that provides power to customers in the Northeast, Yorkshire and northern Lincolnshire. We are responsible for the safe, secure and cost-effective delivery of electricity to around eight million people in 3.9 million homes and businesses.
7. In practice we operate as one company, but we are regulated by the energy regulator, Ofgem, as two licensed businesses: Northern Powergrid (Northeast) Ltd. and Northern Powergrid (Yorkshire) plc.
8. We are one of the largest businesses in our region, directly employing over 2,200 people and a similar number of contractors. The majority of our annual investment in the UK is in regulated electricity networks - we typically invest £340m per annum.
9. Our network underpins the economy in Yorkshire, the Northeast and North Lincolnshire, connecting homes and businesses to transmission network and to generation; we also contact a full range of generating assets to the overall energy system. We are directly important to our local economies through our commitment to on-going investment in our network and see our role as facilitating the effective and efficient operation of the overall energy system and supporting growth in our region.

² www.gov.uk/government/consultations/call-for-evidence-a-smart-flexible-energy-system

³ 'Northern Powergrid's response to 'a smart, flexible energy system call for evidence', January 2017, <http://www.northernpowergrid.com/asset/0/document/3014.pdf>

⁴ www.gov.uk/government/consultations/building-our-industrial-strategy

⁵ www.gov.uk/government/publications/smart-power-a-national-infrastructure-commission-report

Berkshire Hathaway Energy

10. While a separate regulated business Northern Powergrid benefits from being part of the Berkshire Hathaway Energy (Berkshire Hathaway Energy) group. Berkshire Hathaway Energy is a multinational energy company active across the entire energy supply chain through its various subsidiaries, most of which are in North America. Berkshire Hathaway Energy employs 21,000 employees worldwide, owns £53bn worth of assets, and invests more than £3bn per annum. Berkshire Hathaway Energy has 11.6 million customers and runs 34GW of generating assets. It operates 233 thousand miles of power transmission and distribution lines and 43 thousand miles of gas pipelines⁶. In addition to developing transmission and distribution networks we are also responsible for developing some of the largest wind and solar projects in North America as of early 2017 our parent owns 7% of US wind generation and 6% of US solar generation.
11. Northern Powergrid and the other Berkshire Hathaway Energy companies actively collaborate to ensure that lessons learnt in one business are shared across the group as part of a culture of continuous improvement.
12. We believe that the best way to protect and build the value of our business is to:
 - provide excellent customer service, with a commitment to continuous improvement;
 - strive to meet the highest standards of safety and (cyber) security; and
 - strategically invest for the long term.
13. Being part of Berkshire Hathaway Inc. means that we focus on building value rather than paying dividends. We believe that this long-term approach to investing and relatively conservative approach to running businesses is a powerful strategic fit with energy systems which require a lot of capital investment in assets that will last a long time.

Responses to the Commission's questions

14. Our detailed responses focus on those areas where we have the most evidence to provide from our position as a large energy utility centred in northern England and our appetite for infrastructure investment opportunities more widely. We are providing responses to five of the detailed questions. Our thinking is evolving in this space, particularly as we consider our response to the Industrial Strategy Green Paper.

Q9: How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

15. From an energy perspective, it is vital that government takes a whole system approach, as there are interdependencies across the electricity transmission-distribution system as well as across vectors (electricity, heat and gas). We engage across these sectors with various industry parties and we believe that more whole energy system innovation is required to understand the cross-sector opportunities with their associated risks.

⁶ https://www.berkshirehathawayenergyco.com/assets/pdf/2016_corporate_brochure.pdf

-
16. In order to support innovation, there needs to be a re-think of the funding routes available to support 'whole energy system' trials that may deliver customer benefits (current projects in our sector are mostly focused 'network only' innovation).
 17. Cyber security is one such cross-sector risk, born from interconnectivity with data infrastructure, and the interconnectivity throughout the energy supply chain. As a member of the critical national infrastructure community we are engaged in dialogue with a range of organisations and Government. This collaboration is important in order to manage effectively what is arguably the most significant external risk facing the energy industry. The work is successfully identifying a number of routes by which parties may strengthen the energy system's resilience to this risk.
 18. The need to assess our exposure to climate change risks has led us to assess the interdependencies of our network assets with other infrastructure. Our adaptation strategy⁷ is in place and we have a plan on flood resilience whereby we are increasing the level of protection at substations dependent on a risk-based approach. Flood resilience is a part of our capital investment programme that attracts strong stakeholder support and interest. More widely, interaction with local authorities includes dialogue on blue-green infrastructure projects as well as emergency preparedness and response.
 19. Finally, a key area of inter-dependency is on telecommunications infrastructure where we use a mixture of private and public networks. We believe that smart systems offer opportunities towards increased resilience. **We have thoughts on this risks area that we would gladly discuss with the NIC.**

Q10: What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

20. The earlier Smart Power report highlighted the need for network companies to make long term strategic decisions, and work with third parties to help facilitate these investments (Recommendation 6). We agree with this vision, even more so in the context of the Government's Industrial Strategy which aims to stimulate pockets of economic growth with the likelihood of an associated increased in electrical demand. Engagement with our stakeholders indicates that they too support such a vision.
21. Government articulated in their response to Recommendation 6 that Ofgem's Quicker and More Efficient Connections (QMEC) was exploring the issue. We remain engaged with Ofgem and connections customers on this workstream. The priority here is for network operators to engage with local stakeholders and bring forward proposals to Ofgem where alternative or novel arrangements could reduce either or both of the timescales or the costs of connections. As such, we are discussing our customers' needs and exploring alternative arrangements where we can justifiably make efficient anticipatory investment to support regional economic development while also protecting the generality of our customers from increased costs from which they do not benefit.
22. There are some market distortions in the provision of electrical infrastructure that need closer scrutiny. We describe these further in our response to question 20 below.

⁷ www.northernpowergrid.com/asset/0/document/2032.pdf

-
23. We take note of the Commission's view, expressed in the Smart Power report, that the separation of the system operator (SO) function from the transmission operator function should not be a priority. Even with enhanced separation within National Grid, both running the SO as a truly independent function and credibly demonstrating that independence will be very challenging. Time will see if the new arrangements are sustainable.

Q19: What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

24. Across networks there is continuing uncertainty around how domestic heat will be decarbonised (and at what pace), with the prospect of potentially large-scale installation of domestic electric heat at some point in the next decade and, possibly, radical changes to how we use gas distribution networks (which might involve pairing them back or moving to grid hydrogen). This is detailed in the next steps for UK heat policy report by the Committee on Climate Change⁸.
25. The UK growth in heat pumps is well behind the forecasts from 2013. There were around 35,000 installations up to Q2 2016 versus a forecast of around 10 times that amount⁹.
26. Such equipment is more suited to new build, where the design of the heating system is an integral part of the design of the whole house (mainly for reasons of space and retrofit). We observe that the relatively low UK deployment of heat pumps is likely due to the practicalities of retrofit in addition to the subsidy not being sufficiently attractive to customers.
27. Northern Powergrid's Customer-Led Network Revolution (CLNR) project with 380 heat pump installations found that heat pumps were not as popular as expected with homeowners, due to the 'hassle factor' of installation, space constraints, requirement for low temperature radiator/underfloor heating and due to low levels of insulation in rural off-grid properties¹⁰. Some heat pump installations required planning permission from the local authority which caused delays.
28. Thermal storage enables the decoupling of electricity use and heat production, which means that this category of appliances can rank high in terms of flexibility of usage by consumers and thus of DSR potential¹¹.
- Trials of such heat pump combinations in the CLNR project showed that interruptions were successful for 67% of the time with the electricity consumption falling to zero during the control period, with no customer complaint about temperature fluctuations or report of inconvenience during the interruption event.
 - The heat pump was set to build a store of heat for up to two hours prior to an interruption, which meant that the trial participant had a supply of hot water to see them through the peak interruption because thermal storage enables the decoupling of electricity use and heat production, which means that this category of

⁸ 'Next steps for UK heat policy', Committee on Climate Change, October 2016

⁹ 'Pathways to high penetration of heat pumps', Frontier Economics, October 2013

¹⁰ 'Customer experience of demand side response with smart appliances and heat pumps', available as report CLNR-L097 from the project library: www.networkrevolution.co.uk/resources/project-library/

¹¹ 'Future potential for DSR in GB', Frontier Economics, October 2015

appliances can rank high in terms of flexibility of usage by consumers and thus of DSR potential¹².

- As such, we would suggest that one way to increase customer engagement with this category of appliances is to add thermal storage to a heating or cooling system, thereby allowing for the consumer to remain comfortable, even when an appliance is switched off for DSR purposes.

29. The sector is still in a phase where it is exploring and comparing the costs, benefits and practicality of different solutions. As such, we believe that our role for now is to remain engaged with that diversity of solutions, and contribute to the assessment of demonstrator projects. For example we are engaged with the following heat projects:

- Customer-centric: a cross-utility project¹³ researching the attitude, needs and priorities of multi-storey tenants in terms of heat and other services;
- Stakeholder-led: smart systems and heat¹⁴ in Newcastle – a study by the Energy Systems Catapult of the potential heat solutions that would enable Newcastle City Council to meet its objectives for lowest cost decarbonisation of heat;
- Technology-centric: a report¹⁵ investigating the potential for electricity network operators to make a direct contribution to preventing fuel poverty, by investing in domestic energy efficiency improvements; and
- District heat deployment: being led by local authorities in our region to deliver affordable, low carbon heat and attract new businesses to deliver economic growth.

30. District heat is clearly an attractive solution for energy dense areas such as city centres and is being supported through the BEIS Heat Network Development Unit. However there are unintended consequences from these developments by local authorities that are leading in some instances to the inefficient development of energy systems. As they seek to maximise the revenue stream from the CHP system installed, local authorities in the Northern Powergrid region are implementing or considering the option to act as unlicensed energy suppliers over private wires.

- This option is currently the easiest in the current licensing framework, and the most appealing because it deducts from the electricity price the cost of the regulatory overhead and policy costs that would otherwise be levied (i.e. avoiding a “tax”).
- It means that development of the heating and electrical infrastructure takes place ‘behind the meter’. As such, an inefficient system is created with duplication of networks in the same streets and the cost recovery for assets then being avoided by those customers leaving the regulated network and placed on other consumers.
- Building a private wire to maximise income, to bypass the current unsatisfactory supply licence framework, is an infrastructure solution to a commercial and

¹² ‘Future potential for DSR in GB’, Frontier Economics, October 2015

¹³ ‘Sustainable multi-storey communities’ innovation project. Project partners include: Northern Gas Networks, Northumbrian Water, and Newcastle City Council. More information on:

www.smarternetworks.org/Project.aspx?ProjectID=1595

¹⁴ www.eti.co.uk/programmes/smart-systems-heat

¹⁵ More information on: www.northernpowergrid.com/news/new-research-highlights-potential-for-energy-system-win-win-win

regulatory issue. We believe that our stakeholders deserve a commercial solution to a commercial issue.

Q20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

31. Energy systems across the world are experiencing changes on many fronts, uncertainty about how new technologies will be deployed and political uncertainty. Berkshire Hathaway Energy, of which Northern Powergrid is part, is seeing similar challenges everywhere it operates.
32. The changes in the UK are particularly acute: the future shape of the UK energy system is not clear. The broad structure of roles and responsibilities in the UK system works well; indeed, we see regulators in other jurisdictions moving towards the UK model.
33. The challenge is to manage the system to allow for innovation and flexibility of outcomes without introducing unnecessary risks and undermining investment in the sector. Government and regulatory policy needs to recognise this and facilitate innovation, diversity and experimentation while also maintaining the coherence and stability of the system overall. This is an obvious pillar of any Industrial Strategy.
34. In terms of policy development for BEIS and Ofgem, we believe that particular weight should be given to innovations in the system that create flexibility, or those that provide option value – prioritising decisions (to either act or defer) that have low- or no-regrets associated with them.
35. We believe that more customer engagement and regulatory innovation will be needed to unlock the potential of smart appliances and demand side response – applications are more advanced in some US states, in part, because there are fewer barriers to this.
36. The strategic priorities for the development of distribution charges need much clearer focus with an Ofgem-led review:
 - Ofgem should address the barriers and distortions that competition in distribution has introduced to ensure the appropriate socialisation of certain costs.
 - Network charging needs to be reformed to eliminate the scope that exists now for ‘free riders’ between customer groups and the perverse incentives that undermine fair cost recovery.
 - We see a future in which DNOs charge more active customers through bilateral contracts or market platforms, with traditional charging structures remaining for passive customers.
37. The review of charging should focus on the following¹⁶:
 - **Whole system cost-reflectivity and arbitrary distortions:** In future, it will be increasingly important that cost-reflectivity is considered from a ‘whole system’ perspective. Currently, there are different methods to derive grid charges for the transmission and distribution systems, and different methodologies employed at

¹⁶ For further detail see ‘Northern Powergrid’s response to ‘a smart, flexible energy system’ call for evidence from BEIS and Ofgem’ – paras 1.56-1.60 pp. 10-11 and paras 3.67-3.71 pp. 42-44, January 2017, <http://www.northernpowergrid.com/asset/0/document/3014.pdf>

different voltages within the distribution system. These create arbitrary boundaries across which tariffs vary significantly and in a way which does not reflect system cost.

- **Consistency across different areas of charging and the DSO role:** We potentially see three areas of charging that need to be considered simultaneously ensuring that relevant price signals are sent once and once only, namely: connection charges; DSO contracts; and use of system charges. Building in appropriate cost signals at this stage is the most likely means of influencing behaviours.
 - **Equity across consumer groups and avoiding the ‘free rider’ problem:** Outcomes must be good for consumers as a whole and not benefit one sector at the expense of material downside to another. Policy makers and companies need to consider any potentially disproportionate effects on the most vulnerable, and the problems that arise from ‘free rider’ issues need to be carefully considered and mitigated where possible.
38. Whatever generation and demand end up looking like, we see networks at the heart of the energy system. However exactly how technology will be used is not clear, but electricity networks and smart technology going to be key – the focus should be on building flexibility and option value. We think that the next five years is going to be a time of innovation and experimentation and so DNOs should be allowed to play fairly in this space as long as they don’t crowd third parties out.
39. As local networks take more central stage, system operation at distribution level will become essential. Such transition to more active Distribution System Operators (DSOs) merits careful consideration. At a high level we believe that the owner of a network is best placed to operate it, but there are clearly certain functions which sit between different players in the market.
40. We are supportive of the DSO work that Ofgem and the industry have carried out to date, and believe that we are the right party to provide local system balancing as a natural extension of the steps we are already taking to more actively manage our network and our knowledge of the local network requirements. However, clearly defining the scope of DSO activities is crucial as there is a need to ensure consistency and a common industry understanding.
41. Both third party and network companies should be allowed to deploy and operate distributed energy resources (like storage) - these types of asset could be vital tools in managing networks and network companies should be given some space to innovate.
- The *de-minimis* thresholds in the distribution licences could be calibrated to permit DNOs to take controlled but valuable steps towards becoming DSOs, ‘priming the pump’ for more widespread competitive market-based mechanisms to emerge over the medium- and long-term.
 - There needs to be a re-think of the funding routes available to support a ‘whole energy system’ approach for innovation projects that target the delivery of customer benefits from greater overall efficiency, widening the focus from the current ‘network only’ innovation.

-
42. More generally, Ofgem needs to be a proactive regulator - particularly in this space, but it must also open and predictable in order to maintain investor confidence; we welcome the publication of its Regulatory Stances document in that context¹⁷.
 43. We are committed to bringing our broad experience of running energy companies internationally to help the Government and regulators get the balance right and support economic growth.

Q21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

44. Evidence to date suggests that the more widespread charging of electric vehicles could have a significant impact on the distribution network with potentially high costs to absorb the new load. This is because charging of electric vehicles (EVs) unless managed is typically concentrated in the evening, coinciding with the household peak demand, as revealed by analysis from 160 EVs in the CLNR¹⁸ project and other trials. In these trials, time-of-use tariffs were not prevalent, and the EV charging curve closely followed the household demand curve, so we infer that it is strongly correlated with household occupancy.
45. In addition, Energy Networks Association members have worked collaboratively to carry out a high-level assessment of the potential impact of more widespread roll-out of electric vehicles and the associated charging smart-charging infrastructure. Part of that work included an analysis of the potential network investment cost to support charging infrastructure for EVs, which identified that under some relatively ambitious, but nevertheless plausible take-up scenarios, there would be a need for substantial investments between now and 2040.
46. There is evidence to support the fact that smart technology solutions can reduce the costs significantly. The My Electric Avenue project¹⁹ concluded that across Britain 32% of local electricity networks (312,000 circuits) will require intervention when the penetration rate of EVs reaches between 40% and 70%, but that new technology could reduce the cost by around £2.2 billion up to 2050.
47. Looking beyond the simple aspect of load growth we believe that electric vehicles could be a truly transformational technology that provide flexibility services to electricity suppliers or the network (known as 'vehicle to grid'). We supported the proposal in the BEIS and Ofgem call for evidence on a smart, flexible energy system for more demonstration projects in this area²⁰. It is an example of an opportunity to mitigate network capacity constraints, and its value may be maximised if used in combination with other network loads (such as heat).
48. We also welcome Government's continued focus on the issue, as demonstrated in the recent green paper on an Industrial Strategy and in its response to the Office for Low Emission

¹⁷ www.ofgem.gov.uk/publications-and-updates/ofgems-regulatory-stances

¹⁸ 'High Level Summary of Learning: Electric Vehicle Users', available as report CLNR-L254 from the project library: www.networkrevolution.co.uk/resources/project-library/

¹⁹ <http://myelectricavenue.info/> - trial operated by Scottish & Southern Electricity Networks with Northern Powergrid as a project partner and some of the customers clusters based in Northeast England

²⁰ 'Northern Powergrid's response to 'a smart, flexible energy system call for evidence', January 2017, www.northernpowergrid.com/asset/0/document/3014.pdf

Vehicles and Department for Transport consultation on the 'Proposed ultra low emission vehicles measures for inclusion in the Modern Transport Bill'²¹.

49. We believe that there are two unresolved barriers to maximising the value from EVs for the energy industry:
- how a network company accesses services (i.e. either managed charging or vehicle-to-grid) from the end customer when the primary commercial relationship with the customer is through the supplier; and
 - the time and cost associated with the installation of fast-charger infrastructure.
50. We think DNOs could play an important role in rolling out EV charging infrastructure quickly. This could be achieved through the socialisation of the connection costs (i.e. transferring the cost from the connection customer to the entire customer base). Once this is secured, DNOs could invest in anticipatory reinforcement that supports the roll-out plans of stakeholders, such as housing developers or local councils. The DNO would continue to operate under their cost-efficiency, and non-discriminatory duties, and so act as advisors to stakeholders on preferred location, and suggest potential high-value combinations of solutions (i.e. matching complementary loads or generation in order to 'net off' and manage diversity for the benefit of all customers).

²¹ www.gov.uk/government/consultations/proposed-ulev-measures-for-inclusion-in-the-modern-transport-bill

National Infrastructure Assessment – Call for Evidence

Friday 10 February 2017

NORTHUMBRIAN WATER GROUP

Introduction

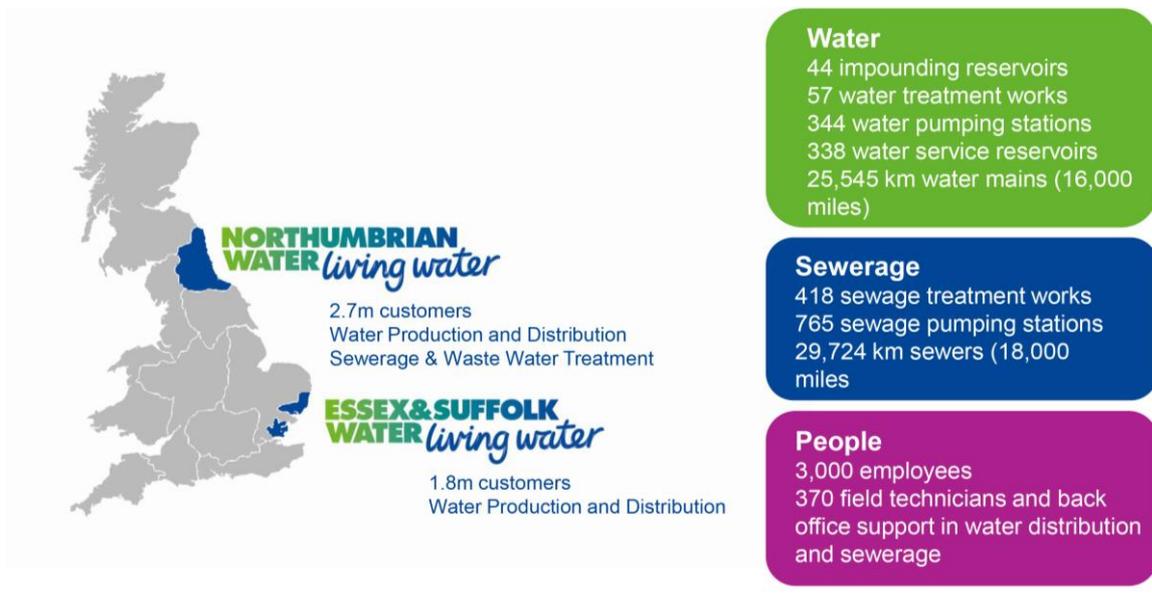
Northumbrian Water and Essex & Suffolk Water are part of Northumbrian Water Limited (NWL), which is a member of Northumbrian Water Group (NWG). We supply water and sewerage services to 4.5 million people. Every day we supply 1,104 megalitres (1.1 billion litres) of water.

North east England

Northumbrian Water provides water and sewerage services to 2.7 million people in the north east of England. The major population centres of Tyneside, Wearside and Teesside are in our area but we also serve large rural areas in Northumberland and County Durham (provision of waste water services only in Hartlepool).

South east England

Essex & Suffolk Water provides water services to two separate supply areas. Our Essex area, which has a population of 1.5 million, is part rural and part urban with the main areas of population being in Chelmsford, Southend and the London Boroughs of Barking and Dagenham, Havering and Redbridge. We serve a population of 0.3 million in our Suffolk area, which is mainly rural with the biggest towns being Great Yarmouth and Lowestoft.



Evidence

Having reviewed the questions put forward in the call for evidence, Northumbrian Water Group would like to put forward evidence for the following questions:

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?
22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?
23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?
24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?
25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?
26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?
27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?
28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Should you have any queries please contact:

External Communications
Northumbrian Water Group
Boldon House
Wheatlands Way
Pity Me
Durham
DH1 5FA

Telephone: 0191 301 5678
Email: externalcommunications@nwl.co.uk

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage

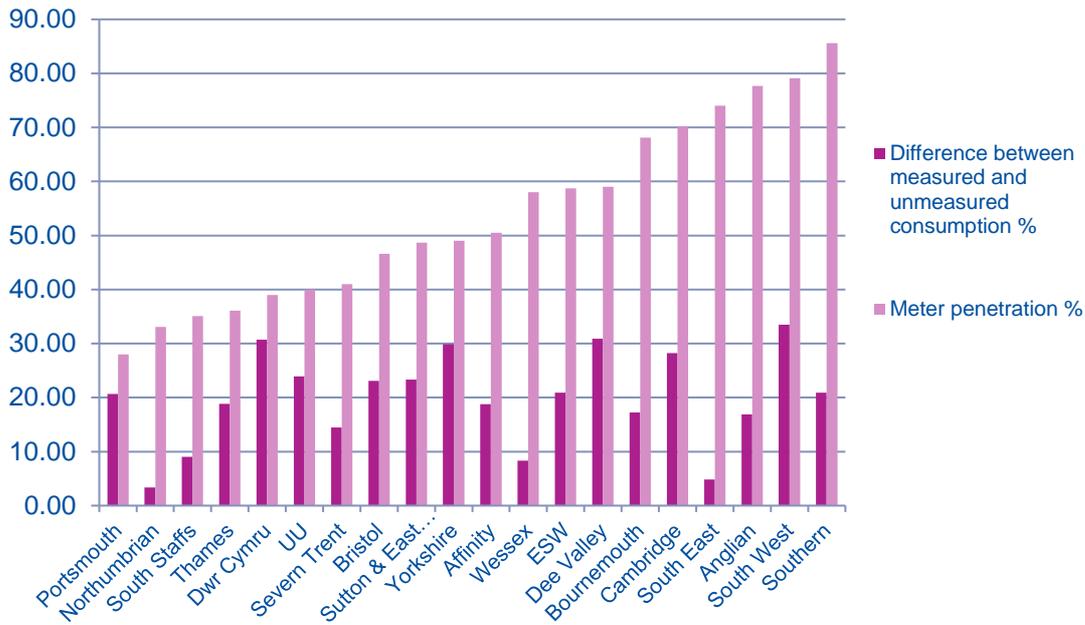
Water demand is the sum of a number of components, the more controllable component is leakage and significant reductions in leakage will require considerable funding. Reductions to consumption may be achieved through lower cost options although the results are less predictable. There is scope for further leakage reductions to be achieved nationwide but most companies focus on maintaining leakage at the sustainable economic level (SELL) through active leakage control (ALC). ALC involves finding and fixing leaks to counteract the increase in leakage through the effect of asset deterioration.

Reducing leakage beyond the SELL would need to be justified given the exponential rise in costs as leakage is driven down. Sustained, intensive ALC could theoretically reduce leakage as far as background leakage levels (around 60% of SELL). However, we estimate this would require five times the number of leak detectors required to maintain SELL. The number of leak repair jobs would increase by an even greater factor as identifiable leaks reduce in size as the level of leakage decreases. Additionally, we estimate that leakage occurring on customer pipework is 35% of overall leakage. It is very difficult to quantify and may be increasing, but identifying and addressing customer-side leakage will remain a big challenge without substantial investment into logging individual properties.

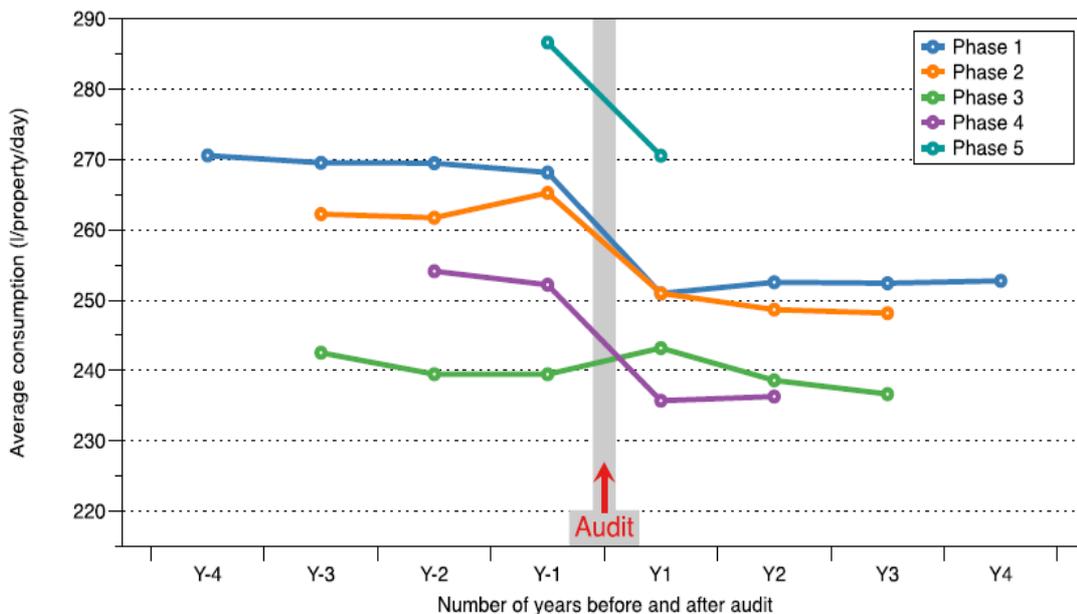
Renewing the water network has the effect of reducing background leakage levels and reducing the natural rate of rise (the rate at which new leaks appear) but the costs are high for the reduction achieved. Background leakage and the occurrence of bursts can be reduced with far less investment through reducing water pressure in the network. The maximum potential reductions that can be achieved with this can only be determined on a case by case basis. In Northumbrian Water (NW), early calculations are that up to a 20% leakage reduction might be achieved. In Essex & Suffolk Water (ESW), we have few remaining opportunities to optimise pressure management. Customer impacts of pressure changes also need to be considered.

Water consumption can be split into two categories – measured and unmeasured. Unmeasured consumption is difficult to quantify and water companies use different methods to estimate this. Based on the figures which are reported, customers with meters always have lower consumption per person than unmetered customers, although the difference on a company level can be as low as 3% or as high as 35%. This does not appear to correlate to the meter penetration level, as shown in the graph below.

Comparison of meter penetration and the difference between measured and unmeasured consumption in 2015/16



Metering alone does not deliver a consistent reduction to consumption. It is more effective when coupled with the promotion of water efficiency, which by itself can be a cost effective method of reducing consumption. The benefits are more easily measured with metered customers although there are often greater potential gains to be had from unmeasured customers. Analysis of eight phases of water efficiency audits over the past four years shows the reductions to consumption which can be achieved are highly variable and therefore uncertain. In the eight phases analysed (total of 4240 properties), average savings ranged from 4.9 litres/property/day to 48.1 litres/property/day. It can be seen from the four earlier phases that reductions have been sustained through time, as shown below.



Our experience shows that a combination of metering with water efficiency advice can lower consumption by 8 – 12% per property, although this only applies to unmetered properties which make up 67% of NW's properties and 41% of ESW's. Meter penetration has a ceiling of approximately 90% as a significant number of properties cannot currently be metered. While reductions in use are on average maintained, during dry weather periods metered customers increase their consumption and return to usage close to the dry year demand of unmeasured customers. This means water companies require the overall dry year water resources and associated treatment and distribution infrastructure to be able to meet these increased demands. More significant reductions to consumption might be achievable with greater grey water use either introduced through technology in the home or if water companies introduced a grey water supply stream. Either way, this would place a significant cost burden on customers and would rely heavily on changing customer attitudes and behaviour, reducing certainty in the effectiveness of a grey water strategy. There are also numerous water quality incidents where cross contamination has occurred between grey water and potable water systems. Appropriate regulation, training and competency is required here. Not just with companies installing this technology, but with the users.

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

There are multiple approaches that may be taken to manage the supply-demand balance where current resources are short. In Northumbrian Water Group's regions (as in the rest of the UK) demand is gradually decreasing through reductions to leakage and customer consumption, and there is still scope for further reductions which should be pursued. However, there are limits to what can be achieved, as described in the response to Question 4. The costs of reducing leakage become increasingly high as it falls below the economic level – the level at which most companies are already managing leakage. Reducing customer demand substantially is also very costly and the effectiveness of investing in metering and/or efficiency promotion is variable and uncertain. At present, demand management measures are forecast to be sufficient to maintain the supply-demand balance for Northumbrian Water and Essex & Suffolk Water over the next 25 years.

Whilst demand management is important it cannot meet future forecast demands arising from population growth, climate change impacts and reductions in current abstractions for environmental reasons.

At present, population growth is not increasing demand to the point where the gains being achieved through leakage management and efficiency initiatives have no beneficial impact on the supply-demand balance, but this may change. In every situation where we have needed to rebalance supply and demand we have considered options on the basis of cost and certainty. As we were able to demonstrate in the case of Abberton reservoir expansion, in some cases it will be more effective for the long term to address a persistent supply-demand imbalance by investing in new or existing resources.

Some areas of the country have plentiful raw water resources which are not currently being used. Improving the connectivity between water resources nationally, enabling the transfer of water into water stressed areas, is likely to offer the most effective solution to chronic supply deficits. Building more treated water storage capacity would also offer greater security of supply and flexibility in the management of short-term supply-demand issues. Further into the future, if population growth or climate change puts strain on resources nationally then transferring water between regions may not be sufficient and it will then be necessary to invest in new dams, reservoirs, boreholes or even desalination plants. In that case, it will also be necessary to expand treatment and distribution capacity.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

The drainage system is complex with fragmented roles and responsibilities which can lead to sub-optimal interventions and solo working often driven in response to performance issues.

There are two types of potential interventions which are not mutually exclusive, reactive and proactive. We are largely focused on reactive interventions however we are exploring proactive flood risk reduction. In our experience the most effective interventions consider the following;

- **Partnership Working**

The Northumbria Integrated Drainage Partnership (NIDP) consists of 13 Lead Local Flood Authorities, the Environment Agency (EA) and Northumbrian Water (NW). The group aligns with and supports the Northumbria Regional Flood and Coastal Committee (NRFCC). The NIDP is successfully providing a link between reactive flood risk management and the desire for a proactive area based risk approach for the provision of integrated sustainable drainage. The outputs from the activities delivered through this group provide a robust evidence base for business planning and subsequent investment. This allows partners to align funding streams, develop schemes which are efficient, provide flood risk reduction from all sources, ensure future demands on the drainage network are mitigated and exceedance routes are created. A case study is located in appendix 1.

We are exploring partnership working with organisations which do not have flooding as a main objective but where working together could be mutually beneficial such as transport departments in Local Authorities. Together with Newcastle City Council (NCC) we were successfully awarded an Innovate UK grant to explore the feasibility of aligning various council programmes with the strategic surface water management plan for the city. This project has highlighted the difficulties in aligning multiple funding sources and programmes of work.

- **Risk Based Prioritisation**

Water and waste water companies face significant challenges relating to drainage such as flood risk reduction, reducing pollution, managing ageing assets, managing impacts of growth and urban creep etc. There is increasing pressure to keep water bills down and we must ensure our interventions provide the best possible outcomes for our customers. Therefore we must ensure that interventions in the drainage network maximise risk reduction. Risk based prioritisation is required for both partnership working and for sole responsibility interventions. NW have an internal risk based prioritisation for sole responsibility issues and have been instrumental in developing a regional risk based prioritisation for the NIDP.

- **Understanding of source/pathway/receptor**

Source control considers that prevention is better than cure. Slowing the flow of rainwater from entering streams, becks, rivers and sewerage systems can reduce the peak flow in the whole drainage system and reduce the risk of flooding to homes, businesses and communities. This approach advocates exploring the interdependencies of the drainage system and understanding that upstream catchment wide interventions can be most beneficial. An integrated catchment approach must consider practices within that catchment. This includes but is not limited to growth, land management, customer behaviours, urban creep, and community engagement.

- **Integrated catchment wide approach to the water cycle considering water quantity and quality**

It is also important to understand that the drainage system is part of the overall water system and that an integrated approach to include drainage issues should also include water quality and quantity issues. During the year we have made the first tentative steps towards aligning the aspirations of the NIDP and the Catchment Partnerships within the region. We believe this alignment of the flood risk and water quality and quantity agendas will provide even greater opportunities to deliver an integrated sustainable approach to water – see appendix 2.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

We recognise the need to take an integrated approach to water management. There is a need to balance efficient delivery of our services with risk/resilience and sustainability so that we can provide affordable solutions for customers. Understanding context and value, making environmentally sustainable decisions, striving for multiple benefits and working in partnership will allow us to be more integrated and take a whole catchment approach to deliver our Outcomes.

To take this approach partners must work together, this poses challenges as there are numerous bodies, companies and institutions with varying degrees of responsibility within catchments. NW have managed to take a catchment approach to flood risk management with our risk management partners and are attempting to develop this framework with other environmental partnerships such as the catchment based approach. With our partners we have taken the NIDP 3 stage process and applied stage 1, collection, collation and identification of partnership risks, to the Don River catchment widening the objectives from drainage flood risk to river water quality, habitat and health and wellbeing.

Although this approach is new, we have already recognised benefits, we better understand partner's objectives, and are developing a Don Partnership Vision. We believe this approach will be beneficial and our partners have expressed their aspirations of developing this approach for other water bodies. This type of approach delivers multiple benefits that are high priority to the community. However, most funding streams focus on one significant benefit with lesser benefits making up a small proportion of any funding bid. This makes multiple benefit schemes difficult to implement as multiple funding bids are required and aligning bids is complex. For example, do partners contribute proportionally? If so, how is the proportion assigned, which benefit is evaluated and over what timescale.

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

Within the water industry the term resilience incorporates the 4 Rs, resistance, resilience, redundancy and response & recovery and therefore a single measure or level is not the most appropriate item to consider. Instead a national threshold should be considered or a national aspiration that no properties should be at risk of internal flooding. Below this level or aspiration the 4 Rs would be used to determine the most cost beneficial technique for critical and non-critical infrastructure. This would allow companies to take a flexible approach to resilience and ensure the correct measures are taken for each piece of infrastructure balancing the risk, probability, cost and benefits to each intervention in relation to the 4 Rs. It would also ensure that the complexities of resilience were not distilled into a single measure which would stifle innovation and lead to an increase in customer water and waste water bills. It would ensure local conditions such as geography, could be taken into account and would also allow for multiple thresholds based on the criticality of assets.

We also consider that responses to Question 24 are relevant to this question – highlighting the role of land management in resilience, working in partnership and taking a pro-active integrated catchment based approach can deliver cost effective multi-beneficial solutions and ensuring source control techniques are implemented, dealing with the issues rather than the consequence, will help to reduce the long term risks posed by climate change.

The Environment Agency's fluvial and coastal flood maps passed the stress test which was carried out as part of the National Flood Resilience Review. Therefore there is a level of confidence of the fluvial and coastal flooding outline to 1:1000. However this review didn't take into account flooding from surface water or ground water. We welcome the development of enhanced, fully integrated and more accurate models and forecasts to predict rainfall patterns and the likelihood of future floods. Robust models would support future business planning in relation to supply and demand by assisting in the identification and prioritization of areas and projects for future investment, together with resilience and exceedance planning at high risk locations. We suggest that current models with a focus upon direct costs may not capture wider, indirect socio-economic costs associated with flooding.

We welcome the Environment Agency's flood risk awareness campaign committed to in the National Flood Resilience Review. Proactively working with homeowners and businesses at risk, both now and in the future, to assess their properties against the 4 Rs and offering incentives on the solutions could be the most cost effective way of making areas more resilient both now and in the future.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: “innovative technologies and practices” can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

Natural Flood Management (NFM) is a tool which can be used to slow the flow of water and reduce the risk of flooding. There are other tools which in essence look to achieve the same objective in the same way such as Sustainable Drainage and Water Sensitive Urban Design etc. It is important that the language used does not fragment the message that all of these tools can be used to reduce the risk of flooding from all sources in a sustainable way which provides multiple benefits to society.

NFM, Sustainable Drainage, Water Sensitive Urban Drainage can be difficult to implement due to the fragmented roles and responsibilities for flooding within England. Northumbrian Water (NW) do not have the rights to construct NFM in and around water courses and therefore any scheme would have to be a partnership scheme. Partnerships are voluntary, it can be difficult to measure and apportion benefits for NFM schemes. NFM needs to have buy in from landowners, and it can be difficult to incentivise partnerships to work together and realise the benefits of innovative technologies. NFM may cause land to be flooded, we must realise that this land is someone’s business and we may need to consider compensation. There are real opportunities to incentivising environmental stewardship through landowners as we move from the Common Agricultural Policy. NFM has been successfully used in a number of projects in the North of England such as Pickering and Belford. It can be difficult to secure funding through Flood Defence Grant in Aid (FDGiA) as the tool used to calculate FDGiA was set up for coastal and fluvial flood defence work and can be very difficult to complete for partnership schemes and for schemes which use innovative technologies.

We consider that elements of our response to Question 24 are relevant to this question – highlighting the role of land management in resilience, working in partnership and taking a pro-active integrated catchment based approach can deliver cost effective multi-beneficial solutions and ensuring source control techniques are implemented, dealing with the issues rather than the consequence, will help to reduce the long term risks posed by climate change.

We also consider that elements of our response to Question 25 are relevant to this question – ensuring that the 4 Rs are considered when implementing property resilience and resistance to ensure the most effective solution, and the development of enhanced, fully integrated and more accurate models and forecasts to predict rainfall patterns and the likelihood of future floods.

NW have a statutory legal requirement to maintain the sewerage network, the highways agency have a legal duty to ensure highway drainage is maintained however the Environment Agency have no statutory obligation to maintain assets and therefore in times of austerity proactive maintenance may be reduced increasing the risk of flooding from the drainage network.

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

The water industry operates within the economic regulatory model overseen by Ofwat who set limits on prices charged for water and wastewater services. Price reviews are carried out every five years and importantly include expected operational efficiencies in protecting customers' bills. A total expenditure (TOTEX) approach was introduced at the 2014 price review to focus on efficient long-term delivery of investment and services, including energy use, waste management and maintenance, rather than capital costs alone. Alongside this was the introduction of Outcome measures instead of the previous approach which centered around meeting Outputs. This economic regulatory framework supports water companies in considering sustainable, resilient and innovative solutions, including effectively managing waste materials.

Waste management regulations clearly define our duty of care and responsibilities for waste. The introduction of environmental taxes (e.g. landfill tax) and the waste hierarchy has encouraged the industry to reduce, re-use and recycle waste. For example, the material we excavate from street works is now used on site or recycled and we also aim to use only recycled materials when backfilling our excavations.

Opportunities continue to be explored to make waste derived products through end-of-waste and quality protocols. Research is also being undertaken into cost-effective methods of re-using chemicals and extracting resources from our waste residues.

Government incentives, such as those that support the increase in the generation of renewable energy, have allowed the industry to invest in innovative treatment processes and sufficient long-term capacity for waste. By securing incentives for a 20 year period this has given the industry the necessary security to implement significant waste management schemes. For example, we treat all of our sewage sludge (remaining after sewage treatment) through two thermal hydrolysis anaerobic digestion plants to generate renewable energy under the Renewables Obligation scheme. The process also significantly reduces the solid material that is beneficially recycled to agricultural land as a fertiliser. We also clean up and enhance the gas generated before directly injecting it to the gas network under the Renewable Heat Incentive scheme - see appendix 3. All of the above is also an example of the circular economy.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

Our aim is to reduce, re-use and recycle waste, generate renewable energy and continue to lead by example as an efficient water and sewerage company in the circular economy. This requires the continued support of Government in setting and securing financial and regulatory incentives so that innovation can continue and we have confidence to invest in new technology, such as advanced resource recovery from wastewater. Environmental regulation change would also allow water companies to co-treat other waste materials for the benefits of customers, the circular economy and the environment.

Appendix 1

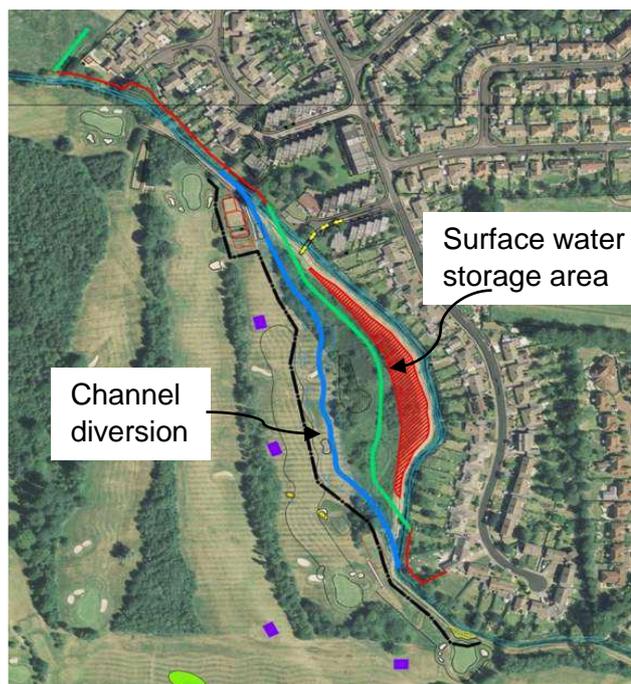
An example of a partnership project which addressed drainage incapacity is Brunton Park an integrated urban drainage scheme.

During heavy rainfall events approximately 100 properties in this residential estate were identified as being at risk of internal flooding from multiple sources – 74 fluvial, 57 surface water and 61 sewer.

Separate studies were carried out by both the Environment Agency (EA) and Northumbrian Water (NW) in conjunction with Newcastle City Council (NCC) to identify the best interventions to reduce flood risk in this area. The common conclusions were that investment in isolation could not successfully deliver the combined reduction in flood risk the community needed.

An integrated option proposed by NW was founded upon sustainable drainage principles and included the diversion of 360m of a main river channel into an adjacent golf course whilst using the original channel to create a 7,500m³ storage area to manage excess surface water flows. The space created, and material excavated, allowed for the creation of a new fluvial flood defence between the river and the community.

Additional components were two kilometres of new surface water and foul sewers with a new underground foul water storage tank. Joint working between the EA, NW and NCC has enabled this integrated and sustainable option to be developed and successfully delivered. By sharing the costs of some components of the scheme, like the channel diversion, the scheme has been delivered with excellent value for money to all partners.



NW led on the scheme design, procurement and delivery (including building the EA's assets) as well as providing a financial contribution. The EA took the role of lead risk management authority to secure the FDGiA contribution to the overall project cost and facilitated land access for working on a main river. NCC provided a financial contribution and supported project delivery.



As well as flood risk reduction this integrated approach also provided:

- Effective and efficient project delivery through alignment of expertise, statutory powers, finance and procurement.
- Cost savings through shared solutions.
- Improved river water quality.
- Improved biodiversity and local amenity (0.5ha of new wetland habitat created).
- Successful community engagement strategy.
- A template for future partnership working.

Appendix 2

An example of slowing the flow through catchment management is at Lound Lakes, in our Essex & Suffolk Water supply area.

Lound Lakes straddle the Suffolk Norfolk border and are nine interconnected water bodies that, along with Fritton Lake, are the local sources of water that we collect, clean and deliver to our customers from Lound Water Treatment Works. They are part of a 280 acre site which we own that is a designated County Wildlife Site.

Working with the Suffolk Wildlife Trust we've created two wetlands with reed bed areas there which have improved the range of habitats in Lound Lakes County Wildlife Site and increased the leisure and educational opportunities for local people.

The wetlands also have a very serious and important role to play in making sure that water quality is maintained in the Lakes. If a catastrophic pollution incident took place in the area (for example from a local farm or the release of oil from domestic premises or a road traffic accident) they can be used to store polluted water. They will give Essex & Suffolk Water valuable time to plan an appropriate response and act to prevent contamination of Lound Lakes.

At the same time the wetlands also benefit water quality generally by increasing the time the water is stored there which means that the sediment and nutrients have time to settle out.

The creation of the wetlands also increases the habitat opportunities for a large range of creatures and in particular for amphibians and bird species such as Reed Warblers, Chiffchaffs and Lesser Whitethroats. It also provides habitat for some of the 22 species of dragonfly that have been recorded at Lound Lakes.

The work was sensitively planned to be in tune with the environment and work commenced at end of August 2015 after nesting birds had fledged. This also allowed the excavator to access the land at its driest. The works settled over winter and filled up to create the wetlands then natural regeneration in spring 2016 provided habitat.

As part of the project we used some of the excavation material to raise a permissive footpath at Bloodmans Corner improving access during the winter period. This provides a perfect vantage point to view the new wetland area and for the public to enjoy the wildlife interest that it attracts.

The way we manage our land at Lound with sensitive grazing using local cattle breeds and the creation of the new wetlands to hold water is a good example of best Sustainable Urban Drainage practice. We have shown how even small areas can be used for effective rural Sustainable Urban Drainage to enhance the environment and slow the flow of water.

Appendix 3

Northumbrian Water (NW) uses the waste customers flush down the toilet, as a fuel, and turns it into electricity and gas which people then use to heat their homes and cook their meals.

We are the first water company in the country to use all of the sewage sludge (the material left over at the end of the sewage treatment process) to produce gas and electricity. We've transformed sewage sludge, from being a waste product that needed a lot of energy to clean up before it could return to the natural environment, into a fuel being used to produce green energy.



Bran Sands



Howdon

We:

- invested £75 million in thermal hydrolysis advanced anaerobic digestion (AAD)
- exceeded our renewable energy target of 20% two years early in 2013
- reduced carbon emissions by 30% towards our target of 35% by 2020
- are annually treating 2,000,000m³ of sludge from 3,000,000 customers and turning it into 10MW of renewable energy
- improved sludge product – safety, odour and value
- reduced transport movements
 - Moving sludge as a cake rather than a liquid as we use 6 regional dewatering hubs
 - Significant reduction in carbon footprint by transporting sludge cake as opposed to liquid
 - 2,000,000m³ liquid sludge = 90,000 tankers
 - 320,000m³ sludge cake = 10,000 trailers
 - Product broken down in the process

This, and other innovations, means our customers have some of the cheapest bills in the industry as it helps save the company millions of pounds in energy bills each year. NW is leading the way in green energy production for the water industry.

Thermal hydrolysis Advanced Anaerobic Digestion (AAD) uses a natural, biological, process which involves taking leftover sludge from sewage treatment and heating it in something similar to a giant pressure cooker. This process breaks down the cell structure of the sludge and kills anything that could cause diseases, releasing more nutrients for energy conversion. (Conventional anaerobic digestion, used by other water companies, does not have this stage so an equivalent amount of sludge would only produce half as much power). The sludge is then fed to billions of bacteria in giant digester tanks.

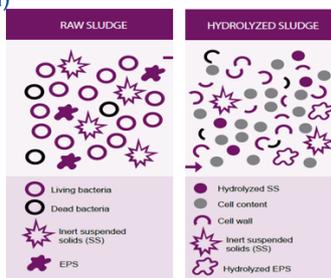


As they eat the sludge the bacteria give off methane and carbon dioxide gases, (similar to us burping and letting off wind), which are collected in two huge golf ball-like biogas storage bags, before being burned in a gas engine to produce electricity and heat. What remains of the sludge after the AAD process is a high quality, safe, odour free fertiliser for farmers.

SLUDGE STRATEGY ADVANCED SLUDGE DIGESTION

Advanced is really a pretreatment stage prior to conventional anaerobic digestion

- Sludge is preheated to 165°C and held at 6Bar for nearly an hour
 - Kills pathogens (e.g. e-coli and salmonella)
- Pressure is then dropped Sludge to ambient
 - This pressure drop causes cell structure to “explode”
 - Exploded cells are easier for enzyme to breakdown
 - More methane
 - More electricity



21 *EPS = Extracellular Polymeric Substances

By 2012 both our Howdon and Bran Sands sites were fully operational converting 100% of our sewage sludge to biogas and then into renewable electricity. At the time, this met 20% of all of NWG’s energy demands and covered more than 40% of all of our waste water treatment costs, which was a great achievement. The AAD plant at Howdon could produce all the sites energy needs.



We’ve made the power from poo process even more efficient by building a pioneering £8m gas to grid plant at Howdon, which is the largest in the water industry. It began producing power in December 2014 when we opened our Biomethane Injection plant at Howdon. It takes renewable biogas from the AAD process and purifies it to an extremely high quality so that it can be injected into the public gas distribution network. With the biomethane injection plant now online a maximum output of 88GWh of renewable energy, sufficient to supply 7,000 homes, can be passed into the grid annually making far more efficient use of the biogas available. The new plant now injects more than 200,000kWh of renewable gas per day into the public gas network.

The gas-to-grid plant delivers a step change in efficiency of over 35% in the use of biogas, equivalent to over 32GWh per year compared to the pre-existing CHP process. That’s 32GWh per annum that does not have to be provided from fossil gas, saving 5,902tonnes CO₂e every year. The plant delivers a £3 million annual efficiency, enabling NW to have some of the lowest bills in the industry.

It's more environmentally friendly in other ways too. Under the previous CHP operation, biogas containing impurities was burnt in gas engines, which released sulphur and nitrogen oxide emissions to atmosphere. These have now largely stopped, as a pre-treatment plant provided for both the CHP and the upgrade plant removes these impurities from the biogas. When the CHP is running on natural gas the exhaust is very much cleaner as the Gas Safety and Management Regulations permit only very low concentrations of sulphur and nitrogen in gas supplied by the public network. The direct environmental advantage of converting the CHP plant to run on natural gas rather than using grid electricity is the CO₂ emission factor which is 2.5 times greater for electricity than for natural gas.

This provides NW with an even more efficient process, generating more than £2.4m additional operational savings per year.



Nuclear Industry Association

5th Floor, Tower House,
10 Southampton Street,
London WC2E 7HA

TEL +44(0)20 7766 6640

EMAIL info@niauk.org

VISIT www.niauk.org

FOLLOW @NIAUK

National Infrastructure Assessment Call for Evidence: Nuclear Industry Association response

1. The Nuclear Industry Association (NIA) welcomes this opportunity to respond to the National Infrastructure Commission's call for evidence.
2. NIA is the trade association and information and representative body for the civil nuclear industry in the UK. It represents around 260 companies operating in all aspects of the nuclear fuel cycle, including the current and prospective operators of the nuclear power stations, the international designers and vendors of nuclear power stations, and those engaged in decommissioning, waste management and nuclear liabilities management. Members also include nuclear equipment suppliers, engineering and construction firms, nuclear research organisations, and legal, financial and consultancy companies.
3. As major investors the nuclear new build developers are better placed than the NIA to respond to the detailed questions in the call for evidence and will be making their own submissions. We would however like to take this opportunity to make some broader points.

Overview

4. The NIA strongly supported the creation of an independent National Infrastructure Commission to consider the UK's long term infrastructure needs. Large scale projects are often affected by the political life cycle and an independent NIC should help overcome this issue by providing greater certainty for both the public and investors.
5. The National Infrastructure Assessment should help ensure the UK's infrastructure needs are met effectively, and consequently that UK economic growth is maximised. However in doing this it is important the Assessment does not reinvent the wheel; the UK needs huge investment in new generating capacity, but this is unlikely to be forthcoming without energy policy stability. The Assessment should therefore where possible identify policy changes that build on existing policy measures such as Electricity Market Reform arrangements and National Policy Statements, rather than starting from scratch.

Question 1: What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of “highest value” should include benefits and costs, as far as possible taking a comprehensive view of both. “Long-term” refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

6. Nuclear energy will play an important role in meeting the UK’s energy policy objectives in both the short and long term. Three nuclear developers – EDF Energy, Horizon Nuclear Power and NuGen – have plans for 16 GW of new nuclear build in the period to the mid-2020s. This will not only help secure our energy security and climate objectives but bring enormous benefits to the UK economy in terms of jobs, skills and global competitiveness. There will also be significant local economic and social impacts, particularly in terms of employment and expenditure.
7. From an industrial perspective these projects will also help put the UK nuclear supply chain in a position to compete for nuclear business overseas. Nuclear power capacity worldwide is increasing steadily, with over 60 reactors under construction in 15 countries – the highest rate of new build in 25 years. As the UK adjusts to a more globally focussed post Brexit economy this could become particularly important in terms of our industrial strategy.

Question 3: How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

8. As stated above we believe the NIC and the National Infrastructure Assessment can play a key role in ensuring the UK’s infrastructure needs are met as efficiently and cost-effectively as possible, but also need to maintain investor confidence through policy consistency. This means that where possible any changes should build on existing policy measures which have been delivering successfully, for example in the case of the electricity industry the Electricity Market Reform arrangements and National Policy Statements.
9. In terms of interaction with housing, there could be a case for the NIC looking at whether development sites for future housing might impact future potential power station sites. As the NIC will be aware the latter are few in number since new nuclear stations currently planned will be sited on existing nuclear sites, and any further stations beyond these are likely to be on existing or decommissioned sites.
10. Conversely associated infrastructure, including enhanced road, rail and sea links, is an important aspect of large infrastructure projects and could usefully be coordinated – where relevant - in a combined strategy covering nuclear and housing development sites. Whilst Local Enterprise Zones (where relevant) will have a role to play alongside developers the National Infrastructure Commission could also play a key role in coordinating this activity.

Question 5: How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

11. It is clearly important to achieve the right balance between the two to achieve the best value for the consumer. In the case of the nuclear sector the investment forthcoming for

maintaining and life extending existing nuclear stations, and for building new ones, is significantly influenced by the policy framework established by Government to achieve the UK's energy security and low carbon objectives, particularly the EMR arrangements, the Capacity Market, and the Carbon Price Floor. We believe these have generally worked well and should be maintained.

Question 7: What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

12. In the case of the electricity industry the investment required to fund new generation capacity, including new nuclear capacity, is being raised against the background of the EMR arrangements, and it is important these should continue.
13. In terms of taxation Business Rates are a tax on power stations that contribute to local services, and the Government have recently consulted on moving to a system of 100% retention by local government. We strongly support this since it would ensure that local authorities are financially incentivised to attract investment and promote local economic growth and development, and would promote acceptance of new nuclear build.

Question 9: How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

14. Key players in the electricity industry contribute to Government and regulator led initiatives designed to increase resilience across the sector, and again the NIC should attempt to build on these. In the case of nuclear the NIA has set up a Cybersecurity working group with a view to agreeing a coordinated approach to addressing cyber threats across the nuclear supply chain.

Question 10: What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

15. To ensure the greatest possible policy stability we would like to see any review of the planning system and infrastructure governance in the electricity sector to build on and improve the existing framework, including the National Policy Statements and EMR, rather than attempting to replace it.

Energy

Question 20: What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

16. With the potential electrification of heating, transport and industrial processes in the period, achieving a zero carbon power sector by 2050 is an important target if the UK is to meet its objective of reducing carbon emissions by 80% overall.

17. In terms of electricity generation decarbonisation can be achieved through the replacement of current fossil plant by a basket of renewable energy – particularly onshore and offshore windfarms and solar pv – and new nuclear stations, and also, if economically viable, with new CCS equipped gas and coal stations.
18. Given the major uncertainties about the most cost-effective mix of technologies and the pace of transition, for example in battery technology, it is impossible at this stage to predict the most effective option. However in principal low carbon technologies with the lowest cost should provide the greatest market share. Against this background we would expect nuclear to make a significant contribution; with at least 16 GW of new plant if current plans come to fruition, and more if new nuclear technologies such as SMRs are deployed.
19. In terms of policies to achieve decarbonisation, we would reiterate that the current EMR arrangements continue to represent deliver the transition, although they may need to be complimented with further measures in the light of developments.

Nuclear Industry Association
10 February 2017

Centre City Tower, 7 Hill Street, Birmingham B5 4UA
21 Bloomsbury Street, London WC1B 3HF

NIC Call for Evidence – Ofwat Response

Introduction

Our regulatory regime has enabled investment of over £120bn into water and wastewater services since privatisation in 1989. We have been responsible for ensuring that the water industry has delivered significant infrastructure improvements for the long term, in the best interests of customers, society and the environment. We have achieved this through price controls which set incentives for innovation and efficiency and which have evolved to reflect the changing challenges of the sector. Our approach has enabled companies to supply reliable water and wastewater services while delivering substantial improvements for customers and meeting the policy expectations of governments.

We are currently developing our methodology for the 2019 price review, our next periodic review of the sector. This will set out our expectations for company business plans for the period 2020-25. Companies will submit these to us in September 2018. We recognise the crucial role that water and wastewater plays in national infrastructure planning, in particular the impact of regional variations in water availability and the need to provide the most appropriate solutions to those problems. We are now more than ever looking for the industry to deliver the best, not simply the least cost, solution.

We have targeted our response and have therefore not provided an answer to every question.

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

(Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice.

Considerations of “highest value” should include benefits and costs, as far as possible taking a comprehensive view of both. “Long-term” refers to the horizon to 2050 and should exclude projects that are already in the pipeline.)

Answer:

The highest value infrastructure investments in the water sector are likely to be those interventions which combine high traditional performance with high adaptation potential to a range of future scenarios.

The vast majority of existing water, wastewater and flood related infrastructure has been designed against a very fixed set of future variables – particularly climatic variables. The next generation of resilience infrastructure will need to adopt a different set of value criteria. It will need to deliver resilience against a more uncertain future within the context of affordability and completeness. Delivering against these criteria will require the sector to better embrace innovations and consider genuinely alternative approaches such as upstream management, water demand management, sharing/trading and cross sector collaboration. A broader mix of supply and demand infrastructure options will likely be key to resilience, sustainability and affordability - an over reliance on a single type of infrastructure will lead to higher risk overall. The optimization of existing capacity and the management of demand are likely to be some of the lowest regret investment options. This is likely to also include network interconnectivity where economically attractive as it adds to the overall level of national resilience.

Demand for water services has been relatively stable over the last 20 years, with strong population growth being addressed by better demand management and reducing leakage. Notably demand has fallen in south east England despite strong population growth. Water resources and infrastructure have relatively low average costs relative to other infrastructure, but high marginal costs for new resources, with companies estimating that new water resources have costs hundreds to thousands times that of existing water resources. This reflects the relatively slow pace of technical change in the sector and the usage of low cost marginal resources in earlier developments. These factors suggest that opportunities to make better use of existing resources and networks via demand management, smarter network management and improve network interconnections are likely to have highest value.

The highest value investment needs to be informed by better knowledge of current and future pressures on the existing system. Advanced decision making approaches, developed in other sectors, are now starting to be utilised in water planning. We have encouraged this approach through our joint Water Resource Management Plan (WRMP) guidance and continue to work with the sector to ensure our model of regulation provides the right incentives to enable high value infrastructure investments. In addition we are starting to see a more coordinated regional and national planning approach being developed which is moving away from optimizing on a company basis which may have been the emphasis previously. This approach provides real opportunities to share water more effectively through trades and transfers. We are particularly keen that customer legitimacy (service resilience and

value for money) continues to have a dominant role within decisions on the need and nature of future infrastructure.

Our work with the sector is also making clear that high value infrastructure is more than just a measure of the intrinsic value. We are starting to form a more fully developed understanding of the value associated with capacity, skills, integrated thinking and behavioral change (planning, decision makers and customers). We think the NIC/NIA can provide a step change in thinking by helping to bring together a high value approach to enable truly high value infrastructure.

We continue to consult with the sector on how our model of regulation can set the right incentives for resilience. We have a series of engagements with the sector planned for 2017 and our consultation on the PR19 methodology in July 2017 will provide a key opportunity to shape the regulatory process.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Answer:

Reliable and efficient water and wastewater services are critical to the country's competitiveness. The National Audit Office (NAO) estimated that water abstraction (only one component of the wider water and wastewater value chain) has a value of £72bn given its importance to a range of industries including agriculture and energy¹. Not only can disruption to water and sewerage services have a direct and immediate impact on the industries that depend on them, but they are also important to the environment and preservation and development of our natural capital.

Water companies play a key role in enabling growth. The ability of the water and wastewater services to respond to the needs of sustainable economic growth has room for improvement, particularly in better sharing of resources between surpluses and deficits across company boundaries. We believe that increased interconnectivity across networks will provide important added value by enabling a more responsive service which will aid the development of our economy. Our Water 2020 programme is focusing on the development of both water resource and bio-resource markets to encourage better utilisation of resources through trading and markets. We expect water companies to challenge themselves in putting together the business plans for

¹ NAO Efficiency in Resource Management. 2005: <https://www.nao.org.uk/report/environment-agency-efficiency-in-water-resource-management/>

the next price review to develop innovative solutions to enable sustainable economic growth within this regulatory framework.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Answer:

Planning for sustainable, affordable water and wastewater infrastructure which provides resilience for future generations requires a strong evidence based approach with customer legitimacy through engagement. There is considerable scope for better outcomes from smart sustainable design of new urban development to make best use of existing resources and networks. Smarter design of new development can reduce per capita consumption of potable water by around 50%. Opening the provision of new infrastructure to a broad range of providers ensures that existing monopolies do not prevent the development of more innovative and effective approaches.

The existing processes of WRMPs and our periodic review provide a strong planning process to deliver appropriate, resilient water supply infrastructure. The inclusion of customer engagement as a fundamental concept incorporated within WRMPs and companies' business plans provides the opportunity for customer input which helps shape infrastructure development around customers' needs and expectations.

Despite these strong foundations, we consider that potential exists for further improvements. A better front end approach using integrated thinking and recognising the benefits of behavioral change and cross sector approaches could enhance customer and societal outcomes. An important example is the current planning and design approach between service providers and developers/house-builders. We are starting to see, often through competition, real innovation in water and wastewater service delivery through new working models with significant service and resilience benefits for both customers and the environment, beyond supporting efficient new development. In addition we are also starting to see a more integrated approach for planning and design with local authorities and the Environment Agency on drainage and flooding issues. Again, these approaches are providing evidence of the value for sustainable economic growth through collaboration and better alignment between the key parties involved.

New providers of local infrastructure such as Albion Water demonstrate how integrating sustainable urban drainage, water efficiency and local supply resilience

into a single development can reduce the need for expensive new resources and network development. This also leads to faster development, supporting the Government's home building commitments, as it limits the pressure on the existing network. It also highlights how competition to provide new infrastructure can both foster innovation and enable more resilient and sustainable services.

As well as new developments, there is also a growing need for sustainable drainage investment in existing areas under threat from increased rainfall and surface water run-off. The RainScape projects in Wales, which seek to collect and store rainwater to mitigate stress on the sewerage system during heavy rainfall, provide an example of what can be achieved. It aims to both enhance customer outcomes through improved sewerage services and greater efficiency, while also having a positive impact on the physical environment and wildlife, all without the need for expensive capital intensive investment.

The above examples highlight what can be done. Our regulatory will promote the development of models that bring in new providers with new ideas where appropriate. However we also expect water companies to continue to challenge themselves in how they approach new development and consider a range of innovative solutions.

4. What is the maximum potential for demand management, recognizing behavioral constraints and rebound effects?

(Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for

demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.)

Answer:

Demand management and leakage reduction are particularly relevant to water and wastewater due to the high marginal cost of new resources and infrastructure. Although some progress has been made over recent years, and the overall demand for water has reduced, we believe that there is the potential for a step change in the water sector. We consider that improved demand management could have

significant positive effects in the water sector and beyond. We expect water companies to be at the forefront of driving more efficient demand management over current and future price controls. We outline below further details on the potential scale of the opportunities.

Impact of water demand management:

Current average per capita consumption across England & Wales is 145 liters per person per day (l/p/d). A modest reduction to 130 l/p/d would result in a resilience equivalent of c750 megalitres per day over the whole of England and Wales. New water resources would likely have a less significant impact – for example the Thames Water’s proposed Abington Reservoir would have provided only around 100 megalitres per day. We could learn a lot from cities such as Copenhagen which managed to reduce per capita consumption from 171 to 108 l/p/d between 1987 and 2010, with particularly significant savings being made in apartments (40%)². Reducing per capita consumption is also likely to be one of the most cost effective resilience actions, particularly when the associated energy/carbon benefits are included within an assessment (see below).

Key to unlocking the potential for reductions in consumption are effective customer engagement and participation to encourage behavioral change. As identified by our review of residential retail competition, retailing in the water sector has lagged behind other sectors in its use of technology and levels of customer service. We continue to see a lack of scale across the water industry which we believe is an important barrier to progress. We have adapted our regulatory model to further incentivise water efficiency at PR14 with some notable local successes. One example is that new market entrants will be able to bid to provide demand management services into incumbent Water Resource Management Plans. Companies will be expected to be transparent in their assessment of these bids and to publish their decisions on each bid.

We will build on this at PR19. For example, bilateral trading of water resources linked to the business retail market in England will also provide the potential for water efficiency and demand management gains beyond those that regulation has traditionally been able to achieve.

² <http://www.sustainia.me/resources/publications/mm/CPH%20Beyond%20Green.pdf>

Impact on energy and carbon:

The water and wastewater value chain is energy intensive with an associated carbon footprint of c5.5% of UK carbon emissions, roughly equivalent to the aviation sector³. Consequently, the demand management of water will result in both energy and carbon savings. Some 90% of these savings tend to be in the household, particularly related to hot water use. Consequently, domestic water demand management can yield savings for customers on their water, wastewater and energy bills, as well as contributing to the UK's climate change commitments. This cross sector benefit appears poorly incorporated within planning process and could provide an important opportunity for the NIC.

Impact of wastewater demand management:

A wide range of evidence supports the value of demand management in wastewater and its benefits in terms of offsetting or deferring the need for costly infrastructure. Sustainable Urban Drainage Systems (SUDS) are a primary example of local soft infrastructure providing a cost effective option with real benefits for sustainable economic growth – particularly in house-building. SUDS can be developed to remove surface water from sewerage systems and to minimise water passed forward for treatment by dealing with the problem at source. However, feedback from new entrants and developers suggests that barriers exist within the system which constrain utilization and adoption in England and Wales.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Answer:

The serviceability of existing assets can significantly influence the need for investment in new assets, as well as securing customer support for new investment. Good asset management can reduce or defer the need for new assets and provide a more sustainable outcome for customers and the environment by eliminating the need to constructions projects and their associated environmental impacts. We expect all water companies to focus on embedding effective asset management

³ *Greenhouse gas emissions of water supply and demand management options* (EA 2008)

strategies, policies and processes to ensure their customers get the greatest possible value from existing assets.

Leakage in the water sector provides a good example of the importance of asset management. Currently over 3000 megalitres (or the capacity of about 1200 Olympic sized swimming pools) of water is lost every day as leakage. This represents some 20% of the water abstracted, treated and distributed by the water industry. Since publication of 'Managing Leakage' in 1994 the industry has worked to achieve the 'economic level of leakage' (or latterly a sustainable level of leakage - a derivation of the same that takes into account an element of social and environmental consequences).

We consider that there is considerable potential for further reductions in leakage. Progress on leakage reduction has largely stagnated and we are concerned that innovations by both the supply chain and internationally (mainly new technology) are not being adopted. We introduced outcome incentives to reward reductions in leakage and penalise those who fail to meet their targets last year, so we will consider what further measures are required in the light of experience and performance against targets. Slow progress on managing leakage levels downwards is a particular concern given the public focus on the issue. It is likely to become increasingly difficult to justify to customer the need of new infrastructure schemes whilst a significant proportion of water which customers pay to be abstracted, treated and distributed is lost through leakage.

Quality and availability of data is a key challenge when it comes to effective asset management and optimization across the sector. Historically water companies have struggled to collect reliable data on the operation of their existing assets. This has had a significant impact on both the implementation of robust approaches to asset management, for example drawing on data intensive techniques like reliability centered maintenance, as well as developing robust datasets on asset health. The former can help to extend asset lives through targeted preventative maintenance, while the latter are particularly important for developing things like whole catchment area solutions which require a holistic understanding of complex networks.

There have been some recent examples of progress leading to improved asset management outcomes. For example, the ability to insert cameras in sewers has led to the wastewater industry developing innovative, no dig and minimal invasion spot repairs. Remote sensors in the sewer network can give good 'lead failure' indications of impending loss of serviceability. In contrast, the challenges faced in inserting similar technology to water mains (disinfection, discolouration risk, partially closed valves, etc.) means that typically water mains are renewed in complete lengths – or repaired reactively on failure. There remains significant scope for the industry to

improve remote sensing and failure prediction and to extend asset life and resilience through targeted investment and maintenance.

However, even with good asset management, new infrastructure will continue to play a role. Factors such as climate and demographic change, as well as the age of some of existing assets can in some cases justify the need for new investment. We expect any new investment to be fully justified through cost benefit analysis that considers a wide range of potential options, not simply those that rely on capital expenditure. Our regulatory approach aims to ensure that companies are incentivized to consider their customers' needs when it comes to deciding whether to invest in new assets or maintain or upgrade those that already exist. As noted above, we have implemented a range of outcome delivery incentives which seek to ensure companies deliver good performance for their customers. These financial incentives reinforce companies own performance commitments, set following engagement with their customers. They also reinforce the strong reputational incentives on companies to provide good services for their customers. From PR14 we also assess companies' business plans on a total expenditure (totex) basis, rather than looking specifically at capital or operational costs. This incentivizes companies to consider the best approach to deliver against requirements, whether this involves maintaining existing infrastructure or building new assets. WRMPs are also critical to the development of new infrastructure. In developing their business plans, we expect companies to be able to justify any proposed new asset investment by reference to the WRMPs they have agreed. This helps to minimize the risk of unnecessary investment or stranded assets which would be higher if a less rigorous approach was used.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Answer:

We consider that there is considerable potential for improved collaboration and competition in water supply services. Water abstraction is a case in point - less than half of the water currently licensed for abstraction is actually abstracted, despite the needs of some companies to invest in new infrastructure to meet demand pressures.

As part of PR19 we are proposing to create markets for both upstream water resources and bioresources. In relation to bioresources, evidence shows there is scope for increased optimisation of activities across the companies – and, looking further ahead, greater participation from firms operating in wider waste markets. In relation to water resources, trading is below its optimal level, and taking steps to reduce identified barriers to this could result in significant benefits for customers. We will take a range of steps for PR19 to ensure that markets can develop in these areas. For example we will introduce information platforms, set network access

prices for incumbents to charge new entrants and have separate binding price controls for water resources and bioresources to ensure transparency of the existing appointees' businesses.

In April 2017 the non-household retail market in England will open to competition. This will mean new entrants providing retail supply services to customers, in some cases in competition with existing appointees. This aims to deliver benefits for customers, including by creating the opportunities for increased innovation around providing new services or changing the way existing services are provided. In Scotland (which already has non-household retail competition) examples of innovations from new entrants include: rain water harvesting for large customers to reduce overall consumption, arranging for maintenance to be performed around customer not company needs and enhanced provision of information to customers to spot anomalies in usage trends which could be caused by leaks⁴. There is also scope for participation from third parties in the market for water resources, for example in water resources providers negotiating directly with water retailers as the business market develops.

Finally, we expect companies to develop proposals for using direct procurement for customers for suitable discrete, large-scale (over £100m of whole life totex) projects as part of their business plans for PR19. Water companies currently use a variety of arrangements to provide these services, including self-provision and procuring services from third parties. We think that encouraging companies to include a broader set of arrangements needed to deliver services, specifically the financing of large-scale projects and potentially the operation of new high-value assets, could realise additional benefits for customers. Under a direct procurement framework, the water company would seek bids from third parties and select the best value offer on behalf of its customers. A key difference between direct procurement and current arrangements is that, under a direct procurement arrangement, the service provider is competing to provide finance as well as construction and, where appropriate, operation of the new asset. This provides market evidence on the cost of finance, construction and potentially operations.

These reforms build on our existing approach. For example, through New Appointments and Variations (NAV) we can allow a new or existing water or wastewater company to replace the existing provider of water or wastewater services for defined geographical area. This includes appointing new licensees, for example to serve a new development that does not currently have water or wastewater services. As such we consider it is has been and will continue to be an important

⁴ <http://www.watercommission.co.uk/UserFiles/Documents/Presentation.pdf>

mechanism to enable new entrants to enter the market, which in turns drives innovation across the sector. The example provided in response to question 3 above notes the benefits of Albion Water’s approach to providing services for new developments; this resulted from its appointment through the NAV process.

With respect to collaboration, the opportunity (particularly for greater collaboration between water companies) is considerable. For example, the existing work of the Water Resources South East (WRSE) has already demonstrated the benefits of cross company collaboration. WRSE brings together the companies providing both water and wastewater services in south east England, along with other stakeholders such as central government, the Environment Agency and Consumer Council for Water. Through initiatives like the regional modelling project WRSE then look to identify strategic opportunities for long term resource management across different companies. At the previous planning round WRSE’s combined regional planning approach identified c£500m of deferrable infrastructure investment by sharing resources to increase utilization of available resources.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

(Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.)

Answer:

Water and wastewater services are funded from customer bills. Historically, each monopoly provider would generally bill the customers in its designated area based on the revenues it is allowed to recover, which in turn are set by us at each periodic review. This would apply to allowed revenue for both retail and wholesale services. With the introduction of retail market competition in England from April 2017, for non-household customers, this approach will change as new retail companies will enter the non-household supply market. These retailers will bill customers and then provide the funding for the non-household wholesale services customers receive from the regional monopoly provider(s).

Direct recovery from customers has worked well in terms of delivering required investment and placing customer legitimacy at the heart of the services companies provide. However, the rigidity of the current funding structure has the potential to limit sector innovation in future. Several examples are illustrative:

- Investment required by local water companies to address environmental improvements – which may have wider national benefits- can create tensions with affordability. For example South West Water has undertaken considerable investment for environmental improvements relating to a large stretch of coastal waters. This has resulted in South West Water having the highest bills in England and Wales. The Government has intervened by providing a £50 bill subsidy for South West Water’s customers. The current funding model means that South West Water can only recover its required revenue from its regional customer base. This potentially limits the scope for collaboration between companies within catchment areas or for the evolution of more national initiatives like the potential development of more interconnection and trading across regions.
- The introduction of social tariffs by water companies has helped to support customers in need of assistance with the affordability of their water bills. While there is some question around the role water companies and their customers should play in supporting their customers versus what role Government social assistance should play, the sector funding model has been able to accommodate social tariffs. This could also potentially become relevant if water companies are asked to provide additional services with wider social or environmental objectives, for example flood defense. We note some of the challenges in the energy sector around levies on customer bills to fund subsidies for renewable electricity generation or social programmes such as the Warm Home Discount.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

Answer:

No, the financing model for traditional infrastructure options is robust and we have also encouraged, and will continue to encourage, new and more innovative approaches such as direct procurement for Thames Tideway. There is scope to remove legislative barriers to the use of direct procurement for customers using a project specific licence (as opposed to a contract between the new entrant and

existing appointee). However we consider this would be helpful rather than essential and that the current framework for direct procurement can work effectively.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

Answer:

The water sector has an increasing interest in wider interdependencies both in terms of the opportunities they raise but also the risks they pose. We see the need for more engagement with other sectors by water companies, particularly related to energy, food and telecommunications/cyber security.

We recognise that Ofwat has a role in supporting this work. We also recognise the need to work with other regulators to ensure potential barriers between regulatory regimes are managed and that incentives are suitable aligned. However, we also expect the water industry to work together and collaborate across sectors to address the collective challenges arising from interdependencies. We believe that the NIC could play an important role in helping to identify interdependencies and to facilitate work across different sectors.

As part of our review of business plans for the next price control period we expect companies to provide robust evidence that they understand the risks facing their networks and services. We expect companies to clearly outline how they are planning and are able to deliver a level of resilience that their customers expect and are willing to pay for.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Answer:

It is not obvious that planning arrangements are barrier to significant infrastructure investment in the water sector. We note that major investment is taking place in the sector such as the Elan Valley (£242m) and Thirlmere Link (£300m). The Thirlmere Link required a public inquiry as part of the water resource management planning process and received quick approval. However, we note there has not been a major new reservoir or interconnector constructed in England and Wales since the 1970s,

so it is unclear how the planning system would cope with such proposals. We expect that the provisions of the Planning Act 2008 should be sufficient to ensure that any Nationally Significant Infrastructure Project in water or wastewater can be progressed in a timely manner. We note, for example, that the Development Consent Order for the Thames Tideway Tunnel projects was approved within the indicated timescales. We also consider that Government's approach of publishing National Policy Statements for water and wastewater has been helpful in providing additional certainty on how projects will be appraised. As a regulator setting price controls of the water and wastewater sector we value certainty on future investment as we set cost allowances for companies, including for investment in new infrastructure. We therefore welcome the publication of further National Policy Statements in future. .

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Answer:

Water/wastewater services are inextricably linked to a finite natural environment. We have reached a critical point in the history of water/wastewater management. For many key parts of the country we have now fully utilized available license capacity to abstract from the environment and discharge more to it. For these areas the next generation of water and wastewater infrastructure will likely be more expensive than existing assets. This would raise significant questions around affordability.

The alternative is to work differently with the environment through catchment/upstream management (soft infrastructure). Not only have such approaches been demonstrated to be cost effective, but they are also likely to be increasingly resilient to future shocks. We are aware of a number of companies actively engaging with other stakeholders to manage catchments and to develop no-build (hence cost and carbon efficient) solutions.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: "credible" improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. "Tractable" improvements are those that can generate usable quantitative outputs. "Transparent" improvements are those that do not rely on 'black box' modelling and assumptions.

Answer: Approaches to cost-benefit analysis are generally well established in the water and wastewater regulatory model. The key area for further work in the

forthcoming Business Plans will be how to represent benefits against a more uncertain future. Specifically the resilience agenda will require companies to consider mitigation for high consequence events against a very uncertain probability. It is likely that a less mechanistic set of approaches might need to be adopted if the process is to be credible, tractable and transparent. We will be seeking reassurance that customers are suitably engaged in this process and that companies work towards best value and not necessarily least cost options.

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: “demand” includes domestic, commercial, power generation and other major sources of demand.

Answer:

There is a well-established water resource management planning process which looks out 25 plus years as basis for managing supply/demand imbalances. Potential issues relate to optimisation across company boundaries and taking a longer term view (beyond 25 years).

Optimisation across company boundaries concerns the need to look at, for example, regional or catchment based approaches where several companies operate within a defined area. This requires information on potential opportunities to provide water across company boundaries, which in turn requires understanding of potential options to improve demand management, reduce leakage and transfer water from areas with surplus to areas with deficit. Ofwat is promoting the development of market information platform to help reveal the opportunities and enable responses to these opportunities by water companies. This builds on the existing water resource management processes, but recognises that in order to facilitate efficient decision making, companies need a better understanding of potential interest to supply outside their areas.

In terms of longer term thinking, the recent WaterUK report into Long Term Drought Forecasting calls for a ‘twin track’ approach and recognises and advocates the need for Demand Reduction (including water efficiency and leakage) as well as regional

transfers to share resources⁵. The report further recognises that once these options are exhausted then new sources and storage may be required. Current national and international thinking is starting to show a clear consensus that managing demand downwards, catchment based approaches and sharing resources are likely to be some of the most effective long term/sustainable interventions in many situations.

This is not to say that large-scale traditional infrastructure (reservoirs, desalination, wastewater treatment etc.) will not be needed, but that they need to be carefully considered in context and need not be an automatic response. Indeed, demand management and reducing leakage may create valuable opportunities to better understand need for further investment by revealing information about demand and allow time for companies to develop a better understanding of a range of options to meet demand/supply balance.

We are currently working with the sector, under the Water and Wastewater Resilience Action Group (WWRAG), to develop a set of resilience metrics. This will enable comparison of level of resilience within and between companies. It is likely that this work will provide a better understanding of the relative hierarchy of different intervention types, including both hard and soft infrastructure options. However, the most effective interventions are also likely to be influenced by local circumstances. We therefore expect much of the progress in this space to continue to be industry led and would strongly welcome any steps the NIC could take to encourage water companies to focus on effective supply and demand management over the long term.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

Answer:

It is generally recognized that the most effective intervention is to deal with the surface water component of sewerage flows. It is rare that sewerage capacity is overwhelmed by sewerage coming directly from properties. Dealing with surface water can be done by delaying the entry of surface water to the sewer, slowing the

⁵https://dl.dropboxusercontent.com/u/299993612/Publications/Reports/Water%20resources/WaterUK%20WRLTPF_Final%20Report_FINAL%20PUBLISHED.pdf

entry of surface water and/or reducing the volume of surface water entering the sewer, in the extreme, preventing its entry altogether. SUDS are vital to address this and a report in 2011 commissioned by Ofwat suggested that the UK could learn valuable lessons from overseas about SUDS implementation⁶. Following this report, we took a number of steps to help the industry improve outcomes. For example, in collaboration with the Environment Agency, we published a drainage strategy framework in 2013 to help companies, in collaboration with other organisations, to deliver the outcomes customers want⁷, including through SUDS.

Surface water separation/ removal (not necessarily using SUDS) can be a cost-effective option. Northumbrian's scheme in Whitburn is an example. The removal of surface water from a supermarket, its car park and farmland from a sewer in the Whitburn area of Sunderland has resulted in the downsizing of new underground storage tanks that are being constructed to limit the frequency and volume of discharges to the environment when it rains heavily and so maintain compliance with the Urban Waste Water Treatment Directive. At £8 million, the current cost estimate for the project is around half of the previous estimate that Northumbrian Water provided to Ofwat in the course of the last price review (PR14)⁸.

Incentives to encourage householders to disconnect down pipes are in place (i.e. surface water drainage rebates) but lengthy pay-back period hinders their effectiveness. Charging based on impermeable surface area would be more cost-reflective and may incentivise disconnection but experience has shown it can be a politically sensitive issue given the potential impact on certain types of customers with large impermeable surface areas (eg churches). However, four out of 10 wastewater companies have moved to surfaced based charging.

The above examples highlight how companies are making progress to better manage surface water drainage. We expect them to continue to focus on this when considering options and how/whether to invest in new assets.

⁶http://webarchive.nationalarchives.gov.uk/20150624091829/http://ofwat.gov.uk/future/sustainable/drainage/rpt_com_201102mwhswd.pdf

⁷ http://www.ofwat.gov.uk/wp-content/uploads/2015/12/rpt_com201305drainagestrategy1.pdf

⁸ See: https://www.nwl.co.uk/media-centre/611_5479.aspx

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Answer:

A whole catchment approach involves managing all the inflows and outflows to the water system in an integrated way. The key to making it work effectively is collaborative or partnership working from water companies and a range of stakeholders, including their customers, within a catchment. Effective catchment management is likely to involve companies working with a range of local and national stakeholders to deliver an integrated and sustainable approach.

There are a number of ways that this coordination could take place, for example:

- Catchment area partnerships – informal or formal collaboration arrangements formed to deliver a whole catchment approach for a defined catchment area. This would effectively create a number of local bodies to manage each catchment with national level coordination through bodies like the Environment Agency.
- More central coordination, for example through establishing a ‘system operator’ role for providing water and wastewater services – this approach would formally bring a greater level of national coordination to catchment management by creating a single system operator for the water and wastewater network.

Both of the above options would have benefits and drawbacks; we do not have a view on which is more appropriate. However we continue to expect water companies to put catchment management at the heart of their business plans for the next price review.

In addition to the organisational challenges of catchment management, there is a number of practical challenges. Diffuse pollution is one of the biggest challenges to improving water quality in England and Wales. Diffuse pollution occurs when small amounts of pollutants – often from many different sources – enter a water catchment across a wide area. On their own, the sources of this pollution can be relatively minor, but across the catchment they can accumulate to significantly affect water quality and to damage the ecosystem.

We recognise the effort and expense that is required to treat raw water to make it good quality drinking water. We further recognise similar effort that is required to treating wastewater such that it will not damage the environment to which it is discharged. Treatment is costly and risks damaging the environment (eg through the use of chemicals). Another concern is that current treatment approaches do not

remove pollutants from the surrounding environment – only from water that is for public use. This means that pollution could remain in the environment where it would continue to affect the wildlife that our rivers and streams sustain.

Upstream catchment management schemes could be a more sustainable way of managing the water cycle and of helping to ensure good quality drinking water. This is because they tackle diffuse pollution at source - before it reaches a water treatment works. They may also help the companies to find more cost-effective ways of meeting their environmental obligations.

These benefits also extend beyond diffuse pollution into flood risk management. An example is South West Water's 'Upstream Thinking' project. This aims to improve water quality in river catchments in the company's area as a way of reducing treatment costs. It also aims to help it manage water volumes during droughts and control run-off during floods.

Water customers could legitimately be expected to pay for those elements of catchment management that bring direct and measurable benefits to them, where schemes for good land management reasons contain measures that produce other benefits, alternative funding sources and contributions should be sought. This is consistent with wider approaches to flood risk management.

The upstream catchment management principles can also be applied to urban environments where surface water run-off and flood risk require a wider range of stakeholders to contribute to identifying, financing and implementing the optimal approach. Some examples of this type of approach are mentioned in our 2013 drainage strategy report discussed above.

There is a further challenge around payments. The catchment management approach may result in the polluter being paid to reduce their pollution. There is a question about the efficiency and fairness of this approach and whether it would be more efficient for the polluter to bear the costs of their impacts on wider society.

Considering natural, social and human as well as economic capital consequences of investment decisions should form part of the understanding of "how much" as well as "who pay".



Ordnance Survey

NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE

Response by Ordnance Survey

FEBRUARY 2017

Responsibility for this document

[name redacted] is responsible for the content of this document.

Change history

Version	Date	Summary of change
1.0	February 2017	First issue

Approval for issue

[name redacted], [job title redacted]

Trademarks

Ordnance Survey and the OS Symbol are registered trademarks of Ordnance Survey, the national mapping authority of Great Britain.

INTRODUCTION

Ordnance Survey (OS) is Britain's mapping agency, responsible for creating and updating the definitive mapping and geographic information database of Great Britain.

Our core business is focused on the collection, creation, maintenance, management and supply of geographic information to meet the needs of national physical and social infrastructure. We are heavily relied upon by organisations spanning transport, digital communications, energy, water and wastewater, flood risk management, and solid waste sectors in addition to the public sector in delivering against regulatory and policy objectives.

OS data is available to over 4,490 public sector organisations, free at the point of use under the terms of the Public Sector Mapping Agreement and the One Scotland Mapping Agreement¹. Additionally, OS expertise and data is being used to provide infrastructure-related analysis and services in a variety of contexts. Examples of these include:

1. Working with HS2 Ltd to provide a service to assure highly-accurate positioning capability to facilitate the rail construction process. A project to fulfil this has recently been awarded to OS, based on developing enhancements to OS's own satellite positioning infrastructure, OS Net², a highly accurate positioning service built on our geodetic framework. This service is widely used for precision tasks such as machine automation and precision agriculture.
2. Provision of ResilienceDirect³ to the Cabinet Office. This is an online service for the resilience community to share information amongst all Category 1 and 2 emergency responders and agencies for planning, response and recovery, built on a queryable mapping interface.
3. Collaboration with DfT to define and create a new generation of definitive road, path and right of way data, developed and maintained as a combination of OS surveyed content and information sourced from highway authority custodians. The resultant data, released in 2016, is highly interrogable and is enabling improved routing and asset management.
4. Working with the Department of Health to develop a map-based tool to visualise live data on localities' performance and process measures in relation to winter pressures on NHS and social care services, enabling the identification of areas under most pressure and facilitating planning and response actions.
5. Supporting Openreach in developing a flood risk mitigation strategy. A bridge collapse in Tadcaster in 2015 disrupted a trunk cable; we subsequently identified all bridges across Britain which carry Openreach assets together with associated flood risk categories. This information was used to establish mitigation and contingency options.

We support the ambition of the NIC and welcome the opportunity to engage and offer support at a strategic level. Our data and services are woven into the fabric of the national infrastructure and the

¹ <https://www.ordnancesurvey.co.uk/business-and-government/public-sector/mapping-agreements/index.html>

² <https://www.ordnancesurvey.co.uk/business-and-government/products/os-net/>

³ <https://www.ordnancesurvey.co.uk/business-and-government/public-sector/resilience-direct/about.html>

planning, operation and resilience of national infrastructure comprises a central component of our mission and our public task.

We provide national and international services to governments and commercial organisations based on our knowledge, skills and understanding of location data and geography. OS is a government-owned limited company, the entire issued share capital of which is held by the Secretary of State for BEIS, who is represented on the OS board by UKGI.

CALL FOR EVIDENCE RESPONSES

CROSS-CUTTING ISSUES

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

No comment.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

We acknowledge that data issues do not form a direct part of the NIC's scope. However, we suggest that one component of the improving the value of infrastructure is to invest in data as part of Britain's digital infrastructure, which offers opportunities for planning, deploying and operating assets, enhancing international competitiveness; not only by reducing costs but also by positioning the UK as a leader, enabling the export of ideas and skills.

An example of this is BIM (Building Information Modelling) Level 2⁴, a standard for enabling data interoperability and collaborative working. In 2011 the UK government issued a directive that from 2016 all public-sector capital projects would be compliant to BIM Level 2 with the aim of reducing costs by 20%. In 2015 alone, construction savings of £804m were reported⁵. This has been hailed internationally as a far-sighted initiative, and has created export opportunities for UK businesses.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Throughout our response, we will make repeated reference to the value of a common location referencing framework. Everything happens somewhere; infrastructure, or services relating to infrastructure, are inherently geographic or location-based. Making use of location as a common

⁴ Further information about BIM Level 2 is available here: <http://bim-level2.org/en/about/>

⁵ Digital Built Britain: Level 3 Building Information Modelling - Strategic Plan, page 5
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/410096/bis-15-155-digital-built-britain-level-3-strategy.pdf

reference links otherwise disparate datasets and enables information about people, properties and assets to be identified, analysed and communicated effectively, through a map or otherwise.

Further information about OS core reference data is provided in the Annexe.

Comprehensive and reliable data relating to natural and built assets is essential to effective management and operation. We argue for the creation of a national Digital Built Environment (DBE), recognising data as a key infrastructure capability for managing assets within an open, secure context. Within a DBE, geospatial data provides the framework within which the relationships across human, natural and built environments and systems can be identified, modelled and managed. If properly curated and maintained, a DBE becomes a single version of the truth, with the capability to improve decision-making and reduce costs.

Achieving this requires capturing and describing the real world, including the built environment, in ways that can be usefully consumed by multiple parties for multiple uses, enabling better outcomes in terms of more cost-effective infrastructure (both in terms of planning, construction and ongoing management), and healthier and more resilient places.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

No comment.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

With reference to our response to question 3, this challenge can be addressed by modelling and evaluation through DBE simulation.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

A single version of the truth – a core element of the DBE concept we highlighted in our response to question 3 – is a powerful enabler of both competition and collaboration between infrastructure service providers.

An example of improved competition lies in connections to existing networks, such as broadband fibre and electricity. Taking the latter as an example, Ofgem has implemented measures to facilitate competition in the provision of utility connections. As a consequence, customer connections can now be undertaken by Independent Connection Providers as well as the incumbent electricity network companies. In 2014 Ofgem published results of its findings in relation to issues frustrating

competition⁶. Access to network information was highlighted as being key to a successful open market, together with the adoption of common processes and practices to facilitate data exchange.

Similarly, collaboration requires a shared understanding of what is where. Ensuring that street works are coordinated and executed in an efficient and effective way is a challenge for infrastructure owners in the context of incomplete access to cross-sector asset information, which in many cases is inaccurate or out of date. As a result, numerous asset strikes occur every year (60,000 according to one estimate⁷), often with severe consequences. In addition, street works are not as efficient as they could be, resulting in longer time for the works with corresponding economic impact. Maintaining and sharing a common view of infrastructure data has the scope to significantly reduce this problem.

The deployment of 5G infrastructure represents a major forthcoming challenge (and is discussed further in our response to questions 17 and 18). DCMS is currently funding research⁸ into how to exploit detailed geospatial data to optimise the planning of 5G infrastructure, which will be essential due to the short range and propagation capabilities of mmWave radio signals. A detailed 3D model of the built environment is required to optimise signal coverage; the figure below illustrates how the two potential base station sites (yellow points) enable continuous radio coverage in the street, with the green and blue areas identifying the lines of sight from these locations. Access to a shared facility of this kind could offer major collaboration benefits – and reduced costs – to government and telco operators.



⁶ See <https://www.ofgem.gov.uk/publications-and-updates/update-competition-connections-market-review-issues-limiting-effective-competition>

⁷ <http://www.online.co.uk/features/striking-out-underground-cable-strikes#.V6DAkKkRPNI>

⁸ 5G infrastructure planning project led by Ordnance Survey, supported by Met Office and University of Surrey; see <https://www.ordnancesurvey.co.uk/about/news/2016/uk-leading-way-5g-future.html>

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

No comment.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

No comment.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

In our responses to questions 6 and 25 we refer to two examples of infrastructure risk (buried asset strikes and flooding). Planning for resilience requires active collaboration between stakeholders, again dependent on a single version of the truth, built on a common referencing framework. In this regard, we commend the MISTRAL⁹ project being led by the ITRC consortium (which includes OS), which is pursuing a 'system of systems' approach in modelling vulnerabilities.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

We refer to our response to question 3, where we introduced the concept of the Digital Built Environment, or DBE. We suggest that a fully-functioning DBE will offer significantly reduced costs and improved effectiveness for infrastructure planning and governance throughout asset lifecycles by providing an authoritative, independent model of the asset in the context of its surrounding geography.

Realising this will require a level of mandatory participation by infrastructure owners, particularly in terms of submitting data to the DBE in accordance with defined standards. This is already being realised in part through the operation of BIM Level 2, as referred to in our response to question 2; this mandates data interoperability and sharing within the supply chain.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The wealth of attention that has been devoted to concepts such as Natural Capital and Ecosystem Services has enabled much greater rigour in modelling and monitoring environmental outcomes from infrastructure projects than has historically been the case.

We perceive two elements to this challenge:

⁹ <http://www.itrc.org.uk/>

- Minimising and mitigating the adverse impacts of new infrastructure, and
- Designing infrastructure specifically to enhance or protect the natural environment

Infrastructure investments should be considered from a range of perspectives, including ecological habitats, ecosystem services and amenity. One area of major current concern is clean air in cities; we advocate seeking opportunities to plan and utilise green space at key locations within urban contexts to absorb pollutants, encourage the flow of clean air and improve the drainage of surface water. OS is working with the Scottish Government and BEIS to create a greenspace register for the whole of Great Britain which could support this.

We also encourage the adoption of a landscape-scale conservation¹⁰ approach when offsetting habitat loss, thereby helping to build a critical mass of habitat and reduce fragmentation.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

No comment.

TRANSPORT

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

The Atlas feasibility study¹¹, supported by the Government's £100m Intelligent Mobility fund and led by OS, is examining the data and communication requirements that will enable autonomous navigation. Our research is focusing on the growth and development of the underpinning technology, data and supporting infrastructure that Connected and Autonomous Vehicles (CAV) will require.

This research has identified the need for the development of high bandwidth communications infrastructure that can enable the exchange of data between fixed assets (such as traffic lights) and vehicles. It is anticipated that development of CAV will lead to the emergence of new business models and transport patterns.

Whilst CAV will be part of a future interconnected transport system, we believe that there will need to be a comparable investment on a national scale to deliver new mass-transit public transport infrastructure which incorporate bus, trains and metro systems.

¹⁰ https://en.wikipedia.org/wiki/Landscape-scale_conservation

¹¹ <https://www.ordnancesurvey.co.uk/about/news/2016/uk-given-green-light-driverless-cars.html>

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Within our major urban centres vehicle congestion and resultant poor air quality is a significant issue with measurable impacts on both productivity and public health¹². In recent years initiatives such as cycle hire schemes in London and several other cities have enabled the growth of low-impact flexible transport. In London specifically, this has been supported by the development of a growing network of segregated and traffic controlled cycle lanes. This growth of urban cycling has also led to the development of innovative delivery services such as Pedals and Deliveroo. The London experience would suggest that investment in cycling infrastructure should be taken seriously and can enable significant beneficial impacts urban outcomes.

Regarding freight, one of the significant challenges faced by cities is the movement of goods and the impact of HGVs, and to this end there have been suggestions to limit the size or weight of goods vehicles in city centres, or to limit the time period that these vehicles are permitted access. The issue of the movement of goods is difficult, as while it may be preferable to use smaller vehicles for this purpose, smaller permitted vehicles will result in greater numbers, which in turn could add to urban congestion levels.

Precise address location data can play a significant part in improving freight delivery efficiency. A major online retailer reported an immediate 10% improvement in delivery accuracy by exploiting OS's address location information (described in the Annexe) within its delivery operations, with consequent wider benefits in terms of reduced congestion and vehicular emissions.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

No comment.

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

The development of Mobility as a Service (MaaS) platforms and the implementation of road user charging should perhaps be treated as two separate issues. MaaS is focussed on the closer integration of multiple transport modes that can be accessed through a single and integrated system. These MaaS platforms have the capacity to deliver significant improvements in users' access to transport services. Today the deregulation and disaggregation of many aspects of public transport, particularly outside London, has meant that city-wide MaaS services are more challenging to deliver.

MaaS is typically focussed on improving the integration of public transport services. The data that these services collect could form the basis for a road user charging model; however, this would need to be intrinsically linked to the development of high quality and meaningful alternative services that

¹² The causes and impacts of poor air quality are set out in a 2016 report by the Royal College of Surgeons: <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>

can offer users convenient, efficient and flexible transportation options and other services such as single-trip insurance models.

DIGITAL COMMUNICATIONS

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

The highest value infrastructure investment will be a combination of 'deep fibre' (sometimes called 'full fibre') and mmWave radio, which is the vision of the emerging 5G world.

This builds on the views of Ofcom, which in a recent consultation¹³ stated:

One of our key proposals is to make a strategic shift to encourage investment in the large-scale deployment of ultrafast broadband networks, including fibre direct to homes and business premises (sometimes called "full fibre"), as an alternative to the predominantly copper-based technologies currently planned by BT. We believe network competition is the most effective spur for continued investment in high quality fibre networks.

The imperatives in this strategic shift are to maximise capacity and coverage, or network bottlenecks will remain.

Location dependency is an issue today; digital connectivity to a large extent depends on where you are. In some rural areas small businesses have relocated to obtain adequate broadband speeds and/or mobile coverage and remain viable. This often precludes remote working and therefore exacerbates the problems of vehicle emissions and transport congestion.

The link between digital connectivity and economic growth is well documented:

- A report by Arthur D Little in 2011 concluded that doubling the broadband speed for an economy increases GDP by 0.3 per cent¹⁴
- A 2011 World Bank report concluded that broadband has a significant impact on growth and deserves a central role in country development and competitiveness strategies¹⁵. This conclusion was reinforced in a 2016 World Bank report¹⁶

The UK is well positioned to take a leading role in the next generation of mobile communications, particularly in opening up mmWave frequencies for 5G use. However, as we discuss in our response to question 18, 5G initiatives and programmes are taking shape in several countries and decisions need to be made at the earliest opportunity to capitalise on this opportunity.

¹³ Ofcom consultation on Wholesale Local Access Market Review, January 2017: <https://www.ofcom.org.uk/consultations-and-statements/category-2/wholesale-local-access-market-review-proposals-PIA>; see section 1.2.

¹⁴ See http://www.adlittle.com/tim-press-releases.html?&no_cache=1&view=346

¹⁵ See http://siteresources.worldbank.org/EXTIC4D/Resources/IC4D_Broadband_35_50.pdf

¹⁶ See <http://pubdocs.worldbank.org/en/391452529895999/WDR16-BP-Exploring-the-Relationship-between-Broadband-and-Economic-Growth-Minges.pdf>

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

No. A core problem throughout has been the pace of change, with regulation consistently lagging behind technology. This is partly recognised in the upcoming Digital Economy Bill; however, we have not taken all steps necessary to lead the world in the drive towards 5G.

Our recommendation is that a UK taskforce of representative experts from all sectors should be formed with the explicit task of driving 5G investments in rapid timeframes, and where possible seeking to explain to the wider community where technology aggregation possibilities might exist.

For a 5G network to evolve we need two fundamental improvements; in the costs of infrastructure deployment, and in predictability of the available revenues to facilitate long-term business planning. We also need to assess the needs of those in what has become the rural information underclass.

On the cost side, we need cheaper fibre and work is already in hand in the UK to enable this. In a densified network, the numbers of radio access points will be significantly higher; by a factor of hundreds of thousands in some locations if mmWave frequencies are used. As alluded to in our response to question 6, geospatial data has a vital role in optimising infrastructure locations, both in terms of signal propagation through the built and natural landscape, and also by identifying other factors such as land ownership, planning consents and environmental risks. Good use of geospatial data has the capability to significantly reduce costs.

On the revenue side, data is increasingly available which can enable demand for radio capacity to be modelled over the space and time. This data is typically derived from records linked to addresses, or derived from crowdsourced methods such as mobile device tracking. To generate the greatest interoperability value, data records of this type need to be tied to persistent unique identifiers, such as the Unique Property Reference Number for addresses or the Unique Street Reference Number for road segments (more information about these identifiers is provided in the Annexe).

The current regulatory regime is still focused on 'fixed' and 'mobile' as separate entities. The market is already moving beyond this (as the BT-EE tie up demonstrates), and despite moves to release spectrum more quickly, we are aware of significant industry concerns that the fine vision set out by Ofcom (including in its capacity as leaders in BEREC) will not be translated into action (for instance spectrum auctions and data sharing) quickly enough. In the meantime, the USA will be releasing the 28GHz band in spring 2017, South Korea will deploy proto-5G systems in 2018, and Tokyo will fully deploy 5G by 2020 in time for the Olympics.

ENERGY

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

No comment.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

No comment.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Low carbon vehicles, and especially electric vehicles, present new challenges for an electricity grid already struggling with the integration of distributed and intermittent generation. The additional complicating factor of mobile demand, generation and storage all present issues and opportunities.

Grid balancing is a preferable approach than network reinforcement, which can create local overload. Local demand for charging electric vehicles can be highly unpredictable, but conversely significant opportunities exist in utilising electric vehicles as local storage units. This is essentially a problem of balancing supply and demand across time and space, and optimising the solution is therefore highly dependent on using a common location referencing framework. The challenge in this example is to be able to integrate physical (actual location) and logical (systems architecture) views of the electrical grid; this has proved a major issue for electricity networks.

Findings from the Low Carbon London study between UKPN and Future Transport Systems¹⁷ showed, amongst many things, that confidence in having access to charging points is critical to the adoption of electric vehicles. By integrating the logical and physical representation of the network to create a holistic view of the system, service providers will be able to dynamically manage demand and supply through feeds from sensors, social media, smart meters and other data sources whilst ensuring that users will be able to charge electric cars at any time at in any location.

WATER AND WASTEWATER (DRAINAGE AND SEWERAGE)

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

No comment.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

No comment.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Please refer to our response to question 26.

¹⁷ See <http://www.ukpowernetworks.co.uk/internet/en/news-and-press/press-releases/Electric-vehicle-lease-scheme-launched-in-London.html>

FLOOD RISK MANAGEMENT

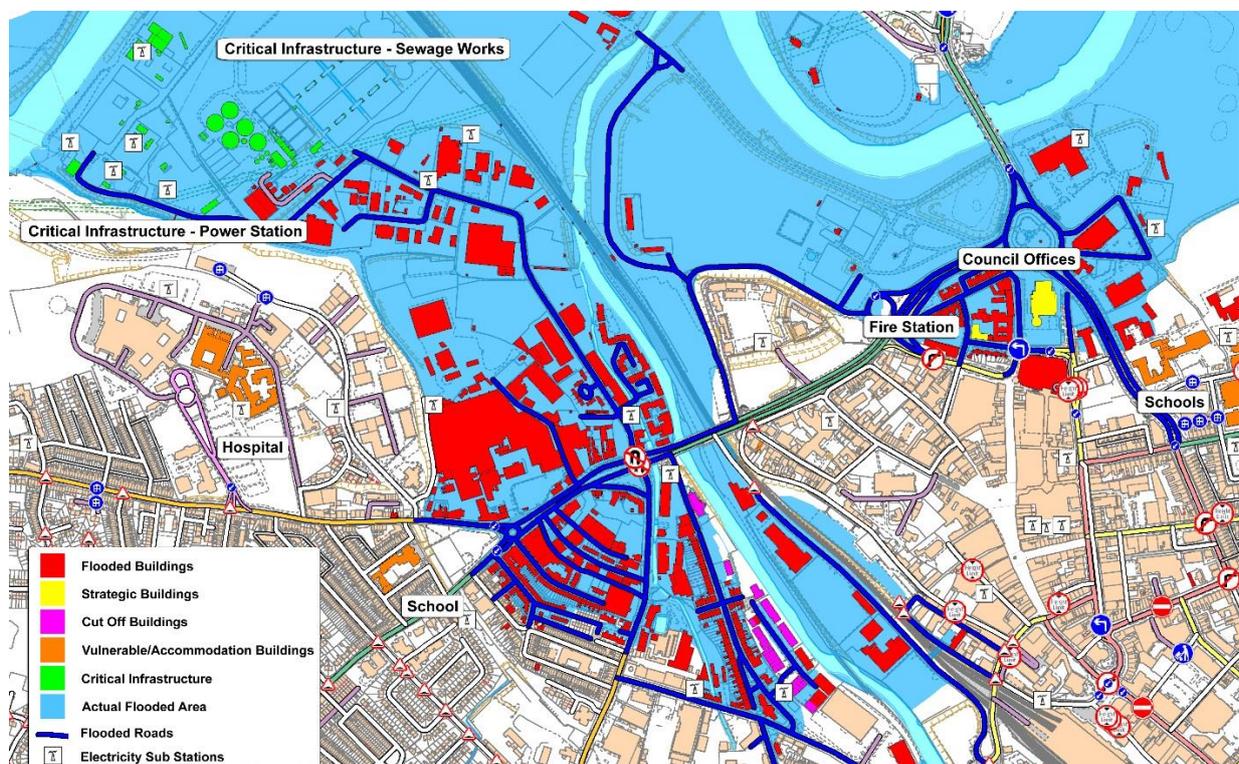
25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

It is widely reported that one in six homes in Britain are at risk from flooding; that is, 5.2 million homes are at risk from river and coastal floods, and a further 2.8 million homes from surface flooding. The problem has become more frequent and severe over the last decade with higher levels of winter rainfall, in line with climate change prediction.

As it is impractical to fully protect all properties and assets in all circumstances, the focus must be on mitigation and prioritisation. OS is working with GO-Science and the Environment Agency exploring new ways to collect, publish and manage flood defence data - such as the creation of a national flood defence/asset inventory, and a consistently heightened river networks – as part of the next generation of property-level flood models which would improve both the targeting of resources and the provision of risk-based flood insurance.

Better data is vital to target investment programmes and financial and policy incentives effectively. This should include a comprehensive, maintained dataset of critical infrastructure which can model the interdependencies of services and therefore flood vulnerabilities. Flooding is hyper-geographic in nature; it involves the interplay of numerous physical, environmental and socio-economic factors which cannot be properly modelled without utilising a geographic perspective.

This is illustrated in the example below, illustrating a part of Carlisle during the flood event of 2005. The flooding of roads has left several buildings, shown in purple in the lower central part of the image, isolated from other services. In the same way, the flooding of the sewage works and power station in the top left of the image will have left their own constituencies without key services. These interdependencies should all be modelled as part of the flood protection prioritisation process.



26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

The National Flood Resilience Review states that one important area for improvement is better management of rainfall in the natural environment by slowing the flow of water from the land into rivers.

Defra's 25-year plan for the environment will aim to achieve these effects by managing whole river catchments intelligently, developing sophisticated modelling to work out what can be done in each part of the catchment to minimise flooding. A 'pioneer' pilot project in Cumbria will test and demonstrate the power of this approach across the different river catchments there. We suggest that funding to landowners for a natural approach to flood risk management could come from a new UK farming policy replacing the Common Agricultural Policy of the EU.

Again, we argue that consistent, maintained reference data at catchment scale is vital for modelling, building and managing natural flood management schemes. For example, OS has collaborated with the Environment Agency to create one of the world's most detailed, heightened water networks showing the flow and precise course of every river, stream, lake, and canal in Great Britain¹⁸.

SOLID WASTE

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

No comment.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

The current disaggregation of manufacturing supply chains and the dispersal of production and consumption have resulted in a net increase in the use of resources. This in turn impacts the cost of goods and services and in addition there is an ecological/environmental impact. Moving towards the implementation of a more comprehensive circular economy could facilitate a reversal of this consumption trend. Work by the Ellen MacArthur Foundation¹⁹ has identified that in advanced economies such as ours there remain opportunities to further advance the implementation of a circular economy. The report suggests that this model could result in additional GDP growth, the creation of thousands of jobs, a reduction in a nation's carbon footprint, and a reduction of up to 50% in the consumption of some material resources.

¹⁸ OS MasterMap Water Network Layer: <https://www.ordnancesurvey.co.uk/business-and-government/products/os-mastermap-water-network.html>

¹⁹ <https://www.ellenmacarthurfoundation.org/publications/growth-within-a-circular-economy-vision-for-a-competitive-europe>

CONCLUSIONS

In your response to consultation submissions for the NIA process and methodology, you state: ‘The Commission recognises the importance of place and will continue to look at its work through a “place lens”’. Geography acts as the golden thread that enables disparate information to be connected and cross-sector dependencies to be modelled.

Through several examples in our response we make the case for using – and investing in – data to support the realisation of desired outcomes. We illustrate how a single view of the truth, enabled by a common geographic referencing framework, can enable cross-sector infrastructure collaboration and better decision making. At the strategic level, a geographic approach is effective at aggregating information to provide regional and national infrastructure perspectives.

CONTACT INFORMATION

We would be pleased to support you with any aspect of the National Infrastructure Assessment. Please contact [name redacted], [job title redacted], Ordnance Survey.

Email: [email address redacted]

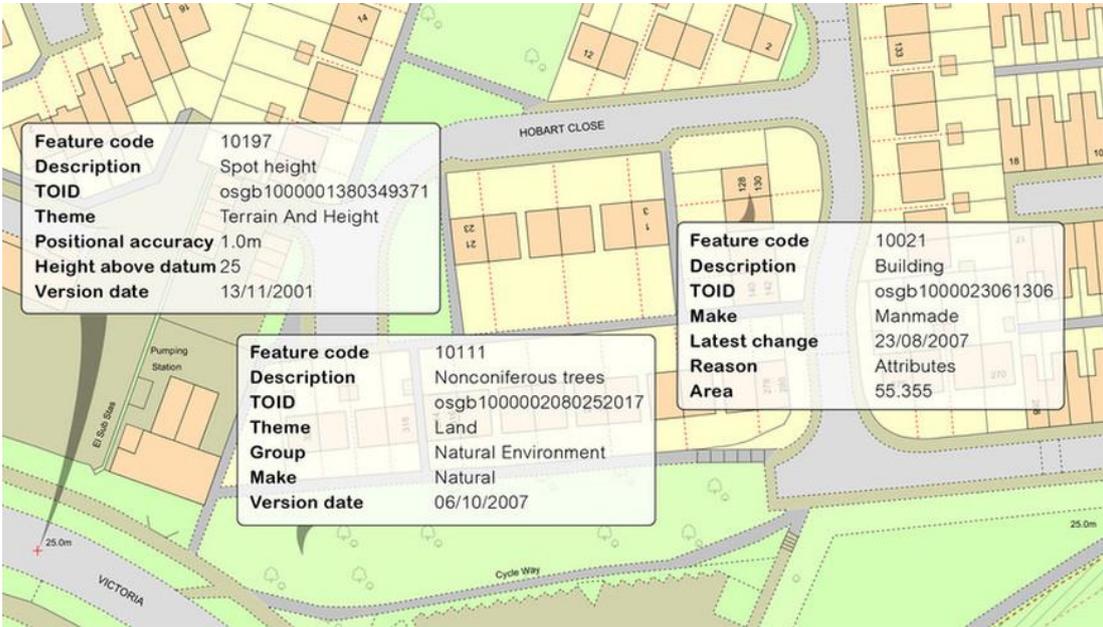
Tel: [telephone number redacted]

ANNEXE: LOCATION REFERENCING DATA

Ordnance Survey information is considered by infrastructure owners to be key to efficient location referencing. This Annexe briefly sets out some core elements of the information which is relied upon by all utility and infrastructure providers, encompassing:

- Topography – mapped real-world objects, enabling assets and events to be analysed in terms of proximity, adjacency and context
- Highways – enabling the referencing of linear assets such as cables, pipes and ducts
- Addresses – representing service end points of linear assets

Topography: we maintain the highly detailed ‘master map’ of Great Britain which provides the context and underpinning data for infrastructure and asset planning and management. The figure below illustrates some of the data attributes which underlie each surveyed object.



The detailed database that powers this output is continuously maintained, with around 10,000 updates registered every day across Great Britain. It is regarded as a core tool for all aspects of asset management, and moreover provides a referencing framework to share information through the unique identifier – the TOID – which is maintained for each mapped object.

Highways: Ordnance Survey is creating a new-generation highways dataset which will consist of the high quality and richly attributed data submitted by local authorities through the National Street Gazetteer (NSG) combined with Ordnance Survey’s widely used authoritative and fully maintained geographic roads data, creating a definitive highways network for England and Wales.

The figure below illustrates the information maintained by road element.



The dataset includes a Unique Street Reference Number (USRN) for each section of road. This identifier is already used as the mandated mechanism to notify the undertaking of street works. The USRN is further used to provide a link between addresses and streets.

Addressing: Through a partnership between Ordnance Survey and the Local Government Association, we maintain and provide the definitive national address database. Each address record is identified by a Unique Property Reference Number (UPRN), has a precise geographic location and a set of attributes relating to functional classification, lifecycle status and alternative address variants.

The figure below illustrates how this can be used to map non-residential address functions.



Access to a consistent and maintained address dataset is vital to manage and share information which links both business and personal customers and properties.

Address changes are built in to the data management and publication process, and are of particular relevance to cross-sector investment projects. The figure below illustrates how the UPRN is allocated and managed throughout a property lifecycle.



The TOID, the USRN and UPRN represent important foundations for data sharing and interoperability. As unique and persistent identifiers, they unambiguously reference geographic entities (such as water bodies and pavements) and addressable properties (for instance homes, businesses and civic functions) in an open way.

‘Sustainable Transport in Growing Non-Metropolitan City Regions’

[name redacted] [position redacted];

[position redacted], School of Built Environment, Oxford Brookes University

[email address redacted]

February 2017

Introduction

This submission is concerned with the scale and nature of the transport challenge faced by growing non-metropolitan city regions and the manner in which it is responded to. Reference is made to important changes currently taking place in local governance giving greater emphasis to strategic issues at the city region scale which should contribute to the Commission’s objectives for identifying and delivering high value infrastructure over the longer term. Attention is drawn to the particular opportunities offered by such a regime to deriving greater benefit from the local rail network whose present form in these areas typically reflects decisions made in the context of their very different economic geography half a century ago.

The general arguments are illustrated by reference to the circumstances of the Oxford area. My credentials for commenting on this and associated research evidence were supplied in my submission to the NIC on its Cambridge-Oxford Corridor Study in August 2016.

Although this submission is written from a transport perspective it is axiomatic that any investment strategy in an area should maximise the opportunities for synergy with land use development and especially with provision for projected housing requirements. In this respect the approach advocated here can be aligned with, and is supportive of, the proposals contained in the separate submission by Dr Nicholas Falk, Director of URBED.

The ‘urban transport problem’ and the demand-management response

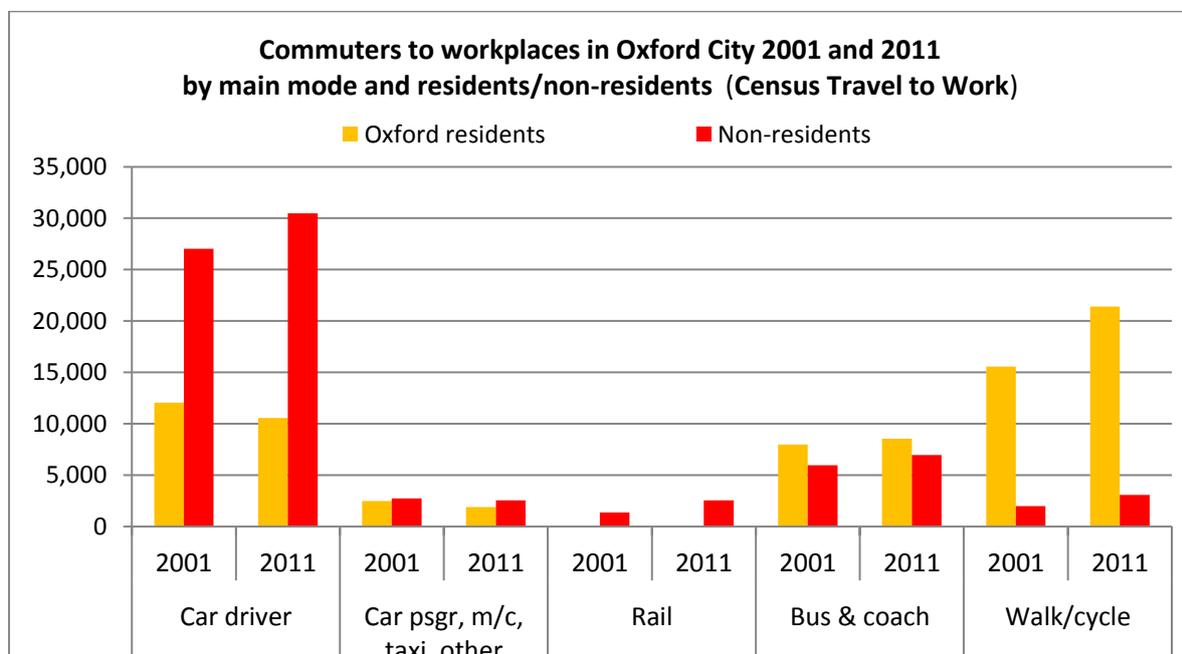
The urban transport problem has traditionally been viewed as one affecting cities and historic towns where the growing demand for car travel (as a product of increased car ownership) has had to be reconciled with the impracticability and/or undesirability of large scale investment to increase the capacity of the highway network, particularly in the vicinity of central areas. Typically a mix of demand management measures has been introduced accompanied by investments to improve the opportunities for travel by modes other than the private car¹.

Oxford was one of the first freestanding cities to adopt such a strategy (in the 1970s). A key feature was the control of on and off-street public parking space in the city centre (extended outwards subsequently) coupled with the provision of several ‘park and ride’ car parks at the city periphery and associated dedicated bus services to the centre. These were designed to intercept motorists travelling from the city’s wider hinterland of smaller towns and villages, most of whom had limited opportunities for using modes other than the car for their journey. Similar bus-based schemes have

since been introduced in many other freestanding cities, including Bath, Cambridge and York. (It is interesting to contrast these bus-based schemes with the ‘park and ride’ role of railway stations serving travellers to London and metropolitan cities where the interception typically takes place at a much earlier point in the journey),

In the intervening decades the distinction between the transport regimes prevailing in and surrounding the non-metropolitan cities has assumed greater significance on account of changes in population distribution. In Oxford’s case the city’s population increased by just 5,000 between 1981 and 2001 (to 135,000) whilst the population of the rest of the county increased by 60,000 (to 471,000). This changed distribution can be attributed to local planning policy (favouring development in the ‘country towns’) combined with the general trend of increasing car ownership and investment in the inter-urban road network which together prompted residential dispersal. By contrast car ownership in the city remains low (at 0.42 cars per adult in 2011 compared with an average of 0.70 in the county’s other towns) and is increasing only very slowly. Jobs remain disproportionately concentrated in the city and this underlines the dormitory or quasi-suburban nature of much of the development that has taken place in recent decades in the outlying towns.

Given these features it is perhaps unsurprising that a majority of people commuting to workplaces in the city now come from places outside it. More significant in terms of its implications for transport management is the fact that these ‘in-commuters’ have much longer journeys on average and are much more likely to travel as car drivers. In the context of planned increases in homes and jobs in the county (of around a third during the period 2011 to 2031 alone) this implies greatly increased pressure not only on transport facilities within the city but on the highway network of Central Oxfordshire outside it.

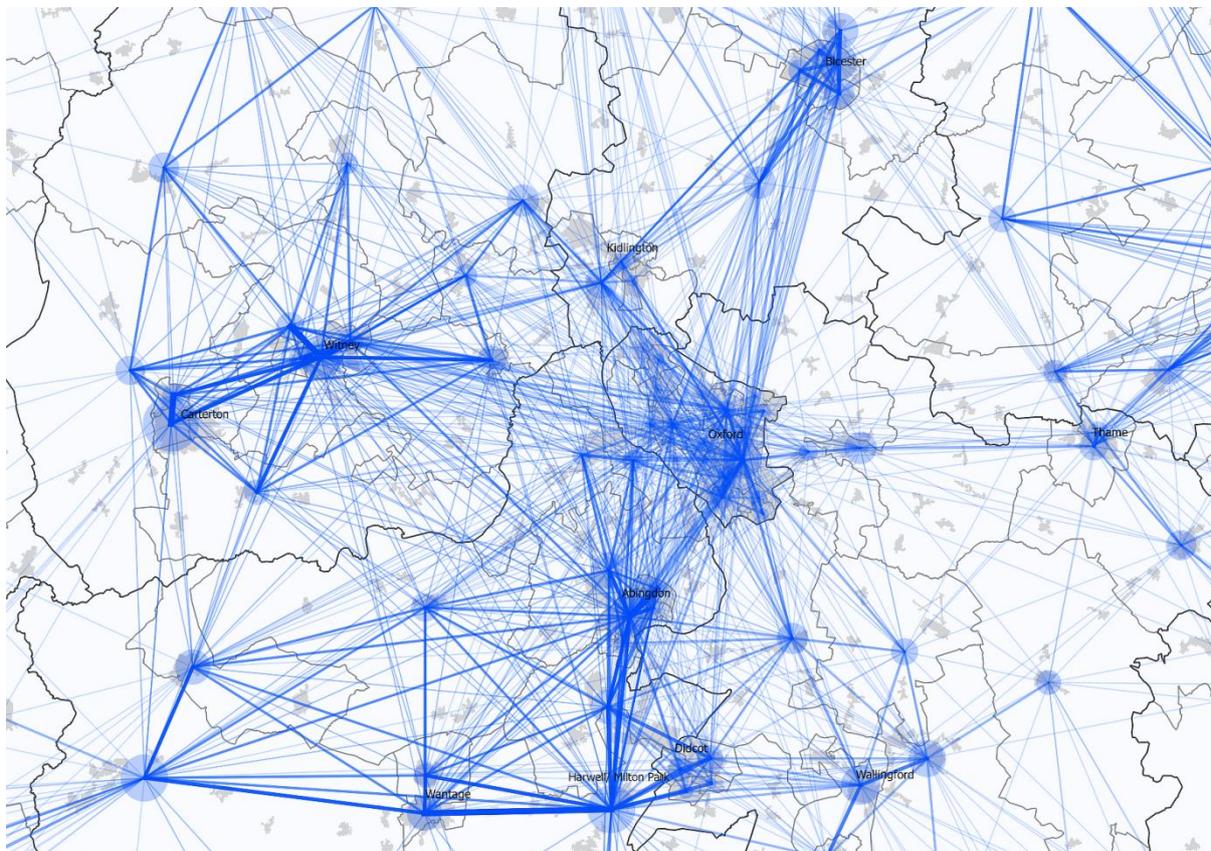


As far as movement into the city is concerned the County Council has responded by proposing major enhancement of the established strategy². This includes nearly doubling the number of park and ride spaces and relocating most of the present P&R car parks further from the city periphery in order to intercept motorists before they contribute to congestion approaching and crossing the city’s Ring

Road. This is combined with proposed investment on the corridors into and within the city to create 'rapid transit' standards of movement for the main bus services. Additional restraint measures in the form of congestion charging within the city, a workplace parking levy and further restriction points for general traffic are also being considered.

There are a number of difficulties associated with this strategy

- Achieving 'rapid' standards of movement for buses on otherwise congested roads is either expensive (if provided in the form of dedicated or prioritised lanes) or politically problematic (if congestion is to be addressed by some form of road user charging, or additional route closures within the city)
- In terms of access to the city centre accommodating the bulk of additional future trips by bus is not problem-free, given the volume of passenger boardings and the rival claims on available street space for pedestrians, public realm improvements etc . (In Oxford's case it has already been mooted that tunnelling under the historic centre will need to be considered in the longer term).
- The Park and Ride system does nothing to counter the growth in traffic on roads outside the city. Over time the car-based movements generated *between* outlying towns (as opposed to movements between them and the core city) form an increasing proportion of the total and are not subject to any of its demand management measures. [See the diagram below of car driver commuting flows in Central Oxfordshire).



Scale 1cm : 2.5km approx. This diagram is generated from 2011 Census Travel to Work data and shows car driver commuters between Medium Super Output Areas in Central Oxfordshire (see reference3) Four sizes of (two-way) flow are shown: 25-100 persons, 100-250, 250-500 and over 500

Inter-action with the strategic road network

Given the trends described above it can be seen how purpose-built strategic roads, originally designed to bypass a provincial city or town have had their role serving longer distance freight and passenger movements undermined by the growth of local traffic within the wider city region. In the case of Central Oxfordshire this is particularly evident on the dual-carriageway A34 trunk road which forms a north-south spine between Bicester, Oxford and Harwell (and also functions as the western arc of the Oxford Ring Road).

One response to this, if conditions are severe enough, is to propose an entirely new route for longer-distance traffic. (In the case of the A34 this is currently being investigated by Highways England as part of its Expressway study for the Oxford-Cambridge corridor). Whilst generating benefits for longer-distance journeys such a scheme is likely to have several adverse consequences. In addition to its very high capital cost and direct environmental impact these include the effects of substantial additional traffic induced by both the new strategic road and by the release of capacity on the existing one. There is no likelihood of car mileage being reduced within the city region as a whole and on most of its main roads traffic conditions will get worse (compounded by the effects of population growth).

In Oxfordshire's case, given that most of its public transport services between towns are bus operated, this prospect directly conflicts with the County Council's aspiration to increase the use of such services as one means of containing future traffic demand. It is in this context that opportunities for greater use of local rail services deserve to be explored as a more effective means of achieving modal shift, reducing overall growth in traffic and lessening demand on strategic roads and their potential investment requirement

Planning at the city region scale – recognising and forging inter-relationships

From the forgoing discussion it is clear that there are critical links between elements of the transport system that in non-metropolitan areas are commonly viewed at separate spatial scales (viz the core city, the outer parts of a city region, and major inter-urban corridors) and in terms of separate modes. Because of their functional interaction policies and investment programmes for all of these deserve to be conceived and appraised as one. In addition strategic decisions on transport and development need to be brought together. This is so that available investment for transport can be deployed to greatest benefit and that the travel outcomes from new developments contribute to rather than reduce overall operating efficiency.

It is unfortunate that at a time of unusually large increases in population and Government emphasis on promoting economic growth the mechanisms for delivering these seemingly uncontroversial objectives should have been subject to serious rupture. In non-metropolitan areas the abandonment of statutory strategic planning in 2011 and the assertion of 'localism' chimed with longstanding cultural and political antipathies between 'town' and 'country'. In Oxfordshire it led initially to protracted and disconnected exercises by the individual (district) planning authorities to fulfil their Government-imposed obligation of identifying developable land in their Local Plans sufficient to meet their 'objectively assessed housing needs' over the next 15 years. Significantly

the County Council's Local Transport Plan (LTP4) followed a separate timetable of preparation such that, general principles apart, the Council's input to Local Plans was and remains constrained to a series of passive observations on individual development site options. In such a situation urban form and functioning is in effect ratcheted forward on an incremental 'business as usual' basis which is entirely at odds with the scale and nature of population and economic change facing the city region.

The responsive position of Oxfordshire County Council as transport authority has continued during the latest phase of planning authorities' Local Plan work in which the four district councils surrounding Oxford City have agreed to accommodate an additional 15,000 new homes to fulfil the needs of the city but which it is not practicable to provide within the city boundaries⁴. In itself this collaborative action can be seen as a somewhat belated response to the 'duty to cooperate' legislated for in 2011 (at the time when regional strategies were abandoned). However it has also been facilitated by the Government's efforts to promote cross-authority working more generally through the Local Growth Deals programme. This has prompted the establishment of an Oxfordshire Growth Board Joint Committee comprising representatives from the six local councils (county plus five districts) together with non-voting participation by the Oxfordshire Local Enterprise Partnership and other key stakeholders. The emphasis on strategic issues in the activities of the Board is an important development within what might otherwise have been a continuation of more parochial and fractious exchanges amongst and between individual authorities.

Green Belt Review and Local Rail Opportunities

Green Belts have been designated around only a small number of metropolitan cities (Oxford being one) but where they exist they have had a profound influence on the pattern of urban growth in the city region. In Oxford's case the designation is the prime reason for the past prioritisation of new development in the 'country towns' referred to earlier (ie as an alternative to outward growth of the core city).

Although there is much antipathy amongst the general public to possible loss of Green Belt land the NPPF does provide for this 'in exceptional circumstances⁵'. The Oxfordshire Growth Board has taken the view that such an argument might be sustained in relation of the housing needs of Oxford City. As part of its collaborative work programme it has therefore commissioned an assessment of land parcels presently within the Green Belt surrounding Oxford which might be released from their current designation. This is an unusual and highly controversial departure from long-standing practice.

In theory, if the principle of Green Belt revision were accepted (and not all the Oxfordshire councils currently do) then the way could be open for a more fundamental review of the spatial strategy for the city region a few years hence. (The bulk of the allocations for the current planning round which lie beyond the Green Belt have already been determined). A much more efficient pattern of development and transport outcomes could be secured - ie less per capita distance and lower car driver share - if there were concentrations of new development close to the city served by 'transit' lines of some kind to which the land value uplift would make a financial contribution (as proposed by URBED⁶).

However it is not necessary to adopt URBED's prescription in full to recognise that there could be opportunities to deliver 'transit' in the vicinity of non-metropolitan cities by exploiting existing rail infrastructure more fully⁷. The scope for such action will vary from place to place but is essentially a combination of the 'inheritance' from past rationalisation of the railway network coupled with current and potential future patterns of development (housing and employment).

Following the recommendations of the Beeching Report in the 1960s many rural branch lines were closed in their entirety. On other routes smaller stations were typically closed and stopping services withdrawn although track and inter-urban services were retained. This retained infrastructure represents a resource which may be capable of more intensive use to serve the much greater volume of internal movement which now characterises non-metropolitan city regions. (An outline of possibilities in Central Oxfordshire is set out here in an annex). Notwithstanding relatively short journey distances and time penalties incurred travelling to and from stations the speed and reliability of rail renders it attractive to motorists otherwise faced with congested roads. The appeal of rail services can also be enhanced by integration and marketing within the wider public transport network⁸.

A longer-term infrastructure strategy for the city region

Under the current statutory planning system, being locally led and confined to a 15 year time horizon, it is almost inconceivable that a pattern of development linked to new or enhanced transport networks could be secured or even contemplated. Some overarching opportunity to inject consideration of potentially transformational investments is needed. Such an opportunity might arise in the event of a longer term infrastructure strategy being prepared for the city region.

The Oxfordshire Growth Board has recently agreed to the preparation of such a strategy with a horizon year of 2040, (ie a decade beyond the Local Plans currently being worked on by the district planning authorities). It is designed in part to overcome the present limitations of fragmented and 'responsive' infrastructure planning:

“ Currently Infrastructure Delivery Plans are developed alongside Local Plans to ensure that, as far as possible, decisions on forward planning are taking account of the infrastructure needs of the area. However this tends to be a **derived product**: the growth options are identified through land availability assessments, and through sustainability appraisal alongside deliverability and viability testing preferred sites emerge. Only then is the infrastructure needed to support these sites identified and tested. We need to do more to look at our infrastructure supply and demand as an opportunity to inform growth in terms of its location, scale and type and to seek to maximise the benefit and minimise the strain on infrastructure provision.

The Infrastructure Strategy is not a statutory policy document but is aimed at shaping and influencing key documents such as Local Plans and service providers' investment strategies”.⁹

The preparation of such a strategy can be regarded as a positive development and, in principle creates the opportunity for more efficient and effective investment programmes being assembled across the city region. However it has to be noted that such an outcome is not assured.

Interventions which straddle local authority boundaries (as with the Central Oxfordshire rail proposal) are bound to result in an uneven distribution of transport and development benefits locally (and no doubt some disbenefits). This may result in resistance to a genuine area-wide strategy by individual councils and lead to the programme consisting of an aggregation of more local, 'incremental' schemes instead. This possibility could be lessened – though not eliminated – by changed governance arrangements in the form of either a Combined Authority or single Unitary authority. Proposals for both of these options are currently being worked on in Oxfordshire at the present time.

The non-statutory nature of an infrastructure strategy would be another potential impediment to securing a satisfactory area-wide outcome. The local autonomy represented by statutory development planning at district council level - having been secured in 2011 - is jealously guarded (and would remain in the event of a Combined Authority being established). An alignment of local interests in development location (especially as perceived by residents) with more abstract 'technocratic' interests in efficient infrastructure networks is not impossible. But there could be resistance to both the principle and practice of longer term infrastructure strategies if it was thought that local discretion over development location through the Local Plan process was being compromised or pre-empted.

Conclusion

Having regard to the transport questions (Q13-15) posed in the Commission's call for evidence....

In the particular circumstances of growing non-metropolitan city regions there is likely to be increasing divergence in per capita travel volumes and car driver mode shares as between residents of the core city and elsewhere.

In the core city more stringent demand management regimes will be needed to contain individual motorised travel, but as far as city residents are concerned this will be facilitated by the improved availability of shared and collective modes which will tend to suppress individual car ownership and use.

In the wider city region where car use is already high there is the prospect of worsening traffic conditions arising primarily from large increases in population (notwithstanding continuing slow falls in trip rates). In the absence of any overarching regime managing the use of roadspace these conditions will be exacerbated by the additional traffic induced by any major investment in the strategic road network.

This deterioration could be lessened by

- a) radically reviewing the settlement pattern which forms the basis of local development planning, achieving a rebalance in favour of locations close to the core city (lessening average trip lengths) along routes well-served by modes other than the car (reducing the car driver mode share), together lowering average per capita car mileage.

- b) exploiting opportunities for greater use of the rail network for journeys within the city region to the core city and other local centres of employment, linking service improvements and station investments with the siting of new or expanded areas of development .

To achieve these benefits and cost-effective investments overall is dependent on governance and public funding arrangements fostering an integrated approach to the generation and assessment of strategic options for transport and development across city regions.

Notes and References

- 1 Headicar P 2015 *Traffic and Towns : the next fifty years* Occasional Paper no 6 Independent Transport Commission , London Available at <http://www.theitc.org.uk/our-research/occasional-papers/>
- 2 Oxfordshire County Council 2015 *Connecting Oxfordshire Vol 2 : The Oxford Transport Strategy* Local Transport Plan 4
- 3 I am grateful to Gordon Stokes (Visiting Fellow, Transport Studies Unit, University of Oxford) for this diagram. It was produced from NOMIS data using QGIS mapping. For more details and mapping of other areas see <http://gordonstokes.co.uk/travcen/censusflows.html>
- 4 Oxfordshire Growth Board *Post-SHMA Strategic Work Programme* Agenda Item 6 Meeting 26 September 2016
- 5 The National Planning Policy Framework (NPPF paras 79, 83 and 84) states that:
“The fundamental aim of Green Belt policy is to prevent urban sprawl by keeping land permanently open.... Once established, Green Belt boundaries should only be altered in exceptional circumstances, through the preparation or review of the Local Plan.... When drawing up or reviewing Green Belt boundaries local planning authorities should take account of the need to promote sustainable patterns of development”
- 6 Rudlin D and Falk N 2014 *Uxcester Garden City* Winning submission for the Wolfson Economics Prize London, URBED
- 7 Nicholas Falk has promoted this idea applying the brand-name ‘SwiftRail’ to the local services – see R Harman and N Falk *SwiftRail – funding local rail transit through smarter growth* Public Money & Management (2016) vol 36(6) Taylor & Francis. Delivery is linked with the possible use of refurbished former London Underground (District Line) trains as rolling stock, although this is not anticipated to be needed in the Oxford context.
- 8 In Oxfordshire’s case the County Council has stated that “(it) will work with operators and other partners to enhance the network of high quality, integrated public transport services, interchanges and supporting infrastructure” Policy 07 *Connecting Oxfordshire Volume 1* (2016)
- 9 Oxfordshire Growth Board *Oxfordshire Infrastructure Strategy Brief* paras 2.5 and 3.2 May 2016 (emphasis added)

ANNEX : LOCAL RAIL OPPORTUNITIES IN CENTRAL OXFORDSHIRE

This note outlines the case for making better use of rail infrastructure to serve local travel needs in Central Oxfordshire. There are particular features of the Oxford situation which make this proposition particularly attractive at the present time. However the basic characteristics of the network and services in the Oxford area have similarities with several other freestanding English cities where the suggested approach might be replicated. These common features are described briefly first before exploring the Oxford example further.

General background

The rationalisation of the passenger rail network which took place in the 1960s was predicated on the assumption that the main market in which rail could continue to offer an attractive alternative to the private car and public road services was for journeys between larger towns and cities. Accordingly branch lines to smaller towns and other lines through lightly populated rural areas were generally closed whilst stopping services and intermediate stations on those inter-urban lines which were retained were mostly withdrawn.

An exception to this general pattern was made in the case of London suburban services and many local passenger services in the provincial conurbations (metropolitan areas). Here it was recognised that it might not be practicable to accommodate future travel demands by relying solely on road-based modes, particularly as far as access to city centres was concerned. In the metropolitan areas Passenger Transport Executives were established to develop and promote what were often run-down local rail services as part of the planning and management of transport within the conurbation as a whole.

Outside the conurbations the pattern of travel has changed very considerably over the last 50 years. Increases in private car ownership have enabled people to live and work across much larger areas. Smaller, formerly more self-contained country towns within the hinterland of the main cities have become favoured residential locations whilst employment and main services have tended to concentrate in and around the core city. The result is typically a tidal set of flows within a 'city-region' centring on the principal city but with increasingly important set of predominantly car – based flows between secondary centres, including locations on the periphery of the main urban area. Problems of traffic congestion are no longer confined to the city centre but occur throughout the wider region, often on routes whose principal function is to serve longer-distance movements.

As a general proposition therefore it is becoming necessary in planning terms to view these shire city regions as modern day conurbations. Although, unlike their industrial predecessors, the built up areas are set against a mainly rural backdrop the contemporary scale and pattern of travel flows requires a managed, multi-modal approach to be adopted of the kind formerly confined to urban centres if efficient and sustainable conditions are to be delivered. Where they exist, opportunities for making greater use of the rail network deserve to be capitalised upon as part of this approach. This is partly because rail can often offer an objectively higher standard of speed and reliability than other modes but also because there is clear evidence of car-owners being willing to transfer to rail for all or part of their journey and thus lessen demands on the road network.

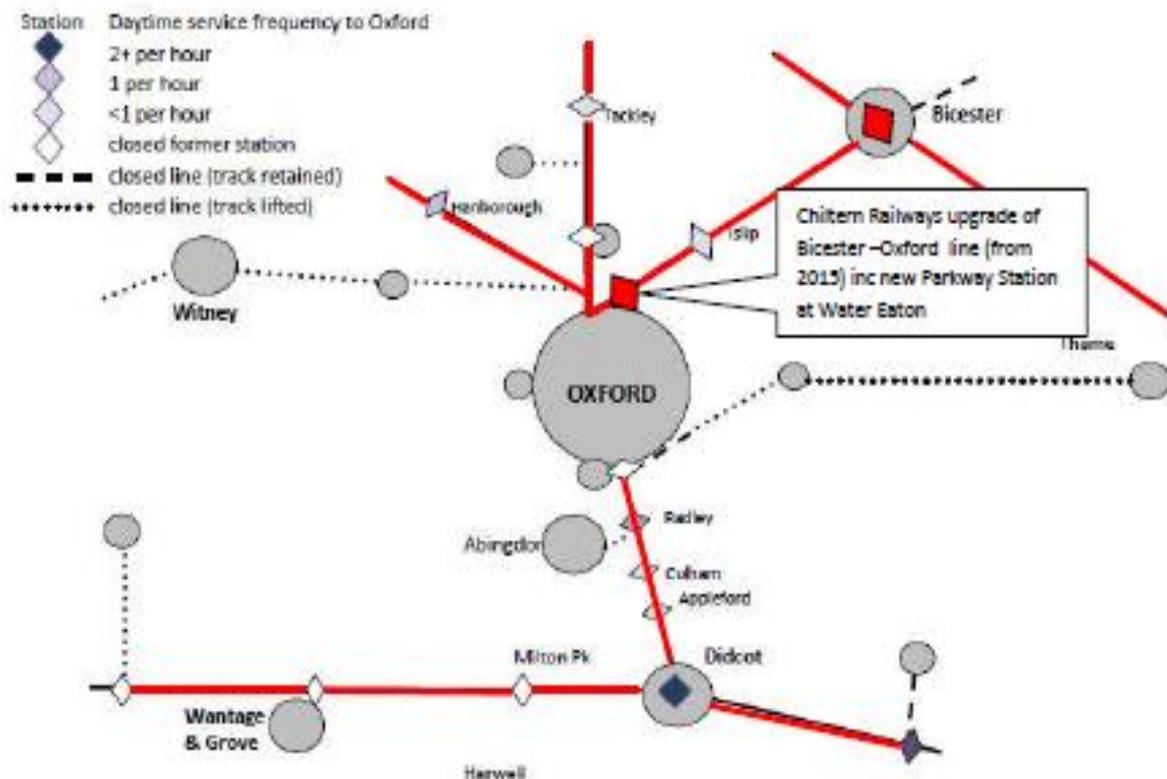
The Oxford situation (see diagram below)

The rationalisation of the rail network in the Oxford area resulted in

- The closure of lines from Oxford to Witney/Fairford and Thame/(High Wycombe), although with a single track freight spur retained on the latter to serve the car works at Cowley
- The withdrawal of passenger services from Oxford to Bicester/(Bletchley) although a limited passenger service was reintroduced over the retained freight line to Bicester from the 1980s
- The closure of branches to Woodstock and Abingdon
- The closure of intermediate stations and local services between Didcot and Swindon
- The closure of Kidlington station, although with other intermediate stations on the line to Banbury and associated stopping service retained

The present pattern of local services in the Oxford area consists of

- An infrequent stopping service from Banbury (supplementing a half-hourly Cross-Country inter-urban service between Birmingham and Reading)
- A half-hourly service from Bicester via a new station at Water Eaton (Oxford Parkway) recently opened by Chiltern Railways as part of their investment in a second 'main-line' service between Oxford and London
- A half-hourly stopping service from Reading via Didcot calling (with varying, lesser frequency) at the intermediate stations of Appleford, Culham and Radley
- An hourly service from Moreton in Marsh calling at Kingham, Charlbury and Hanborough normally originating from Worcester/Hereford and continuing as one of the GWR's fast Oxford–London Paddington services



Opportunities for developing local rail services in Central Oxfordshire

There are two main opportunities for developing local rail services in Central Oxfordshire based on the use of existing rail lines and serving existing land uses. These are

- i) The Cowley branch around the southern edge of Oxford City
- ii) Stopping services on the line between Didcot through Oxford to North Kidlington (Oxford Airport) – the so-called ‘Spine-line’

Services on these lines would complement the local function of the new Chiltern service between Bicester and Oxford.

It is particularly fortuitous that these opportunities are located within the so-called ‘Knowledge Spine’ – the north-south corridor from Bicester through Oxford to Harwell which has been identified by the Oxfordshire Local Economic Partnership as offering the best prospects for economic growth and where investment is being concentrated. Further enhancements could therefore be introduced in future linked to land use developments in the area, several of which are already being canvassed through the Local Plan process. (A summary of possible stations on the Spine-line is listed at the end of this note).

In the diagram overleaf the local rail services are shown linked at interchange points with the bus rapid transit routes into Oxford City proposed by Oxfordshire County Council in their 2016 Local Transport Plan. Together they could form a branded ‘Metro’ network for Central Oxfordshire.

i) The Cowley Branch

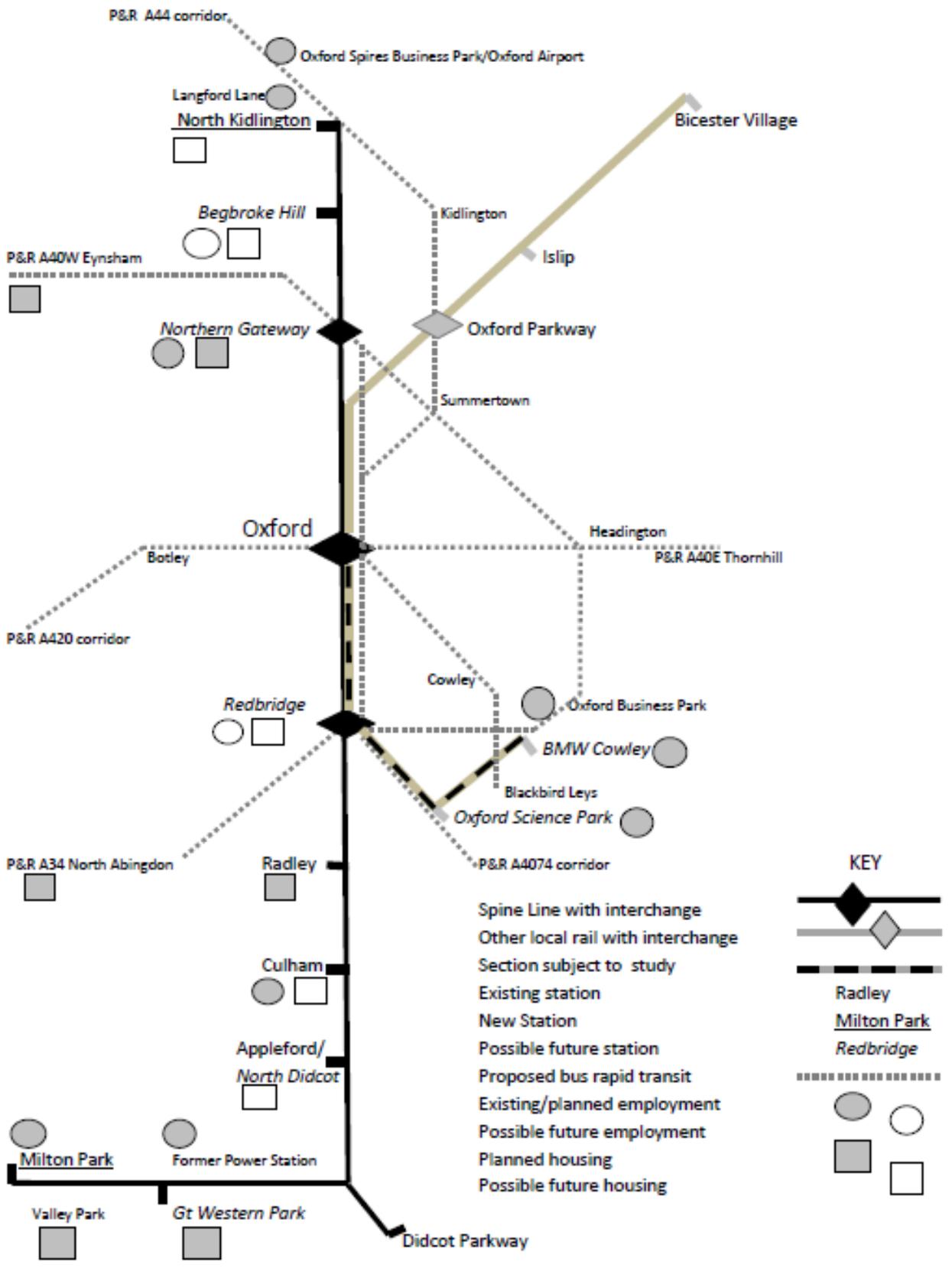
The Chiltern Railways service from London Marylebone via Bicester Village and Oxford Parkway currently terminates at newly-built terminal platforms on the north side of Oxford Station.

Chiltern has already publicised its aspiration to extend these trains southwards through Oxford Station and over the Cowley freight branch. (A demonstration train was operated in 2014.) The extension would include two new stations at Littlemore and BMW Cowley serving the main employment centres of Oxford Science Park and Oxford Business Park respectively and thus provide fast, direct access not only from the city centre but across the city from Bicester and Oxford Parkway (South Kidlington). The new stations would also offer a much quicker means of travel inbound to Oxford City Centre from the residential areas of Blackbird Leys and Littlemore/Minchery Farm. Additional patronage might be generated in future through further development of the employment areas and by the addition of new housing around the southern edge of the city, although the latter (being Green Belt) is not currently favoured by the local planning authority (South Oxfordshire DC).

The present timetabling of Chiltern services involves a half hour layover of trains in the terminal platforms at Oxford Station. In principle therefore extension of services to Cowley (about an 8-10 minute journey) would seem practicable without the use of additional train sets and with only single platforms at the two stations.

Inspection of the present timetables of the main passenger services through Oxford Station (ie the half-hourly Cross-Country and GWR fast London services) suggests that, using the existing single through platforms the Chiltern trains could be extended south to/from Kennington Junction (where

'TOWARDS AN OXFORD METRO': Swift-Rail and Bus Rapid Transit



the Cowley branch diverges) on their existing timetable pattern (ie retaining arrival and departure times at Oxford to/from London Marylebone). In practice however there may be some conflict with present paths for freight trains and generally with the 'crossovers' for northbound trains at Kennington Junction (ie from Cowley) and at Oxford North junction (where the line to Bicester diverges eastwards).

Detailed investigation would therefore be needed to determine whether in fact any such conflicts could be resolved by minor adjustments to timings or whether the extension to Cowley would have to await planned future investment in increasing capacity at Oxford Station (by adding second through platforms) and over the line southwards to Kennington.

ii) the Spine-line

The postponement of electrification between Didcot and Oxford (announced towards the end of 2016) means that the current stopping services from London Paddington and Reading to Oxford (soon to be operated by electric units) will need to be severed at Didcot with the service between Didcot and Oxford continuing to be operated by diesel units.

This separation of the 'Oxford local service' creates opportunities in two respects:

- 1) It allows the possibility of extending the stopping service to provide direct links northwards across Oxford City (otherwise impossible if electric units were introduced from Didcot to Oxford).
- 2) It allows trains to Didcot not necessarily to terminate there (nor continue east towards Reading as at present) but rather to reverse and travel west to serve the major employment and new residential areas immediately west of the town

Because stopping services are already operating over the Didcot-Oxford section and utilising the through platforms at Oxford it is possible to consider their development in a way which does not place any additional demands on track or station capacity (unlike the Chiltern extension to Cowley).

The basic Spine-line proposal is for the half-hourly stopping service north of Didcot to be reconfigured to operate between new (single platform) stations at Milton Park and North Kidlington (Langford Lane/Oxford Airport) on either side of the city. Both are adjacent to existing major employment areas (offering much-improved accessibility 'outbound' from Oxford) and are also well placed relative to A-roads to serve as 'parkway' stations inbound. Milton Park would also serve directly the planned major residential area of Valley Park (west of Didcot, south of the main railway line) whilst North Kidlington would serve existing residential areas in the northern part of Kidlington plus possible future development around its northern fringe.

In operational terms the Spine-line service west of Didcot could utilise the existing freight tracks (on the north side of the main GWR line) plus spurs into the former ordnance depot at Milton Park and/or the (now demolished) former coal-fired power station. A minimum of track renewal/reconfiguration and new signalling should therefore be required. Pedestrian access would be needed from the south side of the railway (ie the future Valley Park), plus probably serving a car park off the A4130 also.

North of Oxford the existing track layout on the line to Banbury is sufficient as far as Kidlington where a new 'siding' and single platform would need to be constructed on the western side of the present line immediately north of the A4260 road bridge, plus a cross-over and associated signalling for return in the southbound direction. Road access (over the canal) would be needed from the adjacent A4260/Langford Lane junction.

The estimated running time between the two new termini plus all existing intermediate stops is 33 minutes. This would require three train units to run a half-hourly service. This is one more than the two likely to be required to provide a replacement solely for the present Didcot-Oxford service

Summary list of existing and (in brackets) possible future Spine-line stations, south to north

Milton Park - new parkway station serving existing employment area to the north and future Valley Park residential area to the south;

(Great Western Park) – future station linked with proposed redevelopment of Didcot Power Station site and Great Western Park residential area (to south) currently under development

Didcot Parkway

Appleford – possible future relocation of present station approx 1km to the south associated with northern extension of main residential area of Didcot

Culham – improved frequency; park and ride facility; future expansion of employment area; possible major residential development in vicinity of station

Radley – planned expansion of village

(Redbridge) - Park and Ride /interchange with bus transit serving outer South Oxford (cf Oxford Parkway to north of city); some opportunity for development in vicinity

Oxford

(Northern Gateway) – possible new station off A40 to serve planned employment development and residential N Oxford; also interchange with bus transit routes

(Begbroke Hill) – possible new station to serve University research campus, prospective major future residential area west of Kidlington and existing central Kidlington

North Kidlington – new parkway station serving Langford Lane employment area, Oxford Spires Business Park and Oxford Airport; also northern residential part of Kidlington

Oxford Brookes University (2) response to National Infrastructure Assessment call for evidence. [Name redacted].

NIA call for evidence February 2017

School of the Built Environment

Oxford Brookes University

I comment here in relation to some of the cross cutting issues. It would be possible to say a great deal under several of the sectoral headings, but I am sure that experts in those fields will be giving a good foundation for work in each case: there is I would say far more recent and effective work to draw on for each sector.

I only make comments on a few of the cross cutting issue questions, in part because they overlap to a great degree. All the questions on funding, financing, maintenance, competition or collaboration are parts of the challenge of the overall approach taken to the provision of infrastructure in the UK. Naturally that approach can be divided up into facets, but how strategy, investment and regulation are carried out all intersect with each other. The UK has in my view a largely broken model for doing many of the things that need to be done. This is critical because it means that it is not only a matter of the NIA pointing out desirable paths. These are likely to be unimplementable unless major changes are made to the whole infrastructure provisioning system. Luckily the NIC has a chance to state a view on improved provision approaches, which the National Infrastructure Plans only addressed extremely gingerly.

Much of the following may appear to be more assertive than evidence based or “scientific”. There are wide swathes of academic work lying at its base. Much that would be more or less directly relevant would be from the fields of political economy and spatial planning, spread over decades, and with large international components, but to reference in this way is inappropriate for present purposes.

Question 1

I will take the opportunity here to discuss some options I see for the Oxford city region, within its wider context. This will I hope lay down some idea of the very big challenges the NIA ought to present to business as usual thinking. Such challenges are only thinkable (if they are) because of the long time frame of the NIA.

Oxfordshire needs a new housing system and a new transportation system (this is far more important than such inter-regional investments as the suggested Expressway or even than East West Rail, as many of us have argued). These are needed to make daily local life more tolerable. At the moment the sub-region is failing to function on numerous levels. It can be argued that only the national linkings (to London and the north) and the international linkings

(to several relatively easily accessed airports and St Pancras) work well. But these are not what determine the quality of life of the majority of Oxfordshire residents.

The change of the transportation system needs a restructuring of the funding and management of present systems. These are now managed in a completely disintegrated way by a range of national and local bodies and companies, none effectively accountable for the outcomes (compare Transport for London for some greater degree of accountable integration). Major new investment and revenue funding is needed to make a functioning region, as has been made clear in valuable work for the Local Transport Plan (LTP4). None of this may appear to be inside the remit of the NIA, but that remit does include national investment in road and rail etc, and the opportunity cost of that investment is clearly related to investment in localities all over England. The very good question put at one of the NIA events, on how much money should be spent on national or on local schemes, needs answering in a sophisticated way. But one part of the answer should I think be to trace the implications of genuinely transformative plans like LTP4 (and that is only a start) being implemented across England. If that is *only* possible by cutting other schemes like Cross Rail 2 or some of the big national transport investment (roads, rail), then at least the choices become clearer.

The new transport system would need to include several of the ingredients which have been discussed in the area over decades, now made potentially more viable by rising population and activity in the sub-region: light rail transit, restored railway lines, restructured bus systems with priority infrastructure, cycle ways built in or sometimes retrofitted. Dozens of European sub-regions have equipped themselves with these infrastructures over the last 30 years. Naturally that has depended on funding and political will, absent here. But if people are asked what they want, that will be a big part of the answer. It will be problematic if the answer when solutions are presented, is that the current system cannot deliver and therefore nothing can be done.

The new housing system for Oxfordshire needs national change and governance change. It may be doubted from initial reading whether the 2017 Housing White Paper will give the lead for such change, but in due course measures will be needed to reduce the continuing escalation of housing costs in areas like Oxfordshire. Control of rents and stopping house purchase price inflation are key parts of that, as well as ensuring new building of permanently usable social housing in the right places (near the improved transport systems of the area). Yet again this is not core NIA territory, but the links will be made in every English locality between the housing dimensions and the infrastructure included in the NIA impacting on that locality, so the connections need to be made in due course, whether by the NIC or by someone else, in a subsequent or parallel step. Perhaps the NIA should call for the making of new strategic plans for sub-regions like Oxfordshire (needed across much of non metropolitan England) to overcome the dramatically ineffective and inefficient present model of five weak Local Plans, most poorly implemented.

So I (like I suspect many people looking at their own localities) would give strong support for local and regionally oriented infrastructure, and for putting the emphasis on working on long term transitions in such infrastructure systems, tied in with overall livelihood. In my case, being interested in national infrastructure, I also argue the case for considerable if selective investment at that level, but within a (for once) clear set of priorities - I would put low carbon and equitable access at the top. That would support for example big investment in rail

including HS2, but making sure that that fits with lower levels investments and meets the low carbon and socially fair criteria (which HS2 may risk not doing, if ticket prices are high). Motorway investment on the other hand may meet socially fair criteria but cannot be low carbon. Similar assessments can be made relatively easily for energy and other big infrastructure systems.

Question 2

I limit comments to a perspective on freight. This has long been regarded as the forgotten and even-less-planned-for transport sector. Whilst the DfT has done interesting work on some of the issues over recent years, this has consistently failed to lead to really full investigation of the core issues of planning and effective implementation. As a result the prospects for any real modal shifts (largely road to rail) in the UK are as dire now as 10, 20 or 30 years ago. This is a major example of governmental policy failure. Given the long term view of the NIA, this is a real chance to change the direction of travel, by suggesting some radical new approaches.

One area I have been particularly interested in is the planning of strategic rail freight interchanges (SRFIs). This is an area where policy has existed, but where the vagaries of the 2008/2011 Acts system (ineffective NPSs in particular) mean that the decisions being taken in this field, regarded by some as critical in moving to a genuine rail based UK freight system, are scattergun and quite unlikely to lead to an efficient system. Poor planning decisions have already been seen such as the approval of a massive warehousing scheme, with some rail access, near Castle Donington in the East Midlands in 2016 (the decision was against Examining Inspector advice, which in turn was constrained by problematic NPS and other government guidance). More problematic decisions on a wave of schemes proposed in the “golden triangle” in the English Midlands are to be expected in the coming years, given the realisation in the logistics industry that such huge warehousing schemes can now be advanced through the 2008 Planning Act regime by the inclusion of rail access, which in the majority of cases appears to be likely to be little used (all schemes are near motorway or strategic road junctions and in reality depend very largely on road access).

A thorough review of the approach of current policy is needed. The situation is crying out for proper strategic spatial planning that can tie up the allocation of such large sites with major transport investment (invariably publicly funded). Without such geographical awareness, the present free for all will result in enormous investment during the next decade, making any modal shift even less likely into the mid and late twenty first century, locking the freight system of the UK even more into its contemporary unsustainable high carbon path. This is as always a mix of regulatory (planning) and investment issues. Only a strong national long term strategy for freight can bring together these two sides, so harnessing industry forces effectively, as against leaving the field to speculative warehousing sectors to control the investment. Such a national strategy can incorporate work done at regional level (such as by Transport for the North and Midlands Connect), but such work is not a substitute for such national leadership. The NIA should lay out the case for a long term national freight strategy.

I would add that a “gateways” approach (drawing on Eddington thinking) is valuable, in pulling together modes and geographies, but it needs to be carried out with an understanding of the particularities of freight. Those mean that freight terminals or warehousing and logistics systems spread around the UK are as critical as the ports or airports that some may

see as the incarnation of gateways. The whole system is “competitive” if it is efficient in social, economic and environmental terms.

Questions 3 and 10

My comments here are to a degree related to the submission of the Common Futures Network, which argues quite correctly for a national spatial strategy for England. My analysis and suggestions however come at the options from a somewhat different angle. I would argue for a radical restructuring of the whole infrastructure planning and provision system at all levels, and that a move to at least *thinking* in national spatial terms must act as one of the route finders and intelligence mechanisms for such a restructuring.

Such restructuring is needed both to choose the right projects (a massive potential gain from the right sort of NIA) and to cut the costs to *society* (the current system is massively wasteful, with schemes being far above costs in many other countries, the result of a largely ill engineered infrastructure provisioning system). Spending less, on the right projects, would be a valuable achievement.

It is not easy to even sketch out what such a new infrastructure provisioning system would look like. The NIC may well express themselves quite happy with the present system, imagining that it can be steered in whatever direction the NIA points. But many observers, from differing political and theoretical starting points, have argued that the whole arrangement of the UK system is problematic – one could mention the work of Dieter Helm on regulation and funding of infrastructure, over a long period, or specialists in the energy and transport fields (Catherine Mitchell at Exeter University, Phil Goodwin ex UWE now UCL, as examples).

Schematically we can divide the infrastructure systems up as being at top (all England or UK), middle (regions and city regions within them) and lowest (town, locality, project) levels. These are densely and fully related to each other, meaning that whilst it is quite understandable that the first NIA will concentrate its fire (we understand) on the top level, this will leave very great problems of actually making any difference, if the other levels are not addressed and then the issues tackled. This is especially obvious when the housing issues are examined (as is becoming clear in the middle level study on Cambridge – Milton Keynes – Oxford). I make some comments on each level here, but the diagonal impacts are critical, one of the several sound reasons supporting the case for a national spatial strategy.

The **top level** is no doubt the one which is going to be easiest to find good evidence for now, given the outputs of the big research programmes, even though even there the challenges are great, in terms of making coherent long term proposals. Part of these challenges is the need to completely re-examine and then overhaul the regulatory and funding regimes across big infrastructure. It will be one thing laying out a path for a sector (such as energy, making recommendations on generation, transport and so on), but quite another working out how such a path can be implemented. Study of the German and French energy transitions is instructive in this regard (there is a mass of website material giving some commentary on this, for example at <https://energytransition.org/>; more considered academic assessment is

only just beginning to emerge). In Germany a very clear route map (the sort of thing one might hope would eventually emerge from the NIA) exists, but the navigation of implementation through a federal state minefield (a problem England at least does not have) and a highly liberalised system (shared by England) is showing how route finding and implementation play into each other in real practice. In France different problems of implementation are beginning to become evident, in a still more centralised and less liberalised state than Germany, but overall the instruments are potentially easier to use there. But in each case the design of appropriate regulatory and funding regimes is proving critical to advancing on the paths chosen. It is difficult to imagine that anything like the mixed energy regime in the UK (OFGEM, energy NPSs and so on) could be remotely fit for purpose for moving along any but the least ambitious path that might emerge from the NIA. Similar analysis could be carried out for each of the other sectors (and has already appeared nicely in some of the early NIC work, such as recently on the structuring of 5G).

The “**middle**” level of infrastructure systems at regional or city region or county level is one that has been hardly thought about since around 2010, although new work by Transport for the North and elsewhere is beginning to change this. This makes any progress on thinking about long term urbanisation especially for housing very difficult. Work for the National Housing and Planning Advice Unit just before its abolition suggested the identification of housing market areas to be a major structuring element of future strategic planning (DCLG 2010). This was not followed up, and the planning system (working with a weakened forward planning tool in the shape of low level Local Plans) has struggled to give any shape to the shaping of real life localities (with travel to work areas far wider than the Local Plan making authorities). The current attempt to explore the possibility of “infrastructure led strategic planning” in Cambridge – Milton Keynes – Oxford project is extremely interesting, but in the absence of effective strategic planning in this part of England is likely to also struggle to find a way forward which will ensure that proposals stick over the many years needed. All this pushes the case for a radically new model to steer investment across sectors (NIC type infrastructure, but also housing and other social infrastructure). Some reinvention of accountable strategic planning is needed, and it is very hard to imagine what this might be if it does not consist of democratically elected bodies spanning many current local authority areas, in other words some new sorts of elected regional bodies. This is of course anathema to many, but I think it is worth stressing that setting paths at this level over the long term needed is almost inconceivably difficult without a new governing mechanism on these lines. These new bodies should have funding power, delegated over reasonable periods by central government, so that they can work with the private sector who will share much of the investment challenge.

The **lowest level** is that addressed in the planning fields largely by the funding mechanisms of planning obligations (Section 106 agreements) and the Community Infrastructure Levy (CIL) processes. Neither now work well (I have not fully taken in the recent CIL review, but it does not look as if fundamental flaws have been tackled), and the NIC, even if this may seem well outside its field, could usefully give an outsider view on these failures, as the non-functioning at this level impacts powerfully on the credibility of any proposals at the middle level just discussed. No authority or other local actors (such as LEPs) can currently make any genuine promises about the infrastructure that local communities may be able to expect, when the framework for such funding has such a broken model. This is a powerful incentive

to the ever increasing loss of trust in the local authorities trying to steer local change. The problems with these instruments have been highlighted often in recent years (the work for the Lyons commission in 2014 is one source), and governmental failure to deal with these problems infects all forward planning for local level infrastructure especially, in England. One solution would undoubtedly be a move to far more public investment (however frightening this may appear to the Treasury in particular). A system like that in the Netherlands could then be set up, whereby the government meets twice a year with local authorities to track investment progress in key projects, in a two way checking process called the MIRT (Zonneveld and Spaans 2014 give some idea of this instrument). This might begin to restore some credibility to forward planning, as well as give both central government and local authorities a sense of shared ownership of projects. The current planning of so called “devolution” mechanisms (combined authorities and so on) may in some parts of England be able to play some role in this, but in many regions there is no sign that this initiative will have helpful effects. A fresh start is needed to examine real local infrastructure needs and create an effective long term mechanism for meeting them.

Beyond this discussion in terms of levels, the following would be necessary related parts of a package to set up a new infrastructure provisioning system.

- The long term reordering of regulation is needed, setting the fresh objective for all infrastructure regulatory bodies of prioritising efficiency and long term sustainability (not as at present liberalisation and the promotion of competition). The goals of planning decision making should be similarly reordered, to make the same objectives central to the real working of the town and country planning regime (NPPF and NPPG), and to the new set of NPSs.
- Change in the management of land is needed, away from a system based on financial speculation, to one based on societal goals. At present, as numerous expert commentators have explained over many years, it is impossible to make a well functioning housing system (especially new production), at reasonable cost, with the present approach to land. If an objective is to make a more efficient infrastructure provisioning system (less concentrated on massively expensive big projects), this land issue has to be resolved. Again, this is not in the core remit of the NIC, but its resolution is integral to any realistic implementation of its recommendations, and especially if there is any linking set up with housing development.

The case for full exploration of really different options

I fear that the NIA may be pressed into considering quite narrowly differing options, at the final stages of its work in particular. This would be a vital opportunity missed. From my perspective, the radical green option is the one essential to the achievement of low carbon and sustainable livelihoods, and I think it is very important that this path is fully explored, not just within each sector (most obviously by demand reduction and / or different tracks in energy and transport), but in an across-the-board fashion. I realise that none of the NIC commissioners identify with this position, and so there may not be much push to give it real weight, given shortage of time and resources. It intersects very strongly with the call for a national spatial strategy, or at least national spatial analytical thinking, because all such green transitioning has to happen in real spaces, locally, regionally and nationally, and coming from

local bases of opinion. Such bases are far from majorities at present, but the lesser influence in the UK than in parts of Europe (and particular parts of North America) may be due in part to the absence of any governmental initiatives with serious interest in such across-the-board change and transitioning. Surely the NIA could be one of the first to promote such a serious discussion, leading (it might be hoped) to a continued interest in such long term oriented radical trend breaks in societal functioning. This could avoid the real risk of being confronted with at best a couple of pretty much business as usual pathways (with of course small percentage differences on a range of issues), when the public consultation takes place in mid 2017.

I would note that I am very sceptical that the control of the Committee on Climate Change (and the 2008 Act) will be adequate in setting the sustainability of the paths analysed. The London airports case does not give confidence that the control worked there (certainly the Davies Commission was strongly constrained by its brief, which it is to be hoped is not the case for the NIC, in this respect). This is one ground for hoping that a strongly sustainable option (as above) can be incorporated into the development of the NIA, rather than largely relying on CCC advice, very valuable though I am sure that will be in many respects.

Department of Communities and Local Government, 2010, *Geography of Housing Market Areas*, DCLG, London.

Zonneveld W and Spaans M, 2014, Meta-governance and developing integrated territorial strategies: the case study of MIRT territorial agendas in the Randstad (Netherlands), *Planning Theory and Practice*, 15, 4, 543-562.

National Infrastructure Assessment: Call for Evidence

Response of the Oxfordshire Growth Board

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

Oxfordshire has the fastest growing economy outside of London and contributes £21.9bn to the nation's Gross Value Added (GVA) output. Over the period 2011-31 the County is forecast to grow significantly with 100,000 new homes required to support demographic growth and the planned expansion of Oxfordshire's economy that will deliver an additional 85,600 jobs.

Oxfordshire's delivery trajectory against these two targets is mixed. Recent job creation has been higher than forecast but housing growth has fallen significantly short of the Oxfordshire SHMA (Strategic Housing Market Area) target for the last five years with only some 15,000 homes completed, with an uneven distribution of the delivery across the County: the significant jobs growth is both adding to pressure on infrastructure and highlighting the need for advances in the provision of affordable housing. This pressure is noted in the NIC Interim Report on the Oxford to Cambridge corridor which concluded that although the fundamentals of Oxfordshire's economy are strong, connectivity and communication across and beyond the county together with a lack of affordable housing are major factors holding back growth and productivity.

Many of Oxfordshire's growth opportunities stem from a high-tech knowledge economy focused primarily but not exclusively along the Oxfordshire 'Knowledge Spine' which connects the strategic growth areas at Bicester, Oxford and Science Vale (Didcot and two EZs - Enterprise Zones), together with the science parks at Begbroke, Culham and Harwell. Much of this knowledge economy centres on the University of Oxford, which recently topped the global rankings for higher education institutes and is one of the UK's most significant drivers of innovation. A number of the University's research sites as well as those of national/international scientific facilities and high-tech businesses that together form a dynamic eco-system are located at the science parks within the knowledge corridor, a number of which have significant capacity for growth.

High quality transport infrastructure is needed to keep key employment growth locations well connected with each other and with the wider regional and national economy. High quality infrastructure is a critical aspect of international competitiveness and Oxfordshire recognises the need to improve our infrastructure to improve productivity and successfully face the challenge of Brexit. It is also needed to connect homes to jobs at a local level, recognising that housing delivery is driven by economic growth. Oxfordshire's roads are already heavily congested, with the A34 in particular operating beyond its capacity, with significant impacts on the health of the city economy. Long term sustainable growth in Oxfordshire will require an effective mobility system that provides both additional capacity for and alternatives to the private car, including rail and Rapid Transit services.

Investment is also needed in:

- communications infrastructure, for example to complete county-wide superfast broadband and 4G telecommunications coverage and to provide further improvements (e.g. 5G) as future technology leads to demands for higher speeds in both residential and commercial premises
- utilities infrastructure to, guarantee adequate water supply long term, provide flood protection to Oxford, and to reinforce the electricity grid to accommodate renewable energy projects and supply electricity to new development when needed

To bring all this together in a composite picture of Oxfordshire's needs and opportunities, the Oxfordshire Growth Board has commissioned consultants to produce an Oxfordshire Infrastructure Strategy (OXIS) to identify and prioritise the strategic infrastructure to support

housing and jobs growth in the County to 2040 and beyond. The completed strategy report is expected in June 2017.

Appendix 1 sets out a list of the highest value national and local infrastructure investments needed to deliver the required housing and jobs growth by 2031 and to support longer term growth based on the draft findings from the draft OxIS report. It includes national, regional and local schemes for which full funding has yet to be identified.

The Oxfordshire Growth Board, alongside the County Council as transport authority are founder members of the England's Economic Heartland (EEH) Strategic Alliance, currently focused on working collaboratively with all District, Unitary and County Councils to improve the efficiency and effectiveness of infrastructure planning across the Oxford to Cambridge growth corridor. Significantly upgrading and enhancing the strategic rail and road network, including the provision of the following missing road and rail links in the national transport network would improve competitiveness of Oxfordshire, the sub-regional Heartland corridor and the UK. Priorities are

- Completion of the East West rail to connect Oxford (and Reading), via Bicester and Milton Keynes to Cambridge and onwards to Felixstowe/Norwich/Ipswich.
- Oxford-Cambridge Expressway to provide improved links between the economic powerhouses of Oxford and the Oxfordshire knowledge spine area, Milton Keynes and Cambridge and elsewhere within England's Economic Heartland.
- Four tracking of the rail network between Didcot and Oxford to increase capacity to cater for growing passenger travel and for freight movements from Southampton port.
- Capacity improvements to the A34 to improve the highway link between the south coast deep water ports - Oxfordshire – the M40/Midlands and to deal with congestion and journey time reliability issues on the strategic network within Oxfordshire as set out in the DfT/Highways England Route Based Strategies.

The Growth Board estimates that there is a £1.7bn gap in Oxfordshire between planned infrastructure investment across all sectors and the actual amount needed to support the scale of predicted growth up to 2030, taking account of potential funding sources. This not a complete picture however, and in our work in preparing the OxIS to 2040 and beyond we will be identifying additional infrastructure needs to support growth in that period.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Oxfordshire occupies a strategic position on the national highway and rail networks, with Oxford now recognised as a major hub. It is at the centre of the rail network for rail passengers in terms of east-west connectivity and the Strategic Freight Network (SFN) for container traffic between the port of Southampton and the Midlands, North West and Scotland operates through Oxford and Didcot.

Network Rail expect that by 2019 available rail capacity through Oxford will be full with significant enhancements and upgrades required, although these are not anticipated to be undertaken until post 2024. Great Western electrification to Oxford has also been postponed until at least 2024. However, as passenger and freight demand continue to grow, and new connectivity opportunities arise (for example connections to growth centres at Swindon, Bristol and the west), capacity issues will be exacerbated and will have a more significant impact on UK's and Oxfordshire's competitiveness unless planned major rail upgrades can be brought forward, particularly on the critical Didcot-Oxford section of the network.

There is also a need for on-going engagement with Government and Heathrow Airport in respect of proposals to expand airport capacity, focusing on the importance of improving strategic connectivity to/from the airport to the wider South East, particularly by rail. The planned Heathrow western rail link to Reading services should be extended to Didcot and (probably when electrified) on to Oxford.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

We currently estimate a £1.7bn gap between planned infrastructure investment in Oxfordshire and the actual amount needed to support the scale of predicted growth up to 2030. Looking forward, there is a need for a strategic infrastructure/spatial planning approach to planning places to live and work to avoid development triggering a need for additional strategic infrastructure items which cannot be funded. The Growth Board have recognised that and have approved the development of a countywide Spatial plan to provide a holistic picture of growth across Oxfordshire.

The development of this Spatial Plan will allow development to be planned where it can take advantage of and help sustain existing and planned infrastructure, ensuring future communities are attractive and thriving places – particularly on/around main public transport corridors and hubs. We believe that the close working arrangements that exist between Councils and other public bodies in Oxfordshire, together with the development of the Joint Spatial Plan provide the right basis for planning coherently for Oxfordshire. This approach will provide confidence to the NIC that the Western side of the corridor has the right tool to grasp the challenge identified in the Interim Report on the corridor, as well as to integrate with other strategic opportunities that emerge beyond the County boundary.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

There is a great deal of academic work currently being undertaken to better understand the opportunities that demand management offers across the range of infrastructures, recognising that they are disparate in nature and have vastly different physical and psychological drivers/motivating influences.

For example, focusing on energy use, BEIS suggest that the UK “could be saving 196TWh in 2020, equivalent to 22 power stations through, socially cost-effective investment in energy efficiency”. All four scenarios set out in the UK 2011 Carbon Plan to achieve the 2050 carbon targets imply a per capita demand reduction of between 31% and 54% relative to 2007. This is ambitious but achievable if properly managed and funded.

We believe that there are similarly significant impacts achievable across the transport and wider infrastructure network: The Growth Board are working to support the development of an intelligent mobility platform that will allow us to better understand the impact of transport pricing on choice of travel mode, applying learning from behavioural economics. Broadly, the challenge will be developing a robust business case for investment to deliver network improvements that can capture positive externalities (improvement in air quality, health outcomes and noise pollution for example).

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The quality of infrastructure profoundly affects both economic growth and productivity and people’s quality of life. Whilst provision of new infrastructure to unlock growth is vital, the quality of existing strategic infrastructure also needs to be maintained to support existing and new businesses and communities.

A good transport network is vital to supporting economic and housing growth. It is essential that new and existing strategic transport assets together provide for the efficient mass movement of people and goods, including the ‘last mile’ of the journey. Programmes for maintaining the condition of roads and highway related assets, including drainage, should prioritise growth corridors in which there are already planned investments with the potential

for rapid transit services and high pedestrian and cycle usage or where there are safety issues. Incremental repair may be a short term solution but may prove more costly over time.

At 2014 it was estimated that to bring all roads within Oxfordshire alone up to a good state of repair would cost £165m and then an on-going year on year investment of approximately £20m per year to maintain that condition level. It is important that the responsibility for maintaining assets is devolved to the local level where there will be opportunities to spot any advantages from asset rationalisation and for economies of scale through combining construction of new infrastructure schemes with maintenance of other assets.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

The opportunities fall in many ways;

- Use of Central Government and other buying organisations frameworks open for collaborative use.
- Combining of spend by local District and County Councils
- Use of open tendering to local SMEs
- Use of 'Construction line' and other pre-qualified suppliers
- Strategic Planning of Contracts
- Local Forums to develop competition and explain to companies how tenders are released
- Development of strategic alliances with sector experts
- Greater use of innovation partnership procurement

Cross-boundary collaboration through the EEH and other partnerships offers opportunities to align activities and share knowledge/experience across teams to improve planning and delivery of infrastructure.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

We highlighted earlier the ambition of the Growth Board to develop an overarching strategic infrastructure vision for Oxfordshire and believe that future infrastructure funding should be tied to the development of such cohesive and inclusive strategies. The Growth Board supports, through the process of devolution, the defrayment of nationally held funds to locally accountable partnerships to deliver against the publicly stated priorities of the strategic vision.

For example, Oxfordshire's devolution bid sets out our ambition to establish a strategic infrastructure fund. The structure assumes a combination of business rate retention, stamp duty land tax and potential business rate levy to create an investment fund. The presumption is that the income streams will support borrowing and enable early delivery of infrastructure. We have also taken a strategic approach to the use of EZ Business rates, enabling advanced borrowing to pump prime development. We have already committed over £40m of borrowing against EZ1 and are currently reviewing the potential of EZ2.

Strategic partnerships, such as the EEH Strategic Alliance, are developing overarching transport strategies that will include the concept of the Major Road Network – a combination of Highways England's Strategic Road network and the more significant local transport authority-owned roads. There may be a case for the ring-fenced Road Fund Tax to be made available to such partnerships for investment in the Major Road Network rather than just being restricted to Highways England's network.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

At a strategic level, there are a number of projects where clear Government and partnership commitments are in place, but without the guarantee of (full) funding or different options for finance – examples include the East West Rail Western Section, which is partially funded, and the A34 interchange at Lodge Hill, which currently has no specific funding allocation but is required to support delivery of 1,000 homes. These are both pieces of critical infrastructure for which a finance solution needs to be sought to prevent barriers to growth arising.

At a more local level, developments may stall where developers are unwilling to provide a bond to ensure key pieces of infrastructure such as schools can be provided in the event that a developer defaults on payment of agreed contributions. It would be beneficial to have a Government agency acting as guarantor for significant deferred contributions to which applicants/developers could go to enable them to provide appropriate security for prompt payment of such contributions. Developers can be reluctant to progress with a development if they consider the cost of a bond prohibitive.

Oxfordshire has benefitted from front funding of affordable housing in Didcot by the HCA which provided the headroom for a developer to progress key infrastructure at Great Western Park in Didcot, thus advancing the development of the site. The Growth Board also supports this approach.

As part of its development of an Oxfordshire Infrastructure Strategy the Growth Board has commissioned a study of the grid capacity in Oxfordshire from SSE. This has highlighted that the current regulatory framework is based on a reactive approach to connecting new development to the electricity grid and does not provide for the electricity suppliers to invest in the supply network e.g. in new sub-stations, in anticipation of planned growth. This lack of forward planning results in capacity in the existing network reducing as developments come forward to the extent that even relatively small developments are asked to pay for significant investment to achieve a step change in capacity - this is reflected in the costs of that investment and can become a barrier to bringing forward development, as shown by the challenges faced at Bicester in ensuring the grid capacity supports Cherwell's ambitious growth programme for the town.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Councils recognise that they are operating in an increasing global supply chain – can we deliver on our responsibilities in this context? Supply chain management and security (pertaining to raw materials needed to provide infrastructure growth) energy security and housing for example, are fundamental to the delivery of a thriving and successful economy and place.

To mitigate, local government can/could take an active role in developing business models (PPPs etc.) that secure service delivery; particularly where market failure arises. There are various examples of LAs undertaking development work in these areas e.g. Leeds City Council are developing and purchasing corporate housing projects and Bristol CC / Nottingham CC are moving into the ESCO (Energy Savings Company) space. If this is a revenue generation opportunity or building resilience it is difficult to ascertain but this type of project may prove to be examples of strong triple bottom line business ventures.

As well as understanding new approaches, Councils need to focus on specific mitigation exercises in a variety of areas such as:

- Cyber security – the partners to the Growth Board are as part of Smart Oxford are working with OII (Oxford Internet Institute) and the Oxford Cyber Security Cluster to develop an Infrastructure Threat Map. This will be required as our infrastructure becomes smart due to the proliferation of Internet of Things (IOT). Consequently threat levels will grow.

- Improving working practices to remove information silos – mapping interdependency – Smart City working helps with this. Cities need help to develop capability by leading and facilitating collaboration with industry, academia and citizens; deploying solutions requires collaboration between different actors/stakeholders and information silos. Local government is ideally placed to support these relationships. Coordinated by OxLEP, partners in OCC Innovation and Research team together with Oxford City Council have been at the centre of this type of activity for the past three years, breaking down the silos and realising the opportunities, and working closely with partners to enable this across both the County and wider region. Collaborative working is essential to coordinating the delivery of significant infrastructure to support planned housing and jobs growth in Garden Towns at Didcot and Bicester, and Cotswold Garden Village north of Eynsham.
- Better Procurement –
 - Increased corporate governance and scrutiny of the supply chain. Globalisation impacts the ability to purchase raw materials: steel price impacts delivery of East-West Rail for example.
 - Interoperability of data management
 - Insuring ISO accreditation (quality management system that can be integrated into any business. It is focused on ensuring the business delivers a consistent level of quality to its customers by having well defined and regularly reviewed processes and procedures)
- Resilient architecture –flexibility and interoperability must be designed in to our built environment to allow cities to be truly smart.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

We would support close collaborative working between authorities/LEPs with appropriate governance arrangements to undertake strategic infrastructure planning; for example;

- Confirm the EEH Alliance of authorities as a sub-national transport body (STB) to help enable strategic infrastructure planning and delivery for such priorities as East-West Rail and the Oxford-Cambridge corridor.
- At a County level, in Oxfordshire this is achieved through the Oxfordshire Growth Board where the OXIS will identify and prioritise strategic infrastructure through developing a Joint Spatial Plan for the County as a whole that is also aligned with those developed for neighbouring authorities so as to ensure joined approaches to key infrastructure are addressed.
- At a local level, strategic infrastructure should continue to be addressed in up to date district focused infrastructure delivery plans that are published alongside Annual Monitoring Reports and reflected in CIL 123 lists.

Removing the restriction on pooling of s106 contributions would remove a major barrier to the timely delivery of strategic infrastructure schemes required to support growth in a locality with several development sites. Current legislation has curtailed, and unless corrected will continue to curtail the ability of councils to seek various “pooled contributions” to address, in particular, the *cumulative* impact of developments. This is an issue where five s106 agreements are insufficient to cover the funding of infrastructure serving a wider area which means that not all schemes contribute to mitigating the impacts they create and there is a funding shortfall.

There may be difficulties in deciding which five developments would best provide funding for an item of infrastructure; a Council may hold off seeking contributions from a significant number of schemes that might otherwise pay in anticipation of contributions being obtained

from larger developments in the future. Changes in ownership or multiple applications on sites over time can erode the level of mitigation. Delays to one of five sites coming forward may result in secured s106 contributions from the others having to be repaid.

Examples in Oxfordshire:

- It is not possible to collect adequate contributions to mitigate the cumulative impact of development on key transport junctions and corridors in towns with significant growth spread across many sites e.g. at Banbury where allocated growth of 7,000 residential units spread across 16 allocations/planning applications renders it impossible to collect contributions from each site toward improvements to the Hennef Way strategic corridor (link between the town and the M40) as to do so would fall foul of the pooling rules;
- Large strategic sites involving multiple landowners and developers are commonly split into multiple planning application areas, each with their own S.106 agreement. As S.106 contributions to infrastructure needed to mitigate the whole strategic site can only be collected from five sites, smaller sites typically avoid paying contributions for site wide infrastructure, leaving a funding gap. For example, North West Bicester Eco-Town - this will be a mixed use development including 6,000 homes and creating at least 4,600 new jobs. The site is split into seven individual application sites, each of which is at a different stage of delivery.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Development of new infrastructure can impact on the environment including through the loss and fragmentation of habitats, pressure from traffic and people, reduced air quality, noise and visual intrusion. Implementation of new and upgraded infrastructure should follow the environmental mitigation hierarchy: avoid – minimise - restore – compensate for adverse environmental effects. However, well designed new infrastructure can offer opportunities for protecting and enhancing the environment for example the proposed A34 interchange improvements at Lodge Hill would have a beneficial impact on Air Quality in Abingdon through re-routing of town centre traffic.

To achieve this infrastructure design teams should seek views on environmental opportunities in the target area at the earliest stage of project planning and, ensure that budgets include environmental aspects from the outset. East West Rail and the Oxford Flood Alleviation Channel are two local examples of a proactive approach to this. It is important that the costs of maintaining environmental features in the long-term are included as an integral part of the budget settlement for infrastructure maintenance.

New linear transport infrastructure – roads and rail lines – can act as a barrier to movement of wildlife; measures such as provision of wildlife bridges and tunnels/ under or across new infrastructure can help to maintain some habitat connectivity. Road and rail side verges offer the opportunity to provide trees and plant-rich areas to encourage wildlife but will need management to maintain quality. Water management features can provide valuable new habitat. Where new infrastructure is required in urban areas there are often significant opportunities to create environmental improvements that improve peoples' well-being including trees and vegetation to reduce pollution, provide screening, shade and complement recreational facilities such as cycle tracks, exercise routes and parks.

Significant infrastructure schemes should be designed with the environment in mind both in terms of reducing landscape and visual impact and in providing net gains in bio-diversity. The Oxford Flood Alleviation Scheme for example will be a four mile relief channel to divert flood waters away from Oxford; it will create new wildlife habitats and natural watercourses, providing new recreational amenity as well as enhancing the environment. Similarly the design of new reservoirs can provide for enhancements to the natural environment surrounding the reservoir as well new water habitat.

A quality environment is important to economic growth, development, health and well-being. The Oxfordshire LEP has published the Oxfordshire Strategic Environmental Economic Investment Plan (SEEIP) which sits under the Strategic Economic Plan. The plan provides direction on how investment in Oxfordshire's environment will be delivered with a view to both making the county a better place to live and do business and to generating new environmental products and services with wealth creation and export potential. In doing so it is recognising large protected landscapes and features as strategic green infrastructure in their own right and looks to improve connectivity and accessibility to and through these areas to help offset the impact of new growth and to improve public health and maintain quality of life.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Some form of cost-benefit analysis, or more widely value for money judgement, is inevitable, either consciously or unconsciously, whenever there is a demand which outstrips the resources available to service it. Once this is accepted then the important issue is to develop the best assessment of the costs and benefits that is available, providing that the effort involved in this analysis is proportionate to the overall investment in the improvement being assessed.

The cost benefit analysis of a project such as a major transport investment is always likely to be a highly complex set of calculations and the reporting of the results of such an analysis will always be likely to seem to be a "black box" from which answers are handed down, as if from high. It is possible that this impression could be reduced to some extent by the development of a standard format for reporting the input assumptions and output results of the assessment. It would not be sensible to attempt to reduce the breadth of the factors included in an analysis in order that the route through which those findings have been arrived at is more easily understood.

The presence of cost benefit analysis in the decision making process is only likely to be fully accepted if it is clear that it is only one of the many factors which is being taken into account. What is needed to be credible, tractable and transparent is therefore not cost benefit analysis but the wider context in which infrastructure investment decisions are made and of which cost benefit analysis should only play a part.

We will be working with Professor Jim Hall to offer Oxfordshire and the EEH area as real world application of the Mistral project that is being undertaken to step change how infrastructure investment decisions are made through better whole system analytics, testing and analysing cost-benefits of strategically significant infrastructure. This will help Government and NIC to better understand return on infrastructure investment, but also assist the EEH area in understanding its own relative priorities intra and inter-regionally.

We will also be working with the Transport and Future City Catapults to develop mobility and city planning tools that are also in development, that enable better decision making in terms of investment, opportunities identification and management of the "place". Imperative to these tools are that they avoid the black box approach through more user centric interaction portals that allow non-professionals/experts to utilise.

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

In the short to medium term, trends indicate further population shift towards more densely populated urban environments. Centres of employment become more concentrated, population growth increases demand on networks. In localities such as Oxford where there are physical, geographical and other constraints for example Green Belt designation, land values increase as demand grows, creating a wider sub- and peri-urban commuter belt that generates further transit network pressures.

In the medium to long term horizon, new, innovative products and systems will create a very different environment for mobility, with new ways of travelling and more efficient use of time, vehicles and space. More intelligent, data-driven transport systems that better integrate with personal and business mobility needs are widely expected to emerge. Connectivity and exponential improvements in virtual reality and Digital Image processing will all have almost unimaginable impacts on the way citizens consume travel services for work and leisure.

Vehicle ownership models will undergo a seismic shift. It's very likely that a child born in the UK in 2017 will never take a driving test – they simply will not need to. In Oxfordshire, Growth Board partners have developed the Science Transit Strategy to address some of these key issues – it aims to;

- Embrace new technologies and data innovation to unlock intelligent mobility, presenting information to all users to allow them to make truly informed choices about the way they travel;
- Accelerate local growth through innovative R&D, providing opportunities for forward-looking business and research organisations and their highly skilled workforces to test and bring new products and technology to market;
- Improve connectivity between places where people live, work and spend their leisure time, ensuring all aspects of the door-to-door journey are fast, reliable, seamless and affordable;
- Integrate transport and land-use planning to improve non-car-based mobility, creating an environment where sustainable travel is the simplest and obvious choice; and
- Deepen public and private sector partnership delivery for the mobility of people and goods, harnessing the respective skills of the different partners to fund, develop and implement new and improved transport systems.

By 2050 wearable mobile devices e.g. Google watches/goggles/glasses will be the norm; self-driving vehicles, smart machines, seamless automatically translated meetings, and biochips will all affect the future of business/leisure and tourist travel management. Big technology game changes for 2050 to include:

- **Wearables, Augmented Reality and The Internet of Things (IoT)** Augmented reality, many wearables and IoT are already available and all around us, and are already making travellers' lives easier and helping travel managers to offer an enhanced level of service.
- **Smart Advisors:** Smart advisors are another technology that is already becoming an almost everyday reality. As the technology advances and becomes more prevalent, these smart machines may become a good friend to the travel manager. Travel itinerary management could be bolstered by helpful smart advisors in transport hubs, providing useful and perfectly up to date information to travellers and answering their enquiries, saving time for the travel manager.
- **Autonomous Vehicles:** We can expect to see the first commercial autonomous vehicles in around 5-10 years, these will revolutionise travel.

These are just a few of the most exciting emerging technologies that are bound to have an effect on the state of travel and the wider world as a whole. Perhaps the most exciting thing will be those technologies and changes that aren't yet foreseen.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Oxfordshire has benefitted from a number of key investments over the past 5-10 years, with more planned by Network Rail and Highways England. Given the scale of currently planned growth the development of strategic rail corridors and hubs- as shown in diagram 1 Oxfordshire Growth & Infrastructure map – gives examples in Oxfordshire along key growth corridors, including;

- The strategic East West Rail network linking Oxford and Cambridge, and extending beyond to link major centres of growth including Milton Keynes, Swindon and Bristol;
- The ‘core’ rail network through Oxford – connecting Didcot, Oxford and Bicester (the Oxfordshire “Knowledge Spine”) with new opportunities for integrated jobs and housing development at locations such as Culham;
- Development of new rail opportunities, e.g. the Cowley line, serving significant jobs and housing growth around Oxford’s “Eastern Arc” and to connect economic and housing growth with travelling in /out of urban area.
- Mass rapid transit – moving large numbers of people into/through Oxford with three major lines proposed connecting new/expanding growth settlements, a ‘ring’ of new ‘outer’ Park & Ride sites and key employment centres in central and eastern Oxford.

We would also highlight the development/upgrade of the Strategic and Major Road network – in Oxfordshire the key corridors include the M40/A34, A40 and A420 (this links this area to the west and critically links Oxfordshire and Swindon growth areas, as well as the strategic links south to the M4 and Southampton port). Investment in the Oxford to Cambridge “Expressway” will be instrumental in providing the additional connectivity required to support growth and jobs on these corridors, supplementing the existing north-south axis. Of particular importance will be ensuring that targeted investment is made so that the “last mile” is covered as well as strategic links, and that highway and public transport solutions are considered together.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

In Oxfordshire mass Rapid Transit services linked to remote Park and Ride will provide fast and frequent links from key multi-land use and multi-modal hubs in rural areas, intercepting car journeys and decreasing congestion on strategic roads into urban areas – see diagram 2 Oxfordshire Illustrative Transit Network. This approach is becoming ever more significant to managing the growth of the economy of Oxford City.

Development located around rail stations can take advantage of planned/potential capacity in rail services to urban areas. For example, Culham in Science Vale, Oxfordshire offers the potential for significant employment and housing growth as part of a Science City based around an improved rail station offering links to Oxford, Milton Keynes and Cambridge via East West Rail, north to Birmingham and south to Didcot, with links to London, Swindon and Bristol.

16. What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?

Enabled by technological advancement, data aggregation and the development of key strategic partnerships with transport providers, researchers and data aggregators, MaaS (Mobility as a Service) can help address our Intelligent Mobility goals, supporting the vision set out in the Science Transit Strategy. There is a clear role for local government in shaping and developing MaaS provision.

An average family in the UK spends circa £300 PCM on personal transport. As vehicle ownership models change less personal capital will be spent on ownership and maintenance of a vehicle (servicing /insurance). Transport network efficiencies will be gained through

improved data collection/management and automation of transport services. This suggests that there will be significant capacity in personal transport budgets. Business models are currently under development to exploit this; a key opportunity for MaaS providers to attract customers is to remove the pain points that travellers face during their journeys. This, more often than not, means delays due to congestion. Dynamic pricing in terms of access to transit and routes could incentivise off-peak travel reducing congestion, delays and travel times.

Congestion charge is potentially a key thought for AV, there is a realistic potential of AV driving around to avoid parking fees in places like Oxford where we discourage vehicles from city centres, through high parking fees, causing added congestion. We are working in collaboration with leading AV companies, like Oxbtoca and Research in ORI to explore potential utilisation of technology, such as real-time geo fenced insurance systems that may allow a simple yet dynamic local added charge to encourage AV use and connected vehicles in an efficient way that works for all city users.

There are few examples of profitable MaaS-style business models, operating at scale. For instance, early mobility experiments in Helsinki have not achieved desired financial results despite their popularity. The MaaS concept is still relatively new to consumers and the market is still in early stages of development stage, some degree of experimentation (and failure of business models) can be expected.

Incumbent transport providers and car manufacturers are beginning to understand that this transition could be shaped by them – public and shared ownership modes of transport may become more widely utilised than the privately owned vehicle in the medium to long term. *These trends are hard to predict as are the supporting business models.* We would therefore suggest Government will need to pump prime this and other demand management technologies and innovation testing.

We are actively looking at a MaaS trial in Oxfordshire that utilises many of existing and emerging partners in transport services, payment platforms and journey platforms to deliver a MaaS offer that would look to be delivered on the basis of an evolving business model, possibly in a joint venture approach. This is still at an early stage but we feel Oxford has more key elements for success than most fully deregulated Cities. In terms of support for this, the initial feeling is that MaaS could be supported via a kick start type mechanism that helps to build a custom base to get to an operating model where, some added administration expenses are reduced, to a sustainable level. As a proportion to N. Users.

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

On the basis that the huge investment required is never going to be commercially viable for the supply market to fund as is, a strategic decision is required as to whether government should step in to directly fund deployment of affordable full fibre infrastructure and to what extent, or if taxation breaks are used to incentivise, or if the UK accepts that affordable fibre penetration will never be achievable into semi-rural and rural geographies. The same consideration applies to enhancing 5G mobile coverage.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

The existing BDUK superfast broadband programme (funded by DCMS, Oxfordshire County Council with contributions from a number of District Councils to extend local coverage) will deliver the infrastructure required to meet current needs, and likely sufficient for the next 5-10 years, to 95% - 97% of the population. Even with enhancements to the existing Openreach copper based access network, it is envisaged that the huge step-change

investment required for end-to-end affordable fibre will never be met under current market conditions.

Distinguishing/categorising digital communications as a utility or not does not help clarify the position. A better analogy is seeing digital communication as Infrastructure, in which case the funding problem is akin to why it is not viable to provide mainline train services to every small community. In the near future it could be argued that digital infrastructure will exceed any other infrastructure in terms of strategic importance for economic growth in the UK.

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Effective decarbonisation of heat remains a barrier to meeting long term national Carbon Reduction Targets. The opportunity of heat networks is well recognised but proving their potential remains very slow. In Oxfordshire, two studies are taking place funded by the Heat Network Delivery Unit in Bicester and Oxford. Continuing the funding of local feasibility will be a key mechanism for supporting delivery.

There is a need for a strategic infrastructure/spatial planning approach that considers 'heat' as a service; networking and collocating heat availability /production with clusters of growth over time. A "heat master planning" approach with investment taken on the basis of cumulative long term development plans will help address the barrier of investment costs seen on single developments.

This approach to considering heat requires a time scale of planning and investment beyond that of most local plans and fits the approach taken in Oxis. There is scope for planning on a larger scale in line with EEH. The future scale of heat demand from dwellings / industry is a major risk factor in the investment decision around heat networks. For this reason clear long term signals from central government on programmes and ambitions for domestic retrofit, standards in new build and carbon regimes for industry will be necessary to support business cases.

Cherwell DC has supported the development of advanced sustainable housing at NW Bicester with delivery undertaken by A2Dominion. Cherwell and its delivery partners have shown what can be delivered as a viable commercial development at a high standard, with a final product that is also selling well to the public on the open market.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Significant generation from distributed renewable energy sources, combined with local storage and demand management through smart grids creates local markets that price/respond effectively for available commodity. A review is needed of the support regime for renewables which has been prematurely removed and is hampering renewable delivery in Oxfordshire. The review should encompass whole system costs in terms e.g. supporting storage on the viability of the renewable sector. There also needs to be greater collaboration, innovation and forward planning between the Distribution Network Operators (DNO), Local Authorities and local users /generators. Grid constraints in Oxfordshire are already reducing scale, delaying and preventing renewable investments.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

The majority of ultra-low emission cars and vans on sale today or coming to market within the next few years are plug-in electric vehicles. "Plug-in vehicle" is used as a generic term to describe Battery Electric Vehicles (BEV), Plug-in Hybrid Electric Vehicles (PHEV) and Extended-Range Electric Vehicles (E-REV) The Government's aspiration is that by 2050 almost every car and van in the UK fleet will be an ULEV (Ultra Low Emission Vehicle) as the number of plug-in vehicles on our roads increases, so will the demand for electricity.

Whilst not a concern until plug-in electric vehicle uptake reaches large numbers, the increase in the demand for electricity from the large-scale adoption of plug-in vehicles will impact the electricity network through changes in patterns of daily electricity demand as well as increases in peak demand. However, increases in peak demand may be more limited because evidence suggests people predominantly charge plug-in vehicles at work or at home at night.

The increase in electricity demand from EVs on local infrastructure will require upgrades to be carried out on the distribution network. There is the possibility that a small number of EVs vehicles charging simultaneously could overload the distribution network at a local level. More work is required to deliver a greater understanding / monitoring at local grid level.

If a large number of plug-in electric vehicles are connected to the grid, the DNO (Distribution Network Operators) could manage charge profile to help balance the network. This improves network efficiency and allows the demand from plug-in electric vehicles to be shifted.

DSR (Demand Side Response): EV's can be used to store energy so in the event of a shortfall in the supply of energy to the network; DNO/Grid Balancing Services / could draw power from large numbers of plug-in electric vehicles simultaneously, re balancing the grid. In the event of a power cut an EV's stored energy could be used to supply power to a home or other local buildings. There's some interesting work being done looking at the interplay between micro-renewables (domestic PV) domestic battery storage and EV battery's which could eventually result in reduced network demand as EV drivers consume more of their home-generated power.

Production of hydrogen as a transport fuel could offer balancing services for the electricity network. Hydrogen can be created through water electrolysis which uses electricity to split water into its constituent hydrogen and oxygen molecules. Electrolysers can respond very quickly to demands to turn on or off and are therefore also very useful for DSR (Demand Side Reduction) and utilisation of intermittent Renewable generation capacity. Electrolysed hydrogen created in this way can be stored, used as a transport fuel or added to the national gas grid.

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Accuracy of demand forecasts: Water demand forecasts should take full account of the scale of housing and employment growth being planned for in current adopted *and emerging* local plans and ideally should look at growth significantly beyond local plan timeframes as meeting demand will require significant investment in large water resources which have a long planning and delivery timescale. Underestimation of growth in demand will result in sub-optimal supply solutions.

Where water deficits are forecast water companies should first seek to reduce water leakage and implement measures to reduce water use by encouraging changes in customer behaviour e.g. through pressure management, installation of water meters and introduction of tariffs.

Strategic water assets need to be managed over a wide area and require significant investment. Within the Thames Water area meeting the growing demand for water from London will require expensive solutions elsewhere in the Thames catchment area; a water deficit is also forecast in the SW-OX (Swindon- Oxford) area by 2020. New resources to meet demand throughout the Thames Water area require long term planning to ensure economies of scale. Preferred solutions will have long lead in times, including taking proposals through the Water Resource Management Plan submission process and through the planning system via the NIC process.

Options being considered for meeting London's demands are costly and include raw water transfer via pipeline from other water areas e.g. River Severn and a new strategic reservoir within Oxfordshire in the Abingdon area. If investment is to tie in with planning timescales, it would be useful if water company Asset Management Plans (AMP) for water investment schemes could have longer time periods– the AMPs prepared by Thames Water currently cover 5 year periods.

Developers of new housing in areas of water stress can contribute to water use reduction by designing in measures to reduce water use and water wastage for example grey water recycling, provision of water efficient domestic appliances and bathroom fittings and the provision of water butts to collect rainwater.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

In the Thames Water area much of the waste water treatment infrastructure dates to Victorian times and is in need of investment in major refurbishment to maintain services long into the future and ensure processes meet industry standards. Timely provision of wastewater infrastructure is an issue. In Oxfordshire the majority of waste water treatment plants are nearing capacity and will require upgrades to cope with demands from projected population growth. Capacity issues across the water treatment network result in the discharge of excessively nutrient rich water to Oxfordshire's watercourses which reduce the ecological value below the Water Framework Directive target standards.

Developers can requisition infrastructure in order for it to be delivered earlier than planned for the overall network to prevent their scheme from stalling but such up-front costs could impact on development viability.

Water companies should be required to comment on all planning applications in relation to sewerage capacity. In doing so, they should take a holistic view of proposed development across each Local Planning Authority area to provide an accurate view; this can be difficult where an up to date local plan setting out the spatial strategy for growth has yet to be put in place.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Management of water supply in areas of water stress may require consideration of options for importing water from catchment areas which have excess water resources. This requires collaboration between two commercial water companies who are answerable to shareholders. A whole catchment approach could require working across local planning authority boundaries on managing wastewater and flooding. Wastewater discharge from new development to local watercourses could increase flooding in downstream communities which may be in an adjoining local planning authority area. There would need to be close cross boundary working to identify and secure funding of appropriate mitigation measures.

Water - environment issues are being addressed through a number of multi-agency Catchment Partnerships across Oxfordshire.

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

We should aim to be flood neutral even if does require additional flood storage or a decrease in the proposed developments. Schemes that protect locations facing significant economic risk from flooding should be prioritised. For example the major floods in Oxfordshire in 2014 resulted in loss of business and disruption to transport as well as personal cost to people and their homes - the cost to the Oxfordshire economy was estimated to be £50m per week. The proposed Oxford Flood Alleviation Scheme will protect Oxford and enable it to maintain its key role in the regional and national economy as a centre for business, research and

learning, retail and tourism. Construction of the first stage of the scheme is scheduled for 2018, subject to full funding being confirmed – it rates very highly nationally and locally but is still short of implementation with a deficit in funding that could and should be secured as a national priority.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Natural methods of flood management are cheaper on materials, but may be more costly on land use. They have the potential for positive environmental effects in terms of habitat creation but also negative impacts in terms of landscape and visual effects and impacts on adjacent farmland if not planned and implemented with care. Natural Flood Management interventions can also improve water quality. The Evenlode Catchment partnership in Oxfordshire has recently started a pioneering project on the use of natural flood management techniques in partnership with the Environment Agency, landowners, local councils and communities. Natural Flood Management will not be the best solution in all areas and should be informed by the hydrological characteristics of the catchment.

New connected technologies can support community based responses to flood risk, an example of this is the Oxford Flood Network river level monitoring system.

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Government should make it a priority to publish their long term strategy for solid waste. A clear direction for waste, resources and the environment, encompassing circular economy principles, would then set the context for financial and regulatory incentives and provide local authorities and businesses with the certainty to develop services and invest in infrastructure.

Since 2007 Oxfordshire has completed a step change in the way we manage household waste; we have introduced food waste recycling from every house, collect residual waste fortnightly, and have procured residual waste treatment so that less than 5% of our waste is sent to landfill. The LATS (Landfill Allowance Trading Scheme) and landfill tax were effective drivers for this change and have resulted in Oxfordshire having one of the highest recycling rates in the country.

To continue this success, national strategy should set stretching targets applying to not only to household waste, but also to commercial and industrial waste. These should encompass reduction and reuse as well as recycling in order to drive waste up the hierarchy. Financial and regulatory drivers should continue to encourage the management of waste at the top of the hierarchy with landfill disposal as the most expensive option.

Extended Producer Responsibility (EPR) should be an integral part of the strategy placing emphasis on front of pipe solutions. Products and packaging should be designed to be durable, easily repaired and reused, and when at the end of use, materials should be able to be easily segregated for recycling. Quality of materials should be incentivised over quantity, for example, higher payments for WEEE (Waste Electrical and Electronic Equipment) that is operational as opposed to one price for all WEEE regardless of quality. New materials will create new waste streams (e.g.: batteries, permanent magnet materials) and viable markets and suitable flows of producer responsibility funds will ensure that it is advantageous to collect, transport and process more unusual/smaller volumes of materials rather than disposing of them.

Waste should be managed on a sub-regional basis in accordance with the hierarchy. The current system creates silo thinking, with one stakeholder group focusing on increasing recycling rather than reducing waste overall. Streamlining this system would enable financial and environmental efficiencies to be realised.

Greater consistency in collection systems for households and businesses, in particular offices that produce recyclables and waste similar to that produced by households, should be encouraged. This will create consistent volumes and quality of materials giving the market more confidence to invest in secondary materials and associated infrastructure, helping to create employment. In addition, collecting the same core set of materials will mean fewer collection and sorting systems as well as a common container system, potentially leading to cheaper procurement of standardised assets.

Assistance should be given to Local Authorities to standardise collection systems enabling local and national communications campaigns (such as those carried out by WRAP) to work to even greater effect, driving up participation, increasing recycling rates and reducing contamination.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

The circular economy should not be considered as a 'waste' issue. It requires a fundamental shift in how we think about goods and products and should be embedded into each area of the economy. The circular economy model provides environmental and economic advantages and works most effectively when materials are able to be managed without becoming waste, or are managed by the manufacturer. Extended Producer Responsibility should be used to ensure product design and use focus on durability, repair and reuse. At the end of life preventing them from entering the local authority waste stream (though repair or distributor take-back) will save public money.

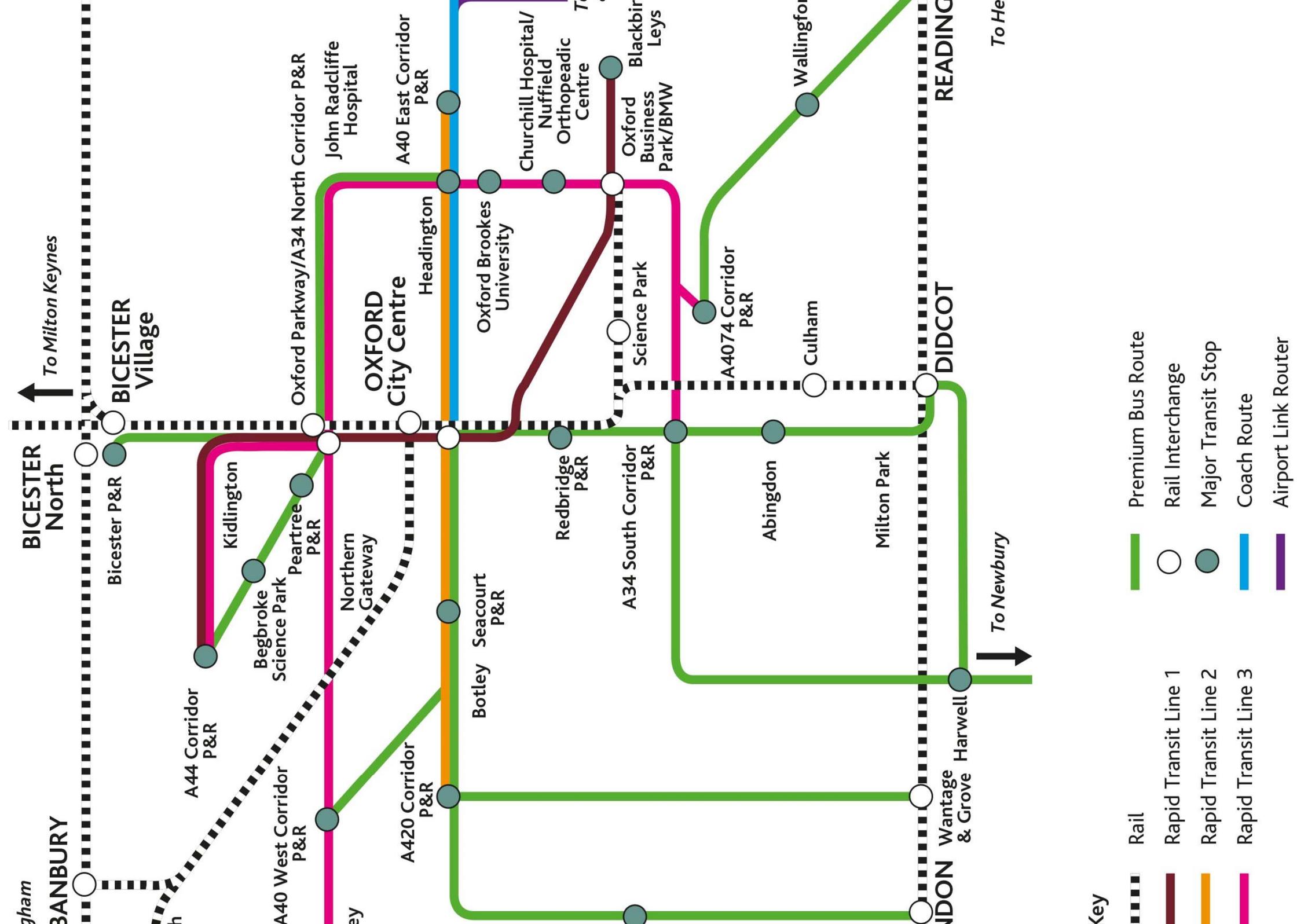
Waste arising's growth tracks Gross Domestic Product (GDP). In times of prosperity, people buy more, undertake renovation projects and therefore dispose of more waste. A circular economy would ensure that the materials are able to be reused or recycled and create jobs but behaviour change and attitudes are vitally important to break the cycle, limit the appetite for 'new stuff', and increase the mainstream acceptance of reuse.

Reuse and repair activities are increasingly being accepted as playing a vital part in addressing social challenges related to poverty and creating paid and volunteer employment as well as training opportunities. Far more capacity is required, however as the industry matures it is important not to lose the valuable social outcomes currently being achieved. Strengthening the social value act could assist this, however it is likely to increase costs (as outcomes will also increase) and this contradicts the current pressure on public services to reduce expenditure.

OXFORDSHIRE HIGHEST VALUE INFRASTRUCTURE PROJECTS: NEEDED TO UNLOCK 100,000 HOMES AND 86,000 JOBS BY 2031 AND CONTINUED GROWTH TO 2050

Scheme	Indicative Cost Breakdown				Planned Expenditure - Total Funding (Project Total)	Gap (LGF Ask or funding shortfall)
	2015-20	2020-25	2025-30	2030+		
COUNTYWIDE TRANSPORT INFRASTRUCTURE						
CORRIDOR STRATEGIES						
A34 Oxford to Cambridge Expressway				£1,000,000,000	£1,000,000,000	£1,000,000,000
COUNTYWIDE RAIL						
East West Rail	£600,000,000	£600,000,000			£1,200,000,000	£1,200,000,000
Didcot East Grade Separation			£100,000,000		£100,000,000	£100,000,000
Four Tracking between Didcot & Oxford			£187,500,000	£187,500,000	£375,000,000	£375,000,000
Re-doubling Cotswold Oxford-Worcester line, including Hanborough Station		£250,000,000	£250,000,000		£500,000,000	£500,000,000
Oxford station masterplan phase 2 - new western platform and Botley Road bridge replacement inc regrading of Botley Road		£110,000,000			£110,000,000	£110,000,000
Oxford station masterplan phase 3 - remaining elements		£75,800,000			£75,800,000	£40,000,000
Cowley branch line		£20,000,000	£20,000,000		£40,000,000	£40,000,000
RAPID TRANSIT						
Line 1 - Langford Lane to city centre	£9,150,000	£9,150,000			£18,300,000	£18,300,000
Line 1 - Blackbird Leys to city centre		2,200,000	£2,200,000		£4,400,000	£4,400,000
Line 2 - Cumnor to city centre	£5,100,000	£5,100,000			£10,200,000	£10,200,000
Line 2 - Thornhill to city centre		£8,500,000			£8,500,000	£8,500,000
Line 3 - Eynsham to Marsh Lane (inc. A40 Science Transit)	£36,200,000				£36,200,000	
Line 3 - Marsh Lane to Hollow Way (inc. A2H)	£16,000,000	£3,500,000			£19,500,000	
Line 3 - Hollow Way to Lodge Hill and Sandford	£13,000,000	£13,000,000			£26,000,000	£26,000,000
Within city centre	£1,200,000	£1,200,000	£1,200,000		£3,600,000	£3,600,000
Rapid Transit potential extensions				£30,000,000	£30,000,000	£30,000,000
LOCALITY TRANSPORT SCHEMES						
CHERWELL						
Bicester						
Proposed new Garden Town motorway junction (location to be determined)				£44,000,000	£44,000,000	£44,000,000
East West Rail phase 2: Charbridge Lane road bridge to replace level crossing - highway works to complement EWR scheme	tbc				tbc	tbc
Replacement of London Road level crossing with bridge or underpass			£60,000,000		£60,000,000	£60,000,000
Banbury						
East of M40 J11 Link Road	£ -	£ 15,000,000	£ -	£ -	£ 15,000,000	£ 15,000,000
Long term considerations for a SE Relief Road (various route options)	£ -	£ -	£ -	£30,000,000	£30,000,000	£30,000,000
Expansion of Oxford airport					tbc	tbc
OXFORD						
Ring road schemes						
A40-A44 link road	£11,800,000				£11,800,000	£4,500,000
Peartree interchange	£12,500,000				£12,500,000	£12,500,000
Botley interchange and approaches	£12,500,000				£12,500,000	£12,500,000
Eastern Arc Phase 2 - Access to Cowley	£11,100,000				£11,100,000	£10,340,000
Short Term Park & Ride Schemes						
Seacourt Park & Ride	£2,135,000				£2,135,000	£917,500
Medium/Long term Park & Ride - new or expanded sites						
A44 corridor		6,250,000	6,250,000		£12,500,000	£12,500,000
A34 (North) corridor			11,400,000		£11,400,000	£11,400,000
A40 (East) corridor			2,800,000		£2,800,000	£2,800,000
A4074 corridor		5,700,000	5,700,000		£11,400,000	£11,400,000
A34 (South) corridor inc Lorry Park		14,100,000			£14,100,000	£14,100,000
A420 Corridor Park & Ride		5,650,000	5,650,000		£11,300,000	£11,300,000
City centre schemes						
Connections to Oxford Station	£14,370,000				£14,370,000	£10,310,000
Becket Street extension	£3,000,000				£3,000,000	£3,000,000
Oxpens to Osney Mead bridge over rail line & river	£15,000,000				£15,000,000	£15,000,000
City centre transit tunnels: east-west			300,000,000		£300,000,000	£300,000,000
City centre transit tunnels: north-south			300,000,000		£300,000,000	£300,000,000
Cycle Routes						
Super, Premium and Connector Cycle Routes	£12,558,000	£8,950,000	£3,750,000		£25,258,000	£20,400,000
SOUTH & VALE						
Highway Schemes						
Didcot Science Bridge & A4130 Capacity Improvements	£43,170,000				£43,170,000	£29,653,000
Central Didcot Transport Corridor (Jubilee Way to Science Bridge)	£7,500,000	£7,500,000			£15,000,000	£15,000,000
Didcot Northern Perimeter Road Stage 3	£12,500,000				£12,500,000	£6,223,000
Lodge Hill south facing slips	£13,000,000				£13,000,000	£8,600,000
Wantage Eastern Link Road (WELR)	£16,715,000				£16,715,000	£3,870,000
Access to Culham Science Centre - Phase 1 (Clifton Hampden Bypass)	£15,780,000				£15,780,000	£11,180,000
Access to Culham Science Centre - Phase 2 (Culham to Didcot Thames River Crossing)			£125,000,000		£125,000,000	£125,000,000
Milton Interchange - Milton Park - north facing slips			£50,000,000		£50,000,000	£50,000,000
Harwell Campus access Improvements (Fermi and Curie Avenues)		£16,000,000			£16,000,000	£16,000,000
Wantage Western Link Road				£30,000,000	£30,000,000	£25,000,000
UK Space Agency Multi Storey Car Park	£10,600,000				£10,600,000	£10,600,000
Botley A420 Corridor Improvements			£10,000,000	£7,000,000	£17,000,000	£17,000,000
A420 Corridor Improvements		£6,000,000	£12,000,000		£18,000,000	£18,000,000
Rail Schemes						
Didcot Parkway Station Package	£45,225,000	45,225,000			£90,450,000	£30,450,000
Culham Railway Station	£4,350,000	£4,350,000	£4,350,000		£13,050,000	£9,000,000
Grove Station			£20,000,000		£20,000,000	£20,000,000
WEST OXFORDSHIRE						
Highway Schemes						
A40 Long Term Strategy - Dual Carriageway & west bound bus lane		£54,000,000				
COUNTY-WIDE NON-TRANSPORT INFRASTRUCTURE						
UTILITIES						
Primary Electricity Sub-station, Bicester	£5,000,000				£5,000,000	£5,000,000
West End District Energy project		£5,301,000			£5,301,000	£1,325,000
Electricity grid reinforcements to 2040					£150,000,000	£150,000,000
Gas grid reinforcements to 2040					£37,000,000	£37,000,000
Renewable energy					tbc	tbc
BROADBAND & PHONE COVERAGE						
Broadband (to 2040)					£43,000,000	£43,000,000

Telecommunications					tbc	tbc
WATER SUPPLY AND WASTE WATER						
Potable Water (to 2040)					£139,000,000	£139,000,000
Waste Water (to 2040)					£139,000,000	£139,000,000
FLOOD MANAGEMENT						
Flood defences					£110,000,000	£27,000,000
Drainage					£18,000,000	£16,000,000
WASTE MANAGEMENT						
Waste					£9,000,000	£9,000,000.00



Peninsula Rail Task Force response to the call for evidence from the National Infrastructure Commission.

2/6/2017

Submitted on behalf of the Peninsula Rail Task Force.
For further enquiries or clarification, please contact:
[Name redacted]

[Phone number redacted]
[Email address redacted]

1. Introduction

The Peninsula Rail Task Force (PRTF) welcomes the opportunity to respond to the National Infrastructure Commission (NIC) call for evidence for its national infrastructure assessment. PRTF also welcomes the strategic overview that the commission intends to apply across the whole of the United Kingdom.

The PRTF published its 20 year blueprint for rail in the South West¹ in November 2016, as a result of a government request to identify what was needed for the region. The PRTF has spent the last 14 months working with the rail industry and the Department for Transport examining and identifying the potential options available to improve resilience, journey times and capacity on our railways to/from and within the South West. This report has identified that improvements to the South West rail infrastructure have the opportunity to contribute to UK plc through potential transport benefits of £1.8bn and wider economic benefits of £7.2bn.

We have suffered from severe weather incidents over the last few years that have highlighted the poor resilience of our rail infrastructure, culminating in the events of flooding across the Somerset levels and the collapse of the cliffs and the seawall at Dawlish, closing large sections of our strategic rail network for several months. Businesses lost confidence, operational costs escalated: an estimated loss of £1.2bn² impacted the economy in Devon and Cornwall for period the Dawlish line was closed.

Network Rail warns that a line closure of between 2 and 7 days every 6 months and significant weeks of, closure to the mainline at Dawlish will occur every 25 years today rising to every 4 years by 2065,³ if no decisive action is taken to address the problems. In addition, we suffer from significant levels of service disruption as a result of trains being used that cannot operate past the seawall at times of high winds and waves, further reducing reliability.

The ability to use diversionary routes east of Exeter is limited due to capacity constraints and has a major impact on established local services when London Paddington services are diverted via this route. Travelling west, once you pass Exeter there is no diversionary route available, with a single mainline to Penzance at an average speed of 60mph. It is acknowledged that potential exists to reopen the route between Exeter and Plymouth via Okehampton and create an additional route to that via Dawlish, however if this is a true alternative it would need to be of sufficient speed and capacity to meet the needs of the region, which would include direct access at Exeter and Plymouth to remove the need to change ends and the subsequent time penalties. In addition, there is also the option to provide an additional direct route between Exeter and Newton Abbot that provides an alternative to the seawall route.

The Exeter to Waterloo line is currently underutilised, but it is key to local transport and growth plans around Exeter and serves as an important second strategic link between the peninsula and London. It is constrained by long, single track sections which limit both the number and speed of trains, not just in the peninsula but also in neighbouring authorities of Dorset and Wiltshire.

The connection to Bristol and the Midlands is a critical artery to support regional connectivity, housing growth and the development of key infrastructure, e.g. Hinkley C.

¹ Within this response the reference to the South West applies to the Peninsula, incorporating, Cornwall, Devon, Plymouth, Torbay and Somerset

² Holding the Line? Report for the Devon Maritime Forum (2015)

³ Severe closure of 1 week or more Network rail

The South West is a peninsula, has an overall population of 2.2 million with an equally significant economy of £4.2bn GVA, but is characterised by dispersed communities. As GVA drops 6% for every 100 miles from London⁴, the further down the peninsula the greater the challenges become. Ensuring shorter journey times, with more opportunities to connect at a local, regional and national level is critical.

Transport spending in the South West peninsula has been an average of £35, per head, compared with an average of £97 per head across the UK and it is plain to see that we are trailing behind other areas in investment, a situation that will only get worse as a result of current and planned rail infrastructure projects like; HS2 and Crossrail.

Our trains are some of the oldest in the UK, with an average age of 32 years old and currently unable to meet the regulatory requirements from 2020.

Rail growth over the last 21 years has reached 128%, and continues to grow. It is clear that both network and train capacity will not be sufficient in the future.

In a society that values the ability to work and communicate on the move, the ability to use Wi-Fi and mobile phones whilst travelling across the rail network is at best patchy and at worst unusable.

Our response to this call for evidence is focused around the rail infrastructure requirements of the South West to achieve the benefits identified above.

2. Resilience

The South West peninsula is served by a single mainline west of Exeter and during 2014 was cut off from the rest of the UK through flooding on the Somerset levels, the collapse of the seawall at Dawlish and the landslip between Dawlish and Teignmouth. It is estimated that these events cost the South West peninsula's economy over £1.2bn. This is a known problem having occurred many times since the line was opened in May 1846, the first of these occasions being in October of the same year as opening.⁵ The spectacular failure of the sea wall at Dawlish followed significant disruption in 2012 through flooding at Cowley Bridge outside Exeter, that washed the railway away resulting in 15 days closure, a similar closure in 2014, and this was repeated in November 2016.

The peninsula geography creates over dependency on the reliability of these single rail routes – and limits connectivity. For example, over 100,000 people in north Cornwall and north west Devon effectively have no access to the rail network.

This line is likely to see greater disruption in the future due to the changes predicted to sea levels in the future. Research carried out by Dr David Dawson, Leeds University, predicts that by 2040 the line will be affected by sea levels by up to 40 days a year and by 2060 up to 63 days a year (Fig 1&2), which will cost the rail industry in excess of £15m by 2060.

⁴ PRTF Productivity and Wider Economic Impact Study April (2015)

⁵ Dawson et al 2015- Summary of findings from a long-term study of the Dawlish mainline, southwest UK

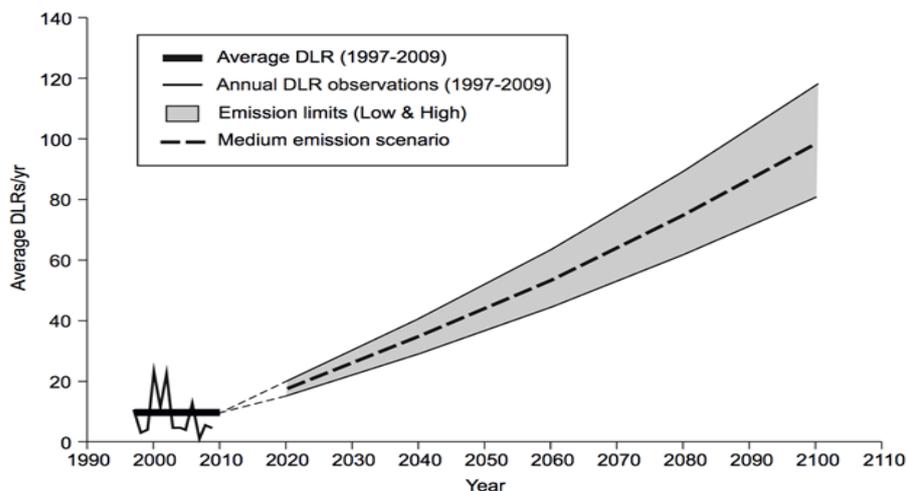


Fig 1: Projections of average number of days with line restrictions (DLRs) at Dawlish as a result of extrapolation empirical trends of sea-level rise and overtopping

Year	Sea-level rise (cm)*	Average days with line restrictions	Increase in DLRs (%)	Annual restriction (%)
1997-2009	-	9.6	-	3
High Emissions				
2020	6.8	19	99	5
2040	22.0	40	320	11
2060	39.3	63	571	17
2080	58.9	90	856	25
2100	80.6	120	1170	33
H++ Scenario				
-	190	269	2732	74

Fig 2: Predicted sea-level rise and estimated days with line restrictions for the 21st century.

The resilience of the rail lines into and out of the South West peninsula cannot just be delivered by Network Rail in isolation and requires a multi-agency approach to deal with the long term problems to drive sustainable improvements based on climate change.

The main rail line to the South West peninsula must be a resilient and reliable connection, protecting our economy, coast and communities with a resilient sea wall and stable cliffs. This does not just mean the seawall and cliffs infrastructure, but also providing an operationally robust service.

Equally other routes that serve the region should be made resilient to prevent further disruption across the Somerset levels and through Cowley Bridge, along with suitable and sufficient resilience along the diversionary route between Exeter and Castle Cary (via Yeovil) to allow London services to operate on a regular timetable when diverted, without compromising local connectivity.

The flooding events on the Somerset levels were identified by the Rail Industry to have cost in the region of £5.15m for the winter of 2011/12 based on Schedule 8 delay compensation payments. In addition, over £3m was spent on remedial works. The direct costs to NR of the 2013/14 events were estimated at £4m of immediate repairs and £13m in compensation costs.

It was estimated that the direct cost of disruption to the Somerset economy was in the region of £92m and the indirect impact, as measured by GVA, was approximately £13m. Of this

between £13m and £21m was attributed to the direct effects of disruption to the railway network. Approximately 22% of the direct impacts of the flooding of the Somerset Levels and Moors were due to the effect on the rail network

A great deal of work has been undertaken since the flooding of 2012 and the subsequent flooding in 2013/14. The works which have been undertaken by the Somerset Rivers Authority and the Environment Agency across the Somerset Levels and Moors should have reduced the impact of such an event on the railway and reduce the duration of major disruption in the future.

2.1. The PRTF has identified a number of key infrastructure schemes that need to be taken forward to deliver the resilience of the rail line to the South West; these include:

- Resilience of the seawall at Dawlish
- Resilience of the cliffs between Teignmouth and Newton Abbot
- Flood resilience works at Cowley Bridge, Hele and Bradninch and on the Somerset levels
- Trains capable of operating along the seawall during times of high tide
- Suitable and sufficient diversionary routes that are able to allow a suitable alternative service to be operated

3. Journey time

The need to reduce journey times to and from London and other key regional cities like Bristol is critical to the economy of the South West peninsula, and as research demonstrates for every 100 minutes journey time from London productivity decreases by 6%.⁶

Investing in journey time improvements will open up opportunities for the South West peninsula to improve connectivity and productivity, improve our contribution to the UK economy and unlock growth. Improved journey times and increased connectivity improves access to education, housing, employment, leisure opportunities and increases social inclusion, all vital to any thriving economy. More frequent connections to London, Bristol and the Midlands will boost productivity. Vital international connections via Heathrow, Manchester, Bristol, Southampton and Gatwick airports will make business more competitive. Improved access to Heathrow through the Western rail link is welcome.

Our average speed to and from London is only 69mph compared to 90mph on the East and West Coast mainlines and over 50% of our businesses rated faster journey times as a top priority.⁷

It should also be recognised that the South West peninsula is far behind other parts of the UK in relation to journey times and earliest arrivals from London, as demonstrated in figure 3;

⁶ PRTF Productivity and Wider Economic Impact Study April (2015)

⁷ PRTF business survey June 2016

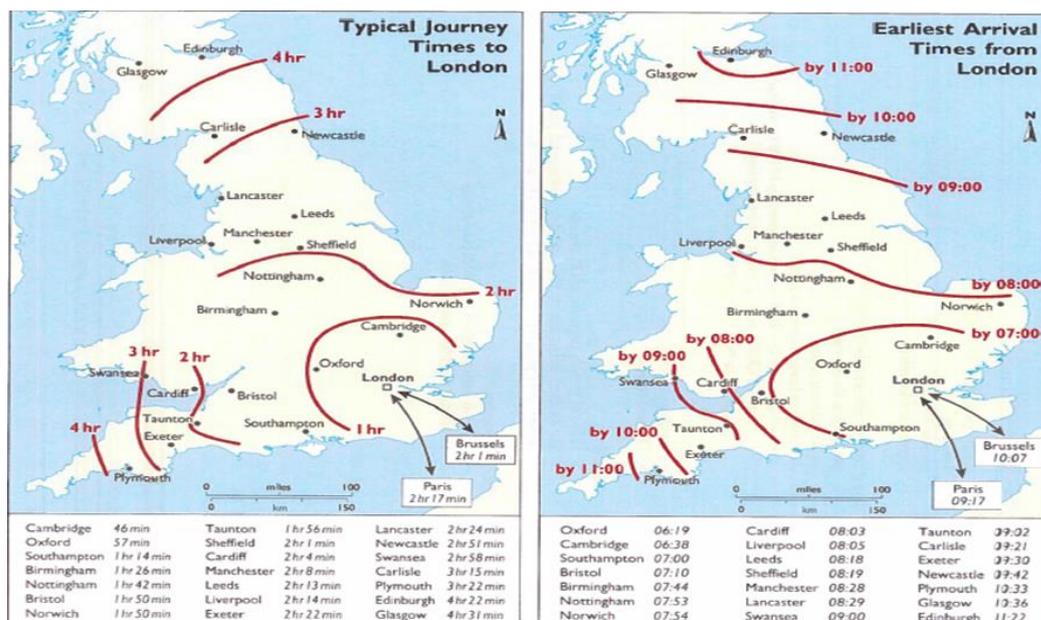


Fig 3. Typical journey times and earliest arrivals across the UK

Access to the rail network is a key element of success for a distributed economy like the South West with many small towns and businesses. Local train services provide access to the inter-city network in addition to linking towns with the major economic centres including Plymouth, Exeter and Bristol. In 2014/15 there were 25m journeys to and from the South West peninsula by rail, a rise of 4.2% over 2013/14, and many of which were to locations other than London.⁸

Through better connectivity and faster journeys there is opportunity and the environment to enable a modal shift to rail, relieving congestion on our roads and improving efficiency and certainty for business. This modal shift also reduces pollution, improves air quality and is an opportunity to maximise the efficient use of the UK's assets. Improving connectivity between urban and rural parts of the South West peninsula also opens up scope for growth with broader travel to work areas, increased tourism opportunities and improved community links.

3.1.

The PRTF identified a number of key schemes that need to be taken forward to deliver the journey time improvements of the rail line to the South West; these include:

- Increased frequency of long distance trains
- Electrification to Bedwyn and line speed improvements between Newbury and Westbury
- A number of line speed improvement schemes between Reading and Newton Abbot delivering 14 minutes journey time saving by 2029
- Further line speed improvements between Reading and Penzance that will deliver a further 19 minutes journey time improvements

⁸ Regional Rail Usage (passenger Journeys) 2014-15 Annual Statistical Release January 2016

4. Capacity and Comfort

Research has shown that the Devon and Cornwall mainline has seen a 128% growth in passenger journeys over the last 21 years with comparable levels of passenger journey growth as other mainlines in the UK, without the level of investment enjoyed by those other lines. It can therefore be surmised that a significant level of untapped demand could be released if investment and improvements are forthcoming to this region. The graph in Figure 4 below demonstrates the increase in passenger journeys.

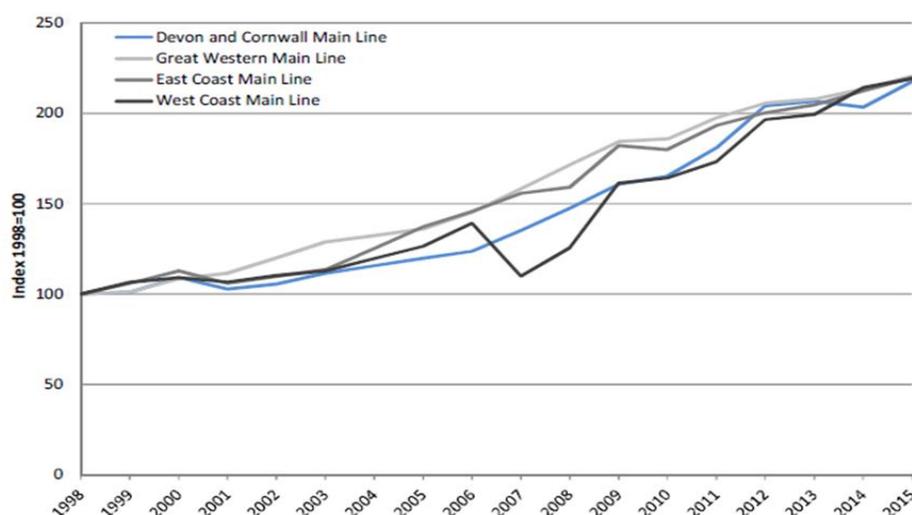


Fig 4; Indexed number of passenger journeys on various mainlines in comparison to the Devon and Cornwall Main Line⁹

Growth within the region has consistently outstripped industry forecasts, with average growth of 5.7% over the last 7 years, compared with the growth rates being used by Network Rail for planning capacity of between 2% and 3.2%¹⁰. This anomaly means that capacity will not be planned and delivered early enough to meet predicted demand. An example of this variation for 2014-15 saw passenger numbers rise by 8% within Devon and 13.1% to Torbay.¹¹ Our previous study into the growth being seen in the South West peninsula identified that industry forecasts for growth in 2019 were exceeded in 2012.¹²

The rail traveller of today expects to be able to access mobile and Wi-Fi services as the norm, with the expectation that it will be available wherever we travel. This is key for business in being able to make travel productive, for leisure and tourism to have access to online or streaming media during travel and for people within the peninsula to carry on with their daily lives.

We recognise that the Government is rolling out free Wi-Fi through the franchise process, but that is only half of the picture. There is no clear single party responsible for delivery of wi-fi and mobile connectivity on the railway system, leading to varied and sporadic implementation. Having the equipment on trains makes no difference if users cannot access or rely the service as a result of the poor mobile phone signal strength in areas that the rail lines pass through, a national rail standard on wi-fi and connectivity would help in establishing the minimum service that should be delivered. This is a particular problem in rural areas such as Wiltshire, Somerset, Devon and Cornwall where topography creates an additional challenge alongside a sparse population. Voice and data signals are affected.

⁹ Dawlish Additional Line study PRTF 2016

¹⁰ Great Western RUS (2010), across Cornwall between 2013 and 2043 in the Western Route Study (2015)

¹¹ Regional rail usage ORR 2014-2015

¹² Spine Report PRTF 2013

Free Wi-Fi on trains is ranked as the 4th highest priority for business in the top ten national priorities for passenger improvements¹³

The benefits of electrification have long been recognised on the railways, probably more so in Europe than in the UK, which include, greater acceleration and faster journey times, lower train failure rates, improved efficiency and reduced noise pollution amongst others. Cornwall County Council and Plymouth City Council commissioned a further study in 2012, refreshed in 2013 on the benefits of electrification to the region which identified that at least £1bn would be saved in operational expenditure over 60 years through electrification in the South West. The introduction of bi mode trains also provides the opportunity to undertake small areas of electrification where there will be a significant benefit to capacity and speed i.e. the Devon Banks.

4.1.

The PRTF identified a number of key schemes that need to be taken forward to deliver the capacity and comfort of the rail line to the South West; these include:

- Improved WI-FI and mobile connectivity, with a clear identification of who is responsible in leading on wi-fi and mobile connectivity along the rail routes
- New line between Exeter and Newton Abbot to increase capacity and allow operation when the route via Dawlish is closed.
- Reopening of the rail route between Plymouth and Exeter via Okehampton
- A series of improvements along the line between Exeter and Plymouth to improve journey times
- Sections of electrification to improve the performance of new bi-mode trains
- Additional infrastructure between the Exeter to Waterloo line to increase capacity

5. Conclusions

There is a widespread consensus across the industry, government and political leadership that the South West peninsula has suffered from under-investment in the railway network, with a resultant loss of quality, reliability and contribution to the peninsula economy.

Much evidence already exists on the contribution to the economy that a reliable and resilient network with quality services and better connectivity will bring. It would be prudent at the very least for investment decisions to be taken in that overall economic context. We have set this out in our 20 year plan which was delivered to Government in November 2016.

The PRTF published its 20 year plan 'Closing the gap' in November 2016, setting out the improvements being sought for the South west peninsula. The 20 year plan outlines these improvements in three phases to 2019, to 2029 and then 2030+, which follow the 3 point plan.

Immediate Priorities to 2019:

- **Invest £284m in resilience**, including commencing the securing of the main rail line through Dawlish and Teignmouth
- **Completion** of committed flood relief schemes
- **Introduce trains** capable of operating along the seawall in all weathers

¹³ Transport Focus Rail Priorities for improvement 2014

- **Invest £2.5m** in GRIP 3 options for the diversionary route East of Exeter
- **Invest £22m** in GRIP 3 options for reducing journey times
- **Increase frequency** to 2 direct trains an hour from Plymouth to London in the new franchise, reducing journey times by up to 10 minutes, whilst at least maintaining existing services
- **Work with the rail industry** to maximise the benefits of the new trains from Dec 2018 and **invest £25m** to make our journeys more productive through on board travelling office, media and mobile/Wi-Fi connectivity.

Medium Term Priorities to 2029:

- **Invest £301m** to complete Dawlish seawall and cliffs resilience, the diversionary route between Exeter and Castle Cary and estuary flood protection
- **Invest £1.5bn** to reduce journey times by up to 14 minutes to Penzance, through infrastructure improvements, partial electrification and franchise renewals
- **Invest £150m** reducing journey times and increasing core capacity on the Exeter – Waterloo line
- **Invest £358m** to improve capacity and comfort through new rolling stock, infrastructure enhancements and phased opening of the Northern Route
- Increase frequency to 2 trains an hour west of Exeter to Bristol and the Midlands

Much has also been made of the heroic efforts of the rail industry to restore services at Dawlish in 2014, however we would like to see a more proactive approach to maintaining infrastructure and development of improvement schemes before failure rather than as a result of. We recognise that this may involve more than one entity and this is where we see a benefit for the route having a strategic infrastructure plan, that maps out and funds a clear progression in upgrades and long term improvements. Key to achieving this is the DfT acknowledging that the infrastructure benefits will deliver real term economic and customer benefits and undertaking the actual work. Commitments have been made, yet remain unfulfilled so we are keen to see deliver.

The PRTF has undertaken a review into the needs and options available to improve the rail service to the South West. It is clear that there is a need for strategically important rail corridors to be considered as a complete entity rather than a series of individual areas or events to ensure that the strategic benefits are realised. The current arrangements where Network Rail considers future capacity, the DfT sets service levels and the operators look to reward stakeholders, appears to miss the point of strategic infrastructure to meet and service the customer and the economic needs of the areas that they serve.

Clearly the ability of Network Rail to undertake a route improvement has been called into question through current difficulties with key projects. The PRTF would like to see the rail route to the South West identified as strategic infrastructure and the options to build a resilient, faster railway explored through different delivery mechanisms, i.e. design & build contracts, where private business takes some risk and deadlines are maintained.

This should include the use of small scale electrification schemes that allow the benefits of new bi mode trains to be realised.

Finally, the South West suffers from only one main line west of Exeter. Moreover, this situation is compounded as although limited diversionary routes are available they have been downgraded to such an extent they are unable to function effectively. In the event of their use, other services are affected, reducing their own capacity or extending the journey time to

unacceptable lengths. We would like to see diversionary routes upgraded to allow a full service to be operated effectively as needs dictate, allowing business and customer to continue to rely on the provision of services.



PENSION INSURANCE
CORPORATION

Pension Insurance Corporation

Response to the National Infrastructure Assessment Call for Evidence

10 February 2017

Contact:

[name redacted]

[job title redacted]

[phone number redacted]

[email address redacted]

Pension Insurance Corporation plc (“PIC”) does not regard any of the information in this document as confidential.

About PIC

- 1) PIC is a specialist insurer providing pension insurance buyouts and buy-ins (bulk annuities) to the trustees and sponsors of UK defined benefit (“DB”) pension schemes. At 30 June 2016, PIC had £18.4 billion in assets under management and had insured more than 130,000 pension scheme members.
- 2) With non-callable pension obligations that stretch out decades into the future, we are the natural home for investments that provide secure long-dated cash-flows, such as infrastructure. As such we are enthusiastic about the establishment of the NIC and their consultation programme which seeks to address a real opportunity to repair the broken pipeline of infrastructure projects.
- 3) From a standing start five years ago we have built an internal team which has developed considerable experience and an exceptional track record in sourcing and investing directly into infrastructure debt. We therefore have relevant experience should help be required to develop in-house expertise at other institutional investors and specifically within pension funds.
- 4) We believe that we are now playing a role of real importance to the UK economy by filling the hole that has been left by the withdrawal of the banks from this space. We have invested about 30% of our portfolio in infrastructure debt and have plans to increase the total amount as our portfolio develops. Our portfolio has grown by more than £10 billion over the past three years. We operate in a rapidly expanding sector and expect to have considerably more assets to deploy in infrastructure over the coming years.

- 5) Amongst other innovative direct investments we have completed in the past 18 months, we have invested £100 million in debt secured on the Thames Tideway Tunnel; £75 million in debt issued by Virgin Atlantic Airways, secured on its portfolio of landing slots at Heathrow, the first time this type of transaction has been completed; and £70 million in debt ultimately issued by the Church of England Pensions Board.
- 6) Previous investments in this area by us include the first listed European solar bond, as well as social housing, hospitals, schools and student accommodation. Our business moves capital efficiently through the economy, from generally sub-scale defined benefit pension funds and into infrastructure investments which support jobs and growth. Our scale and expertise allow us to do this more effectively than the majority of pension funds.
- 7) Our pension fund clients include the Pensions and Lifetime Savings Association (PLSA), the Institute and Faculty of Actuaries, the London Stock Exchange, Alliance Boots, Total, EMI, Cadbury, Honda, and the public sector, including DEFRA.
- 8) PIC is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and Prudential Regulation Authority (FRN 454345).

Introduction

- 9) PIC welcomes the establishment of the NIC and the opportunity to respond to the call for evidence on the National Infrastructure Assessment.
- 10) The UK has an unprecedented need for infrastructure renewal, a government that appears to have recognised the weaknesses of the existing system and investors with pools of capital seeking good quality investments.
- 11) Investment in infrastructure by insurance companies plays an important, and socially useful, role in the development of the UK's economy. Yet the process for procuring infrastructure is difficult and uncertain. Institutional investors require several factors to be able to invest consistently and significantly in infrastructure debt. These factors are:
 - a. The development of a “whole system approach”, which reflects the long-term nature of infrastructure projects and avoids shorter-term political factors affecting the decision making process.
 - b. A predictable deal flow. This would help pension funds and other institutional investors justify building up teams and developing expertise. This creates a virtuous circle of knowledge and confidence, helping more deals to close, lowering costs for borrowers and helping to grow the economy.
 - c. The better alignment of infrastructure investment requirements with the regulatory systems governing institutional investors, such as Solvency II. It is important to make sure that in areas of focus, such as waste and digital, investment risk is managed more sympathetically, perhaps through the creation of investment grade debt structures which work for insurance companies.

- d. The (re-)focussing of (semi) state actors, such as the European Investment Bank, away from opportunities which would naturally attract private sector capital and towards opening up further opportunities by using their balance sheets.
- e. More stability in the planning process.
- f. Making investment more attractive.
- g. Using Public Private Partnerships.
- h. Governance and decision making.

12) PIC would be delighted to help the National Infrastructure Commission with any further work on this topic.

Responses to specific questions set by the Commission

Question 8: Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets? *Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.*

Making investment more attractive

- 13) In principle, infrastructure projects are attractive assets for private investors. They typically offer relatively high and stable returns and can provide a welcome hedge against inflation. Their allure has only increased as long-term interest rates plumb new depths. Pension funds and insurers seeking to match long-term liabilities are perfectly placed to take on the illiquidity of these assets as the cash flows generated from them match liabilities and provide a measure of outperformance.
- 14) The feeling among private investors remains that there is a lack of suitable projects. Infrastructure development in the UK has focussed on a small number of large scale (and high risk) “trophy” projects, as opposed to a larger number of smaller deals. There is also a need for more ready-to-finance opportunities where there is no requirement for investors to involve themselves in the earlier, riskier stages of infrastructure development. Insurers are restricted on their investments due to Solvency II (paragraph 21 onwards), whilst pension funds do not have the necessary in-house expertise to properly assess the risks. We believe this situation can be radically transformed.
- 15) Balancing this lack of expertise in the short term, and encouraging more insurance company involvement in these types of projects, means that the government needs to shoulder more of the early stage risk. Large scale or trophy ventures are typically subject to bidding criteria uncertainties, idiosyncratic contracts, delays in the award of projects and financial approvals, and, reflecting their complexity and technological richness, significant construction risks, as well as the vagaries of the political process. For institutional investors the overwhelming conclusion is that they are not worth the time and effort to understand at this point, let alone invest in.

16) We believe a key objective of the NIC should be to build and then maintain a healthier ongoing dialogue between infrastructure planners and the UK funding markets. In our view there has been a strained relationship in the past, which is now improving. As institutional investors become an increasingly important part of the financing equation, there is a real opportunity now for a more collaborative approach. This would not distort markets, rather it would enable markets to operate more freely.

Predictability of deal flow

17) Compounding the obstacles to investment by institutional investors, outlined in paragraph 15, there have simply not been enough suitable projects to invest in.

18) An unpredictable flow of potential investments means that institutional investors are less likely to invest in building the necessary expertise to allow them to assess risk accurately. The resulting unfamiliarity with risk leads to a safety-first mentality, lowering interest in this area even where suitable opportunities are available. Amongst other issues, this can mean a less competitive tendering process and greater taxpayer expense.

19) It is clear that a lack of follow through on a programme approach to procurement has been frustrating for all parties, including funders. This suggests there is a desire to resolve it and we believe that it is possible to do so.

20) These uncertainties are best exemplified by the ongoing debates around Heathrow, HS2 and Hinkley Point. However, the point is systemic and does not relate just to these projects in isolation. From an investor's perspective, this uncertainty increases risk. And this risk, from a project provider's point of view, increases costs.

Alignment of investment requirements with the regulatory requirements of institutional investors, in particular addressing the limitations imposed by Solvency II

21) The regulatory system for all European insurers, Solvency II, places strict capital requirements on investments that are not based on investment grade (or equivalent) rated debt. This makes it challenging for insurers to invest in some sectors and many forms of infrastructure finance, such as infrastructure equity. A whole-system approach would better align the nation's infrastructure investment needs with the investment requirements of insurance companies under Solvency II.

22) We recognise that this may fall outside the remit of the NIC, but in the interests of joined up government we repeat here the relevant points we recently submitted to the Treasury Select Committee on Solvency II's impact on infrastructure investment.

- 23) A review of the specific rules applied for Matching Adjustment¹ eligibility and the capital treatment of different asset classes could increase the supply of capital to some important areas of the economy. For example, the ability to invest in whole infrastructure projects (not just the debt), or indeed to invest in the equity of key infrastructure projects is precluded by Solvency II, due to the significant capital requirements that currently apply to such investments.
- 24) If the government is to meet its ambitious infrastructure targets with the help of UK institutional investors then the Matching Adjustment and capital rules current in force need to be refined.
- 25) In terms of the Matching Adjustment, we would like to see more pragmatism with respect to the rules around callability and “make-whole” requirements and the need to match in annual cash flow buckets. As an example, we would like to see greater leeway in the longer dated cash flow matching requirements (say beyond 40 years) than is applied to shorter dated cash flows, specifically to be less well matched than shorter term cash flows.
- 26) We see a number of situations where banks wish to sell their PFI / housing association / utility loans as they are no longer capital efficient for the bank to hold. These loans often have very low margins, so offer pre-payment protection implicitly as the funding cost is so low the borrower is not incentivised to repay. However, they do not have explicit “make-whole” clauses so are not eligible for inclusion in the Matching Adjustment Fund under Solvency II. Annuity portfolios are effectively prevented from buying these assets due to the strict rules under Solvency II.
- 27) Similarly, we see a number of project finance / infrastructure transactions which have cash sweeping mechanisms whereby if the project outperforms, excess cash is used to pay down debt. This improves the quality of the asset (due to the deleveraging), but the cash sweep mechanism creates difficulties with Matching Adjustment Fund eligibility because repayment is at par.
- 28) Prior to Solvency II, pre-payment protection in the form of “make-whole” clauses was typically a given for institutional transactions. However, as it is now mandatory for insurers to have pre-payment protection (whereas pension funds and banks don’t need to have it), the insurance industry is at a competitive disadvantage in the lending market, and borrowers can use this as a negotiating tool, in a way they couldn’t before.

¹ What is the Matching Adjustment? Life insurance companies hold technical provisions to ensure they have sufficient funds available to pay their technical liabilities when they fall due. The technical provisions comprise the Best Estimate Liabilities (BEL) and the Risk Margin. The BEL is calculated as the discounted value of the expected future liability cash flows. The default position is to discount the liabilities using a risk-free rate, but companies with highly predictable cash flows, such as pension annuities, can apply to increase this rate using a Matching Adjustment which reflects the risk-adjusted yield on the assets backing the liabilities. The cash flows of the liabilities and the backing assets must be very closely matched in order for the company to be eligible to apply the Matching Adjustment. PIC fully supports the use of the Matching Adjustment for the valuation of long-term, guaranteed insurance liabilities. However, our view is that Matching Adjustment is too restrictive in specifying the characteristics that the assets must display in order to be allowed to be included in the Matching Adjustment calculation.

- 29) A more pragmatic approach to callability / pre-payment protection would therefore be welcomed, whilst appreciating that stability of cash flows is an important requirement for liability matching. It is worth noting that the Solvency I regime had a well understood approach to callable bonds, where cash flows were taken into account on a “call to worst” basis.
- 30) As it stands, it will be a challenge for the NIC to stimulate interest from institutional investors in some sectors of focus, including waste and digital connectivity, which have typically had lower levels of institutional investment because they are perceived to carry higher levels of risk; because there is a perception that returns are poor; and because there is no track record of successful investments. The NIC should look to the levers it has, including subsidies and government guarantees to incentivise this.
- 31) Of the sectors in focus, only transport and energy are currently aligned to the needs of investors under Solvency II. Without further insight into specific risk treatment, it is difficult to see how the NIC will stimulate interest from institutional investors because most of the sectors of focus have historically transferred too much risk to the private sector.
- 32) As the NIC progresses in its work and draws up a National Infrastructure Plan it is important to consider the requirements of insurers under Solvency II in determining how the projects are to be funded. This is particularly the case in the stated areas of focus in this consultation document.
- 33) Judicious use of the government’s guarantee scheme, or leveraging the European Investment Bank’s balance sheet to lower risk in this area, would help ensure that investment by insurance companies flowed into the sectors of the NIC’s focus.

Using Public Private Partnerships

- 34) In the UK, which was something of a global pioneer in the area of Public Private Partnerships (PPPs), these schemes have been bracketed under the term Private Finance Initiative (PFI). The PFI contributed considerably to infrastructure spending over the 15 years leading up to the financial crisis. More than 700 such partnerships were assembled, with a capital value of more than £50bn. This included almost 100 hospital schemes, more than 100 education projects, and around 40 transportation projects and initiatives in areas as diverse as defence and culture. Overall, they were associated with some 12% of total annual capital expenditure over the latter part of that period.
- 35) However, the PFI has been a major casualty of changing political priorities, as well as the banks’ more conservative attitudes to lending, an attitude that has been further encouraged by the losses some banks have made on these projects. Smaller PFI projects in particular were highly dependent on bank finance. The PFI was dealt a further blow by the collapse of the monoline insurers that had hitherto conducted much of the project risk evaluation spadework and lent their stamp of approval as well as their credit enhancement to the bonds issued to finance larger projects.
- 36) Moreover, the more cost-conscious post-financial crisis period saw a growing focus on whether these initiatives were offering sufficient value for money for taxpayers. The net result

is that PFI activities have tapered off decidedly since 2008. The current government has tried to address some of these issues with its PF2 programme, but this effort has yet to reach critical mass.

- 37) We believe that giving new life to PFI should be a central focus of the NIC's efforts to attract institutional investment.
- 38) Under PFI an industry was established around the deal flow, which, whilst having its downsides, was efficient and allowed, in theory, for the taxpayer to obtain better value, because there was lower risk and less uncertainty.
- 39) Today, we seem to have the opposite, where hardly anything is predictable and therefore investors and their advisors can't plan for it. Furthermore, the unpredictability extends beyond the initial planning stages and has become an issue in deciding whether a project can go ahead even quite close to breaking ground, as well as in the financing structure.
- 40) This unpredictability may well be a feature that is hard to remove for the larger end projects, or where they are particularly innovative or complicated. But what we saw under the previous Chancellor was a neglect of the smaller scale infrastructure pipeline, which we believe should be a focus of the new National Infrastructure Plan.
- 41) As regards the largest, most complex, projects, the experience, both in the UK and other advanced economies, is that many of these, such as airports and major railway routes, need a (government) sponsor, even though the bulk of the financing may come ultimately from existing public markets. Government cannot avoid planning, delivering and, to some extent, partially financing projects, at least in their early stages.
- 42) For smaller projects, such as individual hospitals, schools, or renewable energy plants the government is also important, albeit for somewhat different reasons. Historically, equity for a small infrastructure project, such as a PFI deal, came from the sponsor and potentially the constructor, with the debt component supplied largely by the banks. But with the banks now deleveraging, this financing component is in short supply, even though the potential equity providers are still present.
- 43) Hence, to encourage pension funds and insurance companies to invest there is a burgeoning need for government to involve itself in:
 - Managing the procurement process so as to ensure that the debt is delivered to (non-bank) investors in a suitable form, and with feasible timelines in respect of pricing and delivery of funds.
 - Developing risk transfer systems, such as guarantees and stand-by lines of credit.
 - Incorporating into the overall financing assessment the setting of tariffs and user charges for which it is responsible, whether directly or indirectly.

Question 10: What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Stability of the planning process

- 44) From an investor's perspective much time and effort, and therefore expense, is required to do due diligence on each and every project. In practice, investors will have to live with the risks inherent in these investments for decades, with limited opportunity to sell. Moreover, they depend on the cash flows to match pension payments, so have to go to considerable trouble to make sure that the deal works. The uncertainties inherent in the planning system can therefore rule out investments in some types of projects at a very early stage.
- 45) A lower level of interest from institutional investors means that the project developers would have to offer a higher yield to make the project more attractive, ultimately costing the taxpayer more.
- 46) However, there are well-managed and well-run processes which can serve as model projects. For example, PIC recently invested £100 million in debt secured on the Thames Tideway Tunnel, the 25 kilometre tunnel underneath the River Thames in London. This was an innovative investment which required much hard work before the deal was signed. The key aspects of the transaction were:
- The £100m size of the transaction was split across four tranches.
 - A long deferral period (4-5 years), providing certainty of funding cost for the borrower, but reducing cost of carry, with an unusual feature of no funding drawn on day one to help match the cash flow needs of the construction works.
 - A unique inflation linkage, whereby this is the first transaction with inflation linkage with such a long deferral period.
 - The maturity profile has been sculpted to match PIC's long-dated liabilities, a feature which also benefits the borrower as they require long-dated funding.
- 47) We feel that this excellently run project serves as a model of best practice for the following reasons:
- It was a well-managed procurement process.
 - Good co-ordination across different government departments and between government and Thames Water.
 - Rigorous evaluation process reduced bidders down to a very small number, with an emphasis on quality rather quantity, helping to guarantee funding.
 - Smart use of government financial support, which was complex but did not require overall government guarantee. This:
 - i. Was more efficient for government finances.
 - ii. Enabled investors (prepared to commit to the credit work) to obtain a higher return.
 - It was a resource efficient process for investors as the financing competition was based on a firm proposal:
 - i. Certainty of financing provided by initial commitments from banks.

- ii. Institutional debt competition was more efficient as it was not split between different bidding groups.
- iii. The higher certainty of outcome incentivised institutions to commit resources.

Governance and decision making

48) In terms of governance, a stable and accessible long term programme of infrastructure investment will need to be:

- Co-ordinated across different departments and levels of government.
- Devoid of policy reversal and prevarication over key decisions.
- Supported by regulatory stability (especially in relatively regulation heavy sectors such as energy and utilities).
- Cognisant of the ability of construction firms to supply the necessary resources to do the job.



National Infrastructure Assessment – Call for Evidence Response of PIANC UK

Introduction

PIANC UK is the UK Section of the Permanent International Association of Navigational Conferences (PIANC), a worldwide body with a membership in most major maritime nations.

PIANC is the forum where professionals around the world join forces to provide expert advice on cost-effective, reliable and sustainable infrastructures to facilitate the growth of waterborne transport. Established in 1885, PIANC continues to be the leading partner for government and private sector in the design, development and maintenance of ports, waterways and coastal areas.

As a non-political and non-profit organisation, PIANC brings together the best international experts on technical, economic and environmental issues pertaining to waterborne transport infrastructure. Members include national governments and public authorities, corporations and interested individuals.

This document presents PIANC UK's response to the National Infrastructure Assessment Call for Evidence issued by the National Infrastructure Commission in October 2016.

PIANC UK's approach to the Call for Evidence

PIANC UK is of the opinion that port infrastructure and, to a lesser extent, inland waterway infrastructure plays an absolutely essential role in the economic activity and future development of the United Kingdom. It also enables the internal connections between the various land masses forming the British Isles. While the provision of port infrastructure by the public and private sectors aims to meet the demand for transport, decisions taken by these bodies not only have a major impact on the towns and cities in which the infrastructure is located but also influence choices by shippers and travellers that, in turn, have huge impacts outside the immediate vicinity of the ports and, indeed, nationally.

In the planning, design construction and operation of port and inland waterway infrastructure PIANC UK is strongly of the opinion that a balance of economic, societal and environmental factors must be adopted. PIANC operates, internationally, through four main Commissions that address respectively Ports, Inland Waterways, Recreational Navigation and Environmental Issues. It is disappointing that the issue of sustainability is not specifically referenced in the Call for Evidence; in the Call for Evidence the term 'sustainable' is linked only to the term 'growth'. PIANC UK is of the opinion that the Commission should clarify whether it is referring to growth that takes into consideration the three aspects of sustainability or whether it is concerned with recommending measures that ensure that growth itself is sustained.



National Infrastructure Assessment – Response to Call for Evidence

In response to the National Infrastructure Assessment Call for Evidence, PIANC UK has chosen to respond to the issues raised by the Commission by means of a statement that presents four main themes and identifies a number of principles that it believes should be adopted. These principles are referenced to the Commission's questions, as indicated.

Transport of Goods

For transport of goods via the UK's ports and waterways the following principles would maximise the long term benefits of investment in infrastructure:

- An infrastructure planning system linked to demographics and land use. Q2, Q10
- Specific planning for the movement of goods at national, regional and local level. Q2, Q10
- A national strategy for goods distribution recognising major import and export ports, locations of production and consumption, and the location for distribution centres. An objective of this strategy would be to develop efficient links between these points - which may not match established patterns of freight and passenger transport, e.g. routes for cargo from Dover to locations like Purfleet, Daventry etc., or Southampton to the West Midlands. It is important the underlying assessment is based on an accurate understanding of true cargo origins/destinations in the UK and overseas, as the routes used today may not be the shortest but reflect present limitations in infrastructure capacity or quality. Q2, Q10
- Designated locations in and/or around major cities and conurbations for distribution functions, with good access to strategic road network, rail and waterways. At these locations goods could be transferred from larger to smaller vehicles for inner-city distribution, or for reverse flows such as waste, consolidated into larger shipments and into greener modes such as barges or trains. These locations could be decided at a local (city or county) level. Q14
- A balance of competition and sustainability that recognises the importance of port choice for shippers and shipping lines in fostering competitive and resilient supply chains, e.g. no failure at a single point should obstruct major supply chain routes such as cross-channel traffic via the Dover Straits. Q9, Q11
- Government funding support for ports and logistics initiatives that reduce emissions per tonne-mile by re-shaping supply chains to more energy efficient models e.g. allowing use of larger vessels, greater parcel sizes, transfer from road to rail, faster more efficient cargo handling systems, new more efficient warehousing, etc to encourage faster adoption of more energy efficient methods. Q11
- Long term planning that facilitates mode shift when volumes become so large a change of mode is justified, e.g. anticipating provision of rail freight links to ports that currently handle containers and RoRo or bulk without a rail link, rather than assuming all future growth can or should be accommodated by roads. This would have knock-on implications for rail network planning far beyond the port in question to ensure train paths can be provided with adequate gauge clearance. Q11



National Infrastructure Assessment – Response to Call for Evidence

- Rail improvements in terms of debottlenecking freight linkages across the UK, improving route availability for freight, as well as port connections themselves. Q2, Q3, Q11
- Planning of ports and roads that anticipates driverless technologies, e.g. to facilitate a seamless flow for a container from quayside to inland distribution centre, via road, without a human driver. This technology has the potential to change supply chains significantly as the most time sensitive element (in cost terms) for some lorry movements is the driver. Without a driver slower but lower impact routes may become viable for shippers, e.g. taking trucks on ro-ro ferries to ports further inland such as Tilbury. Q13

Transport of Passengers

The following principles should be considered:

- Removal of road bottlenecks around ports – particularly ports located within towns - and increased journey time reliability. Q2, Q3
- Safeguarding of sites close to urban centres and passenger transport hubs for use by ferry or river services, to avoid the situation whereby viable ferry terminal locations become further and further away from centres of population and transport links, therefore less accessible and ferry services less viable. Q2, Q3
- Requiring full integration, in terms of timetabling and ticketing, between public transport services (on rail & road) and shipping services. Q2, Q3

LNG Fuelling

The UK needs to encourage and anticipate LNG fuelling of vessels, partly driven by the Emissions Control Area requirements, through incentives and the creation of availability at key locations. This would have the benefit of reducing emissions within port areas as well as positioning the UK to play a major role in supplying LNG fuel for passing Channel traffic. The Thames, Mersey, Humber, Severn and the South Coast are key locations to capture passing trade. Q13

Network Resilience

Considerable emphasis has been placed in recent years on ensuring that transport networks are resilient in times of disruption from weather, maintenance works, security activity, terrorist incidents, etc. However in the transport field in the last 50 years, almost all developments have resulted in the reverse being the case. The flows of goods and passengers have tended to concentrate on fewer routes with larger flows. As a result resilience has been removed and when disruption occurs the incidents are far more severe, partly because of the concentration of the flows and partly because of the lack of alternatives.



National Infrastructure Assessment – Response to Call for Evidence

Resilience can only be ensured by providing immediately available capacity on alternative routes or transport modes. With the private sector, or the public sector on commercial terms, required to fund an increasing proportion of transport infrastructure, immediately available alternative capacity will not be built. PIANC UK is of the opinion that, if resilience is to be provided and can be justified by means of a cost benefit analysis, it will inevitably fall into the category of capacity that can be funded but cannot be financed. The level of provision of port infrastructure in many European countries is far more generous, and more cost-effectively financed, than in the UK and, as a result, lack of resilience is a far smaller issue. PIANC UK encourages the Commission to investigate means of evaluating the economic, societal and environmental benefits of the provision of resilience in the transport system and to develop methods to justify and finance its provision. Without such an approach, resilience will remain a major problem which will result in the UK not appearing to be “open for business” and place it at a major disadvantage to our European neighbours. Non-market measures have to be taken in the electricity supply industry to ensure system resilience; the same should apply in the transport market. Q8, Q9.

February 2017

We very much welcome the Commission's criteria to collect evidence over a long time horizon. The short termism that has driven many national investment programmes has resulted in prioritisation led by pragmatism, not big ambitions. If we genuinely want to transform the country's economy in a fair and balanced way, we need to be prepared to set ambitious goals, and to recognise the relationship with investment in other enabling factors such as skills, housing and services. All of these factors need to be properly planned, sequenced, integrated and funded to deliver a more prosperous and sustainable national economy. The City council and its partners are already delivering against an ambitious growth agenda and look forward to your support in addressing the strategic infrastructure challenges we've highlighted.

Yours Sincerely

 (signature redacted)

 (name redacted)
(job title redacted)

Enc: National Infrastructure Commission Call for evidence

NATIONAL INFRASTRUCTURE COMMISSION

Call for evidence

10 February 2017



Context

Plymouth is one of the largest cities on the south coast and the 15th largest city in England with a population of approximately 262,700, an economic output of £5.2 billion, 108,000 jobs and a further 100,000 people in its travel to work area. Plymouth is the most significant economic centre in the south west peninsula and the largest urban area in the Heart of the South West (HotSW) Local Enterprise Partnership, making it a key location for growth. However, considered part of the far south west, the city is located 230 miles from London with the average train journey times of 3 hours 15 minutes and a route that is subject to low levels of reliability and resilience. Our nearest core city is Bristol, located 120 miles, or 2 hours away.

The HotSW partnership area is united by a common ambition to raise productivity levels. Our area has suffered from historically poor levels of productivity, with productivity in the HotSW currently below 80% of the UK average (measured on a GVA per capita basis). A key economic priority for Plymouth, the Heart of the South West and our partners is to address and improve this productivity performance. As part of our approach to this we aim to facilitate innovation and growth in our key opportunity business sectors such as marine and advanced engineering which represent the city's main areas of specialisation.

One of the biggest challenges facing the city is our peripherality and connectivity with the rest of the UK and beyond. This situation has been exacerbated over decades by longstanding chronic underinvestment in our physical infrastructure, an overreliance on a few key routes (road and rail) leading to issues around capacity and resilience, and the lack of an agreed, long term, sequenced and integrated strategic investment plan.

We recognise that Plymouth cannot be seen in isolation and the city's growth is mutually dependent on the wider infrastructure provision across the south west peninsula. The city is therefore not only working across the HotSW partnership to tackle the issues of productivity and connectivity (through the Peninsula Rail Task Force) but is also working across local authority areas to develop a joint local plan setting out an integrated approach to how we plan for new homes, jobs and services across local authority boundaries.

Plymouth City Council, South Hams District Council and West Devon Borough Council are preparing a Joint Local Plan (JLP) for Plymouth and South West Devon through to 2034. The vision is to create a highly successful sub-region whose people and businesses benefit greatly from having a major city and network of high quality market towns and sustainable rural settlements, set within beautiful countryside and natural environments.

An Infrastructure Needs Assessment has been undertaken in support of the JLP which identifies over 400 projects across Plymouth and South West Devon at an estimated total cost in excess of £1.5 billion. The Assessment will inform decisions on plans, programmes and priorities and demonstrate to funding bodies and investors that the local authorities have a clear understanding of the areas infrastructure needs through to 2034. It provides an assessment of the funding required to achieve the aspirations for the Plan Area and identifies any gaps in funding provision.

For the Plymouth Housing Market Area the assessed need for new homes, jobs and services will require substantial investment in infrastructure. Current assessments make provision for at least 26,700 new dwellings and over 300,000 sq.m of employment floor space, providing for over 13,000 jobs. The population of the JLP area is predicted to grow by around 35,000 by 2034.

We hope that the Commission will consider the wider implications of infrastructure provision across the JLP area and HotSW Peninsula through its assessment process. This level of development and population growth requires significant investment in infrastructure at both a local and peninsula level.

Plymouth has significant opportunities to compete in global markets but our current infrastructure provision and connectivity challenges represent a major barrier to our future transformation. We believe that the National Infrastructure Commission, through a weighted assessment process, can take a more regional approach to rebalancing infrastructure investment and unlock areas such as ours to turn around decades of low productivity and poor connectivity.

Cross-cutting issues:

I. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

High value investment programmes supporting growth in Plymouth (and the Joint Local Plan area for Plymouth and South West Devon and wider Heart of the South West) include:

- **The 20 year blueprint for rail in the South West**

We need to increase connectivity and capacity together with improvements to rail network resilience to help meet Plymouth and the South West's challenging growth agenda and unlock our potential. This submission supports that of the Peninsula Rail Task Force (PRTF) to the Commission.

The only major rail transport corridor of the far south west runs through Plymouth (from Exeter into Cornwall). Plymouth needs a resilient railway that has fast journey times with sufficient capacity and connectivity to and from Plymouth from the south east (London) and the rest of the UK. The city supports the collaborative efforts of The Peninsula Rail Task Force and the priorities for investment set out in the recent report 'Closing the gap: The South West Peninsula strategic rail blueprint'.

- A resilient network which is not susceptible to regular disruption due to adverse weather;
- Faster journey times to London, the South East, the Midlands and the North; and
- Greater train capacity and facilities to enable travel time to be used productively.

A key aspect of this is digital signalling and the city has already engaged with the private sector to work together on developing this capability within the region and how we could bring economic or social gain as a result of product development, intellectual property rights or skills.

The PRTF's blueprint proposes a long-term programme of investment in rail links between London and the south west which would unlock a host of benefits, generating an additional £7.2bn of GVA and £1.8bn of transport benefits through improving rail journey times to Paddington from Penzance by 26 mins, and similarly benefits of £677m from improving the journey time from

Exeter to Waterloo by 30 minutes¹. The blueprint also suggests productivity benefits from simple improvements such as high quality, uninterrupted Wi-Fi connectivity enabling productive use of the travel time and tackling the lack of resilience in the south west transport networks which are increasingly vulnerable to extreme weather events.

The events in Dawlish and Teignmouth in 2014 highlighted that our rail network is highly vulnerable to impacts of extreme weather events and that urgent action is required to address resilience and improve the connectivity to London and other major cities to unlock business potential. It was estimated that these events cost the South West peninsula's economy over £1.2bn. In 2016/17 we have seen further closure at Cowley Bridge due to flooding and the loss of cross country services at Dawlish when high tides and strong winds are forecast which is becoming a frequent event. Further background is available at <https://peninsularailtaskforce.co.uk/closing-the-gap-the-south-west-peninsula-strategic-rail-blueprint/>

- **Plymouth Railway Station**

Plymouth is the busiest station in Heart of the South West LEP and third busiest in the South West after Bristol Temple Meads and Bath Spa, yet it is the only station in the region that has not undergone major redevelopment or is included in a plan for major redevelopment, since the 1960s. At present the station presents a poor impression for rail passengers arriving in Plymouth and the station needs a major overhaul. There is a need to improve the passenger experience and provide a new gateway for passengers arriving and leaving the station.

Furthermore South West Peninsula passenger numbers have rocketed by 128 per cent in the last 21 years, twice the national average and still growing. Research has shown that compared to other mainlines in Great Britain, demand on the Devon and Cornwall main line has grown at a similar pace since 1998, despite the volume of investment in upgrades and new services being lower than on many other routes. Assuming demand continues to grow at the same rate as recorded until 2015 (5.7%), demand will reach the 2043 level predicted by Network Rail by 2031, when comparing with the conservative Office for Rail and Road growth rate² www.Peninsularailtaskforce.co.uk. Rail is the most important public transport mode for longer distance trips to and from Plymouth.

The comprehensive redevelopment of the existing station and surrounding area involves the landowners Plymouth City Council and Network Rail working in collaboration with Great Western Railway (the franchise holder) and Plymouth University. There is also strong support from Cabinet Office / LGA through the One Public Estate Programme (OPE). The first phase will lever in circa £40m to £50m in private sector investment and is dependent on £5.5 million funding (including a bid under Growth Deal 3) for the construction of a new multi storey car park and demolition of the existing car park. This will enable the creation of several development sites which will attract inward investment in to the station area and funding for the improved public realm and accessibility. The initial phases of development will need to be completed by 2020 in advance of the Mayflower 400th anniversary celebrations where Plymouth and the south west will be on show internationally.

The planned redevelopment will lead to the creation of over 920 jobs. It will transform the station into a state-of-the-art, visitor-friendly facility, able to address current and future demand and providing high-quality business and retail accommodation as well as an 11,000m² academic faculty

¹ Economic Impact of Rail Network Improvements

² Dawlish Additional Line assessment Feb 2016

for the University of Plymouth which will need to be operational in advance of the 2020 academic year.

- **Road connectivity**

Plymouth is a designated port on the Trans-European Network, an international ferry terminal, home to Europe's largest naval base and a regional hub for fuel at Cattedown port; however the City of Plymouth is located 40 miles away from the M5, our nearest motorway. We would ask that the M5 is extended to include Plymouth. The A38 through Plymouth to Exeter (M5) is one of only two major road corridors down the spine of the Peninsula (the other being the A30). In the meantime upgrades to improve journey time reliability on the A38 are vital to the city and wider peninsula.

The Joint Local Plan (JLP) authorities have an ambitious programme of highway improvements but key to the realisation of growth is the role of the A38, Plymouth's main strategic road link, (managed by Highways England). To ensure that goods and services can be delivered efficiently and reliably, the A38 must provide a high quality and resilient connection to the M5/M4 corridor. Effective operation and maintenance coupled with modernisation of the A38 is crucial to the growth of the city and the JLP therefore seeks a commitment that government will ensure that the A38 is fit for the purpose of delivering growth in the city and will develop the A38 into an 'Expressway' between Plymouth and Exeter. The JLP also seeks a commitment to major improvements of the intersections of the city and the A38: including the junctions at Deep Lane, Marsh Mills, Forder Valley, Manadon and St. Budeaux.

The A38 through Plymouth to Exeter (M5) is one of only two major road corridors down the spine of the Peninsula (the other being the A30). Upgrades to improve journey time reliability are vital to the city and wider peninsula. Five strategic transport infrastructure projects along the A38 Corridor are of particular critical importance to the successful delivery of the growth ambitions for Plymouth and South West Devon. These are:

1. Deep Lane junction
2. Marsh Mills roundabout
3. Forder Valley interchange
4. Manadon roundabout
5. St Budeaux by-pass

Funding for road improvements at strategic pinch points requires far greater funding than simply improving junctions. These infrastructure improvements will not only support the growth of Plymouth and its role as the major regional city in the south west peninsula but improve the Plymouth section of the A38 corridor into and out of Cornwall and support the strategic connectivity of the Naval Base.

The inclusion of Plymouth on the Department for Transport's Strategic National Corridors would also be welcomed in order to keep pace with the economic and population growth in the city and across the south west. Plymouth is the largest city in England with no direct road or rail connections on the network of Strategic National Corridors and is a designated port on the Trans-European Network with strategic commercial links to Spain and France, criteria that should be considered when national corridors are designated. The lack of connection to the Strategic National Corridors inhibits our plans for growth and for investor and developer interest.

We also acknowledge that infrastructure improvements in other parts of the UK can unlock growth and connect Plymouth and South West Devon to wider markets as well as improving traffic flow into the south west. This includes improving journey time reliability on the A38/M5/M4 corridors and on the second corridor to London and the south east via the A303/A358/A30

corridor are also vital. The wider economic impact of improving the A303 corridor is £41.7bn over 60 years³.

- **Protecting and strengthening Her Majesty's Naval Base (HMNB) Devonport and Dockyard's strategic role**

Devonport Naval Base is the largest Naval Base in Western Europe currently home to the Type 23 frigates and the primary UK location for deep maintenance of surface ships and submarines including base-porting options for the Type 26 and Type 31 frigates. HMNB Devonport is of vital importance to the UK's defence capability and is important to our overall marine offer. It has world class infrastructure and a highly skilled workforce. It directly supports 8.4% of Plymouth's total Full Time Equivalent (FTE) employment and 11.8% of its Gross Value Added (GVA). When direct impacts are included, this rises to 10.7% of FTE employment and 14% of GVA.

The Dockyard and Naval Base encompasses facilities for highly specialised engineering work including the refuelling and defueling of nuclear submarines. With significant government investment to upgrade these facilities it is vital that the right infrastructure is put in place in the city to accompany this future growth. This includes motorway links and improving the road junction capacity around the Dockyard and Naval Base at Camels Head, the A3064 Wolseley Road and St Budeaux Bypass to accommodate the increased use of this section of the road network. This should also be accompanied by the right skills supported by a national skills plan, please see our response to question 9.

- **Protecting port infrastructure and activities**

Plymouth's waterfront is home to the Royal Navy, strategic defence facilities in the navy dockyard and at Ernesettle, commercial ports in the Cattewater, international ferry terminal at Millbay, a large fishing fleet in Sutton Harbour as well as various marinas and other marine-related uses. Supporting the expansion of port activities in Plymouth with modernised and accessible port infrastructure, and safeguarding the existing port infrastructure including the mineral wharves and fishing industry is critical. The fishing industry brings over £12m in GVA to Plymouth each year, and accounts for around 15% of the entire English fishing fleet by FTEs-supported. Furthermore, in order to support the priority marine employment sector, protecting sites with deep water berths is key.

- **Flood and water management**

The 60 miles of Plymouth's waterfront (accounting for inlets), consisting of the land and the adjacent waters, is arguably the city's most valuable asset and is central to its identity as Britain's Ocean City and vision to become 'one of Europe's most vibrant waterfront cities'. It is essential that government acknowledges the ongoing infrastructure costs and requirements to maintain this unique asset, for example Plymouth Hoe and Foreshore, Mount Batten landing point and Plymouth breakwater (owned by the MOD). With climate change and increasing prevalence of stormy conditions these assets will require repair and ongoing maintenance. The Environment Agency flood zones are based on still water measurements rather than factoring in more extreme and increasingly prevalent stormy conditions. Work is underway to address this failing, the impact of which will be to add further to the infrastructure costs required to support development in the coastal zone and so reduce the viability of development.

Furthermore, drainage in the city centre and waterfront growth area is hampering development. Combined sewers are increasingly at risk of flooding due to extreme rainfall events. Plans to increase residential density in the city centre will require new surface water sewer infrastructure

³ A303 Prospectus and Wider Economic Impact 2013

to release capacity in the foul sewers. The scale of investment is likely to be more than can be supported by new development, and it should be forward funded so that there is a functional network in place for new development to connect to.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Plymouth's ports provide an opportunity for the city to maximise its export potential and contribute to the UK's international competitiveness, in particular Plymouth ports are of national significance for landing and exporting fish. The fishing industry brings over £12m in GVA to Plymouth each year, accounts for around 15% of the entire English fishing fleet by FTEs-supported and is the largest English port by volume of landings. Despite its growing importance nationally, and as a hub for marketing fish from across the south west peninsula, the last major investment in the city's fishing port facilities was 1992 and a major upgrade is required to improve productivity, regulatory compliance and to remain competitive. The fish quay is in a central location in historic Sutton Harbour and redevelopment would have wider regeneration benefits.

Protecting key access routes and where appropriate safeguarding existing land and infrastructure is important. This includes the need to support demand-driven investment in road-rail-port interchanges in order to optimise the economic value to the city of its port and help meet demand for storage and distribution of freight. The facilities at Millbay Docks used by Brittany Ferries for cross channel ferries and international cruise liners has major potential to be developed further as a gateway (as set out in the Plymouth and South West Devon Joint Local Plan). However for these assets to be fully exploited, investment is required to connect different modes to the national road and rail networks.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Recent experiences developing the new community of Sherford highlight that front-loading infrastructure funding is fundamental to the success of new communities and the pace of housing development. In order to 'de-risk' sites for developers Government commitment and support for upfront infrastructure funding is vital if it wants to deliver housing on the scale it has set out in recent announcements.

Plymouth supports an integrated approach to investment in infrastructure as outlined in the Heart of the South West's Prospectus for Productivity which looks to establish an Infrastructure Commission for the HotSW area. Complementing the National Infrastructure Commission the HotSW body would bring together local partners to formulate a HotSW Strategic Infrastructure Plan. As part of this Plan partners could explore more flexible funding models that would enable infrastructure to be designed, planned and targeted at agreed areas of growth as set out in Local Plans; for Plymouth and South West Devon this is clearly set out in the Joint Local Plan. In order to facilitate this Government would need to allow local areas to control investment for example they would need to lift pooling restrictions for those areas that wish to enter into new arrangements for the use of CIL, Section 106 and other capital investments.

The identification of the infrastructure requirements for the JLP are set out in an Infrastructure Needs Assessment which will inform decisions on plans, programmes and priorities for the areas infrastructure needs through to 2034. It provides an assessment of the funding required to achieve the aspirations for the Plan Area, and any gaps in funding provision, and hence will also support the

review of the Community Infrastructure Levy for Plymouth and decisions over the use of Section 106 agreements.

4. What is the maximum potential for demand management, recognising behaviour constraints and rebound effects?

There is considerable potential for demand management on the highway network. With one or two exceptions outside London there is currently unrestrained access to the network resulting in significant congestion at peak time. Examples may include smart ticketing. Improvements to the way we interrogate data and links to the 'big data' and 'smart cities' agendas could improve demand management and influence behavioural change.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

This is a very real issue for Plymouth and the wider peninsula. Whilst improving access to Plymouth and the peninsula through new or upgraded assets is key the maintenance of our existing assets, given the size of our road network in comparison to the rest of the UK places a disproportionately large burden on local authorities. The use of cost-benefit analysis and ensuring there is a strong business case in place are critical when making investment decisions and local expertise should be used to assess whether it is a more efficient use of funding to repair and maintain infrastructure or to replace it with modern infrastructure.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Improvement in the way procurement is undertaken for significant infrastructure projects could be made by government making available a national template on which local areas could draw to drive economies of scale through the procurement process and reduce complexity.

7. What changes in funding policy could improve the efficiency with which infrastructure funding services are delivered?

The current policy of 'funding competition' to allocate large tranches of resources to local highways and transport projects is extremely time consuming and costly to local authorities. Authorities are developing schemes 'at risk' until capital funding is secured and risk the sunk costs reverting to (scarce) revenue pressures if bids are unsuccessful. Making funding available for feasibility studies to develop well thought through projects would be welcomed.

The Industrial Strategy sets out a commitment to drive growth across the whole country and signals its intention to use infrastructure investment to address productivity weaknesses across the country and imbalances between areas. Investment in infrastructure should take account of the economic potential of Plymouth and its contribution to the wider south west peninsula. There is a risk that investment in rail and the Strategic Road Network is only prioritised in areas where it already provides for business productivity. Highways England, through Route Strategies will determine investment priorities for RIS2. The problem will be that those investment decisions will be based on where problems are most severe and where action is the greatest. This approach tends towards investment being prioritised at areas that are already heavily invested in and perpetuates the peripheralisation of the regions such as the south west. A National Infrastructure Assessment weighted to addressing the regional disparities would be greatly welcomed.

One of the key barriers is the siloed nature of funding pots and inflexibility and fragmentation of the current funding regime. The government's current approach to infrastructure spending disadvantages regions such as the south west and therefore Plymouth. This perpetuates years of underfunding in Plymouth and the wider area and the city's ability to transform. An example of this can be shown in the Autumn Statement announcements for Growth Deal 3. The Government will award £1.8 billion to Local Enterprise Partnerships (LEPs) across England. £556 million of this will go to the North of England, £392 million to LEPs in the Midlands, £151 million to the East of England, £492 million to London and the South East and £191 million to the South West. Clearly only a proportion of this will come to the HotSW LEP and subsequently even less for Plymouth.

Plymouth would support a Single Investment Framework for the HotSW area which would bring together public and private investment into a fund that would deliver on the priorities for the area and bring significant efficiencies. Infrastructure investment needs to be planned over the long term such as a 20 to 50 year period not on 5 to 10 years in order for it to be truly strategic.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

No response provided.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

One crucial factor relates to the skills shortages and distortions in the market created by the demand for specialised skills in competing areas. Particular examples relate to the requirement for construction skills which are already in high demand and short supply, and with the imminent significant potential for Hinkley C to draw labour from other areas. Similarly, with the need for specialist nuclear skills at Hinkley, and a growing requirement at the naval base in Devonport for refuelling of nuclear submarines and the Royal Navy's overall maintenance programme.

The risks around skills shortages need to be better understood and planned for at a national level. We would welcome a national skills plan that accompanies the infrastructure plan but with the ability to contribute to it from local and regional intelligence sources. This will aid our planning process, ensuring that resources are located in accordance to need and in turn contribute effectively to the aims and objectives of the UK Industrial Strategy.

We are addressing skills shortages in construction and the built environment through our Building Plymouth Programme and evidence from this points to not only skills shortages but also the need for a responsive skills infrastructure with the ability to flex funding and it them fit for purpose as well as have the ability to deliver localised training products from local centres instead of having to rely on centres elsewhere which are costly to employers. We know there is demand here from our work to date and it is increasing.

As a city we have recognised the importance and contribution that STEM skills makes to our sub region as well as recognising current STEM skills shortages; our STEM strategy is based on growing, keeping and attracting STEM talent. Our Regional STEM Centre of Excellence provides part of our infrastructure from a combined funding package that has enabled this, but as we anticipate an increase in demand for these skills from cross cutting sectors, then this capacity will need to increase as part of our skills infrastructure.

We therefore support the government's Industrial Strategy and in this instance key areas of STEM, Maths, English and Digitalisation of the workforce. We would also like to work with government on the development of an Institute of Technology.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

A challenge for the city is the difference in land values across the country and therefore the contribution to infrastructure from developers. The whole viability assessment process is not currently fit for purpose. Local authorities are ill-equipped to challenge developers' claims that delivery of infrastructure is not viable. These issues cause significant difficulty in securing sufficient funding to deliver the infrastructure required, meaning development impact is often not appropriately mitigated. To avoid this, the planning system needs to be better equipped to either control or capture land value uplift. In Plymouth our approach to challenging the viability assessments of developers has led to increases in both S106 financial contributions and affordable housing but the ability to fund the necessary infrastructure remains a significant issue.

Furthermore, Regulation 60 of the Community Infrastructure Levy (CIL) Regulations makes provision for a percentage of CIL receipts to be used to pay borrowing costs. Currently however the percentage of CIL that can be used to pay back loans, as prescribed within the Regulations, is set at zero. There is also provision for the Secretary of State to change this and allow repayments, specifying the percentage that could be applied.

Often, and particularly in Plymouth's case, infrastructure needs to be provided up front, to enable growth, and before the benefits of that growth have been secured. Not being able to apply CIL funds in this way could be an impediment to growth. We therefore request that the Secretary of State issues a direction that allows a percentage to be used to make repayments on loans.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Plymouth and the wider HotSW is the ideal location to trail blaze natural capital-led productivity growth. It is rich in natural capital, spectacular coastline, and substantial land area within National Parks/Areas of Outstanding Natural Beauty.

The area is reliant on abundant natural assets and the ecosystem services that derive from them to power economic growth. Our coastline, moorlands and countryside attract more domestic tourists than any other UK region. Employment in sectors that depend directly on natural capital, such as agriculture and fisheries, is proportionately higher than any other UK area. However, in contrast, there is also more potential for increasing economic benefits from natural capital than in any other region.

For this reason, we need the National Infrastructure Commission to support areas such as Plymouth and the wider HotSW to develop local strategies that can deliver sustainable infrastructure projects that protect and enhance the natural environment but help deliver on our productivity objectives. Many of the digital industries for example cite natural and cultural capital as pre-requisites before making investment and locational decisions: the quality of the south west's natural capital is a significant draw and part of its essential character.

We should also recognise the ability of the natural environment to offer natural solutions to some of our biggest infrastructure challenges, such as flood management. The natural environment offers the potential for significant benefits at relatively small levels of investment.

In addition, there is no routine allocation of infrastructure for bus networks or walking and cycling networks as part of sustainable transport schemes. There is some flexibility for Local Authorities to use existing capital grants however this can be limited. We would therefore suggest that specific funding should become part of routine national funding allocations for these networks.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

We would like to see public realm improvements for transport schemes acknowledged as core benefits by the DfT and included in the WebTAG guidance for Business Cost Ratio (BCR) calculations. A good example of this would be public realm improvements at Plymouth Railway Station creating an enhanced experience for commuters and visitors alike, as cited in the response to question 1.

Transport

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Our travel studies already demonstrate our networks have limited capacity and demand continues to grow. Commuting patterns are such that overall 71% of the working population of the Heart of the South West LEP live and work within the area. Plymouth sees a +4,700 gain from inward migration of commuters. The support for Broadband and rail improvements could help to influence more sustainable travel and work patterns and reduce problems at peak periods.

Government should enable the market to come up with technology solutions and then form appropriate frameworks for managing new technologies as they mature. A flexible and agile approach is needed to enable rapid response to change as it will be impossible to predict what the technologies and impacts will be. It makes sense to plan ahead in relatively short periods (15-20 years) so that sensible investments can be made for the medium term allowing change to happen in the longer term. It is clear that autonomous vehicles and smart cities technologies will have a radical impact over a relatively short time period.

14. What are the highest value transport investments to allow people and freight to get into, out of and round major urban areas?

As set out in question 1 our rail, road and port infrastructure are the highest value transport investments linked to movement of people and freight. We acknowledge that further work could be done locally in partnership with bus/rail/ferry operators to deliver a more joined up transport system across all modes of transport at key locations within the Plymouth Travel to Work Area.

Smart technologies will become an increasingly important area of investment to facilitate efficient movement into and around urban areas. As new technologies mature and vehicles become increasingly autonomous it could be possible to re-allocate more of the road-space and parking space and dedicate it to other modes.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

There are just two main road routes from London into HotSW: the M4/M5 and the A30/ A303, of which much is a single carriageway trunk road. Both routes are prone to disruption due to road accidents, adverse weather and congestion, making travel times unpredictable and unreliable. An obvious solution to the risk of dependency on the M5/M4, would be to make the A30/A303 a dual carriageway from beginning to end, a project that many consider vital. Partners are also working to deliver series of improvements on the A30/A303 corridor and to address a series of Pinch Points across the LEP area.

Future investment on the Strategic Road Network is fundamental to achieving the ambitions of the Plymouth and South West Devon Joint Local Plan. Plymouth does not currently host an airport and rail connections are vulnerable to disruption and breakdown and suffer increasingly due to severe weather events. Strategic connectivity from Plymouth to the wider economy is a significant issue for Plymouth and the wider HotSW LEP alike. Plymouth is reliant on a single rail line and a single trunk road (A38) for connectivity with the rest of the UK. Plymouth's ambition to grow its population from 262,700 to 300,000 by 2034 will need to be supported by the proportionate level of investment in transport infrastructure.

As stated in the response to question 1, of particular significance in the Plymouth and South West Devon Joint Local Plan area are junctions on the A38 at Deep Lane, Manadon, Marsh Mills, Forder Valley and St Budeaux by-pass. Peak time congestion at these junctions is impacting on Plymouth and South Hams' ability to deliver significant numbers of new homes

Authorities in the south west welcome the opportunity to engage in this consultation and would like it to be recognised that they want to work with Highways England and Network Rail in developing the evidence base and development of schemes for RIS2 and CP6 respectively.

16. What opportunities does 'mobility of service' create for road user charging? How would this affect road usage?

No response provided.

Digital Communications

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

A Full Fibre infrastructure network providing symmetrical and ultrafast connectivity across the country is currently acknowledged as the way forward for fixed Broadband infrastructure. Existing programmes achieved significant uplift in the numbers of premises receiving SF broadband (24 mbps) in a relatively short time, largely by utilising and upgrading existing infrastructure. However a number of these premises will have to be revisited to achieve Next Generation Access (NGA) (30 mbps) speeds. Dated copper networks are being superseded by fibre technology and are unlikely to merit significant or long term maintenance investment. Investment needs to be made as soon as possible as demand increases rapidly and feeds economic growth.

Government should encourage commercial providers to provide this infrastructure. However gap funded or public/ private collaborations should be considered for areas which are not yet commercially viable. Particularly those where the public sector is funded to deliver increases in

uptake and exploitation by business and householders in order to make capital investment more attractive to the private sector.

Continual technical developments should mean that most areas will become commercially viable. This is illustrated by the recent Connecting Devon and Somerset (CDS) experience. In December 2016, CDS awarded 4 contracts for the delivery of NGA Full Fibre services on a gap funded basis. NGA broadband infrastructure requires high levels of investment which are secured by very long term returns of around 20 years. This may point to a different investment model using equity investment. CDS recent experience suggested a good appetite in the market for investment in NGA networks with significant private investment being made. Providers are currently using state aid as a barrier to hold back full fibre networks in urban areas by using their commercially planned areas to block development while in practice not investing.

It is also important to add that with the increase in use and adoption of new technologies come increased risks of cybercrime. While not part of our physical infrastructure, cyber security and safeguarding citizen's sensitive and personal information is just as vital in terms of our virtual infrastructure.

18. Is the existing digital communications regime going to deliver what is needed when it is needed in the areas that require it if digital connectivity is becoming a utility? If not how can we facilitate this?

No. The roll out of comprehensive full fibre networks does not match the timeline for development of alternative solutions.

Fixed connectivity

In addition to testing markets and taking a gap funding/ public/private collaboration approach the following should be considered;

- Pump prime poorly connected business parks/zones.
- Promoting effective competition and seeking to achieve a more balanced market rather than continued market dominance by a single provider.
- Pump-priming more remote communities and business parks or co-investment models using public funds.
- Availability of long term low cost finance whether by loan or equity investment.
- Use of "interim" solutions pending a Full Fibre solution.

Mobile Connectivity

National targets mask under delivery in rural areas. It is anticipated that there will be a shortfall of between 6-10 % indoor 4G mobile coverage in Devon and Somerset and a shortfall of around 1 % outdoor coverage for the area. These are significant shortfalls when compared to the national targets.

Mobile coverage around key rail links should be seen as a priority. The lack of clarity over ownership and responsibility for delivery of WI-FI and mobile phone signals along our rail routes appears to create a situation where no one body is responsible. This leads to the current situation where much of the route from Penzance to London does not have connectivity to WI-FI and mobile phone signals. The current obligation to put Wi-Fi on the main train lines linking the south west with London has been complied with only to be let down by the lack of the mobile infrastructure along the routes.

We would advise;

- more consultation (not imposing large lattice masts on communities where smaller less obtrusive masts would be appropriate);
- being flexible - inconsistencies in mapping between operators needs to be considered; and
- reflecting the costs that the market can sustain when compared to annual revenues

Other ways in which mobile infrastructure might be facilitated include;

- amendments to planning and permitted development rights for small cell sites;
- business rate relief for small masts; and
- offer some form of subsidy for more costly connectivity pending a universal Full Fibre network.

Energy

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Please refer to response provided under question 20.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Plymouth has an ambition to reduce citywide carbon emissions by 50% by 2031 on a 2005 baseline. The evidence behind this target

http://web.plymouth.gov.uk/plymouth_co2_2013_report.pdf is based on an assumed roll out of various demand reduction, energy efficiency, smart and low/zero carbon generation technologies. These assumptions are based around the government trajectories established in national Carbon Budgets. A number of these rely on interventions that Plymouth would like to flag as national infrastructure requirements:

Energy Efficient Housing - Plymouth would like to highlight the role increased domestic energy efficiency can make in meeting the NICs objectives. As well as helping to reduce the cost to energy consumers of the transition to a low carbon economy, this approach can also simultaneously improve the quality of life for those living in the UK, particular the most vulnerable. Recognising energy efficient housing as a national infrastructure priority is widely recognised as an significant opportunity to drive new jobs and economic growth (1 million homes per year need to be energy retrofitted to meet Government CO2 targets), whilst at the same time (i) avoiding the societal costs associated with the morbidity that cold homes prompt, (ii) reducing the cost of investment in new power generation, and (iii) decreasing the need for (and cost) of network reinforcement.

(<http://www.ukgbc.org/sites/default/files/A%20housing%20stock%20fit%20for%20the%20future%20-%20Making%20home%20energy%20efficiency%20a%20national%20infrastructure%20priority.pdf>)

Smart Flexible Power Distribution networks: Plymouth calls the NIC to ensure the city and the south west gets the proactive approach to anticipatory grid investment required to support the future growth of distributed generation. Network constraints continue to limit the growth of distributed low carbon and renewable technologies across Plymouth and the wider HotSW LEP area. RegenSW's study <https://www.regensw.co.uk/distributed-generation-and-demand-study-technology-growth-scenarios-to-2030> considered four technology growth scenarios and even the lowest growth option shows distributed generation will continue to grow placing further demands

on the electricity network. The forecast growth in electric vehicles, storage and heat pumps that will be required to meet national carbon budgets and Plymouth's local targets compound this infrastructure need.

Heat Networks - Plymouth recognises through its Local Plan and infrastructure needs assessment the strategic role district heat infrastructure can play in its required energy transition. Plymouth calls on the NIC to secure further investment initiatives such as that being promoted by BEIS Heat Network Development Unit and associated Heat Network Investment Programme. The NIC should also seek to learn from emerging thinking from projects such as Heatnet <http://www.nweurope.eu/projects/project-search/heatnet-transition-strategies-for-delivering-low-carbon-district-heat/>. Plymouth has developed this project and is seeking to explore potential for 4th generation district heating to bring 'smarter' more integrated approaches to energy efficiency and heat supply technologies.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Please refer to response provided under question 20.

Water and wastewater (drainage and sewerage)

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Water supply and demand are not thought to be an issue in the city. However, much of Plymouth's drainage consists of combined sewers, taking surface water as well as foul sewage. The impacts of more extreme rainfall events (heavier rainfall, and more frequently) place increasing pressure on the sewer network, increasing risks of flooding and increasing operational costs. New development provides the opportunity to design separate surface water drainage, but in large parts of the city development sites are isolated from strategic surface water drains. Studies have identified where these are required but there is no adequate funding mechanism to address this particular infrastructure need: Environment Agency budgets are linked to flooding of homes; South West Water funding to amelioration of specific sewer flooding incidents. Whilst all parties recognise the problem, funding the strategic solutions necessary to respond to the impacts of climate change are nonetheless very challenging.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Close working between the Environment Agency, South West Water, Highways Agency and local planning authority / lead flood authority is important. The JLP policies will ensure embedding the issue in the planning process and have to be informed by water companies and housing/development projections.

In Plymouth City Centre and Waterfront growth area, strategic surface water drainage infrastructure needs to be forward funded. This will enable more effective use of s106 agreements and planning consents conditions and obligations to secure on-site SUDs (sustainable urban drainage systems) and connections to a functional drainage network.

Elsewhere in the city new strategic surface water drainage routes have been identified which will require significant public investment for which there is no clear funding mechanism. The availability of dedicated capital funds at appropriate times will enable other public and private funds to be

levered in to upgrade drainage infrastructure to meet the dual challenges posed by climate change and a growing city.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Partnership working and appropriate funding is critical to the success of a whole catchment approach particularly given that this includes areas outside the city boundaries.

Flood risk management

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

As identified in the response to question 1 under flood and water management, our ports and coastal areas are vital to our identity and economy. Protecting and maintaining them in the face of climate change and increasingly prevalent adverse weather conditions is critical. Unfortunately grant determination often requires maintenance and repair to be undertaken on a 'like for like' basis when in fact it is improvements that add resilience to these assets that are required. We would like grant determination to allow for more flexibility to make these improvements. In addition a more proactive approach to planning for future flood and storm events is required. Supporting the MOD to make sure that the naval base and wider port infrastructure is maintained and upgraded to reflect climate change risks should also be provided for at a national level.

Furthermore in terms of addressing Plymouth's challenges around productivity, ensuring that our port, road and rail networks are resilient to flooding is vital. As previously stated in question 1 the events in Dawlish and Teignmouth in 2014 highlighted that our rail network is highly vulnerable to impacts of extreme weather events and estimating that this cost the South West peninsula's economy over £1.2bn. Finally, the resilience of the Torpoint ferry is important to servicing the travel to work area as is Brittany Ferries to our visitor economy and transport of goods to and from European markets. If flood events and storm events prevent either from docking this will in turn impact on the local economy.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

In densely developed urban environments making space for SUDS (sustainable urban drainage systems) is challenging, and their delivery through planning problematic (problems including aforementioned challenges regarding development viability assessments). The public realm affords an opportunity to achieve multiple benefits, which the Council is exploring through a pilot project, but these are unlikely to be cost-neutral solutions for the public sector. Funds are needed to develop strategic solutions in areas with identified problems.

Solid Waste

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Plymouth City Council as part of the South West Devon Waste Partnership has procured 25-year residual waste treatment solution incorporating a high efficiency combined heat and power Energy from Waste (EfW) facility that effectively treats the city's municipal residual waste and meets the city's landfill diversion objectives with less than 2% of the city's waste being sent to landfill.

Under a commercial arrangement, this EfW meets all the power and heating needs of HM Naval Base Devonport and also supplies surplus electricity to the national grid. However, the facility is performing above expectation in terms of efficiency and has surplus heat which could be used for a local district heating scheme to local housing if government grant funding support can be secured towards the capital infrastructure to make such a long-term sustainable green energy scheme viable.

The city's recycling rate has been on a plateau around 33% since 2007/8. A modernisation programme of waste and street services is currently being undertaken with a key aim to stimulate recycling activity, anticipated to gain around 5% increase in recycling.

If higher recycling rates are to be achieved new material markets for reuse and recycling need to be gained but this is not currently financially viable in the current market conditions coupled with increasing pressure on the authority's budget.

Local authority funding support is needed to explore and gain new material markets for reuse and recycling and to deliver continuing comprehensive waste minimisation and recycling educational and community engagement programmes to stimulate the cultural change in attitude and behaviour towards waste needed to achieve higher recycling rates.

A review of the Landfill Tax Scheme is an avenue which could provide funding support through a central fund open to all local authorities or others such as social enterprise, community groups or partnerships to apply rather than the fund being specific to a locality and the landfill operator.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social be)?

Product design is a key limiting factor; in general it is not cost-effective for reprocessors to prepare household goods and appliances, in particular Waste Electronic and Electrical Goods, for reuse and resale. In addition, many products cannot be readily recycled due to the design or type of materials used, i.e. 'black' plastic food trays the colour presents difficulties for recycling or goods that are difficult to disassemble to obtain the components for recycling, i.e. mattresses are difficult to strip to obtain the metal springs.

The eco-design of products is central to achieving a circular economy through the design and use of materials in manufacture that increase product life, facilitate the reuse of goods and enable maximum benefits to be derived from the product components at the end of the product life.

This could be facilitated by increased producer responsibility measures to improve eco-design which are likely to increase design and production costs but could be outweighed from the benefits of increased life and performance of the products leading to improved and increased longevity of natural resource use and in turn leading to a reduction in the environmental impact associated with the utilisation of resources and manufacturing and inevitably a reduction in waste and the related financial costs. Increased employment opportunities could arise from the preparation and resale of goods for reuse and increased recycling of goods.

Funding support for the development of the circular economy is needed to facilitate the growth in reuse and recycling reprocessors and the creation of increased sustainable markets for secondary material use. Funding streams that support the third sector and provide employment and training opportunities particularly for those experiencing difficulties in finding work confer many benefits although funding for this type of activity has become limited. A review of the Waste Electronic

and Electrical Equipment Producer compliance scheme is one such area in which funding opportunities could be created.



Portsmouth City Council response to National Infrastructure
Assessment call for evidence. Response by [name redacted][email redacted]
[telephone redacted]

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Leader of Portsmouth City Council

Executive Office
Floor 3, Core 3-4, Civic Offices
Guildhall Square
Portsmouth
PO1 2AL

Phone:
E-mail:

Via email:
NIAEvidence@nic.gsi.gov.uk

Our Ref: DJOUT565

Date: 10th February 2017

Dear Sir or Madam,

RE: National Infrastructure Assessment Call for Evidence

Portsmouth City Council welcomes the establishment of the National Infrastructure Commission, and the opportunity to shape the advice to be provided to government on major long-term infrastructure challenges. We are pleased to note that the objectives of the Commission include supporting sustainable economic growth across all regions of the UK, improving competitiveness and improving the quality of life for people.

Portsmouth is a densely populated city that is nonetheless growing in terms of population and economy, despite the physical constraints presented by its geography and the international significance of its environment. It lies in the most urbanised area of southern England and plays an important role both in generating and accommodating economic growth. Both offer - natural infrastructure of international significance.

The city hosts assets of national strategic importance including its sheltered **deep-water** frontage. The Port of Portsmouth comprises Portsmouth International Port and HM Naval Base; neither have a railhead so road connectivity is paramount.

Portsmouth International Port (PIP) is the UK's second largest cross-channel ferry port. It provides an international gateway for over 2 million passengers and up to 1 million cars and freight vehicles to France, Spain and the Channel Islands - 80% of goods consumed on the Channel Islands are exported through Portsmouth. It is the main port in the UK for deep-sea fruit and vegetable imports, with 70% of the bananas consumed in the UK arriving through the Port.

PIP supports 805 direct and 1,595 indirect jobs. It provides an injection of £38.7m into the greater Portsmouth economy and drives an additional £71.3m indirect income. This is set to increase as the Port seeks to increase small to medium-sized cruise calls,

Continued.../

complementing the large cruise facilities offered at Southampton. A recent study carried out by Strategic Transport Solutions identified that the current level of cruise calls to Portsmouth generates £2m income to the city. However, the majority of calls are tourist calls, meaning that connectivity by road between the Port and the city is of strategic importance.

Adjacent to the International Port, HM Naval Base is at the heart of the Solent sub-regional defence cluster which provides 20,000 jobs across the sub-region and contributes over £1.6bn GVA of output. Portsmouth is the base port for half the Royal Navy surface fleet and this drives a strong maritime services sector including integrated ship support, complex software engineering and advanced manufacturing solutions. Associated local businesses include BAE, Babcock, Lockheed Martin, Northrop Grumman, Qinetiq, Serco Denholm Ltd, Vector Aerospace and the Centre for Maritime Intelligent Systems.

The Base will welcome the first of two new QE Class Aircraft Carriers this year. Portsmouth will be their base port, the largest and most complex warships in the history of the Royal Navy. The ships themselves are significant strategic and national assets. They will require around 2,000 crew and associated support personnel with links into the local economy and wider supply chains. Multiplier effects mean that with every £1m spent by the base £0.75m of additional spend is generated locally; and every 100 jobs support up to 66 jobs elsewhere.

Taken together, the Port of Portsmouth's assets provide the anchor for the Solent's global marine and maritime sector, contributing 20.5% of sub-regional GVA, 5% of private sector jobs and 7% of manufacturing in the area. However, as the **National Policy Statement for Ports** makes clear, Government policy is to enable port development to cater for long-term forecast growth in volume of imports and exports by sea, enabling a competitive and efficient port industry capable of meeting the needs of importers and exporters. This means that there is a compelling need for substantial additional port capacity over the next 20 to 30 years, and a clear imperative for the transport infrastructure necessary to support increased capacity. Equally, supporting nationally important strategic defence assets will require reliable and upgraded infrastructure (most notably in relation to transport and energy). The QE Carrier arrivals will certainly create demand on infrastructure and draw on a pool of skilled labour across a national market, meaning that good connectivity is essential.

Base-porting the QE Class Carriers in the city creates an immediate requirement around **energy** supplies. The new high voltage substation at Portsmouth Naval Base will support the energy requirements of the ships whilst in port. Each ship will host an independent distribution network capable of managing equivalent energy to power 5,500 family homes. It is as yet unknown if the upgrade to the energy supply will be sufficient to provide for the occasions (up to ¼ of the year) when both Carriers will be in Port at the same time.

Investment in the Strategic Road Network (SRN) is critical to support access but it is the end of the journey and entry to the city that takes a disproportionate amount of time, with the same routes used by commuters, business (including freight) and visitors.

Continued.../

In Portsmouth, significant investment in the **Portsmouth City Centre road scheme** is needed from where the M275 enters the city. This would provide a fundamental re-design of the most strategic access route into the City Centre and beyond to the Naval Dockyard. This would strengthen network connectivity both north to the "City Deal" development sites at Tipner and Horsea Island as well as south to Gunwharf (retail and leisure centre), the Historic Dockyard and the Seafront. This strategic route carries just under half (46%) of all inbound traffic at morning peak and will be under additional pressure with the base-porting of the Carriers.

More significantly, the majority of future development set out in the Local Plan to 2026 will be on the western side of Portsmouth with a concentration of that development within the City Centre. The increase in development across the whole City is expected to lead to a 41% increase in inbound traffic at the morning peak, the majority of which would be along this M275 and western corridor.

The **Portsmouth City Centre road scheme** is of the utmost importance to the City. It is essential that traffic flows continue to be efficient and avoid being a drag on the productivity to the existing concentration of City Centre businesses and the Port of Portsmouth interests. Importantly, it is necessary for the Port of Portsmouth to maintain the current (and differentiated) competitive advantage in an increasingly competitive international market in order to secure their future attractiveness for growth. It will secure significant transport benefits and be a catalyst and enabler for the additional housing required and employment growth in a tightly bounded, densely populated City.

Without this critical piece of transformational infrastructure for the City, the productivity and future growth prospects of our Marine and Maritime sector will be jeopardised, the extent of development which can progress in the city will be severely constrained, and Portsmouth's role as a world class venue for sporting and leisure events would be compromised, affecting the growth of the visitor economy.

It is not only road connectivity that is an issue for the city, but **rail connectivity** too. Rail travel to Southampton from Portsmouth is slow (45 - 60 minutes for a 20 mile journey, compared to Nottingham - Derby or Newcastle - Sunderland (both 20 minutes for 15 miles). As a further example, from Portsmouth it can be quicker to get to Gatwick than to Southampton Airport. This results in use of the M27 as the default option, resulting in chronic peak period congestion. Rail access between Portsmouth and London is unacceptably slow (a 75 mile journey takes 96 - 129 minutes, compared to Bristol Parkway to London - 115 miles in 100 minutes). This connectivity challenge is becoming even more pronounced as rail access to London from other towns and cities is enhanced. This is detrimental to efforts to build the identity of the city and the region in wider markets.

Continued.../

Portsmouth's "island city" nature also means that there is particular relevance to **flood defence**. Considerable work has already taken place to improve defences, and the next projected phase is the Southsea flood defences. Portsmouth City Council in conjunction with the Environment Agency need to improve a further 2.8 miles (4.5km) of Southsea's seafront and provide coastal defences to reduce flood risk and avoid circa £1bn of direct damages within the city for the next 100 years.

The project is significantly advanced with outline designs and ongoing consultation identifying leading options for infrastructure improvements. The Outline Business Case has been reviewed by the Environment Agency and Defra and now awaits final approval from HM Treasury. This transformational project will:

- safeguard critical infrastructure serving the wider city and region (sub-stations, gas network, roads, water)
- reduce flood risks to 4,114 existing homes and 704 non-residential properties
- unlock development sites in the coastal zone to enable the delivery of 1,000 new homes (following review of the Portsmouth Plan this could increase by enabling further sites to be released for development)
- improve coastal access and promote linkages along the seafront (including to Southsea Town Centre) and wider city
- deliver an attractive waterfront that increases the city's draw as a safe place to live, work and invest and enable the Seafront to grow as a world class events space
- protect significant heritage assets including Southsea Castle, Southsea Common, Long Curtain Moat and the Kings Bastion.
- safeguard significant nature conservation assets

This work has been identified as 'critical infrastructure' needed to support the development proposed in the Portsmouth Local Plan and future growth in the city. Without this the ability of the city to generate and absorb growth will be restricted. Naturally, the costs are significant - the projected whole life cost is £114.5m, with a construction and risk cost of £87.4m.

Therefore, as well as supporting the responses made by the Solent LEP and the Partnership for Urban South Hampshire, the council strongly proposes that the National Infrastructure Commission focuses on:

- Importance of internationally significant infrastructure, such as deep water ports
- Improved strategic connections from Portsmouth to London, particularly rail
- Improved highway access to strategic bases, including the Port of Portsmouth (International Port and Naval Base)
- Improved energy infrastructure to support immediate needs around Carrier base-porting
- Flood defence to unlock and enable growth.

Continued.../

Additionally, we urge the Commission to consider develop recommendations around the **governance structures** required to prioritise and deliver significant infrastructure projects. There are a number of general issues worthy of consideration. One is the extent to which often out-dated administrative and political boundaries can influence the provision of investment in infrastructure and delivery of economic growth. These can inhibit economic growth - so many of our cities are 'artificially' constrained in their growth by their civic rather than economic boundaries.

Current policy to address some of these matters through provision for Combined Authorities is thus far proving an insufficient remedy. Attempts to achieve a Mayoral Combined Authority for the Solent have been frustrated because it is seen as a threat to the corporate entity of organisations, inhibiting the growth agenda and the provision of an additional £30m per annum for infrastructure from HMT as part of the Solent Devolution Deal agreed with HMT, BIS and DCLG in March 2016.

One final point of particular relevance to Portsmouth is the requirement for a more joined up process of **transferring sites between Government Departments** where Department are 'compensated' for any asset transfers but not necessarily from each other - maybe a Government held central pooled fund to facilitate asset transfers could be considered? In Portsmouth and the surrounding area there are a number of complex strategic sites, particularly defence, where the nature of Government landholdings adds greatly to the challenge of bringing development forward.

I hope that, taken alongside other responses from partners in the region, this provides an outline of key infrastructure issues in the city and region, and where we would wish to see particular focus in the work of the Commission. We believe this City has exceptional assets for our national economy but also that there is more required in terms of support for infrastructure if the full potential is to be unlocked and realised.

I would be very happy to develop any of the issues touched on or to follow up this letter with a meeting.

Yours faithfully,

Leader of the Council

Submission to NIC CfE February 2017: Waste Infrastructure

[name and organisation redacted]

NB: This is an edited version of a forthcoming paper “On a voyage of recovery: a preliminary review of the UK’s resource recovery from waste infrastructure.” The document should be read as a whole, but here, we cross-reference to the relevant sections that address the individual questions in the NIC CfE with regard to waste, or resource recovery from waste (RRfW), infrastructure.

Question	Answer
Cross-cutting issues	
1	The highest value investment would be in establishing an “Office for Resource Stewardship” to replace regulation in the sector by environmentally-focused organisations; changing the perception of the industry from one that is tasked with preventing pollution to one that is tasked with protecting UK resources [see §8 esp. 8.6, 8.9], mandating data collection in the sector to promote the emergence of robust markets for recycled materials [see 8.4, 4.1, 4.3, 4.4] and establish distributed responsibility for materials up and down the supply chain [see 6.1, 8.7].
2	See 8.9, 5.4, 8.10.
3	The relationship between waste infrastructure and housing (i.e. residents) is crucial. Recycling targets and secondary material markets can only be achieved if household collection systems are matched to local RRfW infrastructure and behavioural changes promoting e.g. reuse are encouraged. See 3.2, 5.5, 6.2, 6.3.
4	Demand management in this context means reduced production of waste and in turn reduced consumption of disposable materials, increase reuse and changed design practices to promote refurbishment, dismantling etc. See 1.8, 5.7, 6.1, 6.3, 7.5.
5	Not explicitly addressed
6	See 1.7 – the market is difficult to penetrate in many ways for smaller enterprises. Lack of data makes it difficult to project resource flows and hence assess investment risk and uncertainty in the regulatory landscape associated with Brexit does not help [4.2-3, 5.6, 8.5]
7	See 4.2, 8.6-7.
8	See 4.2 esp. footnote 5, 6.2
9	Some analyses suggest that we can only avoid a capacity gap if the ability to transport waste across the country is retained; this introduces a dependency on transport [3.1-2]. The use of energy from waste is a small percentage of our total energy generation capacity and so the interdependence with the power sector is small. The biggest resilience threat is the current reliance on export of refuse-derived fuels (RDF) to the EU to fill our capacity gap for waste management; if this market is closed off, we may well miss recycling targets [3.3-4; 5.4-5].
10	See recommendations in §8, esp. 8.9.
11	Waste management and RRfW infrastructure contributes on two levels; prevention of pollution of air, land and water by waste; and reduction in consumption of declining primary resources and the carbon emissions associated therewith. An additional benefit is the use of EfW to replace fossil fuels, although this is a double-edged sword as it lock-in a dependence on diverting waste to energy recovery – i.e. destruction – rather than recover of valuable materials. The reuse sector is currently under-exploited in this regard. See 5.1, 5.5, 5.7, 6.1, 6.3. Resource recovery should be given equal status to prevention of pollution; the latter currently dominates policy, regulation and hence behaviours in the sector [8.1]. The RRfW sector will be essential to any future ‘circular economy’ [8.3].
12	One of the projects contained within the NERC RRfW portfolio [see 7.3] addresses exactly this issue. Appended to this submission (Appendix 1) is a brief description of the CVORR project.

Solid waste sector specific questions: these are addressed by the whole of the document but particularly pertinent sections are highlighted below.

27 See 2.2, 4.2, 5.4-6 and the recommendations in §8 esp. 8.2, 8.6-7, 8.9.

28 See 2.2, 4.3-4, §6, 7.5 and the recommendations in §8 esp. 8.3-5, 8.8.

1. Existing infrastructure

1.1: Statistics on the UK's waste and resource recovery infrastructure are scattered, inconsistent and riddled with definitional and coherence issues. This makes it difficult to produce a concise overview of waste infrastructure capability and capacity. Some of the available data from key sources is presented here, but a full reconciliation of all the data is beyond the scope of this document.

1.2: **England:** In England, a total of 6305 sites accepted waste in 2014, managing 187 Mt of waste. These facilities are classified as [DEFRA 2016a]:

Facility type	Number of facilities	Mt managed in 2014
Landfill	338	41.3
Transfer	2383	46.7
Treatment	1896	57.4
Metal recycling	1290	13.6
Incineration	74	8.6
Use of waste	143	2.3
Land disposal	181	17.1

1.3: Some double counting is likely to have taken place as an item of waste may pass through two or more of the facilities listed above. As noted by Vinagavado [2013], "*mixed waste might be accepted by a transfer station, sorted and then be transported to a recycling facility or for final recovery or disposal. For this reason, waste managed is not analogous to waste arisings and no direct comparison can be made*". Comparable figures for the capacity in each category do not appear to be available for England; the 2012 capacity figures are unhelpfully reported under different headings [DEFRA 2015] and the 2014 capacity figures are not reported [DEFRA 2016a]. However, in all categories, there are significantly more sites permitted to take waste (9382 in total) than the number of sites that accepted it in 2014 (by between 32% and 96%), suggesting there is unused capacity in the system. Remaining landfill life based on 2014 inputs varies from 3 years in London to 13 years in the West Midlands¹.

1.4: **UK:** Other reports (DEFRA, 2015) break this capacity down differently for the UK as whole:

Process type	Number of facilities	Capacity Mtpa
Energy recovery	27	2.9
Incineration	87	8.4
Recovery other than energy recovery, including backfilling	3542	n/a
Landfill	594	remaining capacity 633 Mm ³

1

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/470475/Waste_management_2014_England_summary.pdf

Energy generation from biowaste was 7.5 GWh in 2014, split between:

- Landfill gas (5.0)
- Sewage sludge digestion (0.8)
- Animal biomass (0.6) and
- Anaerobic digestion (AD) (1.0; 152 anaerobic digestion sites operate in the UK)

with a further 2.0 GWh contributed by the biodegradable portion of EfW fuel [DEFRA 2016a]. This accounts for 2.5% of UK energy generation. In terms of organics treatment capacity this is given as 6.6 Mtpa, broken down as:

- Composting (5.1 Mtpa)
- Commercial, R&D and on-farm AD (1.3)
- Industrial AD (0.3)

with a further 2.4 Mtpa added by mechanical-biological treatment and 3.5 Mtpa AD co-located with drinks manufacturers.

1.5: Residual waste is the fraction of waste that is not separated for recycling (i.e. what is left over after recyclates are removed from a waste stream). It may derive from household, commercial or industrial sources. The DEFRA Waste Infrastructure Delivery Programme (WIDP) Residual Waste Treatment Infrastructure Project List (IPL) “*lists residual waste treatment facilities/contracts in England [and Wales] that are tracked by WIDP for the purposes of assessing treatment capacity. The list includes both existing and pipeline facilities and is informed by WIDP monitoring of its portfolio of PFI (Private Finance Initiative) and PPP (Public Private Partnerships) projects and public domain information concerning other PPP and merchant facilities.*”² As of 31 March 2016, it lists 96 projects, of which 62 are operational and 34 are either in construction, consented, “post close” or with status TBC.

1.6: The operational facilities have a total capacity of 11.2 Mtpa, with:

Facility type	Number of facilities	Capacity Mtpa
Energy from Waste (EfW)	37	8.3
Biodrying mechanical and biological treatment (BMBT)	20	2.2
Landfill mechanical and biological treatment (LFMBT)	5	0.7

Eunomia (2016) report that the UK’s effective treatment capacity for residual waste is 19.5 Mtpa with 47 incineration facilities, 10 advanced conversion technology plants, 36 mechanical-biological pre-treatment facilities, 19 IED (industrial emissions compliant) biomass and co-firing plants, and 8 cement kilns; this suggests a different definition of operational facilities compared with DEFRA data.

1.7: In economic terms, the waste management sector adds just under 0.5% to UK GVA, split between (2014 figures from DEFRA, 2016a) waste collection (£2.9 billion, Bn), waste treatment and disposal (£1.7Bn) and materials recovery (£1.6Bn). The sector is dominated by the so-called ‘big six’ waste management companies³ who between them have a market share somewhere between 70% and 80%. The sector employs around 140,000 people split between remediation (12k), wholesale of waste and scrap (5k), materials recovery (24k),

² See <https://data.gov.uk/dataset/waste-infrastructure-delivery-programme-widp-residual-waste-treatment-infrastructure-project-li>

³ <http://www.rwmexhibition.com/content/Overview-of-the-UK-Waste-Market>

waste treatment and disposal (40k) and waste collection (58k). There was a 50% increase in the number of employees in the sector between 1993 and 2013 [DEFRA 2015].

1.8: The repair, reuse and leasing sectors – arguably operating higher up the waste hierarchy – added a further £40Bn, over half of which can be attributed to the repair, renting, leasing of motor vehicles plus second-hand car sales [DEFRA 2015]. Analyses of the reuse sector beyond motor vehicles are rare, but in Scotland it is estimated that reuse of furniture, electrical items and textiles accounts for 89000 tonnes of material with a turnover of £244M pa, employing 6000 people. A further 3000 fte volunteers were also engaged, highlighting the anti-poverty and social need agendas that drive many of the actors in the sector, who are often associated with one or more charities. It is estimated by local government organisations that the potential scale of reuse in the UK could be as high as 660 thousand tonnes per annum (ktpa) with a value of nearly £0.5Bn [CIWM 2016].

2. Planned infrastructure

2.1: The WIDP-IPL (see §1.5 above) lists 34 residual waste treatment projects as being in the pipeline in the UK. The planned facilities have a total capacity of 8.5 Mtpa, with:

Facility type	Number of facilities	Capacity Mtpa
Energy from Waste (EfW)	30	7.5
Biodrying mechanical and biological treatment (BMBT)	3	0.6
Landfill mechanical and biological treatment (LFMBT)	1	0.4

The National Infrastructure Plan Pipeline [IPA 2016] highlights 10 of these planned waste projects totalling £0.5Bn:

Surrey County Council	Quest Waste Disposal Project	The infrastructure consists of an anaerobic digestion (AD) plant and a gasification plant to be developed within a new Eco-Park at Charlton Lane, Shepperton.
Cornwall	Waste Management Procurement	This is a 33 year semi integrated project for the provision of all waste services (except collection) and provides infrastructure for materials handling, household waste recycling centres (HWRCs), transfer facilities, energy from waste and landfill.
Derby City Council and Derbyshire County Council	Derbyshire PPP Waste Management Project	The new EfW in South Derby is being developed by Derby City Council and Derbyshire County Councils in partnership with Interserve plc and Shanks Group plc. The Waste processing centre will combine recycling capacity with an advanced gasification plant capable of generating power for up to 14,000 homes in the city.
Gloucestershire County Council	Gloucestershire County Council Waste Management project	The project is an EfW facility with a capacity of 190,000 tonnes per annum, to be constructed at the Authority's Javelin Park site just off the M5 in Gloucestershire, by Urbaser/Balfour Beatty.
Milton Keynes	Milton Keynes Waste Management Project	The EfW which is being designed, built and operated by AmeyCespa on behalf of Milton Keynes Council. The plant will process non-recyclable and non-hazardous household waste using gasification technology. This waste will be converted into a syngas using partial combustion heat to free hydrogen and carbon. This will produce high temperature steam capable of generating 7MW of electricity. It is expected to be completed in 2016

South London Waste Partnership	Waste Management Procurement	The plant forms part of Viridor's 25-year contract with the South London Waste Partnership signed in November 2012. It is expected that the plant could begin treating waste by around 2017.
Herefordshire & Worcestershire	Waste Management Project	Integrated contract for municipal waste management services to be provided over a 25-year period including the construction of an EfW facility.
North Yorkshire & City of York	Waste Management Project	The PPP project is being developed by North Yorkshire County Council and City of York Council alongside sponsors AmeyCespa for the construction of and EfW facility.
Merseyside Recycling & Waste Authority	Waste Management Project	The project has begun construction. It is a 430,000 tonnes per annum Combined Heat & Power (CHP) EfW facility at Teesside supplied from a rail transfer station at Knowsely in Merseyside.
West London Waste Authority	West London Waste Authority	SITA, along with its partners Scottish Widows Investment Partners and the Itochu Corp., will design, finance, build and operate the energy-from-waste facility in Severnside, (South Gloucestershire), which will manage up to 300,000 metric tons of residual municipal waste every year.

2.2: Of these 10 listed projects, while 8 involve EfW, only 2 have any mention of recycling; none mention resource recovery, re-use or reprocessing. The perception that EfW is a more stable revenue stream with predictable capital costs is the most likely explanation. No waste or resource recovery programmes are listed as priority projects; the NIP explicitly states that no further investments are planned as the UK is on track to meet landfill diversion targets. It is difficult to see how the focus on this driver alone can be reconciled with the NIPs stated aim “to have the right infrastructure in place” to achieve its ambition to move towards a circular economy. Waste management is mentioned in the NIP as forming part of the UKCRIC science and infrastructure research investment ⁴ and this will stimulate research into more advanced systems.

3. The capacity gap; or surplus?

3.1: Analyses of the degree to which UK waste management and resource recovery infrastructure are operating at capacity differ. National assessments tend to suggest that the UK has sufficient waste processing capacity for the near future, while analyses that disaggregate facilities (i.e. compare local arisings to local facilities) often suggest that local deficiencies exist. The difference can be reconciled by permitting transport of wastes from areas of under- to over-capacity, but whether these transport arrangements are sustainable, desirable or practical is still a matter for debate.

3.2: The National Needs Assessment [ICE, 2016] states that the UK possesses ‘adequate capacity’ to meet projected trends in waste management. Other national reports provide a deeper analysis, largely focussed on the ability of the sector to achieve 2020 targets to divert biodegradable municipal waste from landfill. They suggest that there is a >95% probability that such targets will be met with an excess capacity of over 2 Mtpa [DEFRA 2013]. However, investigators who took into account the detailed composition of waste streams and local variations in capacity and technology suggest that significant capacity gaps exist at regional level; the agglomeration of the data hides the high probability that there will be insufficient treatment capacity at the regional level, perhaps to the tune of a deficit of around

⁴ <http://www.ukcric.com/>

15 Mtpa. They also suggest that the implications of long-distance haulage of waste have not been taken into account [ICL 2014]. In response, it has been suggested that there is no significant barrier to transporting waste between regions and that the system is “*not sensitive to restrictions in market clearing*” [DEFRA 2014]. Other commentators suggest that the appropriate scale for efficient and commercially viable collection and processing is dependent on the waste stream in question. WEEE reprocessing to capture maximum value and plastics recycling requiring collection of high-quality separated material, is best operated at a regional scale; anaerobic digestion of food waste should be handled at the local authority scale [Benton 2014].

3.3: Other investigators have reported various figures for the capacity gap or surplus. Some commentators suggest that a treatment capacity gap of 5 to 15 Mtpa is likely by 2020 when commercial and industrial waste is taken into account [Vinogradavo 2013]. Others state that the UK currently has a gap between residual waste arisings and treatment capacity of between 6 Mt [Eunomia 2016] and 18 Mt per year [SITA undated] caused by closure of 1500 landfill sites and the slow rate at which new facilities are coming on-line [ESA 2010; ESA undated]. The gap is currently filled by over-reliance on export of RDF. This gap is projected by some to disappear by 2020 and change to a capacity surplus of around 4 Mt per year by 2030, mainly owing to a reduction in waste generation and partly owing to an increase in projected operational capacity [Eunomia 2016]; others suggest a capacity gap of 6 Mt per year will remain in 2025 [SITA 2025]. Many commentators note that projections of future waste arisings and thus capacity requirements are complicated by a lack of data on waste flows, particularly for commercial and industrial wastes and that from the construction sector [e.g. ICE 2016; DEFRA 2013; Vinogradavo 2013].

3.4: Exports of waste as SRF/RDF have grown from effectively zero in 2010 to approach 2 Mtpa. However, the point is made that there is no way of forecasting how future export levels might evolve given the uncertain political, technological and economic situation, with some suggesting that this could decrease significantly in the future. Current EfW capacity in the UK is 5 Mtpa and this is will rise to 12 Mtpa by 2020 considering all projects under construction [GIB 2014].

4. Data and investment

4.1: Several shortcomings in the sector need to be addressed before significant progress can be made. The most often cited is a lack of data. There is no responsibility on many waste producers to report on the quantity or quality of the waste they produce unless it is hazardous or otherwise regulated. Data is particularly scarce in the commercial, industrial and construction/demolition sectors which together account for three times the volume of municipal waste [ICE 2016; DEFRA 2013] not least because this sector is not obligated to track and report waste arisings, in contrast to LAs [Vinagavado 2013]. This problem can be further compounded by changes in the definition of waste. For example, in 2011 the definition of municipal solid waste (MSW) was changed to include waste collected by LAs not from households but similar in composition to household waste and thus the reported proportion of MSW attributable to households dropped from 90% to 50% [ICL 2014] unless due regard is taken for new sub-categories of waste (which it often isn't). Even within the waste treatment supply chain, data is non-standardised. For example, DEFRA [2016] report that: “*Generation and final treatment are at opposite ends of what can be a complex and multiple staged treatment process. Different methodology is used to estimate generation and final treatment figures. Furthermore, final treatment excludes some treatment processes*

identified as predominantly intermediate, which nevertheless may effectively be the final treatment for some waste. As a result, there is no direct reconciliation between generation and final treatment of total waste. Users should also be aware that in most cases it is not possible to estimate the final treatment of waste generated by specific economic activities.”

EU “end of waste” regulations, while useful in promoting recycling, can further complicate the tracking of secondary resource flows; some recycling sectors (e.g. packaging) have well-defined processes for tracking waste and secondary resource flows (e.g. the PRN/PREN system) while other recyclers may be handling a mix of waste and non-waste. Such uncertainty and volatility surrounding waste data makes it very difficult to determine what new resource recovery capacity is likely to be needed in the future using robust mass balance approaches. This impedes coherent policy making which in turn increases the risk to potential investors (public or private) wishing to commission new resource recovery infrastructure [ESA undated].

4.2: Yet it is very clear that such investment is urgently needed. Public-private partnership (PPP) finance agreements for local authority waste processing infrastructure are coming to an end (largely because landfill targets for biodegradable waste have been met and thus the ‘problem’ is seen to have been solved), with around £1.7Bn of further investment required by 2020 of which £0.5Bn has yet to secure finance [GIB 2014]. It has been estimated that an additional £5Bn [ICE 2016] to £25Bn [SITA, undated] investment in infrastructure will be required to achieve a close-to-circular economy; this should now be the focus of governmental support for investment. The almost singular focus on EfW plants treating household waste has left investors “...*sceptical that there is enough waste remaining to justify building new infrastructure*” and this increased risk perception has already led to delays and cancellations [GIB 2014] including withdrawal of PPP investment⁵. This risk is compounded by the perceived difficulties in gaining planning permission for new waste-related infrastructure in the UK owing to ‘NIMBY-ism’ [Ekogen 2011] and the increasingly uncertain regulatory landscape catalysed by the Brexit vote.

4.3: Better data and forecasts on the arisings and quality of residual commercial, industrial and construction/demolition waste will be required to reassure investors that there is a gap in the existing market. A coherent, standardised approach to waste data collection, analysis and forecasting would appear to be the most effective way of reducing the investment risk for new resource recovery facilities [Vinogradovo 2013]. Currently, waste data is only recorded and collated in response to specific regulations; wherever deregulation has occurred (e.g. where end of waste status has been achieved) or activities are not covered by regulation (e.g. prevention and re-use, commercial and industrial wastes, construction and demolition wastes) little if any data is collected. Systems have been proposed that would provide a platform for more comprehensive and coherent data analysis⁶ [Aplin 2016]. Better data and information would help communication between LAs (as collectors rather than users of recyclate) to become less detached from the end markets for recovered material.

4.4: Stimulation of the new markets and investments required that move away from a focus on EfW towards resource recovery and/or reuse, to realise the environmental, economic and social benefits of a circular economy, will require strong, progressive policy instruments. These are likely to be based on aggregated services models, creation of resource

⁵ <http://www.letsrecycle.com/news/latest-news/veolias-herts-efw-pfi-withdrawal-blow/>

⁶ <https://www.edoconline.co.uk/>

management networks and extended producer responsibilities for materials in the supply chain [Viridor, undated; CIWM 2016]. The PRN system, where producers of packaging must effectively purchase packaging recovery capacity from recyclers, was supposed to encourage investment in new infrastructure via collaboration between the two sectors but results have been mixed⁷.

5. Pressures on the system and drivers for change

5.1: General social, economic and political pressures for greater resource conservation, lower environmental impact and increased recycling will change how waste management and resource recovery infrastructure operates and develops in the medium and long term. Combinations of climatic and demographic changes will force an increase in waste arisings. The UK, in common with the rest of Europe, is a significant net importer of many resources, some of which (especially high technology metals) are 100% imported [EEA 2012] and resource recovery will need to play a key role in securing the availability of these materials in the future.

5.2: However, a number of specific drivers can be identified that are having a more immediate effect. Many of these are connected to taxation intended to implement pieces of UK and/or EU legislation, rather than an awareness of the inherent value of recovered resources [ITRC⁸, cited in ICE 2016]. The rise of landfill tax to over £80 per tonne (index linked) makes it now the most expensive of the common disposal options and drives increased reliance on resource recovery systems. There are calls for a tax on incineration of waste to be introduced⁹. Changes in EU legislation (the Revised Waste Framework Directive)¹⁰ are expected to effectively ban all recyclable waste, including paper, metals, glass and biodegradable materials from landfill by 2025 and promote the sorting of construction and demolition waste for at least wood, aggregates, metal, glass and plaster; they will also require 70% of municipal waste and 80% of packaging waste to be recycled or prepared for reuse by 2030 [ICE 2016; GIB 2014]. Waste electric and electronic equipment (WEEE) is also subject to EU regulation, with collection (4 kg per person), recovery (70-80%) and reuse/recycling (50-75%) targets. Other targets exist for e.g. tyres¹¹, end-of-life vehicles¹², and batteries¹³ [EEA 2012].

5.3: Other legislative instruments that will drive the need for an increase in capacity for resource recovery infrastructure include the EU packaging waste directives, Zero-Waste Plans in Scotland¹⁴ and Wales¹⁵ and the Waste Prevention Programme for England¹⁶. Allied with the projection that 15% of the UK's recycling capacity is set to close in this timeframe (reducing recycling rates by 5% and costing around 8000 jobs), some commentators suggest that as a result, waste could cost UK businesses and LAs an extra £300M-500M by 2020 [ESA, undated].

⁷ <http://www.edie.net/news/5/ECO-Plastics-Hemswell-sold-by-Coca-Cola-Enterprises-bottle-recycling/>

⁸ <http://www.itrc.org.uk/>

⁹ <http://www.publications.parliament.uk/pa/cm201213/cmselect/cmenvaud/328/328vw05.htm>

¹⁰ <http://ec.europa.eu/environment/waste/framework/>

¹¹ <http://www.depotec.eu/legislation/>

¹² <https://www.gov.uk/guidance/elv>

¹³ <https://www.gov.uk/government/publications/environmental-permitting-guidance-waste-batteries-and-accumulators-directive>

¹⁴ <http://www.gov.scot/Topics/Environment/waste-and-pollution/Waste-1/wastestrategy>

¹⁵ <http://www.wlga.gov.uk/waste>

¹⁶ <https://www.gov.uk/government/publications/waste-prevention-programme-for-england>

5.4: A large proportion of current UK resource recovery capacity is achieved through the export to EU countries of calorific waste – i.e. that which can be burned as fuel in EfW facilities – processed into ‘refuse-derived’ or ‘solid recovered’ fuels (RDF, SRF). Two issues will constrain this route in the future. First, there is a current overcapacity in EfW in continental Europe that drives RDF/SRF production in, and export from, the UK. As EU recovery legislation becomes implemented, this overcapacity will either be filled by local (i.e. continental) RDF/SRF production or decommissioned, decreasing the export opportunities [ICE 2016]. Secondly, the implications of the UK’s decision to leave the EU (“Brexit”) will greatly increase uncertainty around the medium-term viability of such exports [Eunomia 2016], both in terms of a continuing stable regulatory framework and the potentially worsening £/€ exchange rate from a UK perspective

5.5: EfW capacity in the UK is insufficient to absorb this material if it is diverted from export [ESA, undated]. Existing waste management operations in the UK are described as fragmented and inefficient, with huge variations in how waste is presented by businesses and households impeding scale-up of operations. Recycling is currently in decline because commodity prices are depressed, which adds pressure to increasing the quality of recyclates in order that they can compete with virgin materials; yet fiscal austerity for LAs leads to increased contamination [ESA, undated] presumably as collection becomes less specific and/or less well enforced. While commentators present UK EfW as a potential investment opportunity [GIB 2014], there is no specific commitment to promoting EfW as a low-carbon energy source in the NIP [IPA 2016].

5.6: Brexit also generates uncertainty around the UK’s adherence to the current suite of EU legislation surrounding resource recovery (including the Circular Economy Package¹⁷ which further increases the perception of risk surrounding investing in resource recovery infrastructure in the UK.

5.7: The role of resource recovery in reducing carbon emissions is likely to receive increased attention. The carbon emissions associated with the production of the materials that end up in waste in the UK is estimated at over 200 Mt eCO₂ per year i.e. about a third of the total¹⁸; the emissions avoided by the current rate of recycling (i.e. those that would have been associated with the production of the relevant primary resource replaced) are only ~60 Mt eCO₂ per year [DEFRA 2016a]. Direct emissions associated with the sector are comparatively small (~7 Mt eCO₂ per year, mainly associated with methane release from landfill). Hence increases in recycling and recovery rates will be desirable to help balance the UK’s carbon budget.

6. Future system developments

6.1: The evolution of the resource recovery infrastructure will involve changes not only in waste management but also in ‘upstream’ activities – i.e. waste prevention, product specification, design and use – that promote the retention, recovery and reuse of the function provided by products, as well as recycling of the materials or recovery of the energy they contain. The UK recycling sector should be reimagined to include tangible input from manufacturers as well as reprocessors and recyclers. Designing for recyclability, designing

¹⁷ http://ec.europa.eu/environment/circular-economy/index_en.htm

¹⁸

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/496946/2014_Final_Emissions_Statistical_Summary_Infographic.pdf

out waste, eco-packaging and light-weighting to drastically reduce waste volumes¹⁹ will be essential, as waste minimisation offers the greatest 'bang for buck' in reducing waste volumes and their direct (through pollution) and indirect (through reprocessing) impacts on the environment [ICE 2016]. A key driver that would help effect this change is the transfer of responsibility for custodianship of in-use and end-of-life resources from the public sector – where responsibility currently lies via LA obligations for waste management – to supply chains. Extended producer responsibility requires that the producers of products and packaging remain (at least partly) responsible for these materials throughout the lifecycle, obliging them to fund waste collection systems. This would improve incentives to reduce waste through design for recycling as it would reduce direct costs; it would also encourage better recycle and secondary materials markets [ESA, undated] and minimise waste exports [ICE 2016]. It could also help promote reuse, especially if combined with better cross-sector engagement activities and support packages, particularly for the 'micro enterprises' that are prevalent in the sector [CIWM 2016].

6.2: Although such 'upstream' design and behavioural incentives will deliver the most efficient and effective responses in the medium term, waste management by LAs will remain an important activity in the short-term transition phase. By 2020, up to 47 Mt of household waste will be recycled; a 20% increase on current rates and so increases in capacity will be required [GIB2014]. To install the required capacity, especially as new technologies come online, more coherent investment planning will be required and LAs will need to work together to exploit economies of scale. Larger scale investment in energy recovery technologies such as gasification will also require careful collaboration with energy companies (as energy recovery from waste will only ever be a small fraction of total generating capacity) as well as the waste sector to secure reliable supplies of waste material. Financing is severely affected by reliability of supply, and current individual local authority waste contracts cannot be used as financial security [ICE 2016].

6.3: Reuse has been described as the 'neglected child' of the waste hierarchy [CIWM 2016]. While there are established markets for reuse in some areas (motor vehicles, antiques) and guidelines are appearing for the reuse of certain other products (e.g. WEEE PAS141, see footnote²⁰), the potential for exploiting the significant contribution towards a circular economy that reuse could make remains dormant. The reuse sector is dominated by third sector bodies with charitable and social aims, and it is precisely this ability for reuse to simultaneously deliver financial, social and environmental benefits that is the key to its promotion as an important enabler for waste prevention; partnerships between private and third sector organisations regarding reuse can be leveraged via a Corporate Social Responsibility agenda, for example [CIWM 2016]. However, such relationships are currently ad hoc and often driven by key individuals; a stronger policy framework together with fiscal incentives that encourage more coherent investment in reuse will be required to build capacity in the sector [CIWM 2016]. Other recommendations include extending retailer 'take back' schemes, adapting public sector procurement to prioritise reused goods, adopting British Standards for remanufacture in design to promote reparability and using the Green Investment Bank to support innovative products designed for reuse [LGA 2014].

¹⁹ NB: Eco-packaging and light-weighting have to be considered with caution; often eco-packaging such as vegetable-based plastic, and light-weight design can become disengaged from the need to prolong product functionality, durability and manageability by existing waste management/recovery practices, potentially creating more problems than they solve.

²⁰ <http://www.wrap.org.uk/sustainable-electricals/esap/re-use-and-recycling/guides/PAS-141-Guide>

7. Technology developments

7.1: Advances in resource recovery technology will allow a wider range of useful materials to be recovered from waste streams in the future. Naturally, the range of new technologies emerging from academic laboratories and commercial developers evolves daily; here we provide a brief, non-exhaustive summary.

7.2: Commercial technology forecasters have identified a wide range of technologies for waste treatment at varying technology readiness levels²¹ (TRL) [Ricardo 2016]. Those that have a resource recovery component include:

- Various flexible and reconfigurable multi-material recycling facilities that sort residual waste according to a combination of size and density, material sensing technology (mainly based on optical or infra-red sensors) and air separation to recover plastics, paper, cardboard, glass and metals (TRL9)
- Plastics reprocessing using biological enzymes to break down polyethylene terephthalate (PET) into its original monomers, which can then be used to replace traditional petroleum precursors for PET (TRL4)
- Hydro-recovery or composting processes treating absorbent hygiene products (nappies etc.; a mixed material waste that is notoriously difficult to recycle) to recover cellulose fibre for use in e.g. fibreboard, acoustic panelling or biomaterials for land treatment, with recovered plastics sent for secondary reprocessing (TRL8)
- Cryogenic and ultrasonic processes for carpet recycling. Carpets are a pernicious mixed polymer waste stream but new technologies can recover and recycle around 80% of the waste into surface coverings or polypropylene feedstock, with a further 10% being sent to EfW (TRL9)
- Pyrolysis or thermal depolymerisation of wastes to produce charcoal, oil and gas fuels, generally for homogenous organic waste streams such as tyres or wood chips (TRL7) but in some cases for mixed wastes (TRL5). The oils derived can also be used to produce commodity chemicals, replacing virgin petroleum feedstock.
- Micro-AD systems designed for local householders or businesses, producing biogas, liquid fertiliser and solid soil conditioner.

7.3: A great deal of research work on resource recovery systems is also taking place in the academic arena. A complete review of this work is outside the scope of this document, but one major investment is the NERC “Resource Recovery from Waste” programme²². This £7M portfolio of six complementary projects includes:

- Systematic analysis of the suitability of ash and digestate residues from biomass energy generation for use as nutrient providers and conditioners for agricultural soils, in part as replacements for mined nitrogen and phosphorus mineral fertilisers (presented in Chief Government Scientist report From Waste to Resource Productivity, expected publication in 2017)
- Using combinations of low-energy biochemical, dielectric and geochemical processes to refine and concentrate valuable and/or functional materials (including metal sulphides, nano-metallic structures rare earth elements, ‘E-tech’ elements and

²¹ TRL – an estimate of how close the technology is to being widely operational, ranging from 1 – basic science demonstrated in the laboratory, to 9 – technology successfully in operation.

²² <http://www.nerc.ac.uk/research/funded/programmes/waste/>, <https://rffw.org.uk/>

uranium phosphates) from a variety of bulk wastes (refining slags, alkaline mine wastes etc.) either in- and/or ex-situ

- Developing complex value modelling techniques that can assess creation and dissipation of the economic, financial, environmental, social and technological value associated with production systems that currently emit wastes, to highlight upstream interventions in these systems that will prevent the dissipation of value into waste.

Other major research investments that deal with 'upstream' changes to supply systems include: redesigning metal alloys to reduce demand on strategically important elements²³; taking a 'whole systems' approach to the upgrading and reutilisation of unavoidable food supply chain wastes to move towards closed-loop food production²⁴; and developing reliable methods for recycling plastics derived from biological (i.e. non-petroleum) sources by depolymerisation for reprocessing either as new plastics or other value added chemicals²⁵.

7.4: A number of technological opportunities and challenges will arise in the resource recovery space as a result of changes in the mix of materials used in our products and infrastructure. These must be addressed by a combination of design for recovery and development of end-of-life recovery technologies. Chief among these are [KTN 2016]:

- Technologies to recover the valuable and critical materials used in low-carbon energy and transport systems, in particular lithium (used in high-performance batteries in electric vehicles) and rare-earth metals (used in high-strength permanent magnets for electric motors in vehicles and generators in wind turbines)
- Increasing use of composite materials and/or multi-material products (such as insulation-backed construction blocks and sheets)
- Decommissioning of North Sea oil infrastructure and first-generation wind turbines
- Bio-based, bio-inspired and biodegradable packaging materials will require specialist reprocessing (e.g. to capture methane through composting) rather than allowing the false encouragement of 'safe discarding'
- Advances in robotics, automation and sensing/vision technology will allow a wider range of materials to be more efficiently and reliably sorted
- Opportunities and challenges presented by hyper-connectivity i.e. the 'Internet of Things', both in terms of data management and exploitation (opportunity) and the inclusion of WEEE in almost every item of packaging (challenge).

7.5: It is important that such advances in resource recovery technology be considered alongside upstream policy, design and business innovations; they are interdependent. Upstream interventions need to prepare the system such that any downstream wastes are matched to the availability, capacity and evolution of emerging processing technology; technological advances in the waste processing sector must develop mindful of the ability of upstream processes to provide secondary materials of the correct quality and quantity to make them commercially, environmentally and socially viable. Too often new recovery processes are developed with no markets, or interventions are made that rely too heavily on fragile, localised or unproven reprocessing technology. A key aspect of this is skills; the industry has reported that there are skills gaps both within the sector (e.g. insufficient energy

²³ <http://gtr.rcuk.ac.uk/projects?ref=EP%2FL025213%2F1>

²⁴ <http://gtr.rcuk.ac.uk/projects?ref=EP%2FP008771%2F1>

²⁵ <http://gtr.rcuk.ac.uk/projects?ref=EP%2FP016405%2F1>

from waste technicians) and outside it (e.g. a lack of manufacturing and packaging technologists able to make use of secondary materials) [Ekogen 2011].

8. Discussion and Recommendations

8.1: Waste management is a growth industry, with targets being reached and exceeded. For it to continue to grow more infrastructure needs to be put in place. The current focus of infrastructure development is still largely on treatment (i.e. amelioration of the environmental and social impact of waste disposal) rather than on resource recovery (i.e. preserving the value of resources through reuse and recycling).

8.2: Where new, planned and projected infrastructure growth does involve recovery of value, it is almost entirely focussed on energy from waste, as this is seen as the easiest route to financing new waste infrastructure. While this should rightly form part of a balanced resource recovery portfolio, it should not be the whole of it. In a commercial sense, reduced residual waste arisings and the development of more efficient recycling technology and systems will eventually reduce the amount of waste available for EfW systems over time; uncertainty over continued viability of exports further complicates the picture.

8.3: From a resource recovery perspective, overuse of EfW destroys technical value by rendering potentially useful material unrecoverable, and creates an infrastructure system that paradoxically relies on the continued creation of suitable waste, reducing incentives to find reuse and recycling routes. The NIP's aspiration to move towards a circular economy will not be realised without a much greater focus on preventing waste and recovering recyclates, rather than burning them. The proportion of waste that is sent for energy recovery should be a function of its ability to be recycled, not of the ratios between the price of fuel and materials; this is a 'market failure' that needs correcting.

8.4: A recurrent theme in most the publications reviewed here is the deficiency of data on waste flows in terms of quality, availability and consistency. The collection of data is driven solely by the need to achieve targets for recycling broadly-defined fractions of waste, or requirements to account for the correct disposal of hazardous materials. An example of the perverse behaviour driven by this is that the sectors producing the majority of total waste arisings are under no obligation to report on the quantity, quality or destination of this waste. As such, what limited data is collected is not of the required quantity or detail to allow mass flows of materials and their quality (i.e. useful physical properties) to be calculated. Within agencies, data is reported in such a wide variety of formats, typologies and units that calculating the flows of material through our economic systems is impossible; these agencies explicitly admit that it is not even possible to reconcile waste arisings with waste managed using public domain figures.

8.5: This in turn prevents the development of new infrastructure technology; impedes the efficient recycling of useful materials; adds unnecessary risk to investment in infrastructure projects; obscures comparative analysis at local, regional and national scales; and stymies the communication between materials suppliers, product designers and waste managers that will be necessary for the circular economy. Data collection and reporting in the sector should be rationalised, with a first priority of accounting for the value and volume of material flows; the current requirement to demonstrate adherence to health or environmental legislation would follow naturally.

8.6: The role of public investment in the sector should be re-examined. Fiscal support for the industry should be focussed on protecting investments in both the supply chain, from design through to recycling, and the waste infrastructure, that prevent dissipation of material value (technical, environmental and social as well as financial) into waste. This might include providing a buffer against price volatility for recovered materials; supporting markets in recyclates; incentivising design for durability, upgrading, refurbishment and reuse; providing platforms and standards for data collection; and investing in research and development in the sector. The overall aim should be to shepherd in a transition towards the infrastructure required for a circular economy by removing barriers and/or providing support for business models that move away from the linear make-use-dispose consumption of materials. Existing market support such as the PRN system should be better administered to provide a revenue stream with which to develop and install new resource recovery infrastructure, in collaboration with all actors in the supply chain.

8.7: All such support should be based on reinforcing a principle of extended producer responsibility, where the manufacturer of a product explicitly shares responsibility for the life cycle management of the materials from which it is made with materials suppliers, users and waste processors. Public procurement processes also have the ability to send powerful economic and cultural signals; a requirement for the public sector to prioritise the use and reuse of British products made from recycled materials is a possibility in a post-Brexit UK, for example.

8.8: All the above must be reflected in regulation of the resource recovery sector. The most damaging implication of Brexit on resource recovery infrastructure development is simply the uncertainty generated with respect to continued adherence (or otherwise) to the existing suite of EU regulation that currently dominates behaviour in the sector. The Government needs to move quickly to reassure the industry and potential investors that a stable policy and regulatory framework for waste management, recycling, resource recovery and associated activities will be implemented as soon as possible.

8.9: Brexit also offers opportunity for fundamental changes in regulation. Perhaps the most radical change would be to move responsibility for waste management regulation from environmental agencies (which implicitly reinforces the culture that waste management is first and foremost an environmental protection issue) to a new Office for Resource Stewardship. Such an agency would have a specific focus on protecting the national interest by enforcing efficient use of materials, and by extension preventing waste and encouraging reuse and recycling. Targets would be expressed in terms of recovery of value and function, rather than diversion of waste from landfill. Political drivers would include increasing the material security of the UK by reducing reliance on imports; creating both low- and high-skilled jobs in the reuse, recovery and recycling sectors and associated infrastructure provision; developing new recovery technologies for export; and achieving sustainable development goals.

8.10: As the UK embarks on developing a new industrial strategy alongside redefining our trading relationships with the world, it would seem an ideal time to reimagine the resource recovery industry as an engine for sustainable growth at home and a crucible from which we export the science, technology and services required for a global circular economy.

References:

- Aplin, 2016: Aplin S, Waste Data in the UK. Report for RWM Ambassadors (RWM, 13-15 September 2016, Birmingham UK) ED61133 Issue 1 19/01/2016. Ricardo Energy.
http://www.rwmexhibition.com/files/ed61133_160115sa_rwm_ambassadors_waste_data_report_vfinal_with_logo.pdf
- Benton 2014: Wasted Opportunities – smarter systems for resource recovery. Report for Circular Economy Task Force, D. Benton and J. Hazell. Green Alliance, London, 2014.
http://www.green-alliance.org.uk/resources/Wasted_opportunities.pdf
- CIWM 2016: Reuse in the UK and Ireland. Chartered Institute of Waste Management, October 2016. <http://www.ciwm-journal.co.uk/downloads/Reuse-in-the-UK-and-Ireland-WEBSITE.pdf>
- DEFRA 2012: Department for Environment, Food and Rural Affairs, Waste water treatment in the United Kingdom – 2012.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69592/pb13811-waste-water-2012.pdf
- DEFRA 2013: Department for Environment, Food and Rural Affairs, Forecasting 2020 Waste Arisings and Treatment Capacity (Revised February 2013 report no. PB13883).
- DEFRA 2014: Department for Environment, Food and Rural Affairs, Forecasting 2020 waste arisings and treatment capacity Analysis to inform the review of Defra financial support for the Hertfordshire County Council residual waste treatment project (October 2014, report no. PB14216).
- DEFRA 2015: Department for Environment, Food and Rural Affairs, Digest of Waste and Resource Statistics – 2015 Edition. January 2015.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/482255/Digest_of_waste_England_-_finalv3.pdf
- DEFRA 2016: Department for Environment, Food and Rural Affairs/Government Statistical Service, UK Statistics on Waste (25th August 2016).
- DEFRA 2016a: Department for Environment, Food and Rural Affairs/Government Statistical Service, Digest of Waste and Resource Statistics – 2016 Edition (revised).
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/567502/Digest_waste_resource_2016_rev4.pdf
- EEA 2012: European Environment Agency, Material Resources and Waste – 2012 update of The European Environment State and Outlook 2010 (SOER 2010). Available from
<http://www.eea.europa.eu/publications/material-resources-and-waste-2014>.
- Ekogen 2011: From waste management to resource recovery – a developing sector. A report to the Dept. of Business, Innovation and Skills, May 2011.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/31750/11-1088-from-waste-management-to-resource-recovery.pdf
- ESA 2010: Environmental Services Association and the Environment Agency, Waste Sector Plan: 3 Year Progress Report 2006-9
- ESA undated: Environmental Services Association, RESOURCEFUL: Delivering a strong and competitive UK resource economy.

Eunomia 2016: Eunomia Residual Waste Infrastructure Review, Issue 10 (May 2016).

<http://www.eunomia.co.uk/services/waste-recycling/treatment/rwir/>

GIB 2014: Green Investment Bank, The UK residual waste market.

<http://www.greeninvestmentbank.com/media/25376/qib-residual-waste-report-july-2014-final.pdf>

ICE 2016: Institution of Civil Engineers, National Needs Assessment - A Vision for UK Infrastructure. <https://www.ice.org.uk/media-and-policy/policy/national-needs-assessment-a-vision-for-uk-infrastr>

ICL 2014: Imperial College London Centre for Environmental Policy, Waste Infrastructure Requirements for England (March 2014).

IPA 2016: UK Infrastructure and Projects Authority, National Infrastructure Delivery Plan 2016–2021. <https://www.gov.uk/government/publications/national-infrastructure-delivery-plan-2016-to-2021>

KTN 2016: Innovation Opportunities from Industrial Waste. The Knowledge Transfer Network, June 2016.

<https://connect.innovateuk.org/documents/2832130/32795723/Innovation+Opportunities+from+Industrial+Waste/e150620e-4007-4b7c-8730-93f98378739a>

LGA 2014: Routes to reuse. Local Government Association, March 2014.

<http://www.local.gov.uk/documents/10180/5854661/LGA+Routes+to+Reuse+FINAL+FINAL.PDF/5edd19ba-7c13-47c5-b019-97a352846863>

OFWAT 2015: Towards Water 2020 – meeting the challenges for water and wastewater services in England and Wales. OFWAT, London ISBN 978-1-910739-08-2.

http://www.ofwat.gov.uk/wp-content/uploads/2015/10/pap_tec201507challenges.pdf

Ricardo 2016: Waste Treatment Technology Foresighting – Report for Birmingham City Council QU01. Ricardo Energy and Environment ref ED61680, UK, 22 Jan 2016.

https://www.birminghambeheard.org.uk/place/from-waste-to-resource/supporting_documents/ED61680%20BCC%20Technology%20Foresighting%20FINAL1.pdf

SITA undated: Mind the gap – UK residual waste infrastructure capacity requirements 2015 to 2025. SITA UK. <http://www.sita.co.uk/downloads/MindTheGapReport-SITAUk-1402-web.pdf>

UKWIR 2015: Biosolids: good practice guidance leaflet. UK Water Industry Research Limited, London. See <http://www.water.org.uk/publications/reports/biosolids-good-practice-guidance>

Vinagravado 2013: M Vinogradova, S Gandy, S Aplin; CIWM Report 2013 Commercial and Industrial Waste in the UK and Republic of Ireland. Ricardo-AEA/R/ED58810 Issue 4, 15 Oct 2013. Available from www.ciwm.co.uk.

Viridor undated: Building English Resource Networks: The Aggregated Services Model. <https://blog.viridor.co.uk/wp-content/uploads/2016/01/VIRIDOR-ENGLISH-RESOURCE-NETWORKS.pdf>

Water UK 2010: Recycling of biosolids to agricultural land. Issue 3 January 2010. Water UK, London. http://www.nutri-bio.co.uk/doclib/1_1414_270416_water_uk_recycling_of_biosolids_to_agricultural_land_2010_final_briefing_pack_1_.pdf

Appendix 1: CVORR

Complex Value Optimisation for Resource Recovery (CVORR) – Phil Purnell, February 2016.

Summary: *We all want to live in a world without waste, where resources are recovered, reused and recycled, not squandered. Sometimes, efforts to achieve this can have unintended consequences. For example, using biomass to replace coal shuts off the recycling route for the ash; mining the metals used in low-carbon technology causes serious pollution in other countries. This happens because we don't have a framework for analysing the system-wide effects of local decisions. The CVORR project will provide this framework. It will track how "complex value" – the combination of economic, social, environmental and technical costs and benefits – is created and destroyed in production systems. It will allow analysts to identify impacts that might occur upstream or downstream of a proposed change in a process. It will allow policy-makers to design regulation that prevents negative impacts occurring, or helps industry generate and distribute the value created by positive impacts. Ultimately, it will help us achieve a circular economy that preserves our resources and environment for future generations.*

One way to preserve our planet's resources and environment is a circular economy that works towards eliminating waste. We must keep products in use as long as possible and make sure that at the end of their useful life, the materials and resources they contain are recovered and reprocessed into new products. We must also make sure that any outputs from industrial processes that are not sold have environmentally harmful or technically useful resources removed before we send them for disposal. In short; we must recover value from waste.

At the moment, society is trying to do this by bolting on a recovery technology to the end of a process and assuming that because we're recovering materials, everything else is OK. For example, we have set targets for recycling of household waste. Yet relatively little of that collected in the UK is turned into new products in the UK. Some of it is burned, which provides energy but destroys the value of the material resource. Still more is exported for reprocessing, often to countries where not all industries meet modern environmental and health & safety standards. Some exported materials including electronic wastes end up being recycled by manual labour, including children working under dirty and hazardous conditions. In such cases, have we really achieved recovery of value from waste, or have we just gained some environmental value at home while destroying social value somewhere else?

Even when we find ways to use wastes, changes in the primary processes that produce them may have knock-on effects. Ash recovered from the chimneys of coal-burning power stations can be 'upcycled' as an ingredient to reduce the carbon footprint of concrete. But as we switch from using biomass and fuel derived from wastes to replace coal, we change the chemistry of the ash – one of its technical values – such that it is no longer suitable for concrete. Because of this, there are now shortages of low-carbon concrete. We've saved carbon in one part of the system, but lost the ability to save it elsewhere and closed off an upcycling route. How do we work out the overall impact of this complex change in value?

Looking at broader system-level impacts is also difficult. Mining of the 'rare earth' metals (mostly in China) needed for low-carbon technologies such as wind turbines and electric vehicles is reported to have serious impacts on local environmental and social value. How do we account for and balance saving carbon in the UK with polluting cities and lakes in China? Analyses using life cycle assessment (LCA) of proposed processes for recovering rare earth metals from wastes don't accurately predict their environmental impact and neglect social, economic and technical value altogether.

We aim to take on this problem by creating a new way of modelling these systems. CVORR will design a framework for analysing how value is created, destroyed and distributed in waste-producing systems. It will treat value as a multi-dimensional concept that includes environmental, technical and social value as well as traditional economic value. Taking a wide view, it will be able to look upstream and downstream of individual processes into the other systems with which they are connected. It will bring together the best aspects from existing analysis techniques – material flow analysis, LCA, value chain analysis and others – into a

flexible, totally transparent and user-focussed toolkit that will help industry, policy-makers and communities make better decisions concerning waste-producing processes.

We expect that CVORR will be operated in two ways. First, it can be used to highlight how changes made in one part of a production system or supply chain might have unintended impacts in other parts of the system, often by swapping one dimension of value (e.g. carbon savings or recycling) for others (e.g. social impacts or the amount and hazard of waste produced). This will help us avoid making well-meaning interventions that actually do more harm than good.

Perhaps more interestingly, it can also be used to highlight how making changes in specific parts of the production system could create increased value for society overall. If we can identify and capture this value, it can then be redistributed to help firms to make the required changes, correcting a market failure. For example, if a producer makes an item of plastic packaging by joining together different plastics, recycling is difficult. If this item could be made out of a single plastic, recycling would be much easier and system value in multiple dimensions could be created (reduced use of raw materials, increased recycling, reduced carbon emissions etc.). But if the producer has to incur costs by e.g. changing machinery, using a little more material, or reducing profit margins, they won't automatically make the change. If CVORR can identify the added value that moving to a single plastic product would create elsewhere in the system, policy makers can set up rules that take this added value and recycle it back to the producer, providing the incentive for change.

In this way, CVORR is as much about creating business opportunities as it is about environmental and social science. It will be a tool to help align the incentives of the actors in a system such that those who most need to act can benefit from the advantages of working towards the circular economy.

Sources:

DEFRA, UK Statistics on Waste (15 Dec 2015):

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/487916/UK_Statistics_on_Waste_statistical_notice_15_12_2015_update_f2.pdf

DEFRA, Digest of Waste and Resources Stats (Jan 2015):

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/482255/Digest_of_waste_England_-_finalv3.pdf

Wilson et al, Habitat International v30 n4 797-808

<http://www.sciencedirect.com/science/article/pii/S0197397505000482>

Mann, Concrete shortage looms for major projects. New Civil Engineer, 29 July 2014.

<http://www.newcivilengineer.com/concrete-shortage-looms-for-major-projects/8666481.article>

Kaiman, The Guardian, 20 March 2014, <http://www.theguardian.com/sustainable-business/rare-earth-mining-china-social-environmental-costs>

Maughan, BBC Future, 2 April 2015, <http://www.bbc.com/future/story/20150402-the-worst-place-on-earth>

Sprecher et al, Environmental Science and Technology v48 n7 3951-3958,

<http://pubs.acs.org/doi/full/10.1021/es404596g>

Progressive Energy Response to the National Infrastructure Assessment Call For Evidence October 2016

[name redacted] [job title redacted]

[email address redacted]

10 February 2017

1 Background to Progressive Energy

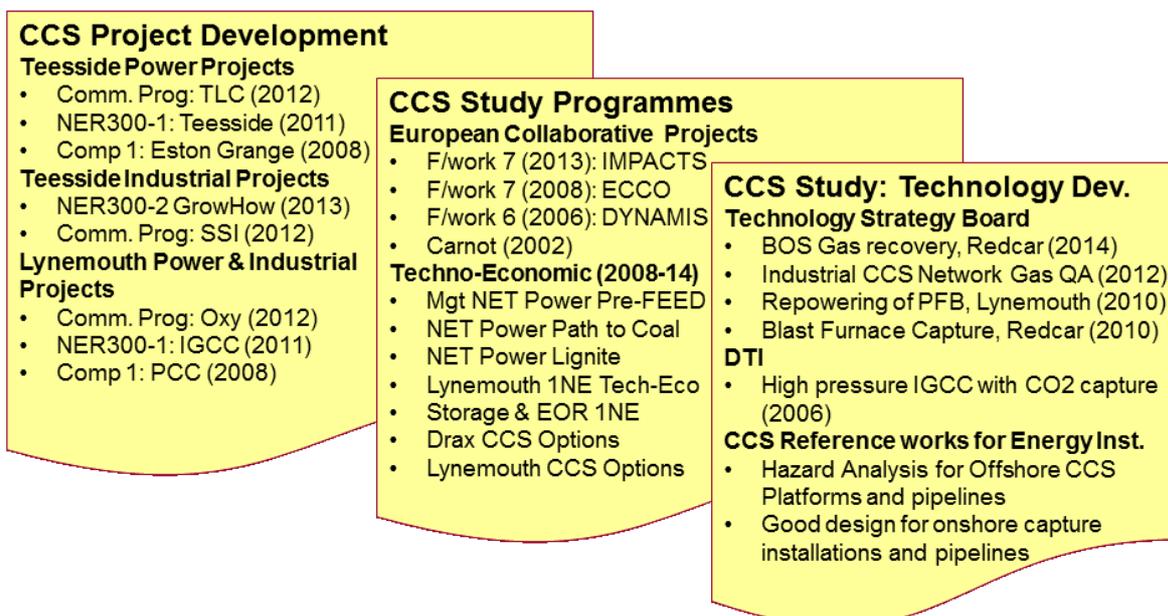
Progressive Energy is an established independent UK clean energy company focusing on deployment of emergent technologies and associated project development and implementation. It has pursued Carbon Capture and Storage since 1998 with an international reputation in the sector in particular associated with capture from industrial processes and activities relating to decarbonised hydrogen production and power production. It also has particular expertise with regard to decarbonisation of heat and transport. It also provides advisory services, in particular providing expert due diligence to a range of investors considering investments in new low carbon technologies. It undertakes advisory work for policymakers and is a founding member and on the industrial advisory board for the EPSRC Supergen Bioenergy Hub. With regard to this scope of this consultation it is most active in the energy and waste fields so is responding to the specific consultation questions relating to these sectors (Q19,Q20, Q21,Q27 and Q28), although we have also commented briefly on Q1, Q2, Q4, Q5, Q7 & Q8.

1.1 PROGRESSIVE ENERGY BACKGROUND RELATING TO CARBON CAPTURE AND STORAGE

Progressive Energy has been at the forefront of CCS development in the UK since 1998. Early work was based on development of a 400MWe coal to hydrogen power plant in south wales with carbon capture. Subsequently it conceived and developed the Eston Grange Project, an 800MWe IGCC with CO₂ Capture of CO₂ based in Teesside, linked to the necessary CO₂ storage and transportation in the North Sea. In 2006 secured investment from Centrica through two subsidiaries, jointly owned by both Progressive and Centrica. In 2009 Centrica relinquished its stake in the project. Progressive Energy subsequently redeveloped it, and this formed the basis for the Teesside Low Carbon Anchor Project. The 400 MW Teesside Low Carbon Project (TLCP) was developed in consortium with GDF Suez, BOC/Linde and Premier Oil. The TLCP was a £2 billion venture that bid into the DECC Carbon Capture and Storage Commercialisation Programme as well as the NER300 process. It was shortlisted down to the final 4 projects, but did not proceed through the latterly cancelled programme.

In parallel to pursuing power related CCS opportunities, Progressive has worked on industrial CCS opportunities, primarily predicated on an intermediary hydrogen vector, including development of patented technology relating to decarbonisation of steelworks. It undertook a significant element of the engineering work with Amec Foster Wheeler in the 2015 Teesside Collective Industrial CCS programme. Latterly it is undertaking work with National Grid Gas distribution regarding the role, opportunity and development pathways for hydrogen infrastructure and CCS as related to industrial users.

An overview of its CCS activities is shown in the figure below, including wider European research it has undertaken.



1.2 PROGRESSIVE ENERGY BACKGROUND RELATING TO LOW CARBON GAS FOR HEAT AND TRANSPORT

Since its inception in 1998, Progressive Energy has always been active in the sector of thermal conversion of solid feedstock to syngas and subsequent upgrading. In 2010 it undertook a feasibility study with CNG services for National Grid, Centrica and the North East Process Industry Cluster (NEPIC) into the production of Bio- Substitute Natural Gas (BioSNG) for heat and transport. BioSNG is biomethane produced by thermal means, as opposed to Anaerobic Digestion. This approach produces the same fungible natural gas fuel, but uses a wide range of feedstocks including residual mixed waste, enabling production of significantly greater quantities of gas in the UK.

Since 2012 it has worked in consortium with National Grid and Advanced Plasma Power to deliver initially a pilot plant funded through BESTF and OFGEM's Network Innovation Competition (NIC). The consortium is now delivering the world's first full-chain, waste-fuelled BioSNG full chain plant, taking residual waste input and producing contracted renewable gas output. This is funded by both Department for Transport (under the Advanced Biofuels Competition) and NIC. This facility will be operational in 2018 and produce 22 Giga-watthours of gas per annum. The facility will deliver gas both to a haulage company with an existing Compressed Natural Gas (CNG) fuelling station, to convert their HGV fleet to renewable gas, and to the local gas grid for heat consumers. Further information about these projects can be found at <http://gogreengas.com/>

Since 2016 Progressive has developed the HyDeploy Project in conjunction with a consortium including National Grid Gas Distribution and Northern Gas Networks. The project will demonstrate that natural gas containing levels of hydrogen beyond those in the GS(M)R specification can be distributed and utilised safely & efficiently for the first time in a section of the UK distribution network. Successful demonstration has the potential to facilitate 29TWh pa of decarbonised heat in the GB, and more by unlocking extensive hydrogen use. This was successfully bid into OFGEM's Network Innovation Competition (NIC) and secured funding in December 2016.

We welcome any opportunity for further discussion on the points raised in this response

CMW February 2017

2 Response to specific Consultation Questions

Cross-cutting issues

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

We believe that development of carbon capture and storage infrastructure (CCS) has the potential to deliver cross cutting value to enable UK growth.

Universally 2050 UK energy system models (based on cost and benefit) show a role for CCS, and often BioCCS to meet our targets. An example is shown below by the ETI.

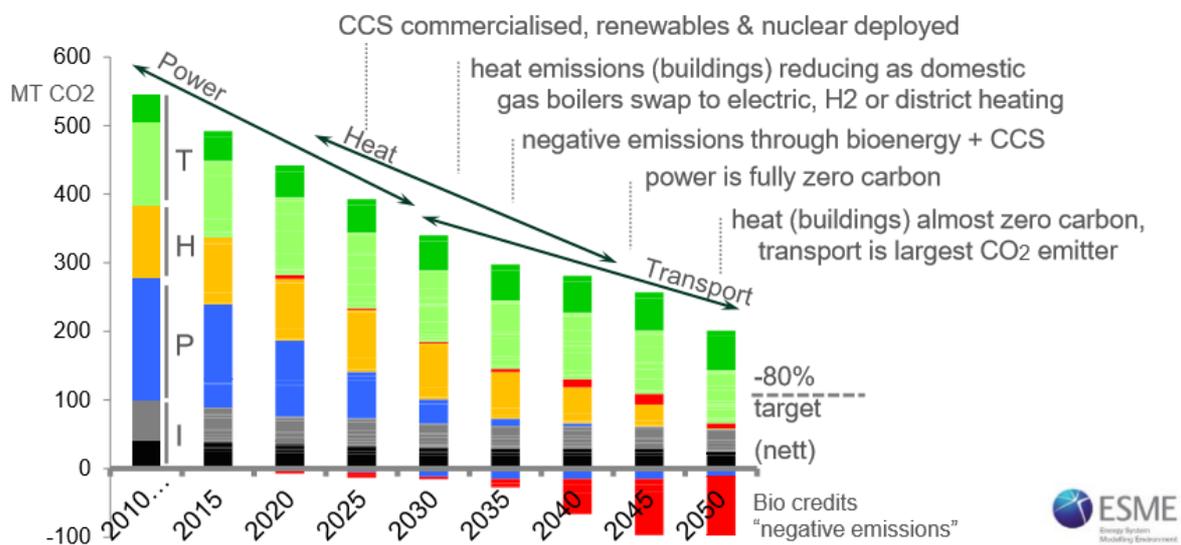


Figure 1 UK Energy system decarbonisation routemap to meet 2050 targets¹

The offshore geology around the UK provides a unique opportunity for CCS which few other countries in Europe or around the world can match. There is extensive, well characterised, deep storage yet in relatively shallow waters.

This not only provides opportunity to provide flexible decarbonisation of our heat and power demands, it allows decarbonisation of industry – particularly those for whom carbon emissions are not just a consequence of energy consumption but of the chemistry of the process, such as fertiliser, chemicals and steel production. In a global low carbon economy, this should provide a huge opportunity for growth in export of low carbon goods, which other countries cannot deliver. To achieve this requires (a) deployment of CO₂ transport and storage infrastructure and (b) a drive to retain our industrial base rather than allowing it to close down (and mistakenly assume that the corresponding reduction in UK stack emissions of CO₂ is benefiting the planet, rather than simply being emitted elsewhere, often with a worse carbon footprint). Given this issue there is an urgency to pursue CCS infrastructure before the opportunity is lost.

¹ Heat and Energy Systems, Dr David Clarke FEng, Chief Executive ETI, Heat Catapult November 2016

Linked to this is the continued use and transformation of our world class gas infrastructure asset which provides a means by which we can distribute decarbonised energy to users

2. How should infrastructure most effectively contribute to the UK's international competitiveness?

The CCS infrastructure opportunity shown above is a good example, building on unique aspects of the country's geological and existing asset base.

3. No Comment

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

We are not able to comment in detail. However, we recognise that energy efficiency should be pursued and is an important element to most energy system models, but that the 'rebound' effect is a real phenomenon. Furthermore, UK population growth, particularly when compared with 1990 levels does represent an additional constraint on demand management.

Therefore, a resilient view of energy infrastructure going forward needs to be realistic about both these factors if we are to meet our 2050 obligations.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

We are not able to comment in detail on this, but this should also consider positive *repurposing* of existing assets such as the gas network to carry low carbon gases.

Like many infrastructural assets, they are the result of decades or a century of development, often built under less constraints (smaller population, less built-up environment, lower planning constraints, different economic environments). The value these assets deliver should not be overlooked (eg their capacity to deliver highly variable energy and their world class interconnectivity). Furthermore, were such assets allowed to decline, this would be a one-way event, so decisions not to continue to use them would not be reversible, so any alternative would have to be absolutely resilient and risk free.

6. No Comment

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered? Note: by "funding", the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

Infrastructural assets are capital intensive and long life. The cost is highly sensitive to the required return on capital. Where assets can be delivered in a regulated rate base environment there is the potential to substantially drive down cost. This does require an appropriate risk allocation between the private and public sector, but given this, there is no shortage of private sector funds. A good example is CCS infrastructure. The issues are well laid out in the Oxburgh report².

This is also relevant to wider energy infrastructure. In the highly liberalised UK market, the focus has been on private sector investment for infrastructure which is of national importance. Not only does this

² http://www.ccsassociation.org/index.php/download_file/view/1043/508/

increase cost, it can introduce misaligned objectives between the needs of the country and shareholders, and the balance sheets of the large energy companies are under stress.

Going forward a more nuanced role for private sector efficiencies within public sector/regulated environment is important with regard to infrastructure.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

CCS is a good example, as shown in the Oxburgh report.

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

We have responded to aspects of this question in detail below, but our key observations are:

- The UK's world class gas infrastructure has a critical role in the delivery of heat, in a way that the electricity system is not well suited.
- Decarbonising this infrastructure delivers cross cutting solutions: low carbon heat for domestic consumers, low carbon energy and feedstock for industrials, low carbon transport as well as enabling low power
- Decarbonisation is likely to take the form of both renewable gas and hydrogen with a progressive roadmap of delivery from biomethane today, through to higher volumes of BioSNG, blended hydrogen, industrial users and potentially roll out of 100% hydrogen.
- This depends on deployment of CCS infrastructure, which also offers the possibility of negative emissions.

In order to deliver this requires:

- Firm and stable, cross-cutting energy policy across heat, transport and electricity
- A recognition of the challenge of delivering low carbon, heat and particularly need to meet customer's needs
- Recognition that the gas infrastructure is a world leading network; this asset should not be discarded but should be developed to deliver low carbon
- Recognition of the importance of and GVA opportunity in decarbonising of industry, rather than simply accepting its closure and 'offshoring'
- Firm CCS policy, recognising the genuine world-leading opportunities the UK has with its offshore geological storage
- A Practical CCS roadmap, recognising the reality of post "CCS-commercialisation programme" world

Timing

- The next RIIO period will drive key decisions on the gas network asset management and direction. Evidence base and policy direction is required before then.
- The perception that we can "wait and buy CCS later" fundamentally misunderstands where the key cost reductions come from CCS – which is from build out of infrastructure and its utilisation, not primarily from incremental technology improvements which can be bought in
- We will not meet our 4th and 5th carbon budget without action now.

The Role for Gas

The UK is committed to a pathway to carbon reductions through the Climate Change Act. On the 30th June 2016 it adopted its ambitious and legally binding fifth carbon budget for the period 2027-2032 as part of this trajectory. Heat contributes a third of the UK’s carbon emissions. The Carbon Plan³ specifically identifies the need for low carbon heat in order to meet these targets. In its July 2016 Progress Report to Parliament⁴ the Committee for Climate Change has highlighted that whilst there has been progress in decarbonising the power sector, there has been ‘almost no progress in the rest of the economy’, citing specifically the slow up take of low carbon heat.

The Carbon Plan identifies that by 2030 there is a requirement for between 83-165TWh of low carbon heat per annum. In 2015 the combined domestic and non-domestic RHI delivered less than 4.5TWh, with an expectation by DECC⁵ in 2016 that by 2020/21 the Renewable Heat Incentive (RHI) could deliver 23.7TWh of renewable heat. Therefore a step change in low carbon heat is required.

Currently gas dominates the UK heat supply curve, with 83% of the UK’s buildings heated by gas, typically using efficient modern gas boilers as shown in Figure 2. Similarly, most industrial heat demands are fuelled by gas. The entire existing gas network asset has over 284,000km of pipelines, delivering over 720TWh per annum to over 23 million customers with 99.99% security of supply⁶.

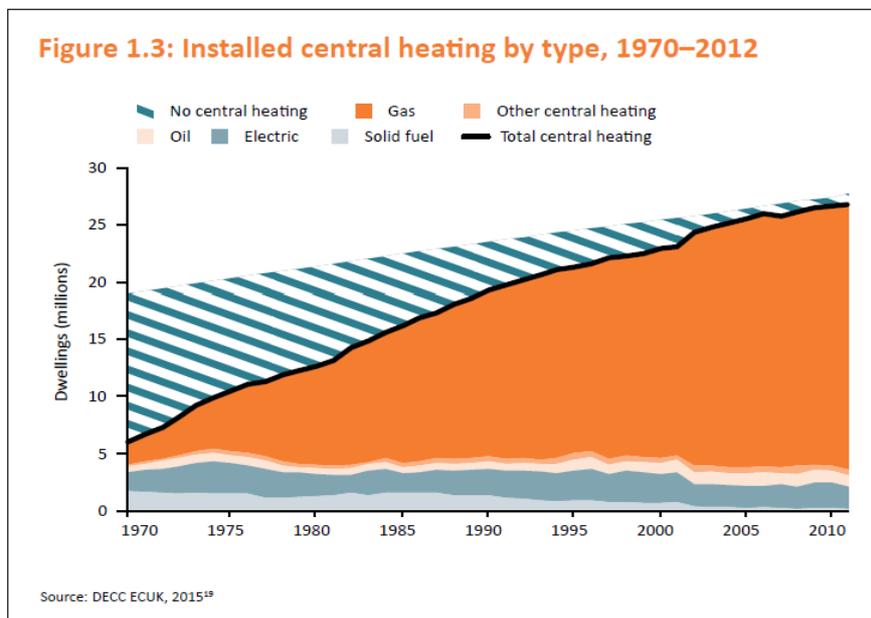


Figure 2 UK Installed Central heating (Policy Exchange⁷)

³ The Carbon Plan: Delivering Our Low Carbon Future December 2011, updated 2013.

⁴ <https://www.theccc.org.uk/publication/meeting-carbon-budgets-2016-progress-report-to-parliament/>

⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505972/The_Renewable_Heat_Incentive_-_A_reformed_and_refocussed_scheme.pdf

⁶ <http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas/>

⁷ Too Hot to Handle? How to decarbonise domestic heating, Policy Exchange, Richard Howard and Zoe Bengherbi, September 2016

Heat demand is highly variable, as can be seen by heat demand curves used by the Gas industry and work by Robert Samson, Imperial as shown in Figures 3 and 4 respectively. The gas network is able to meet peak demand for any 6 minute period over 20 years. The gas system not only sustains peak heat demand but also supports the very large swings in demand within the day through significant storage capacity.

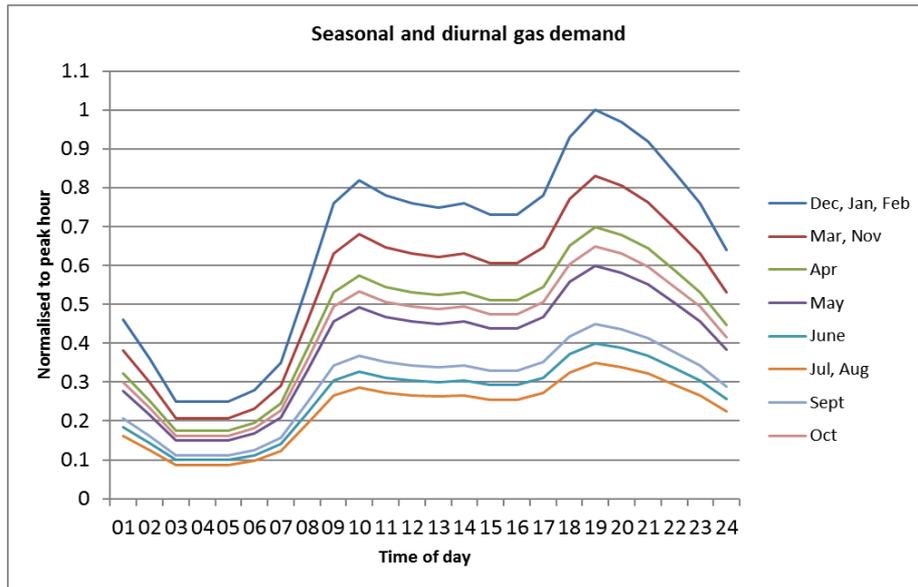


Figure 3: Diurnal gas demand throughout the year

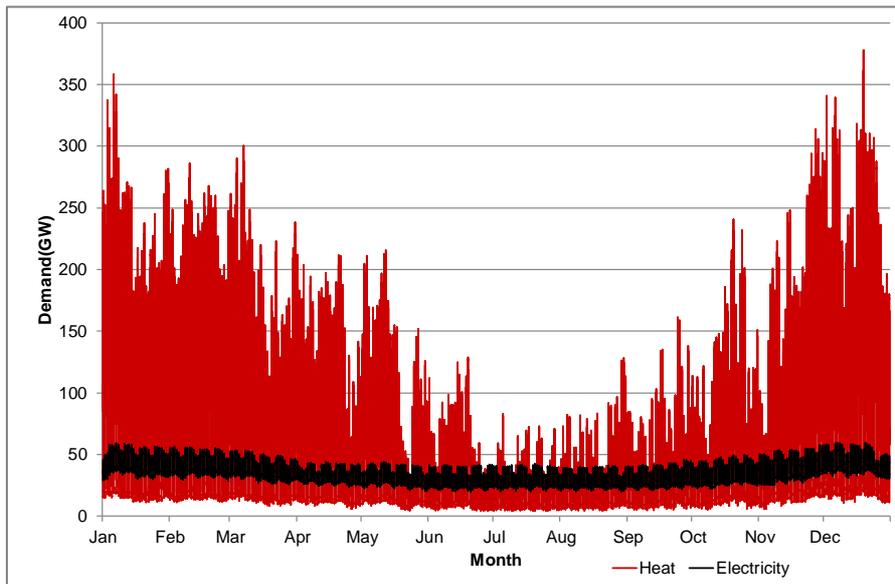


Figure 4 Comparison of half hourly electricity and heat demand variation⁸

⁸ THE IMPACT OF FUTURE HEAT DEMAND PATHWAYS ON THE ECONOMICS OF LOW CARBON HEATING SYSTEMS, Sansom R et al, Imperial College, BIEE – 9TH ACADEMIC CONFERENCE 2012, OXFORD

The peak capacity load on a daily basis is more than five times the lowest day, and the peak capacity hour is more than ten times the lowest hour, which places particular challenges on low carbon solutions for heat.

Alternative means of delivering low carbon heat other than low carbon gas include:

Electrification: Efficient electric heat pumps will make a contribution, but, as recognised in DECC's Heat Strategy⁹, and more recently in its RHI consultation, they require substantial consumer capital outlay and disruption, as well as national infrastructure investment. Consumers are required to change the basis of their heating system in terms of heat source and low temperature heat distribution systems. Furthermore, electricity generation, transmission and distribution network will require additional capacity to handle the additional variable demand for heat.

Biomass Boilers: Biomass installations require substantial capital outlay, are large and cause disruption. In practical use, there is concern that small scale biomass boilers can be inefficient and give rise to air quality issues because of high emissions of particulates¹⁰ and potentially nitrogen oxides.

Heat networks: Heat networks have a role in delivering low carbon heat, but themselves require a low carbon source of heat, new infrastructure and sufficient heat density of the load which constrains their use, and have challenges associated with counterparties to provide the basis for investment.

All of these approaches require that the consumer makes substantial changes to their own heating system. This represents a substantial barrier to adoption of such low carbon heat solutions, as demonstrated in the NIA Funded Bridgend study undertaken by WWU in 2015¹¹, which drew the primary conclusion that *'the majority of domestic consumers (87%) will not change their existing heating provision unless significant financial benefits will be accrued, and only then if they have funding available... If their current system was operating well and providing heat for their homes they would not change their heating systems and spend money unnecessarily.'*

Further, it is difficult to conceive of alternatives to gas for industrial heat applications, so renewable gas is the only realistic decarbonisation option for much of our industrial heat usage.

The gas asset therefore has an important role to play in the cost-effective delivery of heat into the future¹². A key element of this is delivering low carbon gas, as outlined in NGGDs Future of Gas review.

Gas can be decarbonised by:

- (a) using bio- rather than fossil- carbon, i.e biomethane, already increasingly & successfully deployed in the UK, as described below, and;
- (b) removing the carbon entirely by using hydrogen as identified as important by DECC¹³. Two hydrogen scenarios are envisaged; either as a blend in the network feeding existing appliances

⁹https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/190149/16_04-DECC-The_Future_of_Heating_Accessible-10.pdf

¹⁰ Contribution of wood burning to PM10 in London, 168 Fuller, G. et al Atmospheric Environment, 87-94 (2014)

¹¹http://www.smarternetworks.org/Files/Bridgend_Future_Modelling_%E2%80%93_Phase_2_150910_144351.pdf

¹² 'The Role of Gas in UK Energy Policy', Le Fevre C, Oxford Inst. for Energy Studies (2015)

¹³ 'The Future of Heating: Meeting the challenge' DECC (March 2013)

with no requirement for changes to equipment or infrastructure, or as a conversion to 100% hydrogen. The former has the potential for roll out in the near future. It offers not only valuable decarbonisation and financial savings across the distribution system with no disruption to consumers, but it also provides a pathway to establishing hydrogen more widely through areas of 100% conversion as proposed by the H21 Leeds CityGate project.

Renewable Gas

The benefits of renewable gas in the energy system, compared to a scenario without it were quantified in the business case for National Grid's 2015 bid for funding from Ofgem's Network Innovation Competition for a Commercial BioSNG Demonstration plant. The benefits were found to be a £0.5 billion per year energy system cost saving in 2030 (for 37 TWh/a of renewable gas) rising to £3.9 billion per year in 2050 (for 100 TWh/a of renewable gas).¹⁴

National Grid has published a series of documents intended to inform this debate, including one on the supply of renewable gas¹⁵. That publication noted that there is a consensus in the industry that UK sources of wastes and residues could generate 80 to 120 TWh/a of renewable gas, and so could meet around one third of future domestic gas demand.

Anaerobic digestion (AD) plants are already producing more than 2TWh/a of biomethane. However, conventional AD can only process some wastes which limits the potential of the technology to around 20TWh according for an SKM Enviros report for DECC¹⁶. In order for biomethane to make a significant contribution to meeting heat demand is it necessary to develop technologies that can process all types of waste.

This is the rationale for the development of Bio Substitute Natural Gas (BioSNG) project: biomethane produced by the thermal conversion of mixed wastes and residues. We have been working with National Grid and Advanced Plasma Power since 2010 on the development and demonstration of this technology. The consortium has constructed a pilot plant that has demonstrate the technical, commercial and environmental feasibility of the technology and commercial plant is now being built in Swindon. This will produce 22GWh/a of gas from local household's residual waste. Further information about these projects can be found at <http://gogreengas.com/>

The new commercial BioSNG plant will commence operations in early 2018, and the intention is for this plant to lead to the development of large scale thermal biomethane production plants later in the decade. National Grid forecasts that by 2025, BioSNG will be a mature technology. At this point, given a favourable policy environment, the adoption of the technology could accelerate such that by 2030 over 50 large scale plants could be in operation, producing 37TWh/a of BioSNG.

In view of the very large potential contribution that renewable gas could make to the decarbonisation of heat, **it is important to prioritise the allocation of waste and biomass resources to the production of renewable gas, and to make the decision to do this in the very near future, before such resources are locked into long term contracts for electricity generation.** There are many other

¹⁴ https://www.ofgem.gov.uk/sites/default/files/docs/national_grid_gas_distribution_-_commercial_biosng_demonstration_plant.pdf (Appendix 2)

¹⁵ <http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Gas/>

¹⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48166/2711-SKM-enviros-report-rhi.pdf

ways of generating low or zero carbon electricity (e.g. nuclear, wind, or solar) but few readily-accessible alternatives for producing low carbon heat. In addition, the efficiency of energy conversion from waste or biomass to renewable gas (c. 65%) is much higher than the efficiency of electricity generation from waste or biomass (c.25% for conventional incineration plant or 35% for very large ex-coal steam turbine plant).

Hydrogen

BioSNG has the potential to make a significant contribution to heating UK homes and businesses but will not be able to meet all of the UK's demand. It is ultimately limited by the availability of sustainable feedstocks. Heat pumps and heat network will fill some of the gap but in order to fully decarbonise heat it is essential to develop hydrogen production through steam methane reforming combined with carbon capture and sequestration (SMR with CCS).

Hydrogen can be blended into the existing gas grid and is compatible with existing appliances at higher blends than currently permitting under the gas quality regulations. The HyDeploy¹⁷ project will test the impact of increasing the hydrogen blend to 20% by volume for the first time in the UK network. This offers a route to establish low carbon hydrogen production, distribution and use without disruption to the gas consumer.

As discussed elsewhere in this response, low carbon hydrogen also provides a route to decarbonise industry which cannot otherwise be decarbonised. It can provide a low carbon feedstock, and deliver heat, including high grade. Furthermore, it can provide a valuable part of the roadmap towards wider hydrogen adoption. By deploying hydrogen supply to selected industrial plant, it is possible to achieve substantial emissions reduction, establish hydrogen production volumes including CCS, and potentially assist in managing wider network demand fluctuations.

Longer term, it may also be possible to convert complete sections of the gas distribution network to 100% hydrogen, as proposed by the Northern Gas Networks H21 programme¹⁸

Carbon Capture and Storage

In view of the important contribution that hydrogen can play in decarbonising heat that it is important **the Government supports the introduction of infrastructure to enable carbon capture and sequestration** as recommending in the Oxburgh report¹⁹.

Key requirements include a firm CCS policy, recognising the genuine world-leading opportunities the UK has with its offshore geological storage.

Delivery requires a Practical CCS roadmap, recognising the reality of post "CCS-commercialisation programme" world. This involves a staged, incremental, deployment plan rather than the previous ambitious large scale infrastructure approach. This requires a focus on projects with lower initial investment (and so low cost capture, limited CO₂ volume requirements, transport and storage options which are low cost for limited volumes and have growth potential).

¹⁷ https://www.ofgem.gov.uk/system/files/docs/2016/04/ng_ngn_hydeploy_isp.pdf

¹⁸ <http://www.northerngasnetworks.co.uk/wp-content/uploads/2016/07/H21-Report-Interactive-PDF-July-2016.pdf>

¹⁹ http://www.ccsassociation.org/index.php/download_file/view/1043/508/

To make CCS happen Government must:

- Accept storage and cross chain risks
- Be prepared to invest itself
- Work in partnership with industry
- Commit to a believable near term deployment vision

Deeper decarbonisation

There are substantial synergies between BioSNG production and the conversion of the gas network to hydrogen. The technology used to produce BioSNG can be easily adapted to produce hydrogen or to produce a blend of hydrogen and BioSNG. BioSNG facilities can offer the flexibility to adapt to increasing levels of hydrogen as the network evolves. This provides a very cost effective route to hydrogen production, and unlocks early adoption of hydrogen.

The GHG impact of BioSNG improves dramatically when it is combined with carbon sequestration. The BioSNG process creates a stream of relatively pure carbon dioxide that is suitable for sequestration. If infrastructure for storing carbon dioxide is developed the GHG savings of BioSNG increase by more than 50%. If a BioSNG facility using carbon sequestration is converted to biohydrogen production even higher savings are achieved because all of the carbon in the feedstock is captured. The biogenic carbon dioxide captured from the atmosphere in the biomass is sequestered creating genuinely negative carbon emissions.

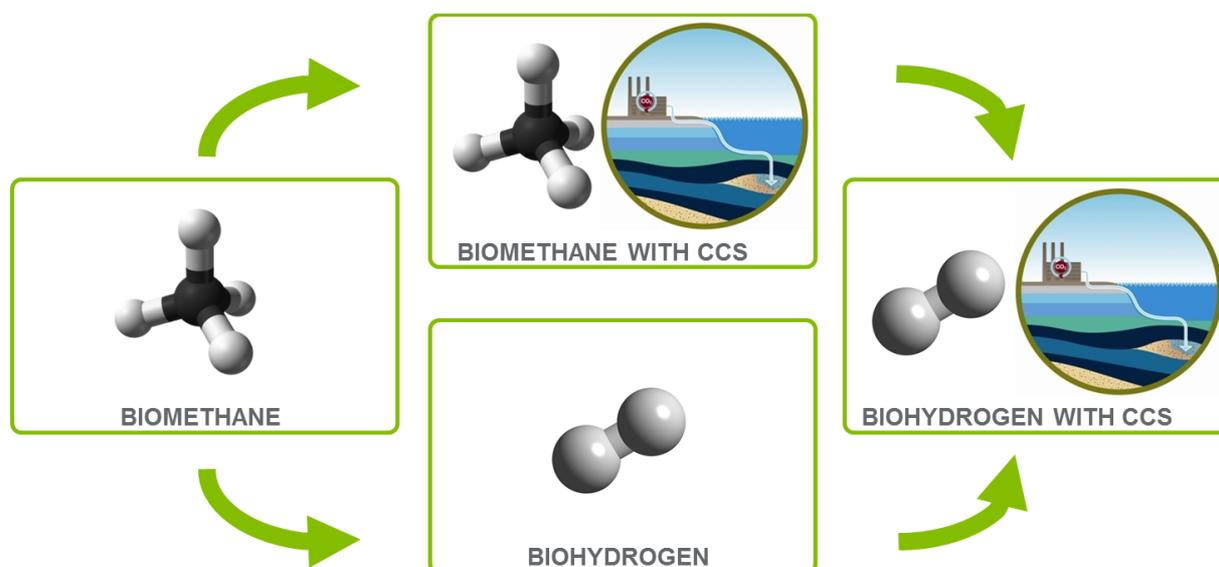


Figure 5 Routes from BioSNG to deeper decarbonisation

Developing technologies with negative carbon emissions is essential in meeting 2050 climate change goals. The negative emissions will offset emissions from hydrogen produced by SMR with CCS and from other sector that are hard to decarbonise such as aviation and farming. The imperative of this is shown very clearly by ETI in their ESME Modelling in Figure 1

The incentives for production of low carbon heat should recognise and support the importance of hydrogen whether it comes from renewable sources or fossil sources combined with CCS technology.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

We believe that such a sector will involve zero carbon renewables such as wind and solar. However, these cannot provide reliable and dispatchable power. Therefore, there is likely to be a role for both nuclear and electricity storage. However, recognising (a) the baseload nature of nuclear and (b) the quantum of the storage phenomena required at a grid scale, there will also be a need for dispatchable fossil fuel with CCS, which can provide the resilient supply required. Both CCC and ETI share this view.

Furthermore, CCS also unlocks opportunity for negative carbon emissions via BioEnergy CCS (BECCS), which cannot be achieved elsewhere. This provides vital offsetting for other aspects of the energy system which cannot be decarbonised.

The ETI show this as being significant. We are of the view that it could certainly play a role in the electricity sector, although from our responses elsewhere, our biomass should probably be focused on the heat sector which is harder to decarbonise than electricity, but it can deliver the same outcome across the energy system – negative emissions. In reality there is likely be element in the electricity sector, for example where a generator is fuelled by negative-carbon hydrogen.

Whilst we understand the role that distributed generation can make, there will always diseconomies of scale in terms of resource utilisation and cost, as well as need for resilience, that means a balanced portfolio that includes centralised as well as decentralised power. We have a world class transmission and distribution network and this asset should continue to be used.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Electrification of passenger vehicles is an important element of decarbonising transport and also addresses air quality concerns especially in cities. This will place increased demand on electricity generation and networks. Given that generation capacity is already under considerable strain and reliant on sweating old assets and new interconnectors, this cannot be ignored. Additional demand in this sector also has cross-cutting implications for assumed electrification of part of the heat sector.

Whilst there is an argument that the inherent storage provided by EVs may assist in balancing the electricity network, the utility of such vehicles to consumers will remain paramount. It is unlikely that there would be universal acceptance of that storage being drained to fulfil network load demands thereby precluding the consumer from making planned journeys.

Charging times are also likely to become a significant issue as the vehicle parc increases. This may be ameliorated by advances in battery technologies but will remain a fundamental limitation. Hydrogen as a low carbon, low emission vector offers the opportunity to address this, with filling times more consistent with existing fossil routes. Development of robust electric drive trains and vehicle platforms provides an excellent foundation for hydrogen vehicles in the future. Combined with the potential transition of the gas network to hydrogen there is an obvious and practical roadmap towards alternative low carbon passenger vehicle infrastructure.

However, whilst continued electrification of passenger vehicles is inevitable, this is not suitable for HGVs where the battery payload and charging times become a major constraint. Renewable gas provides a deployable technology today to replace diesel HGVs, recognising that current biodiesel is not truly fungible with blend limits. This can deliver savings in the current and foreseeable carbon budget periods as well as low noise and address city air quality issues. Furthermore, as with passenger vehicles, a

transition towards gaseous based fuels provides a transition route to hydrogen in the future on a longer-term basis. Air quality and noise are on a par with electric vehicles.

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Financial incentives are extremely important in the short term to develop a sustainable waste to energy industry, but that currently they are not correctly aligned between heat, transport and electricity outputs to produce outcomes that optimise least-cost carbon reduction. Some very specific issues are discussed below across each of those incentive regimes.

In addition to coordination within BEIS and between BEIS and DfT it is also important that there is a joined-up approach between DEFRA (and WRAP) and the energy related departments. The requirement for public health considerations of waste and the recognition of it as an energy resource needs to be appropriately joined up.

As is discussed elsewhere in the consultation, there needs to be careful treatment of the waste hierarchy. Waste avoidance and recycling are undeniably highest priority. In terms of recycling, the primary focus should be on materials with the highest inherent carbon, energy and resource intensity; glass and metals. It is also important to recycle plastics and paper – however only providing that the quality of the recyclates are sufficient to provide good quality products. There is a limit to this downcycling; either by the carbon/energy involved in the upgrading chain, or the genuine lack of utility of the output. It should be recognised that taking the materials down to their fundamental hydrocarbon building blocks as C1 chemistry which can then be rebuilt into new materials or energy vectors is a valid form of molecular recycling. Historically this position has been considered an anathema, and that recycling should be pursued at all costs. It is time for a more nuanced understanding and application of the principles. Currently the energy market values the renewable, biological element of this (with BioSNG being a good example of the pathway and providing the early platform), but over time bio-materials will be valued.

Renewable Heat Incentive (RHI)

The RHI provides support to biomethane produced by AD and gasification technologies such as the BioSNG process. However, support drops off rapidly for facilities producing more than 40GWh/a of gas. This is an appropriate limit for AD, which works best in small facilities designed to use locally available agricultural feedstock, but it is too restrictive for BioSNG, which operates in an urban environment where waste volumes are higher.

DECC launched a consultation on reforms to the RHI in the spring of 2016. We, along with National Grid, the Renewable Energy Association, and range of engineering companies responded to ask for more focussed support for BioSNG with a separate RHI band providing 5.87p/kWh without any limits on scale.

BEIS published their response to the consultation on 14th December 2016. They agreed that BioSNG could increase the supply of green gas but rejected setting up a new band because of lack of evidence on costs and the risk of overcompensation.

Issue

Progressive Energy and its partners in the BioSNG projects are engaging with waste companies to start development of large scale BioSNG plants. The completion of the first commercial plant in 2018 will be followed by facilities around ten times bigger if appropriate support schemes are in place.

However, the failure to amend the RHI to support BioSNG plants is likely to have the following impact:

- A significant delay in deployment of an innovative low carbon heat solution.
- Failure to exploit the R & D into advanced biofuels funding by Progressive Energy, National Grid, APP shareholders and the UK Government.
- Continued landfilling and export of waste and inefficient use of waste to generate electricity with Government support under the Contract for Difference scheme.

Solution

We accept the Government's position and recognises that it is not feasible to introduce a new RHI band for BioSNG. A compromise would be to keep BioSNG within the AD band but to increase the size of the first tier when calculating support. This would be done with the following change to paragraph 21 of the RHI order.

(a) "initial biomethane" means the amount of eligible biomethane measured in megawatt hours which is injected in the 12 month period commencing with, or with the anniversary of, the tariff start date for the original biomethane ("the relevant period") up to 40,000 megawatt hours in the case of biomethane made by anaerobic digestion or pyrolysis and 120,000 megawatt hours in the case of biomethane made by gasification;

This minor increase in the tier would provide sufficient support to enable the development of the first large scale commercial plants.

Renewable Transport Fuel Obligation (RTFO)

The RTFO is a further scheme that has the potential to incentivise waste to renewable fuel plants. The Department for Transport issued a consultation on changes to the RTFO on 29th November 2016.

The key proposals are to:

- Increase the level of renewable fuels from 5% to 10% by 2020 and maintaining it at 10% or above until 2030.
- Introduce a cap on the amount of biofuels produced from crops that can contribute towards the 10% target – the consultation proposes 2%.
- Introduce a new obligation for the supply of development biofuels that are produced from wastes and residues. This will grow to 1.2% (3.8TWh) by 2030. The consultation asks if biomethane should be included in this development category.

In our response we said that:

- The proposed changes are good for decarbonising transport and establishing a biofuels and low carbon transport industry that will create jobs, investment and exports.
- Biomethane is one of the best candidates for decarbonising heavy goods vehicles and buses and should be included in the development target.
- The buy-out price for development fuels should be set at a high level to provide strong incentives for this new technology.

Contracts for Difference (CfD) Scheme to support renewable electricity generation

We have recently responded to BEIS's call for evidence on fuelled and geothermal technologies in the CfD scheme. In summary, we have suggested that so-called Advanced Conversion Technologies (ACTs) should no longer be supported by the CfD scheme but that ACT-based heat and fuels are appropriately supported. This is because the current ACT regime means that some projects are receiving a substantial subsidy for converting waste to electricity at efficiencies (<18%) lower than open market projects which operate with no support. This means that consumers are paying a subsidy for a worse carbon outcome; this is certainly not cost effective decarbonisation.

As noted above, the journey to decarbonise electricity generation has progressed far further, and there are many options available to produce clean electricity. Being mindful of the relative immaturity of the heat and transport sectors on the low carbon journey, and the many options for electricity production, we believe that feedstocks potentially capable of producing low carbon fuels for heat or transport must be carefully managed. Incentivising their use in electricity generation could lock away valuable feedstocks for many years e.g. 15 year waste contracts, or sewage treatment investments.

We suggest that removal of support for ACTs under the CfD regime should be undertaken in a co-ordinated way including enabling support for heat and fuels. This must focus on ensuring the future incentive regime for renewable heat provides the transitional support which was formerly delivered to AD, to allow gasification to deliver early commercial projects prior to being able to operate without support. Similar co-ordination is required with the Department for Transport on the Renewable Transport Fuel Obligation which is also currently under consultation.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

A circular economy delivers effective resource utilisation. As noted previously, simply burning waste to generate electricity misses the opportunity which this bio-rich resource offers. Reforming the waste to a clean syngas, which can be used as a chemical precursor for production of fungible gas, fuels or chemicals, is a perfect form of molecular recycling.

Production of a clean syngas by gasification of waste also facilitates carbon capture using existing proven carbon dioxide separation technologies which have been operating for many decades. Conversion of a solid to a gas or a liquid inevitably leads to excess bio-carbon which is rejected as bio-carbon dioxide. This forms the basis for the use of BioEnergy CCS (BECCS) which is recognised by both the Committee on Climate Change²⁰ and the ETI²¹ as fundamental to meeting our 2050 targets. This approach already delivers captured bio-carbon dioxide today. For example, production of methane from solid biomass leads to around half of the carbon separated as storage-ready carbon dioxide. This is already undertaken at all ~70 AD biomethane plants, some of which capture the carbon dioxide and sell it to industry. It will also be demonstrated at the BioSNG project at Swindon, where 5000 tonnes of carbon dioxide per annum will be sold to industry. In the future, this approach can be extended (simplified), with hydrogen produced as the energy vector with separation of all the carbon for storage.

²⁰ https://www.theccc.org.uk/archive/aws2/Bioenergy/1463%20CCC_Bioenergy%20review_bookmarked_1.pdf

²¹ <http://www.eti.co.uk/insights/the-evidence-for-deploying-bioenergy-with-ccs-beccs-in-the-uk>



NATIONAL INFRASTRUCTURE ASSESSMENT – CALL FOR EVIDENCE

Submission from Publica

10 February 2017

1. INTRODUCTION

- 1.1. Publica is a London-based public realm and urban design consultancy, specialising in research, strategy and design for public space, urban design and masterplanning. Since Publica was formed in 2010, every masterplan we have worked on has had a significant infrastructural change as its catalyst. We welcome the opportunity to provide a view on the pressing infrastructure challenges to be highlighted by the National Infrastructure Assessment.
- 1.2. Our response to the call for evidence relates to the 'Cross-cutting issues' and 'Transport' sections of the call for evidence, as these most closely relate to Publica's area of work and expertise.
- 1.3. The material shared is underpinned by our belief that the future lies in compact urban growth, and recognises the importance of density and intensification in the development of high quality urban neighbourhoods. It focuses on the relationship between infrastructure, urbanism and liveable cities, and is based on evidence from Publica's projects in London as well as international case studies.

2. QUESTION 2: HOW SHOULD INFRASTRUCTURE MOST EFFECTIVELY CONTRIBUTE TO THE UK'S INTERNATIONAL COMPETITIVENESS?

- 2.1. Infrastructure has a vital role in supporting cities' efficiency, resilience and their attractiveness to future and current residents as well as investment, both internally and externally.
 - 2.1.1. Infrastructure is an intrinsic part of development across London. The link between infrastructure investment and large scale change and development is visible on a map of Publica's recent projects (see Appendix 1), which have all overlapped with the routes of the Elizabeth Line and the proposed Crossrail 2. Embracing this opportunity is currently led by the private sector's energy and enthusiasm to contribute to the improvement and development of London as a liveable and internationally competitive city.



- 2.2. One of the truly critical factors which supports modern cities and their infrastructure in allowing their populations, economies, and built and natural environments to thrive is strong leadership and vision.
 - 2.2.1. In France, Mayor Anne Hidalgo is leading work to improve the pedestrian experience in Paris's public squares, as well as running a major competition – *Réinventer Paris* – for the private sector to lead in re-positioning Paris as a city of innovation. This has signalled a major shift in how the city is viewed and used; streets are being given back to people, the city is re-establishing its relationship with the river Seine, and, as a result, the urban competitiveness of Paris is on the rise.
 - 2.2.2. In the Brazilian city of Curitiba, three-time Mayor Jaime Lerner provided a visionary leadership needed to deliver truly transformative infrastructure. One of the city's key achievements is its Bus Rapid Transit system. Facing the option of the costly construction of subway lines, Lerner commissioned instead a functional bus network with attractive transit stops, dedicated bus lanes along the city's main arteries, and handicapped access equipment. This ambitious programme succeeded in rendering public transport accessible to all and the BRT system has become a symbol for the city.
- 2.3. A city's international competitiveness is fundamentally tied to the quality of life that it is able to offer to its inhabitants. Offering citizens a clean, green, safe and attractive environment is therefore crucial to cities' prosperity.
 - 2.3.1. The City of London is aware of the pressure on its streets and spaces, and how the area's qualities affect its overall global competitiveness as an international financial and business services hub. Once the domain of private vehicles, the streets of this area are being re-imagined as spaces for pedestrians, cyclists, consolidated servicing, increased spatial efficiency, and enhanced public space in response to rapid intensification and growth. Publica's Bank Area Strategy¹ for the City of London demonstrates this shift in understanding space in the area. It sets out the City's vision for transportation and public realm improvements in the Bank area over the next ten years. A long-term vision planning for future growth is crucial in maintaining the City's status as the world's leading international financial and business centre.
 - 2.3.2. Pollution, in all its forms, is a major issue faced by many cities around the world. The City of London, for example, has some of London's highest levels of pollution due to its central location within the city and also the density of development in the area. In 2015, the City of London appointed Publica to produce a set of site-specific recommendations for public realm enhancements, and general recommendations or principles for public

¹ <http://www.publica.co.uk/projects-bank>



realm design that mitigates the impact of air pollution (see Appendix 2). This is crucial to improving the health and wellbeing of residents, workers and visitors – a central aspect of global competitiveness.

- 2.4. With growing and aging populations, we need to design our infrastructure and developments with capacity to accommodate future growth. To do this we must: make more of what we have work harder (including land, building stock, spaces in between); integrate infrastructure which is sensitive to the specificity of place and its character as well as its pattern of use; and apply long-term thinking to ensure future resilience and sustainability.
3. QUESTION 3a: HOW SHOULD INFRASTRUCTURE BE DESIGNED, PLANNED AND DELIVERED TO CREATE BETTER PLACES TO LIVE AND WORK?
 - 3.1. The first thing to establish in deciding what a new site needs is what already exists in the district and what is missing as the basis for the integration of a new neighbourhood. Publica’s methodology begins with a wider area survey to look carefully at existing spatial, social, and cultural conditions. This informs all aspects of the design process.
 - 3.1.1. In April 2014, Publica was commissioned by the Northbank BID to produce a Public Realm Survey.² The project examined existing public realm conditions within the Northbank area – an area stretching between Trafalgar Square, Covent Garden, the Thames, and Aldwych – and to make recommendations for potential future improvements to the district as a whole, providing a strategic overview to identify key issues and opportunities. This careful survey of existing conditions is necessary to ascertain improvement needs.
 - 3.2. Infrastructure, often considered as a ‘hard’ element that allows a city to function, should be recognised as an integral part of city life and incorporated within it. For example, new infrastructure can provide opportunities for new public amenities and open spaces.
 - 3.2.1. The Westway, in west London, opened in July 1970 as the A40(M). A 3.5-mile elevated dual carriageway section running from Paddington to north Kensington, it was built to relieve congestion at Shepherd’s Bush caused by insufficient capacity on central London’s roads. Its construction also bisected neighbourhoods, changing their character forever. However, the Westway Development Trust was established soon after the completion of the Westway to claim back and develop surrounding land for local community uses. The charity has had a significant impact on the territory underneath the Westway, converting 23 acres of previously vacant land into a thriving sports and amenity zone.

² <http://www.publica.co.uk/northbank>



ground level activity is for the city. Animating the ground plane and creating a sense of civic identity is key in designing infrastructure to create better places to live and work.

- 3.4.1. Hanover Square is a historic London square laid out in 1713, situated between Oxford Street, Regent Street and New Bond Street. The opening of the Bond Street East Elizabeth Line station on the square has been the catalyst for an integrated approach to public space improvement around new infrastructure, which has also offered a chance to restore a once over-looked square in the heart of London's West End. Further detail on the work that Publica has been undertaking to integrate this key new infrastructure within a central urban neighbourhood can be found in the project summary in Appendix 3.
- 3.4.2. In August 2014, Publica was commissioned to develop a detailed Vision for the Northbank and Public Realm Strategy for the district. The Northbank is a district subject to several new development proposals. These include a number of major infrastructural projects, such as the proposed Garden Bridge, the removal of the Aldwych gyratory, TfL's east-west Cycle Superhighway and changes to the riverbank as part of the Thames Tideway Tunnel works. Publica's Vision sought to build upon this context to reinvent the area's identity and maximise its potential by giving consideration to the public realm. Four key themes were used for analysis: mitigating the impact of traffic, upgrading the public realm (including greening, materials, lighting, and decluttering), connecting the public realm (wayfinding strategies, strategic walking routes and connections, and improved crossings), and celebrating public life (cultural programming and supporting an active and vibrant street life).
- 3.5. Infrastructure also has a key role to play in addressing socio-economic inequalities, by improving connectivity within cities and regions, promoting local economic growth, and supporting access to, and provision of, social infrastructure.
 - 3.5.1. In 2004, Mayor Sergio Fajardo implemented a new city plan in Medellín targeted at reducing social inequality by identifying priority areas for intervention, where social and economic issues were more acute. Part of this plan was a cable car transport system (MetroCable) that was a solution to the challenge of isolation and poor connectivity created by the natural topography of the city. It now connects the informal residential areas with the centre of the city; bringing citizens close to economic opportunities, leisure, culture and education. Social amenity is clustered around MetroCable stations, bringing transport and social infrastructure together. This can be seen in the example of the *Parque Biblioteca España*: designed by Giancarlo Mazanti, three black buildings house a public library, which hosts a range of programmes, resources and services for



the local population; the public space formed by the buildings directly connects to the MetroCable station.

4. QUESTION 3b: HOW SHOULD THE INTERACTION BETWEEN INFRASTRUCTURE AND HOUSING BE INCORPORATED INTO THIS?

4.1. Infrastructure and the built environment should support and promote density and diversity to ensure our cities remain liveable and attractive places for people to live and work.

4.1.1. The creation of new transport hubs can unlock new areas for the creation of liveable urban neighbourhoods, which bring work, amenities, and living closer together. Transport developments like HS2, the Elizabeth Line and Crossrail 2 have the capacity to unlock land for denser residential and commercial use, which will in turn create new demands on infrastructure; including water, internet, and electricity as well as increased demand for new and existing transport links.

4.1.2. In London, the development of large sites – potentially a valuable resource for meeting the city’s housing needs – has historically been constrained by a lack of local and transport infrastructure. As a key criterion in determining the levels of density permissible in London, transport infrastructure should thus be considered and designed as a key driver for housing growth.

4.2. Densification, which involves increasing the number of dwellings per hectare through a number of methods including infill, and demolition and rebuild, is currently viewed as having great potential for increasing housing supply, specifically in London. If this represents a crucial opportunity to address persistent housing shortages, the potential of new developments in stretching the local community resources and infrastructure should be carefully assessed.

4.3. The provision of social infrastructure – referring to a wide range of assets and services, including those related to health, education, community, culture, play, recreation and sports, faith and emergency facilities and services – is also central to meeting local needs and contributing to quality of life of residents.

5. QUESTION 11: HOW SHOULD INFRASTRUCTURE MOST EFFECTIVELY CONTRIBUTE TO PROTECTING AND ENHANCING THE NATURAL ENVIRONMENT?

5.1. A sustainable city requires for its operation that natural systems are fully integrated within its physical structure and that their benefits – often referred to as ‘ecosystem services’ – are fully recognised. Green infrastructure – defined as any system in which active biological



organisms participate, ranging from green spaces to green roofs of walls – performs multiple urban functions including transportation, waste removal, temperature control, removal of air pollutants, power generation, stormwater management etc.

- 5.2. Conceptualising cities and their natural systems in more holistic terms, through concepts such as green infrastructure, is crucial in protecting and enhancing the natural environment.

- 5.2.1. The All London Green Grid (ALGG) policy framework, first initiated in 2012, gives a comprehensive overview of London’s natural assets, what it terms green and blue infrastructure. The policy asserts that the city’s green open spaces, woodlands and rivers should be seen alongside what we typically regard as infrastructure, and be managed in a similar long-term strategic vision.

6. QUESTION 13: HOW WILL TRAVEL PATTERNS CHANGE BETWEEN NOW AND 2050? WHAT WILL BE THE IMPACT OF THE ADOPTION OF NEW TECHNOLOGIES?

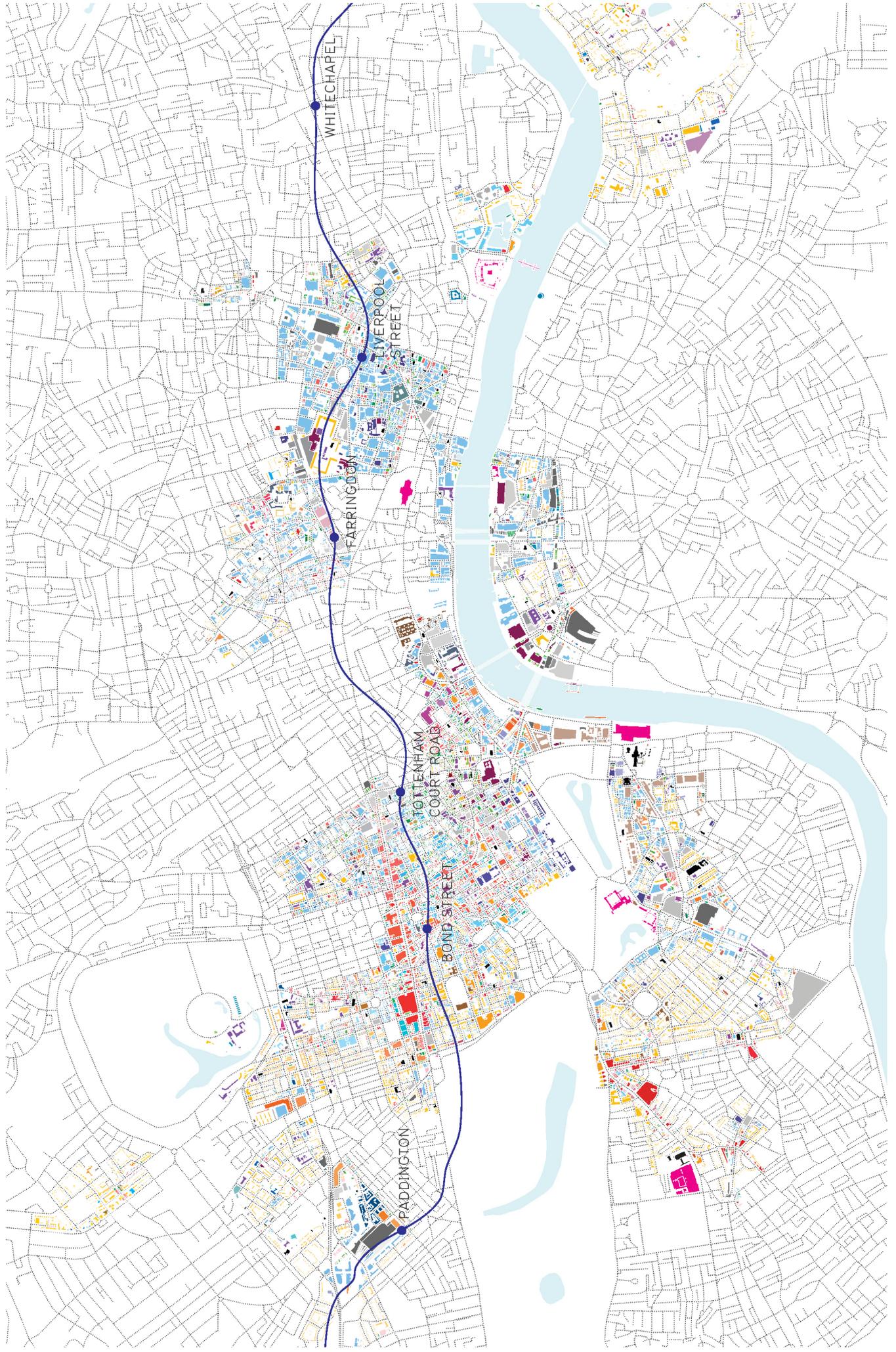
- 6.1. In modern cities, transport and communications technology are becoming increasingly interdependent, with communications being key to the operation and integration of a modern transport network. Transport users expect increasingly up-to-date service information, access to Wi-Fi on the underground network, and the ability to navigate the city using GPS on their mobile phones. This can be an opportunity to reimagine the space of public transport and the public realm as one in which people are increasingly connected. As technology develops, it is important to growth the capacity for connectivity throughout the transport network.
 - 6.2. Active travel is expected to become increasingly important, as cities densify, and seek to reduce their carbon impact. It is therefore important that active travel infrastructure is not just built to respond to current problems, but rather pre-empts future challenges and can be adapted to respond to future unknown problems. For example, a sustainably designed public realm would consider our ageing population, and include regularly placed seating, and crossings that are timed to meet the needs of older pedestrians. The ‘Healthy Streets’ approach developed by TfL and the GLA, and shortly to be launched as a core element of the Mayor of London’s Transport Strategy, provides further detail on this.³
 - 6.3. The growth of the night time economy, an important part of what attracts people to cities, is likely to impact travel patterns and intensify pressures on transport networks. Night time travel will have to be supported by an animated and inclusive public realm, allowing those people who might feel more vulnerable at this time, such as women, to take full advantage of the night time economy.

³ <http://content.tfl.gov.uk/improving-the-health-of-londoners-transport-action-plan.pdf>



6.3.1. Publica has recently developed a vision for Oxford Street, in partnership with economic planner, Volterra, and planning consultants, Gerald Eve. The study looks at the whole Oxford Street district, accommodating diverse projects and drivers for change, including increasing capacity for additional workspace, the provision of new public spaces and amenity and uses to ensure a long-term dynamic future for this economically vital district. One of the principles seeks to diversify uses on Oxford Street, incorporating additional evening services for locals and visitors to support the introduction of the Night Tube and to support the cultural and entertainment uses of neighbouring areas.

APPENDIX 1: PUBLICA'S CURRENT AND RECENT PROJECTS AND THE ELIZABETH LINE





APPENDIX 2: CITY OF LONDON AIR QUALITY STUDY

Executive summary

Air pollution is the introduction into the atmosphere of chemicals, particulates or biological materials that cause discomfort, disease or death, and damage to the natural and built environment. It can exacerbate potentially fatal health conditions, including asthma, heart and lung diseases, other respiratory diseases, and allergies. In the UK it is estimated that air pollution costs the lives of 29,000 people each year; over 4,000 of these are estimated to be of Londoners.

The City of London has some of London's highest levels of pollution, due to its central location within the city and also the density of development in the area. In February 2015, the City of London appointed Publica to prepare a report on opportunities for reducing exposure to air pollution through public realm considerations.

In preparing this report, Publica carried out a literature review, examining best practice in mitigating the impacts of air pollution, as well as relevant EU and UK air pollution policy. The central focus of the study was an analysis of three streets in different parts of the City of London. The analysis of these streets—Beech Street, Liverpool Street and Mansell Street—included: an examination of plans for the surrounding areas; meetings with a small selection of stakeholders; an on-site survey to understand how the streets are currently used; and an assessment of the impact of air pollution on those using the streets.

Publica produced a set of site-specific recommendations for public realm enhancements, and general recommendations or principles for public realm design that mitigates the impact of air pollution (shown on the next page). These recommendations are designed to assist decision-making, as the City of London strives to meet its commitment to improve the health and wellbeing of residents, workers and visitors.



General recommendations for reducing exposure to air pollution through public realm considerations

- Consider all efforts to reduce exposure as accompaniments to committed, borough-wide (and London-wide) actions to reduce emissions.
- Enforce idling bans across the City of London, particularly at known high exposure sites, such as residential areas and schools
- Ensure ongoing monitoring of air quality within the City of London, and explore the possibility of raising the visibility of monitoring stations to increase awareness of the issue.
- Consider developing a coordinated communications strategy, to ensure consistent messaging when engaging with a range of different stakeholders on the subject of air quality.
- Continue to engage with City businesses, supporting their encouragement of employees to walk and cycle to work.
- Consider each specific site and its wider context when looking to implement public realm enhancements and measures to reduce exposure; use TfL's Roads Task Force Street Types and site analysis to understand how to reduce exposure of people when they are stationary as well as when they are moving through the City of London.
- Explore how efforts to reduce exposure can be balanced with a desire to maintain vibrancy at street level.
- Explore promotion of pedestrian priority in high exposure areas, in order to encourage walking and reduce use of vehicles.
- Identify opportunities to enhance the pedestrian environment, in order to encourage pedestrians to use low emissions routes.
- Consider and review the impact on pedestrian flows which the 2018 opening of Crossrail stations across, and in close proximity to, the City of London will have on particular areas.
- Explore how greening efforts (including tree planting and green wall installation) can be used to signify and encourage use of lower emissions pedestrian routes and places for people to sit.
- Explore options for establishing low emission neighbourhoods (LENs) at City of London air pollution hotspots.



APPENDIX 3: HANOVER SQUARE FOR WESTMINSTER CITY COUNCIL

Public realm upgrades to Hanover Square and its environs will create a well-designed public space fit for the arrival of Crossrail, as a new front door to the West End and a true oasis space in the city. This project will provide a step change in the quality of public realm provision in the West End heralding a new approach to the district's historic townscape, its integration with the upgraded transport infrastructure and restoration of an important and beautiful amenity space. The project will provide a high quality setting for a number of significant new buildings, and help to support the promotion of the wider West End as a retail environment, place to do business and area to visit.

The project is currently at early design stage and is planned to be delivered for the opening of the Crossrail station in late 2018, to address the acute need for improvements to the public realm outside Bond Street (East) station. The project is being developed with Westminster City Council, Transport for London, Crossrail, Historic England and with the neighbouring landowners and developers, funded by GHS (GP), represented by Great Portland Estates. Publica is developing materials that will allow stakeholders to adopt a shared vision and concept design and for the East Mayfair Project Board to take forward. Potential additional funding streams and promoters are currently being identified.

The project for the garden square will be fully integrated with the Crossrail public realm works for Tenterden Street and the immediate setting of the station. The relationship with connecting spaces such as Harewood Place, Princes Street, Dering Street, St George's Street and Brook Street will be considered to optimise benefits for the West End.

Expected outcomes and benefits of the project will include:

- Improvements to pedestrian environment; including expanded pedestrian space outside Crossrail station exit
- Accommodation of new pedestrian flows, minimised pinch points and congestion, and accommodation of pedestrian desire lines
- Improvement of the experience of shopping, visiting, working in and commuting into the West End, as well as the arrival experience into this unique area of London
- An improved look and feel of the streetscape; including optimisation of the latent townscape assets, views, landmarks and the unique built heritage, to allow access and enjoyment by all
- A fully restored garden square as a high quality, green and restful oasis space close to Oxford Street, Regent Street and Bond Street
- Better dispersal routes for the increased pedestrian flows and connections through the West End towards Oxford Street, Regent Street and Bond Street from the new station
- Encouragement and facilitation of walking at street level through the West End, to help relieve use of Underground, buses or vehicles for short journeys
- A strengthened north-south walking route through the West End, from Marylebone and Oxford Street into Mayfair on the axis of Cavendish Square to Conduit Street through Hanover Square and St George Street
- Improved cycle facilities, cycle parking close to major transport interchange(s)



- Changes to vehicle access and routes, which will have benefits for local air quality
- Linkages with and support of wider public realm objectives in the West End, such as review of bus operations and an emerging taxi ranks strategy
- Integration with neighbouring public realm projects on Oxford Street West, Cavendish Square, Bond Street, Brook Street, Mayfair traffic management, and the Royal Academy north-south walking route
- Building on recent upgrades in the area, such as Regent Street and Oxford Circus
- Development of designs in collaboration with WCC to ensure long-term management
- Improved image of the West End, its range and quality of spaces, for all local and international visitors, workers, businesses and residents.

Elements of the project will include:

- New natural stone paving and materials
- New pedestrian crossings
- De-cluttering of street spaces through removal of superfluous objects in the public realm,
- A new lighting strategy
- Opportunities for public art and other markers in the area
- New trees, and improvements to existing gardens,
- Improvements to reveal historic vistas, listed buildings, the Pitt statue and the historic cabmen's shelter
- Vehicle access changes, which might encompass timed service access only or bus priority streets in some areas and a new taxi rank.



Mobility • Safety • Economy • Environment

RAC Foundation's Response to the National Infrastructure Commission's Consultation on National Infrastructure Assessment Call for Evidence

February 2017

Introduction

The RAC Foundation is an independent transport policy and research organisation which explores the economic, mobility, safety and environmental issues relating to roads and motoring. The Foundation carries out independent and authoritative research with which it promotes informed debate and advocates policy in the interests of responsible road users.

In August 2016, the Foundation responded¹ to the Commission's earlier consultation on The National Infrastructure Assessment Process and Methodology² and some of the material in this earlier document are relevant to the current consultation – particularly on cross cutting issues that affect road transport. Again the Foundation's response deals mainly with roads as these are the type of infrastructure of greatest significance to the responsible road user, hence in the pages that follow we have focused on the specific transport questions in the Call for Evidence.

On your cross cutting-questions we offer the following observations which we would be happy to discuss further if you wished:

Q 3: How should infrastructure be designed, planned and delivered to create better places to live and work?

With the benefit of hindsight it is at least questionable whether we would have sought to bury so many network services underneath our road carriageways. The resulting streetworks are a particular problem where those utility networks are ageing and in need of frequent repair/maintenance. Looking ahead, we could look to new technology to limit the problems by the use of better, more resilient materials, and by 'keyhole surgery' techniques that minimise the need to break the road surface. There is plenty of material to be found in the DfT about options for improving streetworks management.

¹ RACF 2016.

² NIC May 2016.

Q 3 (part 2): How should the interaction between infrastructure and housing be incorporated into this? How should the interaction between infrastructure and housing be incorporated into this?

This question is absolutely central to the Commission's work, and warrants a questionnaire all of its own. The Government's appetite for new housing development suggests that while brownfield development might be part of the answer, entirely new greenfield (even green-belt) development is possible, with consequent opportunities to get all the infrastructure services and connections, including transport, right from the outset.

Q 4: What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Our submission, below, touches on road pricing. Clearly there are other traffic management options, some of which would have the potential to limit the capacity of road infrastructure required, though probably not the corridors i.e. same route, fewer lanes.

Q 5: How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

For roads, in particular, this is a key issue. Whilst new capacity gets the headlines, the condition of the existing network is a cause for concern. We would urge the Commission to look carefully at the risk to network resilience of inadequate maintenance provision, in particular on the vast majority of roads that fall to local government to maintain (see 'The condition of England's local roads and how they are funded', RAC Foundation, November 2015). This links also to question 12.

Q 12: What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Investment appraisal could also, as a topic, absorb the Commission's time in perpetuity, not least because the accurate forecast of economic benefits and, often environmental, disbenefits over several decades is both hard to calculate and hard to monetise. The answer probably rests in ensuring that cost-benefit calculations are always presented in ranges. The Foundation has offered thinking on the refinement of transport appraisal (see 'Transport Policy, Appraisal and Decision-Making', RAC Foundation May 2015). Not so much a thought about technique, there is a case for improving the economic appraisal of maintenance activity. This clearly needs more work, one avenue of which might be to assess more thoroughly the traffic impact of deteriorating road condition, in terms of pothole claims, then reduced speeds and ultimately impassibility (see 'The Economics of Road Maintenance', RAC Foundation, June 2013).

Questions on Transport

Q1: How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

1.1 Future travel patterns will depend on the size and location of the population, the form and patterns of economic activity, developments in transport technology, the costs of transport fuels, the provision of transport infrastructure and public policies on matters such as transport pricing and environmental regulations. Ranges for some of these factors can be estimated with a reasonable measure of certainty for some years ahead³, whilst others are so uncertain that their future can only be a matter of speculation. Attempting to forecast all of these and how they will interrelate over thirty years ahead with any confidence is beyond the Foundation's (and probably any other organisation's) capability.

1.2 The most thorough attempts to estimate future transport demand for England and Wales have been made by the Department for Transport⁴ and the most recent estimates of road travel demand stretch out to 2040⁵. For planning purposes this is a reasonable horizon in avoiding the huge uncertainties of trying to forecast further ahead yet giving a sufficiently long timespan for major infrastructure decisions to be made taking account of the first 15+ years of their operational lives. However it is important that this horizon is rolled forward every few years to incorporate changes in current circumstance, improvement in forecasting methods and ensure a significant number of projects' early lives are captured in the appraisal process. The Scottish Government has published its own Economic Strategy, and plans for infrastructure investment⁶ but these do not include detailed forecasts like those for England and Wales.

1.3 The DfT forecasts are based on 5 scenarios for England and Wales with trip rates, income elasticities and general economic conditions varying between them. They incorporate the established drivers of travel demand (population, income, car ownership etc.) and also take account of limitations in the capacity of the road system. The forecasts are disaggregated by trips numbers and distance, traffic volumes and congestion, vehicle type, road type, time of day, area type and region.

1.4 The forecast traffic growth between 2020 and 2040 ranges from 10% to 27% with the median (3) forecasts giving an increase of 18%. The greatest growth is forecast to be in LGV traffic with articulated HGVs also growing faster than car traffic. Growth in larger urban settlements and cities is expected to be less than in rural areas. There are also regional differences with the North East and North West expected to see less growth than average and the most growth forecast for the East of England. As would be expected London is

³ Population being perhaps the best example as in NIC 2016d.

⁴ DfT 2012a.

⁵ DfT 2015a.

⁶ Scottish Government 2014a.

forecast to have the lowest road traffic growth but the estimates nevertheless paint a picture of substantial traffic pressures on the Capital's road network.

1.5 Whilst these estimates do not claim to be precise forecasts, they are a useful guide as to how travel demand is likely to develop; given what is known about current travel patterns and their causes and on reasonable expectations of how economic, social and, to a degree, technological conditions will change in future. The range is sufficiently broad to encompass reasonable sensitivity tests for appraisal of infrastructure projects. However, as in our earlier response, we believe that more attention should be paid to social and cultural changes (response⁷ to Q3).

1.4 Much of the technology that will affect our transport system over the coming two or three decades is already available in one form or another. The major uncertainties relate to its rate of adoption, the types of applications it will be used for and the role of public policies promoting, steering or regulating its use. The major changes that currently appear to be in prospect most likely to affect road transport are:

- changes in road vehicle traction systems – more efficient ICEs, hybrids, plug in electric (light) vehicles and, in due course, fuel cell drives;
- increased use of technology in vehicle operations ADASs (Advanced Driving Assistance Systems) and autonomous operations (Connected and Autonomous Vehicles (CAVs));
- improved information systems allowing more sophisticated travel planning, traffic operations and vehicle scheduling; and
- further improvements in general electronic communications which will aid transport operations but also allow more physical transactions to be replaced by electronic transactions.

1.5 It is also possible that we will see a migration toward electronic Pay As You Go (PAYG) charging systems for road use, e.g. for a more sophisticated congestion/emissions charging regime in London.

1.6 The first of these should allow the problems of fossil fuel dependency and road transport emissions (assuming a sympathetic national energy strategy) to be much reduced and, as such they should be positive for road transport. The second presents the greatest unknowns as this type of innovation is still at the 'nursery' stage and in a state of considerable flux. The Foundation believes that there is considerable scope to improve safety and ease the driving task by the use of this family of technologies but that, with present and prospective systems, it would be unwise to assume that there will be widespread use of autonomous vehicles which substantially increases the efficiency of all road use – although this may be possible on motorways and some expressways. A recent study for the DfT has concluded that CAVs could improve the operation of the Strategic

⁷ RACF 2016a.

Road Network and, when they form a substantial proportion of traffic, urban roads - but was not able to adequately represent the interaction of CAVs with cyclists, pedestrians and other non-motorised users and roadside activities⁸.

1.7 The recent emergence of drones has led to speculation that these will become a common means of home deliveries. However the costs, nuisance and safety considerations are likely to limit this to a range of niche markets; as is 'aerial congestion' in urban areas. Past predictions of mail being delivered by parachute in 1921 and the widespread use of personal helicopters in 1951⁹ have not come to pass as a result of insufficient attention to the laws of physics and economics.

1.8 Information on the operations of road and rail transport has been transformed since the turn of the century and most travellers are able to access information on existing travel conditions and, to a lesser extent, how these are expected to change in the near future. Improvements will continue to be made, with more widespread consumer information on parking availability and public transport crowding - and more immediate information on events causing travel disruptions. The challenge in this area is to provide more accurate information on prospective travel conditions further ahead – and to allow for the effects of this on traveller behaviour.

1.9 There is also a public interest issue as to whether travel advice should be used to manipulate travel behaviour (by for example spreading traffic between two or more routes to ease pressure on the preferred route) to moderate congestion. Developments of these technologies has the potential to improve road travel, but their effectiveness will depend on the availability of a range of acceptable travel options. A classic example of this problem is that of congestion on the SW-W quadrant of the M25 where the rerouting options are so poor that even perfect information for road users is unlikely to provide significant real-time improvement to traffic flow.

1.10 Increasingly rich and inexpensive electronic communications have been affecting the way firms conduct their business, people plan their lives and public and private service providers interact with their clients for many years. Whilst these have to potential to substitute electronic communications for some physical movements they also allow more efficient operation of transport systems and widen trading, market and social hinterlands so expanding travel potential. It would be unwise to assume that travel will be largely replaced by electronic transactions, although we might expect the nature (frequency, destination, duration etc) of that travel to change over time¹⁰.

⁸ Atkins 2016a.

⁹ Popular Mechanics 2011a.

¹⁰ Cairns estimated in 2004 that that with realistic levels of take-up, a direct substitution of car trips by van trips for shopping for food and other household items could reduce vehicle-km by 70% or more – clearly an over estimate.

1.11 The concept of ‘telecommuting’ goes back to the early 1970s¹¹ and is probably now not far off achieving maturity as a working practice. Internet shopping is still growing and has reduced shopping trips from home with shopping travel rates in England reducing by 13% between 1995/7 and 2012 compared with a 6½% reduction for other trips¹². To some extent this has been associated with an increase in van deliveries but if shopping travel were to reduce by a further 13% then this would reduce overall travel by 1½% before any compensating increase in van traffic was taken into account.

1.12 Teleconferencing is an established business practice and is used for a limited range of types of transactions however there are a number of good reasons why its impact will be limited unless the functionality of existing systems is significantly increased¹³. Again where it is used it can open up new (and more distant) business alliances which in turn may generate longer physical journeys. It would appear that the use of these technologies will have some limited effect on overall travel demand but more important impacts on patterns and times of travel.

1.13 Electronic Road Pricing is a well-established theoretical concept and its economic rationale clearly spelled out as long ago as 1952¹⁴. The technical and economic merits in the UK context were established as long ago as 1964¹⁵. The economic merits are widely accepted and, with the subsequent developments in Information and Communications Technology (ICT) the practicability is now beyond doubt. General acceptance of the widespread tracking of mobile communication devices might, to some extent, have eliminated concerns about personal location privacy but public and political resistance to its widespread use remains. The potential advantages of PAYG include¹⁶:

- moderation of the use of congested roads producing large economic savings;
- creation of a new and buoyant revenue stream to fund the maintenance, management and development of the road system;
- a reduction in the need for some of the most costly additions to the road system’s capacity; and
- providing a powerful indicator of where additional capacity is needed and how much it is worth paying for.

1.14 If an acceptable scheme for the introduction of PAYG road charging could be devised then the development of the national road infrastructure to meet future needs would be an easier task with funding assured and reduced congestion providing benefits for business and general motorists alike. But the fact, at the time of this evidence-gathering exercise, is that no such scheme has yet been devised – let alone achieved political acceptability – anywhere

¹¹ Niles 1998a.

¹² DfT 2016b.

¹³ Bublely 2015a.

¹⁴ Buchanan 1952a.

¹⁵ MoT 1964a.

¹⁶ DfT 2004a and Banks et al 2007a.

in the world, and that has not been for the want of trying. And in thinking about infrastructure needs, even a sophisticated and intrusive scheme that seeks to deter certain trips is likely to be indicative of an infrastructure shortfall, just doing so more accurately than might otherwise be the case. The advance of technology *per se* does not solve all of the practical challenges in bringing this particular piece of economic theory to life.

Q2: What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

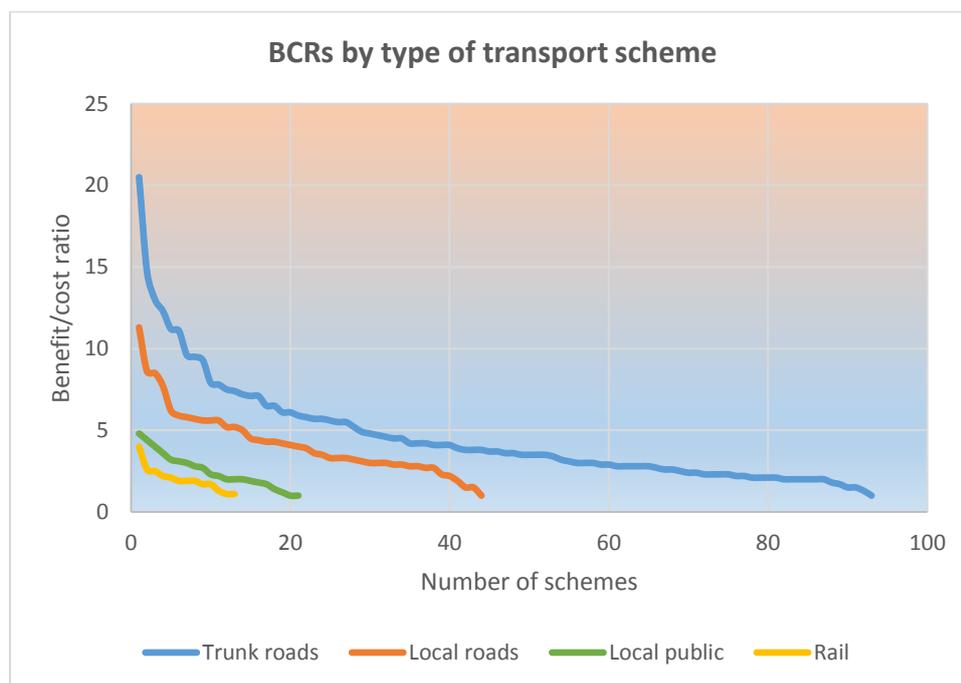


Figure 2.1: NATA¹⁷ B/C Ratios for a Range of Transport Projects by type

Source: Eddington 2016b.

2.1 Comparing the value of transport investments is complicated by the circumstances in which they are made. Thus a new freight railway may make a good deal of sense in linking a port to a major industrial complex but much less so in other situations. One of the most recent studies of the benefits and costs of a wide range of transport investments was carried out as part of the Eddington Study¹⁸. As part of this, evidence was gathered on the findings of appraisals of roundly 170 transport projects and further assessment was carried out on a few others. The distributions of Benefit:Cost ratios from this work for four different types of projects are shown in figure 2.1. These excludes a few projects such as public transport service & fare changes and canal path schemes, which are recreational in nature, as these are not strictly 'transport infrastructure' projects.

2.2 Local road projects appear to give the best value for money using the NATA assessment with an average B/C ratio of 4.71:1 followed by trunk roads at 4.15:1. Local public transport schemes were found to have an average B/C ratio of 2.64:1 and major rail projects 1.9:1. The analysis also classifies schemes by geographic type (inter urban/rural, urban and major city) and, in some cases separated out the freight and business benefits.

2.3 For local roads business benefits were double the (total) costs of the schemes. In the case of trunk roads benefits to business were 90% more than their (total) costs. For major

¹⁷ DfT 2012b.

¹⁸ Eddington 2006a.

rail schemes these benefits amounted to 75% of costs and for local public transport projects half the scheme costs.

2.4 The Eddington study showed that major rail and local public transport schemes were most often designed to facilitate passenger (but not freight) movements in and out of major urban areas with most trunk roads helping inter-urban travel (both passenger and freight). However inter-urban travel also included longer distance movements between major urban area and their hinterlands. Of the trunk roads schemes that helped movement into and out of large urban areas those on the periphery of metropolitan area stood out – particularly the M25 around London.

2.5 We would counsel the Commission to think laterally about its definition of ‘urban areas’. As has already been noted in the Commission’s work, it is impossible to separate thinking about network infrastructure from thinking about housing and household formation. The highest value transport interventions might well prove to be those which link new housing to established commercial/industrial/employment areas in, and around, cities.

Q3: What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

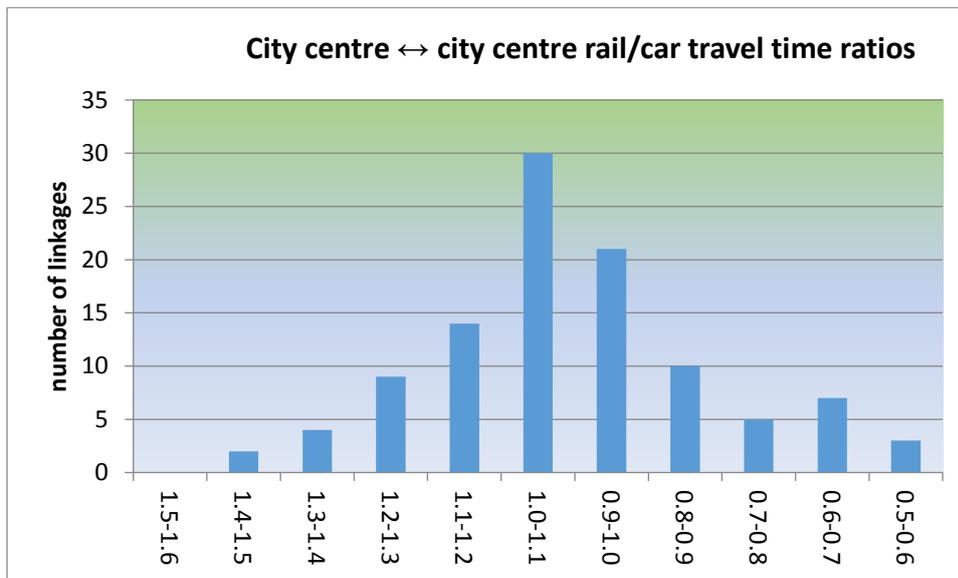


Figure 2.2: Distribution of Rail/Car Travel Times between selected British City Centres

Source: Google 2014a.

3.1 It is useful to clarify the respective travel time (as a major determinant of mode choice) advantages of road and rail – the two main form of domestic transport infrastructure in the UK - for journeys between different types of settlement. Figure 2 shows the ratios travel times by road and rail between the centres of 15 British cities. In 59 cases car travel is faster whilst in 56 cases rail is faster. So for these types of journeys rail times are very competitive with car travel the overall ratio is unity. Between city suburbs (see figure 2.3) however the picture is rather different with 85% of linkages having faster times by car. These are for large cities as there is scarcely any suburb ↔ suburb rail travel in medium sized and smaller urban areas and even some of these will involve bus access to the rail network. The overall average ratio here is 1.32:1.

3.2 Between nearby towns rail will often not be a practicable means of transport as buses and coaches will provide a faster (and cheaper) service. Figure 2.4 shows the distribution of relative public transport/car travel times between towns that are well enough apart for rail to be a reasonable travel option. Some of these journeys will have gone by road based public transport so this is probably a favourable picture of the rail/car ratios. The overall average for these types of journeys is 1.8:1.

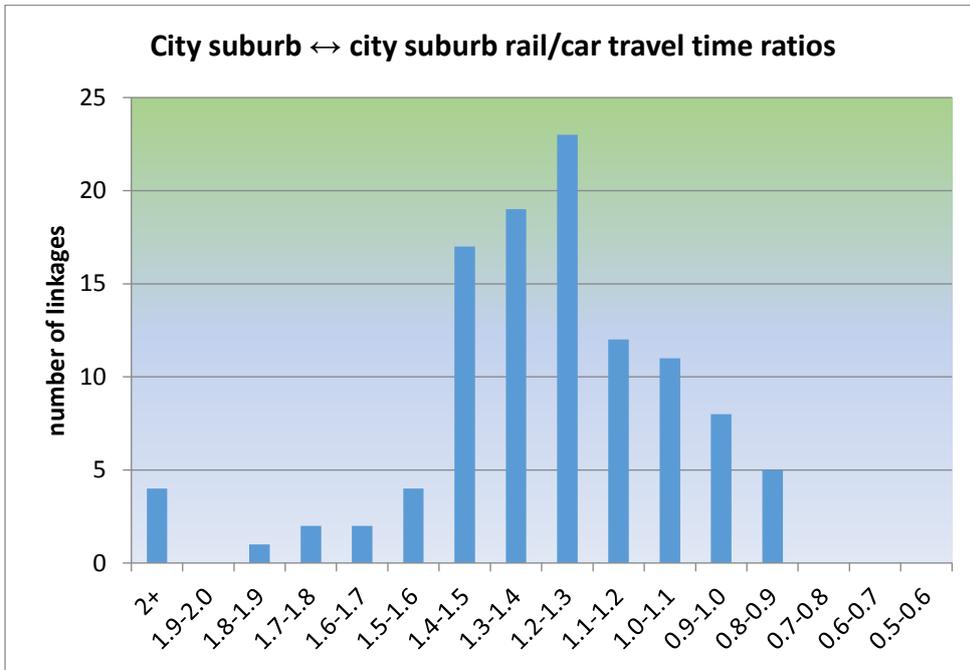


Figure 2.3: Distribution of Rail/Car Travel Times between selected British City Suburbs

Source: Google 2014a.

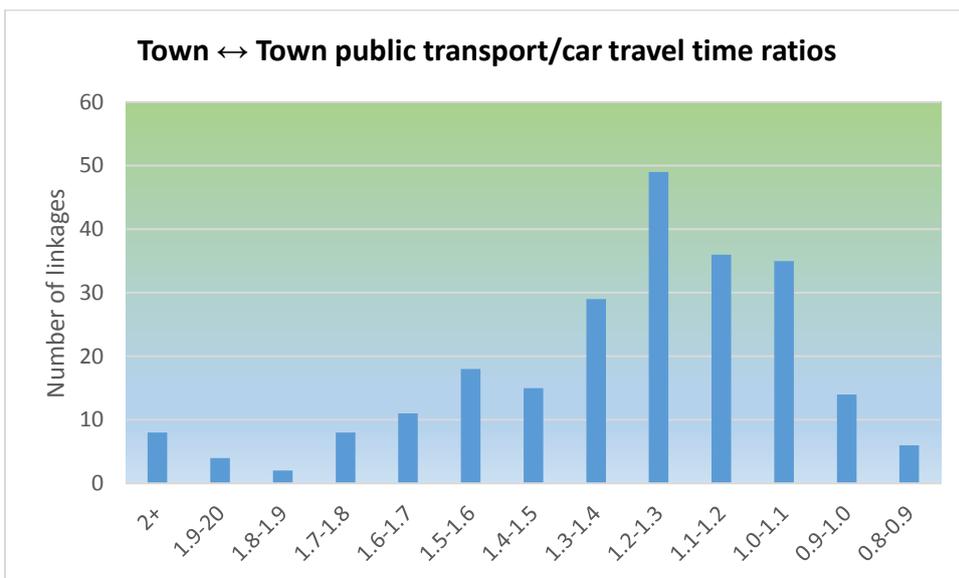


Figure 2.4: Distribution of Rail/Car Travel Times between selected British Towns

Source: Google 2014a.

3.3 Whilst these comparisons are illustrative they clearly indicate that road and serve different travel sectors with rail being strongest in intercity and metropolitan commuter markets and road in a wider range of markets with least potential in central commuting and between the centres of cities.

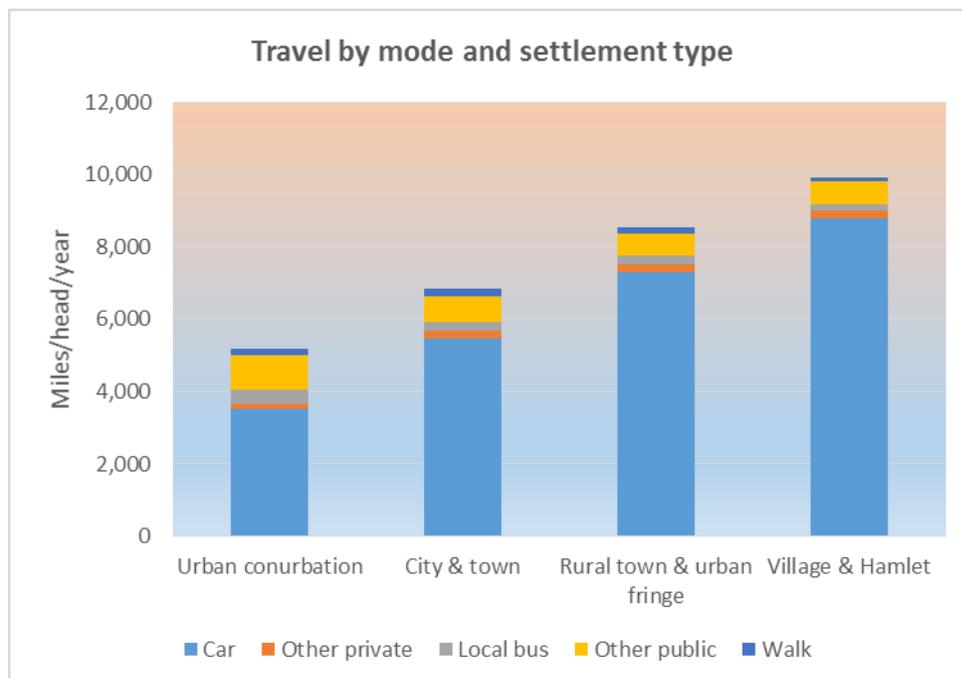


Figure 2.5: Travel by Mode of Transport and Settlement Type – England 2014/15

Source: DfT 2016j.

3.4 Figure 2.6 shows how the use of different forms of transport changes with settlement type. Whilst cars generally are the dominant mode both bus and other public transport modes (including rail) reduce with settlement size. Given that non local bus public transport will be less rail orientated the smaller the settlement (many small towns and villages have limited or no direct rail services) it is fair to conclude that residents free standing towns will make between 350 and 500 miles of rail travel a year compared with 6,000- 8,000 by road transport. This is consistent with the analysis set out in figures 2.2, 2.3 & 2.4. (See also para 2.4 above).

3.5 The geography of the location will play an important part in determining the merits of different types of investment. Towns located at important rail nodes (e.g. Carlisle, Crewe, Derby, Peterborough, Stafford and Wolverhampton) will have a significant use of rail for medium and long distance access whereas others which are not (e.g. Barrow, Ipswich, Leicester, Newquay and Plymouth) less so.

3.6 23m international passenger journeys were by sea in 2015¹⁹ compared with 201m by air²⁰ and 21m via the Channel Tunnel. Air transport is consequently the most important for international passenger movements. Figure 2.5 shows the means of passenger access to the 15 UK's major airports. Seven of these rely almost exclusively on various forms of road transport for passenger access. The London airports rely substantially on rail access; as do those of Birmingham and Manchester. All of these have 'direct' connections between the airport and the city centre which provides convenient access for business personnel and

¹⁹ DfT 2016d.

²⁰ DfT 2016e.

tourists based in the centre and indirectly, via the metropolitan public transport system, to a wider area. Clearly road access is important for all airports (for both passengers and freight) but where corridor flows are sufficiently high or where a low cost linkage allows airport travel to 'piggy back' on other rail services the case for expanding rail access to a wider range of airports should be considered – there being 18 UK airports with throughputs greater than 25m passengers/year²¹.

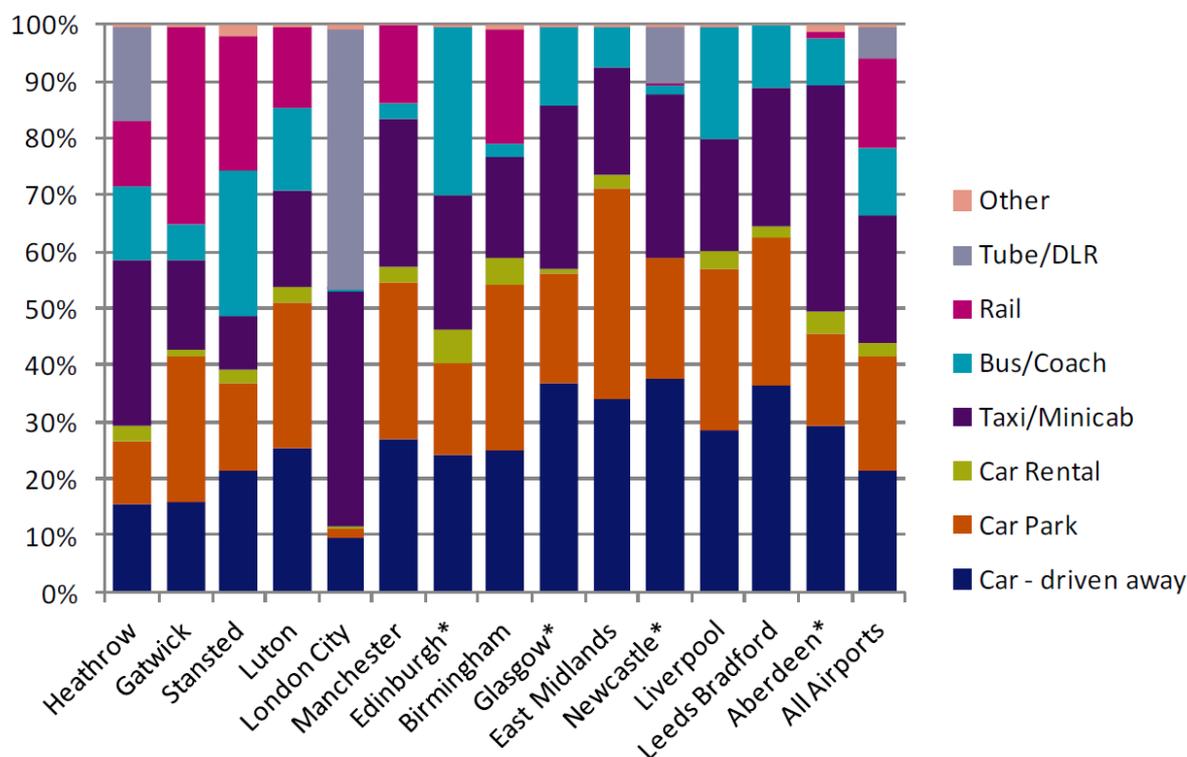


Figure 2.6: Means of Passenger Access to Large UK Airports 2013/14.

Source: CAA 2016a.

3.7 International freight (by weight) is carried mainly (94%) by sea, 5% by Channel Tunnel and the remaining 1% by air (although this is higher value freight)²². Of the channel tunnel freight over 90% is carried by lorries using the Shuttle²³. Overall about three quarters of European international freight is carried by road in the UK²⁴ so road transport is very important for ports access but rail also provides linkages of varying value to eighteen of the UK's 54 sea ports²⁵.

3.8 As a rule free standing towns have no direct rail sidings and only 48 intermodal rail sites²⁶ – mostly at ports and in large industrial complexes rail access to these towns for the carriage of goods will be negligible. Again this points to road improvements as the most

²¹ CAA 2016b.

²² DfT 2016f, DfT 2016g, DfT 2016h, DfT 2016i and Eurotunnel 2016a.

²³ Eurotunnel 2016a.

²⁴ DfT 2006a.

²⁵ DfT 2016h & Network Rail 2017a.

²⁶ Network Rail 2017a.

10 February 2017

useful way of improving access and connectivity to these towns and, because of their more local hinterland than the large cities and conurbations, these are likely to involve a mixture of trunk and local authority schemes.

Q4: What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?

4.1 Road users are presently charged for using public highways through vehicle excise duty and fuel duty. If these were replaced, in whole or in part, by an electronic PAYG system then there would be opportunities for closer integration of payments for road use and other transport services. The most obvious of would be to extend the road charging account to include, vehicle hire, fuel and parking services. In principle this could be extended to other modes of paid for surface transport such as taxi, bus, tram, and rail - and the larger the PAYG (as opposed to ownership) costs element included the less incongruent the charge rates would be so removing the bias of car or season ticket ownership.

4.2 This would allow a mixture of market (e. g. fuel) prices and social (e.g. congestion and pollution) prices to be included in the charges levied to users making, in theory at least, a level playing field for all forms of surface transport. A regime of this kind was advocated by McLean Hazel in a study for the Foundation in 2010²⁷ but so far there have been only limited examples of significant applications. Within the public transport sector the London Oystercard is a good example of paying for a service rather than an individual journey, in offering multi - (public) modal travel on a period and PAYG basis. Within the private transport sector both cycle hire and car club schemes provide a combination of ‘service’ (membership fee) and PAYG (time used) charges so are a form of hybrid conventional/mobility service.

4.3 Examples of public/private mobility services are uncommon, but a long established example is the Annual Travel and Mobility card offered by the Zurich public transport operator²⁸. This allows users to unlimited public transport access to Zurich’s public transport system as well as a fleet of cars both in Zurich and across Switzerland – but does include an hourly charge for occasional – but not full tariff - car users. Where most urban public transport operators extend their tickets to include other services however, there are usually in the form of discounts for entry to tourist attractions or discounted charges at restaurants, served by the public transport network.

4.4 Overcoming the fragmentation of ownership, sponsorship, regulation and pricing of the various modes of transport is a formidable task but a mandatory system of PAYG charging for road use has the potential to greatly ease this is the knotty problems - if revenue allocation can be satisfactorily resolved. This could promote a more efficient use of the main modes of transport, increase consumer choice and provide rational funding for the operation, maintenance and development of transport system.

²⁷ MRC 2010a.

²⁸ VBZ 2017a.

Sources

- Atkins (2016a), *Research on the Impacts of Connected and Autonomous Vehicles (CAVs) on Traffic Flow: Summary Report*, Department for Transport, January 2017, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/530091/impacts-of-connected-and-autonomous-vehicles-on-traffic-flow-summary-report.pdf
- Banks N. Bayliss D. & Glaister S.G., (2007a), *Roads and Reality*, December 2007, http://www.racfoundation.org/assets/rac_foundation/content/downloadables/roads_and_reality-glaister_et_al-041207.pdf.
- Bubley D., (2015a), *Videoconferencing does not replace business travel*, June 2015, <https://www.linkedin.com/pulse/videoconferencing-does-replace-business-travel-dean-bubley>
- Buchanan J. M., (1952a), *The Pricing of Highway Services*, National Tax Journal, Washington D.C. 1952.
- Cairns S., (2007a), *Delivering supermarket shopping: More or less traffic?*, February 2007, <http://www.tandfonline.com/doi/abs/10.1080/0144164042000218391>
- Civil Aviation Authority, (2016a), *Review of market conditions for surface access at UK airports Final Report, CAP 1473*, December 2016, <http://publicapps.caa.co.uk/docs/33/CAP%201473%20DEC16.pdf>.
- Civil Aviation Authority (2016b), *Size of UK Airport 2015 compared to 2010*, Retrieved 4th January 2017 from <https://www.caa.co.uk/Data-and-analysis/UK-aviation-market/Airports/Datasets/UK-Airport-data/Airport-data-2015/>.
- Department for Transport (2004a), *Feasibility study of road pricing in the UK - Full report*, July 2004, https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/DfT%20road%20pricing%20feasibility%20study.pdf.
- Department for Transport (2006a), *Focus on Freight*, TSO, London, December 2006,
- Department for Transport (2012a), *National Transport Model - Working Paper 1*, January 2012, <http://webarchive.nationalarchives.gov.uk/+http://www.dft.gov.uk/pgr/economics/ntm/pdfnatransmodwp1.pdf>.
- Department for Transport (2012b), *Transport appraisal and modelling tools*, October 2012, <https://www.gov.uk/government/collections/transport-appraisal-and-modelling-tools>.
- Department for Transport (2015a), *Road traffic forecasts 2015*, March 2015, <https://www.gov.uk/government/publications/road-traffic-forecasts-2015>.
- Department for Transport (2016b), *Average distance travelled by trip purpose: England, 1995/97 to 2015, Table NTS0404*, July 2016, <https://www.gov.uk/government/statistical-data-sets/nts04-purpose-of-trips>.
- Department for Transport (2016c), *Mode of transport to selected UK airports Table TSGB0207 (AVI0107)*, 2005-2015, December 2016, <https://www.gov.uk/government/statistics/transport-statistics-great-britain-2016>.

Department for Transport (2016d), *UK international sea passenger movements, by port and port area: 1950-2015, Table SPAS0101*, December 2016, <https://www.gov.uk/government/statistical-data-sets/spas01-uk-international-sea-passengers>.

Department for Transport (2016e), *International passenger movements at UK airports by country of embarkation or landing, 2005-2015, Table TSGB0205 (AVI0105)*, December 2016, <https://www.gov.uk/government/statistical-data-sets/avi01-traffic-passenger-numbers-mode-of-travel-to-airport>

Department for Transport (2016f), *Channel Tunnel, traffic to and from Europe: annual from 1994, Table TSGB0607 (RAI0108)*, December 2016, <https://www.gov.uk/government/statistical-data-sets/rai01-length-of-route-distance-travelled-age-of-stock>.

Department for Transport (2016g), *UK major and minor port freight traffic, international and domestic by direction: 1965 – 2015, PORT0102*, September 2016, <https://www.gov.uk/government/statistical-data-sets/port01-uk-ports-and-traffic>.

Department for Transport, (2016h), *Summary of domestic and international road freight by UK HGVs, annual and quarterly: 2004 to 2015, Table TSGB0433 (RFS0144)*, December 2016, <https://www.gov.uk/government/statistics/transport-statistics-great-britain-2016>

Department for Transport (2016i), *Air traffic, United Kingdom airports: 1950 to 2015, Table TSGB0201 (AVI0101)*, <https://www.gov.uk/government/statistics/transport-statistics-great-britain-2016>.

DfT (2016j), *Average distance travelled by mode, region and Rural-Urban Classification: England, 2014/15, Table NTS9904*, September 2016, <https://www.gov.uk/government/statistical-data-sets/nts99-travel-by-region-and-area-type-of-residence>.

Eddington R., (2016a), *The Eddington Transport Study*, December 2006, <http://collections.europarchive.org/tna/20100408160254/http://www.dft.gov.uk/adobepdf/187604/206711/executivesummary.pdf>.

Eddington R., (2006), *Evidence base for the Eddington Study's strategic assessment of returns to transport investment*, DfT, December 2006.

Eurotunnel, (2016a), *Traffic volumes for the past 10 years*, Retrieved 4th January 2017 from <http://www.eurotunnelgroup.com/uk/eurotunnel-group/operations/traffic-figures/>.

Google Maps, (2014a) *Directions*, Retrieved November 2014 from <https://www.google.co.uk/maps/@52.8382004,-2.3278149,6z>

Ministry of Transport, (1964), *Road Pricing: The Economic and Technical Possibilities*, HMSO, London, 1964.

MRC McLean Hazel, (2010a), *Complete Mobility Providing Transport as a Service*, RAC Foundation September 2010, http://www.racfoundation.org/assets/rac_foundation/content/downloadables/achieving%20complete%20mobility%20-%20mrc%20mclean%20hazel%20-%20main%20report.pdf.

National Infrastructure Commission (2016a), *The National Infrastructure Assessment Process and Methodology: Call for Evidence*, May 2016,

<https://www.gov.uk/government/consultations/national-infrastructure-commission-call-for-evidence/national-infrastructure-commission-call-for-evidence>.

National Infrastructure Commission (2016b), *The National Infrastructure Assessment Process and Methodology: Consultation Response*, October 2016,
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/563529/NIA_consultation_response_October_2017.pdf.

National Infrastructure Commission (2016c), *The National Infrastructure Assessment: Call for Evidence*, October 2016,
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/563516/NIA_call_for_evidence_October_2017.pdf

National Infrastructure Commission (2016d), *The Impact of Future Population Change and Demography on Future Infrastructure Demand*, December 2016,
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/579986/Population_and_Demography.pdf

Network Rail (2017a), *Intermodal Rail Sites*, Retrieved 5th January 2017 from
<http://www.networkrail.co.uk/searchresult.aspx?q=Ports>.

Niles J., (1998a), *Thoughts on the Future of Telecommuting*, Fleming Ltd., January 1998,
<http://www.davidflemingltd.com/commentary/Jack%20Nilles.htm>

Popular Mechanics (2011a), *The Future That Never Was: Pictures from the Past*, January 2011,
<http://www.popularmechanics.com/flight/g462/future-that-never-was-next-gen-tech-concepts/>

RAC Foundation (2016a), *Response to the Consultation on the National Infrastructure Assessment*, RACF, London, August 2016.

Royal Academy of Engineering (2015a), *The transport congestion: challenge getting the most out of the UK's road and rail networks*, November 2015,
<http://www.raeng.org.uk/publications/reports/the-transport-congestion-challenge>.

Scottish Government (2014a), *Ambition · Opportunity · Place: Scotland's Third National Planning Framework*, June 2014, <http://www.gov.scot/Resource/0045/00453683.pdf>.

VBZ (2017a), *Annual Travel Card and Mobility*, Retrieved 6th January 2017 from
<http://www.zvv.ch/zvv/en/travelcards-and-tickets/travelcards/networkpass-mobility.html>

Rail Delivery Group

Response to consultation:

The National Infrastructure Assessment: Call for Evidence

Date: 10 February 2017

Rail Delivery Group response to consultation: The National Infrastructure Assessment: Call for Evidence

Name: [Name redacted]

Organisation: Rail Delivery Group

Address: 200 Aldersgate Street, London EC1A 4HD

Business representative organisation.

Introduction: The Rail Delivery Group (RDG) was established in May 2011. It brings together Network Rail and passenger and freight train operating companies to lead and enable improvements in the railway. The purpose of the RDG is to enable Network Rail and passenger and freight train operating companies to succeed by delivering better services for their customers. Ultimately this benefits taxpayers and the economy. We aim to meet the needs of:

- Our Members, by enabling them to deliver better outcomes for customers and the country;
- Government and regulators, by developing strategy, informing policy and confronting difficult decisions on choices; and
- Rail and non-rail users, by improving customer experience and building public trust.

For enquiries regarding this consultation response, please contact:

[Name redacted]

[Job title redacted]

[Email address redacted]

[Telephone number redacted]

Rail Delivery Group
2nd Floor, 200 Aldersgate Street
London EC1A 4HD

Overview

The Rail Delivery Group (RDG) welcomes the opportunity to contribute to the National Infrastructure Assessment Call for Evidence. The response has been led by the RDG Planning Oversight Group, who's remit is to provide strategic planning information for decision makers, including overseeing the Long-Term Planning Process work at Network Rail.

The key points of the RDG's response are as follows:

- In recent years, Britain has had the fastest growing and safest railway in Europe. Rail journeys have doubled in the last 20 years and are expected to double again by 2040. Over the last decade the industry has also halved the subsidy required per passenger. Today the industry generates sufficient revenue to cover its day to day running costs. This is a remarkable success story.
- This success has delivered much for the country but leaves the industry with significant challenges to deliver the capacity and the level of service customers expect. There are specific parts of the network where the level of performance and crowding has reached unacceptable levels and this must be addressed as a priority.
- The rail industry is already working with its funders and stakeholders to deliver a range of infrastructure investments which will support the growth of the economy at a national, regional and local level. However, these will only just be able to keep pace with expected levels of demand growth.
- The highest value infrastructure investments proposed by the rail industry are those which seek to address the most severe performance and crowding challenges on the network. The capacity of the rail network to carry more passengers and freight services is fundamental to the industry delivering more punctual comfortable journeys, and ultimately supporting and driving a number of socio-economic benefits.
- Through its Long Term Planning Process (LTPP), the rail industry has agreed long term forecasts for passenger and freight demand, and has developed a further 'pipeline' of enhancements to address anticipated capacity bottlenecks.
- Alongside conventional infrastructure solutions, the more widespread use of digital signalling technologies could provide an alternative means of increasing the capacity of the network. These technologies are being developed as part of the industry's extensive modernisation agenda.
- The industry is working to diversify its sources of funding, moving away from a historic reliance on government funding and investigating the potential for greater private financing.

Cross-cutting issues

Q1: What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

The railway plays an essential role supporting sustainable economic growth, by enabling the safe, fast and efficient movement of large volumes of passengers and goods into and between major economic centres, their catchments, and international gateways. The rail network is particularly important to the success of large urban areas, where some of the most productive parts of the economy are based. The huge volumes of commuters carried by the railway drive the economic growth of the nation.

Great Britain has one of the fastest growing railways in Europe and the second most intensively used – passenger journeys have more than doubled since 1996, adding up to over 1.69 billion journeys per year. £30 billion of goods are moved by the freight sector every year, equating to £10.1 billion of added value that the rail sector contributes to the UK economy every year. In addition, the supply chain employs around 120,000 with an estimated annual economic contribution of around £7 billion. However, the significant growth in demand brings both benefits and challenges – the performance of the network has become inadequate in many areas, and passengers experience levels of crowding well beyond acceptable levels.

The rail industry is already working with its funders and stakeholders to deliver a range of infrastructure investments which will support the growth of the economy at a national, regional and local level. Current initiatives such as the 'Northern Powerhouse' are a positive step towards a more polycentric pattern of economic and urban development in Great Britain. It is recognised that a more even pattern of economic development across the country would in itself lead to a more efficient, effective and even utilisation of railway resources over the network.

The Thameslink and Crossrail projects are nearing completion, and both will deliver a significant increase in capacity on services into London, and will dramatically reduce journey times by providing new cross-London journey opportunities. Across the North of England, a more diverse range of services will be able to operate as a result of the Ordsall Chord - a short stretch of line linking the cities of Manchester and Salford scheduled to begin passenger operation in December 2017.

Looking further ahead, government and the National Infrastructure Commission have both expressed their support for four schemes which will transform the rail network:

- HS2, which will provide fast, high capacity services between London, Leeds, Manchester, the East and West Midlands and South Yorkshire. The integration of HS2 with the existing network will also allow for faster direct trains to cities such as Liverpool, Newcastle, Glasgow and Edinburgh; and will increase capacity for freight on the conventional network.
- Crossrail 2, which will transform travel across London and the wider South East, linking destinations to the South West and North East of London with direct train services.
- Northern Powerhouse Rail (also referred to as HS3), the strategic priority for providing significantly better rail links between the key economic centres in the North. The project is aimed at transforming the rail journeys between the key economic centres of Leeds, Manchester, Liverpool, Newcastle, Sheffield and Hull, together with Manchester Airport.
- East West Rail, which will provide improved connectivity by providing new and rehabilitated infrastructure along the corridor between Oxford, Milton Keynes and Cambridge.

Through its LTPP, and ongoing dialogue with funders and stakeholders, the industry has identified a further range of recommendations designed to enhance the capacity and connectivity of the railway. The LTPP consists of a number of different elements, which, when taken together, seek to define the future capability of the rail network over a 30-year horizon¹:

- Market Studies forecast future rail demand, and develop conditional outputs for future rail services. These outputs are based on stakeholders' views of how rail services can support delivery of the industry's strategic goals – covering economic growth, reducing environmental impacts, enhancing quality of life and improving affordability.
- Route Studies develop options for future services and identify options for investment in specific areas of the network. Options are based on the conditional outputs and demand forecasts from the Market Studies, and are assessed against economic appraisal criteria to provide choices for funders.
- Cross-Boundary Analysis considers options for services that run across multiple routes, providing consistent assumptions across Route Studies.
- Network Studies consider network wide issues such as providing capacity for freight, or enhancing the inclusivity of the railway.

Each study or analysis is delivered through a Working Group, including funders and train and freight operators, which will consult wider stakeholders such as local authorities, passengers, freight users and their representatives and Local Enterprise Partnerships as part of their work. A Board oversees the delivery of the work and all studies will be published on Network Rail's website in draft form and subject to consultation for 90 days. The final study will then be established within 60 days of its publication subject to approval from the Office of Rail and Road.

Through its LTPP the industry has identified the scale of the capacity challenge on the network. This shows that:

- The volume of rail passengers into London in the peak hour is three times the combined volume of all other urban centres.
- The level of crowding (expressed as number of passengers to available seats) on services into London today is, on average in the peak hour, a third more severe than on any other parts of the network into major urban centres.
- Nine of the ten busiest stations in the country are in London (Birmingham New Street is the exception). Over the past 20 years, passenger demand at London Waterloo, the country's busiest station in terms of passenger numbers has doubled.

Whilst the committed programme of enhancements will provide a 10% increase in peak seats into central London (relative to current levels), and a 30% increase in overall capacity, this will only broadly be able to keep pace with the expected increase in demand.

These aggregate figures mask significant variation between routes. Standing is common on many inner suburban services, in part reflecting the fact that these trains are designed to carry high volumes of standing passengers over short distances. Of greater concern is standing on outer suburban and long distance services, given the longer journey lengths and resulting need for some passengers to stand for long periods of time. Without further interventions, the Brighton and South West Main Lines are expected to be experiencing severe levels of crowding by 2026, with some passengers having to stand for over 30 minutes. The industry is developing proposals to address the severe capacity challenges it faces on these routes, which should be taken forward as a priority.

Recent work undertaken under the auspices of the LTPP has also identified a number of stations that need congestion relief schemes. A combination of years of under-investment in stations (apart from a select few such as Reading, Birmingham New Street and London King's Cross), as well as significant passenger growth, will lead to many stations being severely overcrowded in the coming years. Priority stations to be addressed in the short term comprise Clapham Junction, London Liverpool Street and London Euston.

Alongside additional physical infrastructure, digital signalling technology can offer a less disruptive approach to increasing the capacity of the network, in turn supporting sustainable economic growth. Other industries, from aviation, to roads, and the London Underground, have already unlocked significant additional capacity through digital control systems. Rail has the opportunity to make use existing technology, similar to systems currently being used on the London Underground, and due to be deployed in the coming months and years on Thameslink, Crossrail and HS2.

The industry's vision for new technologies is set out in the recent Rail Technical Strategy Capability Delivery Plan², which covers 12 Key Capabilities (KCs). One example is KC02: 'Minimal disruption to train services'. This aspires towards 100% availability of assets when needed, which requires investment in a range of technologies and new approaches to infrastructure renewal and maintenance, for example in real time asset intelligence that leads to 'predict and prevent', coupled with a far more modular approach to infrastructure assets that leads to rapid 'swap in, swap out' replacement. Lowering the cost of the infrastructure will also be a significant contributor to long-term sustainable growth and opportunities for connecting communities, particularly on less intensively used parts of the network. KC11: 'Low-cost railway solutions', is focused on this.

Finally, infrastructure investment in a number of key areas will enable the freight sector to realise its potential in serving the British economy and driving down carbon dependency:

- A rail network fit for freight: dedicated investment in a Strategic Freight Network linking key deep sea, short sea and bulk ports with the terminals and railheads serving centres of production, distribution and consumption.
- Railheads and terminals: a network which adequately reflects projected traffic levels and patterns

- Network performance and availability: enhancing the capability of the network to support longer, heavier and faster freight trains.

Beyond these priority investments, the interventions identified by the LTPP form a further 'pipeline' of choices for funders covering the entire network. These are designed to be taken forward on a rolling basis, as and when individual projects reach sufficient design maturity, enabling better alignment with franchising and facilitate a broader range of funding models.

Q2: How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

The government's recent industrial strategy³ identifies upgrading infrastructure as one of its 10 key pillars for driving growth. As the strategy indicates, high quality transport infrastructure can reduce delays, and raise productivity by enabling towns and cities to achieve agglomeration effects, supporting the rebalancing of the economy.

An effective, extensive and reliable rail network can effectively bring cities and their catchments closer together, opening up new markets, improving access to extensive pools of labour, providing new employment opportunities, encouraging the transfer of knowledge and improving the efficiency of supply chains. Rail can support this in four key ways:

- Connectivity – by providing higher frequencies, new direct services, more convenient connections and reduced journey times. Connectivity to other modes; whether air, sea or local modes, is also key.
- Capacity – providing sufficient seats or standing space to allow sufficient numbers of passengers to undertake the journeys they need to make.
- Performance – providing a reasonable level of certainty of journey duration to allow passengers and businesses to plan effectively, avoiding spending unproductive time on disrupted services, or having to allow additional time for their journeys in the anticipation that services could be disrupted. For goods markets especially, competitiveness is extremely sensitive to journey time.

Through its LTPP and ongoing dialogue with funders the rail industry has set out a series of interventions to improve the connectivity, capacity and performance of the network.

Improving access to ports is one of the key priorities for the rail freight strategy. As referenced in the response to Q1, the Strategic Freight Network aims to provide a freight-capable network linking ports with inland terminals close to the main centres of population. The priority investment corridors to improve access to ports comprise:

- Felixstowe / North corridor: the priority freight scheme to establish a direct freight capable route from Felixstowe through the Midlands to the North West avoiding London. This will become the country's high capacity arterial maritime intermodal import/export corridor, enhanced through a programme of interventions to address bottlenecks at Haughley Junction, Soham, Ely, Peterborough, and Leicester.
- Solent / North West corridor: linking the UK's second largest deep sea port to the distribution and manufacturing heartlands of the West Midlands and North West, serving both import maritime intermodal traffic and export automotive traffic. Beyond near term initiatives to optimise train lengths ultimately line of route capacity will become constrained with the interaction of forecast passenger and freight volumes, potentially requiring major interventions such as grade separation at Basingstoke.
- Trans Northern corridor: the work of Transport for the North in developing Northern Powerhouse Rail offers a new northern rail freight opportunity, building on the major port developments in the

Liverpool and Hull and Humber City Regions. It demands identification and development of a freight capable Trans-Pennine corridor serving intermodal and industrial traffic between manufacturing centres and ports, and bulk construction flows serving northern cities.

- Cross-London corridor: enhanced cross-London freight capacity on the North London and Gospel Oak to Barking lines through the development of 'filter lanes' to separate the movement of freight services joining/leaving these orbital London lines from the high frequency passenger service. This would be underpinned by rerouting of non-London destined traffic through the Felixstowe/North Corridor (where this offers a more direct route) and the realisation of a Thameside Nodal Yard complementing that established at Wembley.

Rail links to and from airports and ports can be considered to be gateways to the country. However, the current quality of these links is variable; therefore, more targeted investment to make all airport and port links an equivalent standard is therefore desirable.

The enhancements pipeline includes a number of schemes specifically designed to increase train ridership to airports, including Western Access to Heathrow and enhancements to the passenger circulation facilities at Gatwick Airport station. Responding to the work of the Airport's Commission, the Government has recently agreed that the most appropriate way to increase airport capacity in the South East is through a third runway at Heathrow. In making this decision the Department for Transport (DfT) noted that Heathrow Airport already has good rail and road links, but in future these will be improved by direct access from Heathrow to Crossrail and linked to HS2 at Old Oak Common. Network Rail's report into Southern Access to Heathrow published in April 2016 identified significant economic benefits could be accrued by a link from Heathrow Airport into the existing South West Trains network near Staines. Such a scheme would enable direct services from a wide range of towns in Surrey, Hampshire and South West London to the airport.

Rail infrastructure can most effectively contribute to the UK's competitiveness more directly, through the development of new rail technologies and talent, which could allow the UK to export expertise and skills. The industry has set out a modernisation agenda which will accelerate the adoption of new technologies and working practices, with the aim of strengthening efficiency, enhancing the skills of the workforce and ultimately the quality of the customer experience. The industry intends to use the opportunity of delivering these priorities to realise the wider economic potential of a vibrant, world-class UK-based supply chain by collaborating with the Rail Supply Group to deliver their strategy 'Fast Track to the Future'. Rail investments form a significant part of the potential workload for the UK-based supply chain, and provide the confidence to support investment in skills, equipment and innovation. This investment will support efficient delivery and provide a platform for import substitution and, ultimately, an increase in exports.

Q3: How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

The best way to assess and deliver the benefits of better places to live and work is to collaborate effectively with a variety of stakeholders throughout the design, planning and delivery process. Relevant stakeholders include funders, business groups, local authorities, operating companies, and user groups. The rail industry's planning processes already encourage extensive stakeholder involvement: in the Market Studies, future demand and requirements (expressed as 'conditional outputs') of the rail network were built upon stakeholders' views, and thorough review of how rail services can support delivery of the market's strategic goals. In Route Studies, when options are developed for geographically aligned routes they are assessed against the identified market study outputs, funder and stakeholder criteria, and an early assessment of value for money.

Early stage planning and design could arguably be further improved to focus upon 'better places to live and work' through increasing consideration of social value planning and wider benefits in the appraisal of options. Wider benefits such as community improvement, jobs creation, and social value can be difficult to capture in an economically aligned business case. Effective project sponsorship will be key to providing an infrastructure option which delivers the benefits outlined in earlier integration of strategies and planning.

There is also the opportunity to promote rail and the industry as a 'good neighbour' that will introduce new technology and ways of working that, for example, minimise the impacts of infrastructure maintenance on neighbours (noise, vibration) through better design and operation.

It is important that housing and more sustainable transport modes are considered jointly. Ideally, development planning should be integrated with transport planning; ensuring higher densities of development around transport nodes, and the appropriate distribution of employment opportunities. Improving bus or cycle connectivity to existing stations may provide the connectivity to support development as part of a wider transport strategy.

Where contingent developments such as housing are dependent upon infrastructure, early collaboration and integration are key to successful delivery of ultimate benefits. For example, large housing developments can deliver benefits of better living and working if they are situated near a station. However, aspirations for new stations need be considered carefully alongside the market characteristics and long term plans for the corresponding rail corridors. The construction of new stations on congested parts of the network, or where the adding a new stop would disadvantage long distance passengers, can act to contradict other industry objectives such as reducing journey times or increasing capacity.

For the rail sector, the railway station is the key interface where the industry has the opportunity to help create better places to live and work. Its 'Vision for Stations'⁴ sets out nine principles to help achieve this:

- Customer focused
- Intelligent use of technology
- Seamless journey experience
- Reflect local needs and opportunities
- Safe and secure environment
- Entrepreneurial spirit
- Flexible and long-term stewardship
- Shared industry know-how
- Optimised network

The industry recognises the need to support an enhanced role and profile of stations within the communities of Britain through facilitating them as demonstrators of technology, active supporters to local small businesses and community organisations.

The rail industry also recognises the need to engage with other wider policy such as industrial strategy, land use and housing planning to help ensure a closer match between rail demand and capacity. It is committed to encouraging new ways of delivering its plans by engaging with a wider range of partners.

Q4: What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

As discussed in the response to Q1, demand for rail infrastructure services has increased consistently in recent years, and is set to continue under any forecast scenario. Where demand is expected to outstrip capacity, the LTPP works to identify options to address the resulting gap. Notwithstanding required infrastructure enhancements of varying scales, in a capital and capacity constrained environment, demand management can provide additional tools to alleviate or redistribute some demand for the benefit of increased efficient use of an existing network.

The rail industry has practised demand management through pricing for many years, and customers are familiar with the concept of saving money by avoiding the busiest times. The more widespread adoption of online ticket retailing has been instrumental in supporting this trend, and as technology evolves customers will be able to buy tickets in an increasing number of different ways.

The growth of smart ticketing offers considerable potential at being able to tailor this in a way that is easy for consumers to use and understand. In particular, there is considerable potential to use smart pricing in the context of the traditional season ticket market to further encourage the existing trend towards working from home for at least part of the working week. This will also offer companies the potential to provide part-time and shift workers with season tickets that reflect how they work.

At the moment, traditional season ticket products do not provide mechanisms to credit non-use and can therefore encourage travel to work at the margins where the incentive of 'saving' a day's trip might otherwise tip the balance towards staying at home.

However, the contribution which smart ticketing can make towards managing demand should not be overestimated. For example, research carried out in 2007, 2012 and 2014 from three separate sources placed a considerable question mark over the ability of pricing and smart ticketing alone to tackle the periods of most intense demand. For commuting such as into central London, this is typically the period between 08:00 and 08:45 Monday to Friday, where there are many services that are at absolute capacity. Studies into the kind of price differentials that might be required to shift people away from this peak established that there was an extreme inelasticity for this period, meaning that price differentials would need to be at politically untenable levels to achieve any meaningful shift in travel patterns.

Fare regulation has not changed for 20 years, and the existing peak fare structure sits within a very crowded product structure which has evolved in a very short term tactical way and is subject to multiple layers of regulation. This complexity, and the risk of there being customers which stand to lose from overhauling fares regulation, has meant that the political will to undertake such a review has not been forthcoming. However, this is set to change, as it was recently announced that passengers on trains between London and Sheffield or Scotland will be among the first to benefit from an overhaul of rail fare regulations as part of the tests agreed between train companies and the government. Due to start in May 2017, the trials to simplify the complex rail fares system will mean:

- **A route will be overhauled** to reflect what is actually on offer, ending the existing situation where changes to train services in many cases only allow fares to be added to the system rather than older, less relevant routes which customers do not use being removed from the fares system to make it clearer;
- **A best value end-to-end 'through fare'** will be offered for test journeys where customers change trains, by offering one price combining the cheapest fare for each leg of the journey. Current rules require operators to set and maintain a through price even where there are cheaper deals;
- **Easier journey planning** by showing customers the best price in each direction on selected routes, allowing customers to mix and match the best fare – like airline bookings.

This requires changes to regulated return fares dating back to the 1980s that can't be sold easily online, giving customers much more clarity and simplicity.

A ten-point plan and design guidelines for ticket machines include getting rid of jargon, informing customers when a machine will start to sell cheaper off-peak tickets and making clear what types of tickets machines do and do not sell. All the improvements to ticket machines will be in place by the end of 2017, several by the summer.

On an infrastructure level, day-to-day demand spikes and recovery from incidents can be managed through improved traffic management technologies and performance strategies. For example, one element of the Digital Railway programme is deployment of a traffic management system which could assist signallers and operators to more efficiently manage increased levels of train service on the infrastructure.

Q5: How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Any activity on assets should be directed to support statutory and customer requirements. In the case of infrastructure, this normally means delivering safe, reliable assets that have capacity and functionality when the customer requires them. A balance needs to be struck between ensuring that the established capability of existing infrastructure is retained (where still required to meet customer needs), and investment to offer new and improved capabilities (providing expanded services to existing and new customers).

Network Rail's capital expenditure is typically disaggregated between maintenance, renewals and enhancements:

- Maintenance activity involves keeping the existing assets in a fit-for-purpose state, without requiring significant replacement of the asset
- Renewals occur on a periodic basis and involve the replacement of the asset with a modern equivalent capable of delivering a comparable output.
- Enhancements entail the replacement of an existing asset, or supplementing the existing infrastructure with new assets, to deliver an enhanced level of output – primarily accommodating an increased level of traffic.

Whilst the precise level of maintenance and renewals activity will be dependent on a range of factors, some level of activity will always be required, even if the assets are not used on a regular basis. However, investment in a range of technologies and new approaches to infrastructure renewal and maintenance offers the opportunity to deliver improved maintenance techniques and procedures that will in turn deliver asset renewal more efficiently/quickly, and with less disruption to services, than is possible today.

In contrast, enhancements are discretionary in nature, and are developed and implemented where circumstances require. As discussed previously, the rail industry's LTPP is the primary route by which these drivers are identified – with the Market Studies identifying likely changes in demand, and the Route Studies identifying the interventions required to support this. Whilst maintenance and renewals activity are effectively covered by income from passengers, enhancements require government investment, and consequently decisions around which enhancements to progress are made by the industry's funders – under current arrangements principally the DfT and Transport Scotland.

Q6: What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

When the rail sector was privatised in the 1990s, responsibility was split between managing the infrastructure and operating train services. Whilst there was a strong justification for this division, at the same time this has generated some inefficiency and misaligned incentives, which have prompted several external reviews.

The sector is responding to these reviews in a number of ways, most importantly through accelerating the process of Network Rail devolution, which encourages greater collaboration between the infrastructure provider and passenger and freight operators. Network Rail further recognises the benefits of collaborating with train operators in an increasing number of 'railway alliances'. These can be undertaken through a number of models, such as the joint management of ScotRail and Network Rail Scotland, with ultimate aim of providing enhanced service and value to users and funders.

In the renewal and enhancement of rail infrastructure, Network Rail additionally welcomes competition and collaboration. Indeed, most railway renewals and enhancements are already provisioned through market competition.

Increased collaboration with the supply chain through Early Contractor Involvement is now widely recognised to be essential in helping to keep costs down. The 'Staffordshire Alliance' of Atkins, Laing O'Rourke, Network Rail and VolkerRail is successfully delivering infrastructure to address a historic bottleneck on the West Coast Main Line in the Stafford Area, and the Digital Railway Programme is aiming to maximise supplier buy-in

from an early stage to drive down costs and ensure alignment of supplier capability with the emerging needs of a railway which adopts digital signalling on a more widespread basis.

Q7: What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Funding is the commitment of ultimate payment mechanisms to pay for the revenue requirement of the infrastructure provider. The funders will be parties recognising benefits arising from railway enhancements, but without the infrastructure provider taking on a capital repayment liability.

Currently the rail industry derives its funding from taxpayers, users and third parties. Government policy for a number of years has been to shift the burden of funding from the taxpayer towards users, and this trend is expected to continue. Accompanying changes to channel more government funding through train operators, rather than through payment of a direct grant to Network Rail, are designed to encourage greater efficiency through a stronger focus on users. Third party investment primarily takes the form of rental payments for property, or contributions from the beneficiaries of enhancement schemes.

Securing financial contributions from the beneficiaries of enhancement schemes is a means to ensure that the industry is able to monetise the value it creates for third parties, as opposed to this value being lost. The Shaw Report challenged Network Rail to 'explore new ways of paying for the growth in passengers and freight on the railway' and identifies that the private sector also has a part to play in supplementing available railway funding, particularly for enhancement projects, for example from property developers, local businesses, airports, freight terminals, train operating companies as well as from other parts of the public sector (for example local authorities and Passenger Transport Executives) and publicly funded bodies (for example Local Enterprise Partnerships or Growth Deals).

Whilst securing of such funding is not new to the business, the future incremental non-government funding requirement for infrastructure schemes will be a higher scale and will need to focus on some key priorities. To pursue these opportunities, Network Rail will need to:

- Integrate its processes for strategic planning and prioritisation of projects (which also involves the DfT) with its seeking of funding commitments for example prioritising projects supported by third party funding. This is a change to long-established public-sector and railway industry practice which ranks projects primarily by a cost-benefit analysis including non-financial and socio-economic elements.
- Develop a pipeline and gear up for project preparation and procurement.
- Put in place additional internal commercial capability to seek and manage funding commitments at earlier stages of project development.

Funding plans are being developed to capture non-DfT incremental funding, the value of which will be dependent on a wide range of variables and subject to caveats and assumptions around certainty, phasing and availability of ring fenced and other government funding.

Recognising that third party funding requires significant lead times to reach commitment, enabling work is already under way to support mobilisation of the required route-led capability by spring 2017. This includes the development of funding and governance guidelines and high level local funding strategies, sharing of proven practice, organisation proposals including a route business development role to lead this activity and consideration of commercial tools, resource and governance requirements across the business. Network Rail is also engaging more widely across the industry for support to unlock funding locally, and is supporting the RDG's Alternative Finance and Project Delivery workstream.

Additionally, the structure and geographies in which funding is provided can have secondary efficiency impacts on a variety of factors, such as flexibility of long-term planning and supply chain confidence. Network Rail is moving its enhancements model towards a progressive funding situation built around stage gate joint governance, which aims to resolve some of the inefficiencies created by the existing five-yearly control period structure.

Q8: Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Financing involves the provision of capital by private sector investors and lenders in the expectation of a repayment of capital and/or, a financial return on capital.

In general, the cost of private sector finance will typically be higher than the public sector cost of capital faced by Network Rail. Therefore, the use of private sector capital will create incremental value for money if the efficiency and performance gains, innovation and the risk transferred outweigh the extra cost of finance (the differential is at historic lows), transaction costs and any incremental interface costs. Projects which cannot be structured to separate adequately risks to the project's promoters from risks to be borne by Network Rail are likely to be delivered more effectively through Network Rail's standard procurement processes. In addition, there is a minimum size of project for private sector financing to make commercial sense and the scale of some projects will be relatively small.

Supported by Cambridge Economic Policy Associates (CEPA), the RDG's Alternative Finance and Project Delivery workstream has undertaken a two-phase project to consider:

- The obstacles faced by investors interested in rail and the opportunity for private delivery and/or finance to play a greater role; and
- How the obstacles might best be addressed in order to take advantage of the opportunities identified.

The project identified clear opportunities for the sector, but also found some key obstacles which together mean that projects can be funded but not financed:

- Significant change requires whole industry support.
- It is not clear what the industry is being asked to achieve, beyond an aspiration to attract private finance.
- Projects have a lack of certainty throughout their development, which investors dislike.
- Many current projects are unsuitable to attract private finance / delivery and would need to be rethought to be able to do so.
- There is a lack of clarity and transparency which has a strong negative impact, particularly if the industry fails to speak with one voice.
- Level of interaction between projects adds complexity to seemingly simple schemes.
- There is complexity which can be perceived as the industry not having a 'can do' attitude, particularly in terms of timescales and processes.
- The industry may not currently have the required skill set and the private sector needs to have confidence in the industry's capabilities.

The report made the following key recommendations to improve financing in the rail industry:

- There should be a clear and transparent process for seeking private involvement.
- An appropriate detailed and independent approach to value for money analysis is required. Value for money is predicated on effective transfer of risk to the party best placed to manage it.
- Costs to investors should be minimised, and project timescales should be short as practicable.

- A sustainable pipeline of PPP projects (including for the longer term) should be developed and published. The aim should be for a pilot programme of 5-6 projects.
- ORR should review its accessibility to investors and ensure that regulation facilitates alternative approaches, without undermining the principles of the existing track access regime. Project promoters will potentially bear risk on the outputs of the assets they deliver, but not on wider system outputs (which they could not effectively control and to attempt to transfer this risk to them would be poor value for money). The exception to these assumptions might be a concession under which a whole region of network is to be recapitalised by the private sector which takes over as a network owner and operator.
- Projects to be structured appropriately (standardised where possible, e.g. contract form, risk share, etc.). It will be necessary to structure availability or usage payments to the project deliverers based on the availability and performance of their assets. Many schemes may not be fully self-funding, meaning that DfT and other funders may need to consider how it allocates its long-term support to privately financed assets, including some projects which may have some element of other funding as well as generating project income.
- Institutional capacity in the industry needs to be developed and relationships built directly with the private sector.

There is currently a strong availability of funds looking to invest in infrastructure, part of an ongoing and upward trend of greater allocation of long term investment into infrastructure assets. The evidence suggests that there would be a strong take up for a pipeline of appropriately structured deals which could either offer a self-generating revenue stream for investors and/or which provide opportunities for efficiency and innovation; provided the identified obstacles can be addressed.

Delivery credibility should be supported by the introduction of the 'Integrated Assurance' improvements but will also be dependent upon DfT funding continuity to enable committed projects to be taken to conclusion. In addition, to increase Network Rail's attractiveness to third-party investors, it is important to address the size of Network Rail's existing debt and to develop a future funding approach that is more sustainable.

Q9: How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

There are a variety of interdependencies which arise between infrastructure sectors – some of which have been identified by the National Infrastructure Commission for investigation, which can provide uncertain and varied risks to service provision. For example, a key interdependence for rail is with the energy sector. An increasing degree of electrification of the rail network can bring a number of economic and environmental benefits, but requires a robust and reliable energy supply network.

Increased collaboration and visibility between sectors, alongside effective integration of resilience in planning, asset management, and operations, can help identify and mitigate these risks. For example, the rail sector working with key stakeholders such as Highways England, National Grid, MI5, and the Environment Agency could allow for information sharing and the development of strategies cognisant with identified interdependencies and risks in areas as diverse as climate change, environmental management, energy policy, and security incidents etc.

Long-term consideration for interdependence and resilience could be built into planning through engagement between contingent system operators, regulators, government organisations and stakeholders in different sectors. Collaborative working with other transport operators can produce resilient operational strategies where interdependent risks arise. For example, a failure of a transport mode – such as a major road incident – may significantly increase pressure upon rail transport along a geographically similar route.

Another way of ensuring resilience is to be less reliant by managing the energy mix differently through, for example, increasing the proportion of energy recovered through regenerative braking, energy generation

and storage technologies, self-powered (battery) trains, etc. This is covered by KC05 'Optimum energy use' in the RTS Capability Delivery Plan.

Climate change poses challenges for the resilience of infrastructures and their interdependencies. For example, better drainage and the management of flood events collectively will help manage impacts across sectors.

Q10: What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The planning processes of Network Rail's Enhancement Programme 2014-2019 were recently the subject of a review by Dame Colette Bowe. One recommendation made by the Bowe Report, when issued in November 2015⁵, was for the DfT and Network Rail to reset the formal framework for enhancements planning, implementation and oversight. The issues highlighted, and processes put in place, could provide lessons learnt for wider how infrastructure planning and governance is conducted with a variety of funders.

In response to the report's recommendations, both the DfT and Network Rail issued a Memorandum of Understanding⁶ to jointly commit to new working practices and governance. The Enhancement Improvement Programme has been established to address major structural issues in the industry around the planning and delivery of enhancements.

Additional governance has been put in place to assist in the timely and efficient delivery of works, and to recognise that projects and programmes in early development are highly immature. Network Rail now aims to develop a pipeline of projects to be put through a series of joint decision points, so that funding is committed progressively and the value for money of delivered outputs is tested at key points in development. Funding should only be committed to progress to the subsequent joint decision point, to ensure clarity of cost and outcome expectations. Through this process, it is envisioned that at each stage planning faces discipline to investigate an increasing clarity of scope, outputs, outcomes, and benefits, as well as decreasing risk to funding and timely delivery.

Alongside these improvements to the planning and delivery of rail enhancements, the planning system could arguably be further improved in a number of areas. Continued review of processes and planning strategies on a variety of levels is required to ensure that supporting processes are effective, and that infrastructure developments have line of sight to national, regional, and local goals. For example, the Transport and Works Act could be reviewed to reflect experiences of major programmes. Similarly, if timelines of delivery for contingent projects and programmes are not aligned, then it can lead to frustration of stakeholders and delays to benefits. Collaborative working and transparency through such processes can provide opportunities of continuous improvement and likelihood of efficient delivery on time.

Q11: How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Existing rail infrastructure can frequently offer a habitat for a range of wildlife. However, difficulty arises when the primary use of this land, safe railway operation, potentially limits or comes into conflict with these environmental benefits. As such, proper planning and an understanding of estate and ecological management are required to provide both transport and environmental benefits. Gathering environmental data in partnership with organisations outside of the rail industry, and contributing to national datasets by enabling access to experts to catalogue habitats and species on railway land, provides a better understanding of the rail estate and information on affected species.

Major investment projects are often required to enhance natural environments and some are involved in the biodiversity 'net gain' trials. Collaboration is key to effectively deliver environmental benefits, including within; data collection and analysis, access, use of natural resources, use of personnel and knowledge sharing.

The industry has agreed a series of Rail Sustainable Development Principles⁷, and recognises the need to embed these in all its activities.

At the national level, government policy will be critical to meeting to ensuring sustainable outcomes. It is vital that the correct incentives are in place to make the best decisions for the whole railway and for the long term.

Ensuring better alignment between operator and infrastructure manager and between operational and capital costs will be fundamental to delivering sustainable long-term benefits for customers and taxpayers; environment and society. Greater consistency in sustainability performance and collaboration across devolved routes and investment projects needs to be ensured – there is still significant variation in how routes and train operators collaborate on issues including noise, non-traction energy and asset renewals.

Although whole life costs are considered, environmental and social benefits are often the first to be cut when project costs come under pressure, leading to higher operational costs. It is vital to ensure that opportunities for greater operational efficiency are not so easily lost to ‘value engineering’ projects. This balance between capital and operational costs will be critical in ensuring a more sustainable railway.

Q12: What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Business cases for transport investments are typically supported with cost benefit analyses which follow the guidance set out in the HM Treasury Green Book⁸ and DfT Transport Appraisal Guidance (WebTAG)⁹. These use welfare benefits (for example, the value of savings in travel time) as key measures of the benefits of transport investments. However, maximising welfare benefits is not always the sole or even main objective of decision-makers. For example, economic growth, rebalancing the economy and deficit reduction represent different objectives; and the investments that would be most effective at achieving these are not necessarily the same as those that would maximise a traditional welfare-based Benefit / Cost Ratio. It is important that business cases consider the extent to which the investments are likely to achieve the desired objectives, even if this is difficult to quantify precisely, rather than the extent to which they meet objectives which are easier to measure but are not the primary goal of decision makers.

It is also important that cost-benefit analyses consider the full range of costs and benefits from a given scheme. This includes using whole-life cost estimates, and assessing schemes at an overall programme or strategic level. Transport investments are increasingly being planned as part of wider development strategies that include multiple investments in transport, housing and other infrastructure, as well as non-infrastructure investments such as in skills and training. Consequently, assessing the transport investment in isolation will not give a fair assessment of the overall strategy. As referenced in the response to Q3, wider benefits such as community improvement, jobs creation, and social value can be difficult to capture in an economically aligned business case.

Although there are a number of ways in which transport cost-benefit techniques could be improved, it is important that decision makers do not place too much emphasis on a single quantitative output – numbers like the benefit-cost ratio should be one of the key things that inform a business case and thus decision-making, but not the only one. There are few, if any, major investments for which cost-benefit analysis is likely to accurately quantify, let alone value, all the relevant considerations. Ironically, appraisal guidance itself often recognises this, stressing the importance of qualitative considerations in the overall decision. In practice, however, an arguably disproportionate amount of effort is sometimes put into the quantitative cost-benefit analysis.

Transport

Q13: How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Growth in rail travel markets, or indeed any mode, is dependent on a number of changing factors and trends: macro-economics such as employment and economic activity, land use, micro-economics such as travel costs and competition, demographics of population and age, consumer tastes and perceptions, and the supply of travel opportunities such as modal generalised journey times can all affect travel pattern changes.

As part of the LTPP, Network Rail facilitated the production of four Market Studies to estimate how demand is expected to change over the subsequent 30 years in rail’s four key markets: long distance, London and South East, regional urban and freight. The passenger Market Studies concluded that the number of rail journeys would double over broadly the next 25 years. This growth is expected to be driven by a combination of economic and population growth, and deep rooted structural trends in the market which have supported

growth over the last two decades. These trends include re-urbanisation and growth of the 'knowledge-based' economy in large towns and cities. A positive shift in rail's competitive position against car travel has also contributed to growth, although in rail's largest markets (most obviously the commuter market into central London) travelling by car rarely offers a practical alternative. The strength of these underpinning structural trends were particularly evident during the economic downturn of 2008-9 when the passenger market continued to grow throughout despite a 6 per cent fall in economic output (although a change in ticket purchasing patterns did place greater pressure on passenger revenue growth during this period).

Whilst the economic impact of the decision to leave the European Union is uncertain, the medium to longer term drivers of rail growth remain fundamentally robust. As a result, it is difficult to construct plausible scenarios in which rail passenger demand growth stagnates, particularly in markets where rail is fundamentally aligned to the direction of economic development – commuting into large cities, high speed travel between urban areas, and providing connections to international gateways.

Based on the Office for Budget Responsibility's (OBR's) most recent forecast for the UK economy it is anticipated that the rail passenger market in England and Wales (measured in terms of passenger kilometres travelled) will grow by 13 per cent between 2015-16 and 2023-24, with a range around this central forecast of between 8 per cent and 18 per cent reflecting the OBR's range for GDP growth over the period to 2021. This forecast reflects 'external' drivers of rail passenger demand only (for example, anticipated economic and population growth), and is based upon an assumption that rail fares will increase by no more than the Retail Price Index (RPI) measure of inflation during the term of the current parliament.

In addition to this 'external' growth, once completed the committed components of the Railway Upgrade Plan could generate up to 9 billion more rail passenger kilometres per year by the end of CP6 - an increase of up to 15 per cent on today's total - even before major schemes such as HS2 and Crossrail 2 are taken into account. Further growth can also be expected as the result of operator initiatives delivered through the franchising process. As a result, committed improvements to the railway are expected to make a substantial contribution to demand and revenue growth over the next Control Period, potentially doubling the level of growth delivered by 'external' factors only.

Changes in energy generation policy and the simultaneous impact of a globalised steel manufacturing market have prompted a period of rapid structural change in rail freight's commodity base. This structural shift entails the loss of traditional commodities such as coal for the electricity supply industry and reductions in steel rail industry raw material / finished product traffic.

However, whilst volumes of coal for energy generation have reduced significantly, demand for rail freight is expected to grow strongly across a range of other commodity sectors: intermodal, construction, automotive and express freight and urban logistics. A new geography of rail freight demand is emerging, an increasing density southward from a line between the Humber and the Mersey increasingly focused on sectors with a fiercely competitive road haul alternative.

Adopting new technologies that can significantly reduce the cost of the delivery of railway services to customers will open up new market opportunities and present new options for connecting people with jobs, family and friends. Taking a radically different approach to the design, build and operation of the railway network will open up opportunities for less intensively used parts of the network, bringing the many benefits of rail to more people.

Major new technologies of note emerging in the UK rail sector include those which enhance national and regional infrastructure capability (such as High Speed Rail and Digital Railway signalling), and those which enhance transport service provision (such as 'Smart Ticketing' and digital communications technologies). The former should build upon rail's established economic benefits with technologies providing opportunities of enhanced inter-regional connectivity, increased capacity on congested routes, and better operational performance. The latter may allow for increased user experience and productivity, as passengers can prospectively integrate journey planning, efficiently purchase travel, and work on the move with high-speed internet connectivity.

Technologies of note emerging in other sectors include the possible development of new transport modes, such as Autonomous Vehicles (AVs) along road networks. If technology develops to maturity where AVs can operate safely at high speed in a coordinated manner, it could arguably provide large benefits and advantages to road transport. However, rail may still maintain an advantage with the efficiency it transports

large volumes of passengers. Indeed, AVs could be regarded less as a competitive threat, but as a complimentary means to plan for – for example, station planning and development could integrate AVs as an additional transport mode in a customer's journey.

Should AVs become viable modes that compete with mass transit, then decisions will have to be made as to whether their rollout is purely market led, or whether regulation and a level of accompanying infrastructure is to be invested in at a city, regional or national level. Where there are finite resources, there will be opportunity cost impacts from deciding to invest in infrastructure and systems for AVs, instead of the already established modes. This may slow down the forecast rate of growth of these modes, including rail.

Assuming some form of regulation and supporting infrastructure for AVs is granted, then the impact it has on changing patterns of rail demand travel will be critically dependent on the eventual form it takes. Careful long-term forward planning and in-depth consideration is required to ensure that infrastructure and systems to support AVs act to complement sunk and planned infrastructure investments in other modes.

The industry continues to assess the prospects for further growth under a range of scenarios. Most recently the RDG commissioned a study that addresses the question of how resilient rail demand is to a broad range of future 'shocks' to the economy¹⁰. The Commission is invited to discuss this work with RDG.

Q14: What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Rail's key strengths are in transporting large volumes of passengers, both for long distances between major cities, and for short distances within large urban areas. Many of the largest urban areas in England and Wales are already served by dense urban rail networks; all of which have experienced significant growth in passenger demand in recent years.

As highlighted in the response to Q1, following the completion of the schemes currently committed or underway, the next priority for the rail industry will be to support the delivery of the priority schemes identified by its funders and the National Infrastructure Commission. The schemes which fall within the remit of this question comprise Crossrail 2 and Northern Powerhouse Rail.

The next category of schemes is those which the industry has identified as priorities in light of the severe capacity challenges they seek to address. All of these interventions will support travel into, out of and around London; comprising upgrades to the Brighton and South West Main Lines, and interventions to address passenger crowding at Clapham Junction, London Euston and London Liverpool Street stations.

The next highest value investments are the projects set out in the enhancements to improve access to major urban areas. Examples include:

- Greater London: potential increased capacity of up to 27 trains per hour delivered by Great Eastern Main Line Upgrade Programme through train headway reductions.
- Northern city regions: transformation in the North of England to be delivered by the Northern Powerhouse Rail Programme (specific schemes and outputs to be developed).
- West Midlands: various interventions to accommodate passenger growth on services into Birmingham as part of the Midlands Rail Hub.
- Leicester: increased capacity to accommodate passenger and freight growth through Leicester delivered by Midland Main Line Programme.

In addition to enhancements, removing 'barriers' between transport modes through – for example – improved interchange, addressing ticketing and more personalised information will support the greater mobility of people and goods. New technology will support greater mobility and the true 'door to door' experience. Key Capability 3 'Efficient passenger flow through stations and trains' and Key Capability 9 'Personalised customer experience' in the CDP and the RDG Customer Experience activities address these areas. Additionally, the end point of having intelligent and autonomous trains is to deliver far greater flexibility and

far more journey opportunities that will support greater movement in and around urban areas and connect seamlessly with other mobility services.

Q15: What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

The key arteries for long distance rail travel in Great Britain comprise the following:

- East Coast Main Line: London Kings Cross to Leeds, York, Newcastle and Edinburgh.
- Great Western Main Line: London Paddington to Reading, Oxford, Bristol, Cardiff, Swansea and Plymouth.
- Midland Main Line: London St Pancras to Leicester, Nottingham, Derby and Sheffield.
- West Coast Main Line: London Euston to Birmingham, Manchester, Liverpool, Preston and Glasgow.

HS2 represents a significant expansion in capacity and connectivity from London to the Midlands and the north, with Phase 1 between London, Birmingham and Handsacre (near Lichfield) to be opened in 2026. Without HS2, the West Coast Main Line will be unable to meet the demands placed on it by passengers, freight or the economy. By 2033 HS2 services are expected to be running on Phase 2 between London, the Midlands, North West, Yorkshire and North East. Ultimately HS2 will offer transformational levels of connectivity between destinations currently served by the East Coast, West Coast and Midland Main Lines; and will provide links to international gateways at Birmingham and Manchester airports, and Heathrow via an interchange at Old Oak Common. For the East and West Coast Main Lines, the highest value investment comprise the various schemes included in the enhancements pipeline to provide additional capacity to support existing and post-HS2 traffic patterns. Examples include the East Coast Main Line Power Supply Upgrade project, and capacity improvements at Newcastle station.

Northern Powerhouse Rail aims to transform rail connectivity between the main economic centres of the North by offering faster and more frequent journeys. It will deliver enhanced east-west rail links with significantly reduced journey times and higher frequencies by developing a network comprised of new routes in some corridors, and significant upgrades in others. HS2 will be an integral part of Northern Powerhouse Rail, and Northern Powerhouse Rail and HS2 will together deliver the vision of city to city links, both east-west and north-south. Northern Powerhouse Rail will also be an integral part of the wider rail network and needs to be planned as such from the outset. Northern Powerhouse Rail stations will be integrated with local services with smart ticketing across the network.

The Great Western Main Line is currently undergoing an extensive upgrade which will deliver electric trains and increased train frequencies, and further enhancements in the future will build on this programme of work. Towards the west end of the route, the highest value investment will be to address the resilience of the coastal section from Exeter to Newton Abbot through Dawlish and Teignmouth. The Exeter to Newton Abbot Resilience Programme is being developed by Network Rail to achieve this.

In recent years the reopening of previously closed rail lines has transformed connectivity and brought significant new traffic to the railway. A particularly successful recent example has been the Borders Railway, which has linked Edinburgh and the Scottish Borders by rail for the first time since the closure of the 'Waverley Line' in 1969. Opportunities exist to support similar schemes elsewhere on the network.

Investing in the technologies that will enable the closer running of trains and far greater flexibility in delivering services will directly support connecting people and goods outside of a single urban area.

Q16: What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Although not strictly related to road user charging, Mobility As A Service (MAAS) offers further opportunities for people to access rail by providing people with far greater flexibility and choice as to how they use rail services. For example, through purchasing packages of travel as opposed to the more traditional season tickets and not having to purchase individual and different tickets for different modes.

¹ Long-term planning, Network Rail, 2016: <https://www.networkrail.co.uk/running-the-railway/long-term-planning/>

² Rail Technical Strategy Capability Delivery Plan, RSSB, 2017: <https://www.rssb.co.uk/rts/Documents/2017-01-27-rail-technical-strategy-capability-delivery-plan-brochure.pdf>

³ Building our Industrial Strategy: Green Paper, Department for Business, Energy & Industrial Strategy, 2017: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/585273/building-our-industrial-strategy-green-paper.pdf

⁴ Vision for Stations, RDG, 2015: http://www.raildeliverygroup.com/files/Publications/2015-10_vision_for_stations.pdf

⁵ Report of the Bowe Review into the planning of Network Rail's Enhancements Programme 2014-2019, Department for Transport, 2015: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/479560/bowe-review.pdf

⁶ Memorandum of understanding between Department for Transport and Network Rail on rail enhancements, Department for Transport, 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/509545/mou-dft-network-rail-rail-enhancements.pdf

⁷ Rail Sustainable Development Principles, RSSB: <https://www.rssb.co.uk/improving-industry-performance/sustainable-development/rail-sustainable-development-principles>

⁸ The Green Book: Appraisal and Evaluation in Central Government, HM Treasury, 2011: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf

⁹ Transport analysis guidance: WebTAG, Department for Transport: <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>

¹⁰ Rail Demand Resilience Study, Final Report, Mott-MacDonald / Rail Delivery Group, 2016.

National Infrastructure Assessment – Call for Evidence

Response from Rail Freight Group

February 2017

Rail Freight Group (RFG) is pleased to respond to the National Infrastructure Commission's Call for Evidence on the National Infrastructure Assessment. No part of this response is confidential.

RFG is the representative body for rail freight in the UK. We have around 120 member companies who are active in all areas of the rail freight sector, including train operators, end customers, ports, terminals, developers, equipment and rolling stock suppliers and support services. Our aim is to increase the amount of goods moved by rail.

In responding to this call for evidence we have focussed on the cross cutting and transport questions. Other areas of infrastructure development are however relevant for the rail freight sector – for example, we are involved in the construction phase of some new energy projects, and move fuel for power generation. Decisions on other infrastructure can therefore create business opportunities for the rail freight sector. Conversely, unclear policy direction in such sectors can hinder business planning and detract from investment. A coherent approach to infrastructure planning is therefore welcome.

General Comments

The movement of freight by all modes is critical to the effective functioning of the UK economy. This relates to imported and exported goods via the UK's ports (including Channel Tunnel) and domestic distribution of materials. With a renewed focus on post Brexit trade, the effective functioning of freight links will be more important than ever – if the UK cannot compete on transport costs and on 'time to market' it will impede our ability to grow exports.

Despite its importance, the movement of freight can often be overlooked in discussions on transport infrastructure. The recently published Government Green Paper on industrial strategy does not reference freight at all, and mentions logistics only once. Flagship policies, such as HS2, have no compelling case for freight as central to their development, and public policy is often negative towards both road and rail freight. City centre transport policy is a particularly acute example of this.

The competitive, private sector operation of freight transport on publically owned infrastructure compounds this position. Freight operators are low margin business, with efficiency gains competed away in pricing to customers. This is good for customers, and the economy, but tends to mean that the financial contribution of freight operators to network costs is limited. Although comparative data is not available, both road and rail freight fail to cover their full costs to some extent. This includes both infrastructure costs and social costs (particularly for road freight). Given the current focus on how transport infrastructure should be funded, the

inability of freight transport to pay more without passing costs onto customers is a key factor.

Presently rail freight has around 10% of the UK surface transport market overall, but has (for example) around 25% of imported containers, and around 40% of construction aggregate supplies into London and the South East. This means that increasing the ability to operate more rail services can make a significant impact on road traffic volumes on key routes.

Specific Questions – Cross Cutting Issues

Q1 For rail freight, schemes which improve the capacity of the rail network, and enhance the efficiency of rail freight are most likely to deliver value for the UK. Although there are local bottlenecks, most often interventions will be necessary on the trunk route network between conurbations, and between ports and inland destinations. Current priorities include;

- Transpennine corridor to enable freight to operate alongside enhanced passenger services;
- Enhanced capacity from Port of Felixstowe, including the route via Ely, and from Southampton and around London;
- Capacity for all users on the northern section of the West Coast Main Line after the start of HS2 services to Scotland
- Measures to improve the efficiency of rail freight services on the network, including incremental gauge enhancement, removal of speed restrictions, enhanced timetabling and so on.

Q2 Rail freight already plays a significant role in the inland distribution of port traffic, and a smaller role in through services of international freight via the Channel Tunnel. The cost and efficiency of such links is important in ensuring that UK trade can prosper. Supply chain failures will influence trade decisions particularly when other economies are investing to ensure their goods have effective routes to market. In a post Brexit economy this is likely to be even more important. As such, we believe that investment in links to international gateways remains critically important.

Q3 Decisions on housing and infrastructure must be cognisant of the needs of freight and other industrial activity. This is particularly acute for the road freight sector that must have full urban penetrations for (e.g.) shop deliveries, whilst for rail freight; it means that the planning framework must support rail deliveries into urban terminals. Presently, we are finding that rail activities are hampered by inappropriate adjacent development which can lead to operating constraints – for example, night time planning conditions at terminals which conflict with the available capacity on the rail network which is set to avoid peak times. We also see land sites lost to rail, or planning rejected particularly for construction use – meaning that house building materials cannot be rail served. Warehousing on rail connected sites is desirable, but the inability to get planning consent frustrates many developers.

We believe there must be clearer and stronger planning guidance which balances industrial and housing use, protects existing facilities and helps promote a use of rail.

Recognition of the ongoing need for industrial land, and for the distribution of goods, must be a stronger consideration in urban planning.

Q4 Such effects are less common in freight transport than passenger. However, constraints on movement – for example, peak time bans – will have consequent impacts on the efficiency and hence cost of freight deliveries, which should be factored in to decision making. A move towards road pricing could be helpful for rail freight if it was targeted effectively – however the inherently different charging frameworks for road and rail makes it difficult to fully understand the impacts.

Q5 We believe there is a place for both. Rail infrastructure must be maintained in a fit condition for freight.

Q6 The currently ongoing Hansford Review aims to assess the role of third parties in developing Network Rail's infrastructure. We believe that there may be merit in considering alternative delivery models in certain circumstances. For small freight schemes, our members have expressed frustration with the cost and timescales associated with Network Rail projects, which can be an impediment to their plans.

Q7 As outlined above, the competitive model for freight distribution means that the ability of freight operators to pay an increased charge for infrastructure is difficult. For rail, an increase in cost tends to result in modal shift to road, with associated dis-benefits. We have distinctly different cost models between modes, and the transparency of information for rail is greater than for road, which makes comparisons difficult. We consider that;

- There must be proper cross modal consideration of infrastructure funding and charges
- Decisions which increase (overall) the cost of freight transport must take explicit account of the impacts on customers and the wider economy
- Government should be explicit in its support of the transport infrastructure for freight and provide a long term stable framework which supports third party investment in equipment and terminals.

Q9 Building resilience into rail infrastructure is a key priority which includes establishing a network of diversionary routes between key hubs. Stability in Government policy to infrastructure over the long term also helps to ensure effective investment – for example, changes in Government support for biomass generation created uncertainty in the rail freight sector.

Digital technology represents a large opportunity for the rail sector, which is arguably lagging in this area, and the interface of these areas should be a priority.

Q10 As outlined above, there needs to be a greater emphasis on planning for industrial and distribution land use alongside housing priorities, including on adjacent development. The Planning Act 2008 reforms have helped provide certainty for some larger rail freight developments, but others are still frustrated by extended timescales, and a lack of specialist knowledge within planning departments e.g. on minerals planning.

Q11 Rail freight has environmental advantages over road freight and should be a core part of transport policy. Government should also clarify its future position on rail electrification to inform future traction investments, and also consider how the long term reliance on diesel can be reduced, given air quality concerns.

Q13 For freight transport, the overall volume moved will rely on a significant extent to UK economic performance, and the balance of import / export and domestic trade. Assuming no seismic shift, we would expect to see a continued emphasis on port trade, including to the major deep sea ports in the south east and the smaller ports in the north which are more likely to be dominated by feeder services. For domestic movements, the balance of retail and e-commerce will be an important factor.

Q14 For rail freight, there are three principle markets. For bulk materials such as construction materials and waste suitable urban terminals with suitable rail access can help minimise road trips and should be protected. For retail deliveries, rail linked warehousing and consolidation on the edge of urban centres can make end road delivery more efficient. Although undeveloped, use of rail stations for retail deliveries is also growing in interest, and can exploit passenger trains for niche deliveries including e-commerce and biomedical products.

Q15 Unlocking capacity and improving the efficiency of freight movements is the priority, as outlined above.



10 February 2017

Railway Industry Association

22 Headfort Place
London SW1X 7RY
United Kingdom

Telephone: <personal>

E-mail: <personal>

www.riagb.org.uk

RESPONSE TO THE NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE

Background to the Railway Industry Association

The Railway Industry Association (RIA) is the recognised Trade Association for UK-based suppliers of equipment and services to the world-wide industry. It has around 200 member companies, active across the whole range of railway supply, both infrastructure and rolling stock. That range is exceptionally diverse and includes many skills and resources which were previously part of the national railway undertaking but which now operate commercially in the private sector.

RIA members represent the greater part of the UK railway supply industry by turnover. Most large firms are members, as well as a wide range of smaller companies.

Relationship with the Rail Supply Group and the Rail Delivery Group

RIA is key supporter (and co-funder with DfT) of, and delivery partner for, the Rail Supply Group which is the sector leadership council which has an underpinning industry sector strategy entitled “Fast Track to the Future”.

As a member of the RDG Planning Oversight Group (POG), representing the supply chain, RIA has been party to the development of the Rail Delivery Group (RDG) response. We strongly endorse that response which we would like to supplement with the following supply chain specific comments.

Supply Chain Specifics

It is essential that investment in infrastructure is focussed on supporting sustainable economic growth. In addition to the points that the RDG response makes about the important contribution the rail industry makes to economic growth we would highlight the additional contribution of a strong UK based supply chain.

Employing over 120,000 people and with an estimated annual economic contribution of around £7bn the UK supply chain makes a key contribution to the wider economic benefits realised by investment in railway infrastructure.

However the UK has not always successfully maximised the benefit for the UK economy. Given the £80bn pipeline of domestic rail projects there is a great opportunity to strengthen the domestic supply chain, reduce imports and create a platform for export growth.

Rather than repeat the RDG response we set out below some key considerations which, if addressed, would help the UK rail supply chain deliver infrastructure even more efficiently.

Pipeline Visibility/ Stability

To support supply chain investment in people, plant, process and innovation to drive productivity and competitive advantage it is vital that there is visibility of a stable workload pipeline. As we have stressed in our responses to various rail industry consultations (Bowe, Hendy, Shaw and the initial ORR PR18 consultation), this is critical if suppliers are to invest in the resources and kit required to deliver the required volumes of work. And the corollary is that spiky demand profiles drive up costs. We have previously submitted evidence to the Commons Transport select Committee and to the McNulty review that demand volatility adds between 10-30% to the cost of products affected.

And whilst the move from an annual funding round to the current 5 year Control Period funding blocks for Network Rail is hugely welcome, there is still an issue around demand hiatus towards the end of a Control Period and the start of the next – with the attendant implications for supply chain mobilisation and efficiency. Consideration of a rolling 5-year programme might help smooth this volatility.

Whole-Life Costing

We would encourage major infrastructure programmes to focus more on whole-life costs rather than initial up-front cost as a way of achieving longer term savings and reducing potential exposure to increased operational and maintenance costs.

Greater Use of Output Specifications

The greater use of output specifications rather than input specifications is another area of potential efficiency. The former allows much greater scope for innovation on behalf of suppliers in order to either speed up process, reduce costs or both. It is accepted that the use of output specifications comes a responsibility on the supply chain to warrant that their products will meet them.

The Thameslink Programme, for example, was ambitious in adopting and contracting on an 'output specification' of 24 trains per hour when the perceived wisdom was that this was high risk. The difference here was that 24 tph was the output needed for the business case to work and therefore there was a 'grand challenge' which had to be achieved and focus was applied to delivering this output whilst mitigating the risk.

Consistent use of procurement and contracting best practice

There are clear lessons from a number of recent rail projects which can be applied elsewhere when the situation is appropriate.

The Staffordshire Alliance is an excellent example of success being delivered through aligned objectives and incentives. This challenging multi-disciplinary project was contracted with a target cost lower than estimated cost and all parties including the client were subject to pain/gain share. This created an environment where all parties collaborated and innovated to deliver to time and target cost.

Early Contractor Involvement (ECI) also has a major role to play, typically bringing in contractor construction and integration expertise before the design and programme are finalised. ECI was successfully used on Thameslink Civils projects and was recently used on the Digital Railway Programme where it identified a potential 30% cost reduction subject to a collaboration between client and supply chain throughout the life-cycle.

For all types of projects, including the less complex projects there is a strong argument that delivery will be improved and costs reduced by a mature long term collaborative and trusting relationship with suppliers.

Stimulating innovation

The public sector has been dominant in rail industry procurement and often adopts a risk-averse approach favouring proven technology over innovation. It is common for 'proven technology' to be an explicit sponsor requirement. It therefore can be difficult for suppliers to prove new technology and obtain UK reference cases to support exports.

However these challenges are not insuperable. Public procurement bodies can choose to set ambitious output requirements, such as the Thameslink example cited above, to achieve their business case and thus drive the innovation that will both improve the outcomes for the customer and help the UK supply chain develop new world leading products and services.

It is often the case that the technology to achieve a particular outcome is available but may not have been proven in the required application or simply has not been used in the UK. For public funders there may be a good case to de-risk the most ambitious new technology off line and in advance of the need on the main programme. This can be supported by the 'Innovation Partnership' arrangements included in the EU Public Contracts Directive (2014). This provides a mechanism to allow the selection of the partner(s) to develop solutions where products are not yet available to deliver the required outputs. This could, for example, be a route to de-risking the collaborative development of ETCS Level 3 for the Digital Railway Programme.

Conclusion

We realise this is only a snapshot of a number of key issues and we would be delighted to talk these through in more detail if that would help.

<name>

<name>



Rees Jeffreys Road Fund

A Major Road Network for England

A Rees Jeffreys Road Fund Study

David Quarmby
Phil Carey
October 2016



The **Rees Jeffreys Road Fund** has, since its inception in 1950, provided support for education and research in all forms of transport. It helps to fund projects that improve safety, the roadside environment and rest facilities for motorists and other road users. The Fund has nine Trustees, all with considerable transport experience. This study has been overseen by a Steering Group drawn from the Trustees, comprising David Bayliss, Stephen Glaister and David Tarrant, and chaired by David Hutchinson. For further information, please see www.reesjeffreys.co.uk

The study has been led by David Quarmby, with Phil Carey as co-author. The study administrator was Frances Leong.

David Quarmby CBE has had a long career in policy, planning, management, operations and research, mostly in transport, with 38 years' board-level experience in government, public agencies and the private sector. For the past 18 years he has had an extensive portfolio of chairman and board appointments in transport, railways and tourism, and in transport research and consultancy. David was Chairman of the RAC Foundation to 2013, a member of the **London Mayor's Roads Task Force**, and an Adviser to the Airports Commission. He led the **Government Review of Winter Resilience of England's Transport Systems** in 2010 and was a member of the A12 Commission in 2008. Prior to 1996 he was a main board director and joint Managing Director of Sainsbury's; up to 1984 he was a board member and Managing Director (Buses), London Transport after a period as Head of Research and then Chief Planning Officer.

Phil Carey has been working as an independent consultant specialising in roads strategy challenges since leaving the Department for Transport (DfT) in 2011. He is the Road User Policy Advisor to **Transport Focus**, which now has the role of statutory consumer representative for users of the Strategic Road Network in England; he is also Vice-Chair of the **Transport Associates' Network**. In a series of Deputy Director roles in DfT and elsewhere in the Civil Service, he led projects ranging from the Transport Strategy Review for the Cabinet Office in 2001-02 and the Ports Policy Review in 2006-7, through to the road pricing research programme in 2007-9, and the cross-cutting transport security and contingencies team after that.

Contents

Executive Summary	iii	5 The Fit-for-Purpose Major Road Network What's needed for the Major Road Network to deliver its potential.....	22
Foreword	vii	6 Making It All Work Planning, managing and funding the Major Road Network.....	36
1 The Challenge A new approach for planning and developing England's major roads.....	1	7 Ensuring A Sustainable Major Road Network The challenges of technology and future demand.....	42
2 The Growing Gulf Roads reform is exacerbating the divide between the Strategic Road Network and local major roads.....	5	8 Conclusions and Next Steps	57
3 Defining our Major Road Network Designating the roads that deliver most value.....	11	A: List of Supporting Documents	60
4 Supporting Growth Spatial and economic planning and the Major Road Network.....	18	B: Acknowledgements	61
		C: Sources	63

This study report should be read in conjunction with the series of Supporting Documents, listed at Appendix A, and available at www.futureroadsengland.org and at www.reesjeffreys.co.uk/transport-reports, where the Report Summary may also be found.



Executive Summary

1: A Major Road Network that is more than Highways England's SRN

Roads are vital to the economy and for mobility to support quality of life. Roads account for 89% of all personal travel – by car, bus, coach, cycles and motorbike – and 86% of all inland freight movement.

England's economy – nationally and regionally – needs a designated, coherent network of major roads with good connectivity and geographical coverage. We conclude that the 4,200 mile Strategic Road Network (SRN) of motorways and trunk roads run by Highways England – important though they are, carrying a third of the nation's traffic – is not sufficient for this. With a major increase in investment now lined up, we must focus too on the more important local authority

'A' roads, which also play a crucial role in meeting the needs of business at both national and regional level.

We have identified another 3,800 miles of 'strategic' local authority-controlled 'A' roads – also heavily trafficked, especially with commercial transport, providing essential connectivity by filling the gaps in the SRN. Together, these constitute an 8,000 mile **Major Road Network (MRN)**, carrying 43% of England's traffic on 4% of its roads.

See page 14 for a map of the MRN.

2: A consistent approach to planning, management and funding of the network

The whole MRN needs to be planned, managed and funded in a consistent

way – to fulfill its potential in supporting economic growth, through providing the effective service that users need. Consistency does not mean uniformity, though: we recognise three different tiers of road within this MRN, reflecting the diversity of the network.

We are not proposing any changes in the existing split of responsibilities between Highways England and local authorities – this is to avoid unnecessary upheaval, and to retain local accountability for the local authority roads on the MRN.

A high degree of collaboration between Highways England and the relevant local highway authorities (LHAs) would be needed for planning and managing the MRN in each area. The current momentum of devolution in England could facilitate this, with new sub-

national transport bodies, combined authorities and Local Enterprise Partnerships (LEPs) able to inject a strategic view of need in their region.

With connectivity underpinning the MRN, this network should help 'join the dots' of spatial planning and economic development at a regional level. Achieving this alignment can be elusive, where various institutions with differing jurisdictions hold the respective responsibilities. LEPs have an increasingly important role in facilitating this process of integrating land use and economic growth plans. Meanwhile, clear spatial planning policies are essential to head off any adverse development pressures generated by otherwise beneficial transport improvements.

Roads are crucial, but can only perform well if managed as the core infrastructure in an overall transport strategy, to support economic growth and improve the quality of life and mobility. This must recognise the wide range of transport modes which use roads, as well as the role of rail, and embrace a willingness to consider options for demand management to contain road traffic congestion over the longer term.

The funding challenge

Government is already committed to substantial and rising investment in Highways England's SRN, to underpin the growth agenda, and in the face of traffic levels already at their highest to date, and expected to climb further. A £15 billion programme of improvement and renewal is in train over the six years to 2020/21.

But the problem is the gulf between this funding for the SRN (and the planning regime which supports it) and the unsatisfactory arrangements still in place for the 98% of roads that are run by over 150 LHAs – this includes nearly half the MRN as we have defined it. They face declining revenue support and a patchwork of capital funding pots. There's a pressing need to avoid focusing the roads investment programme too narrowly. The local authority sections of the MRN deserve a better deal.

Any new funding arrangement should enable prioritisation of need and value for money irrespective of administrative boundaries, and should provide stability, certainty and continuity of funding over a reasonable planning period. An opportunity may come with the

prospective National Road Fund (NRF), due to start in 2020 and fed by Vehicle Excise Duty receipts in England, from users of all roads. This is expected to fund the SRN. Now is the time for government to consider whether local authority Major Roads should also be eligible for contributions from a new NRF.



3: The Major Road Network must be fit for purpose

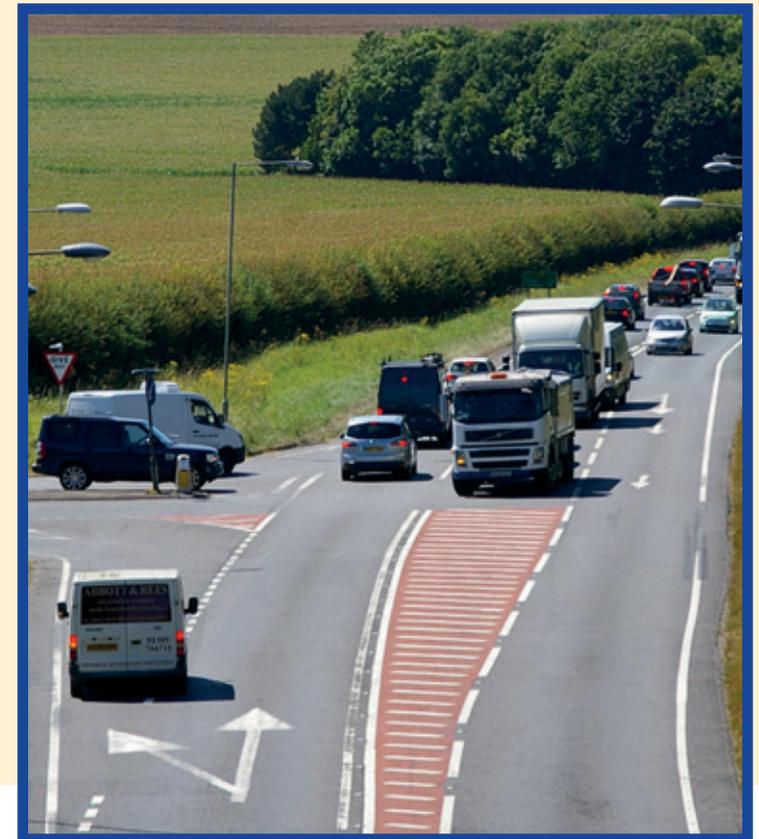
The MRN will only succeed if it is 'fit for purpose' – putting service for its users, as well as the wider needs of communities and the environment, at the heart of its planning and management, while ensuring the fitness of the asset itself and the way it is managed.

- **Fit for the user** means understanding users' expectations for a decent level of service – and then setting out to deliver on aspirations for the speed and time taken for their journeys, and their reliability and predictability. Roads in the MRN will vary by topography and current standard – so we have grouped them into three tiers according to the function they perform and the standard they offer.
- **Fit for communities and the environment** means tackling noise, air quality and severance, and integrating mitigation measures into the ongoing management of the road and its traffic.

- **Fit-for-purpose management** means making the best use of capacity and the resilience provided by the network; exploiting technology to give road users the information they need to make better decisions; controlling traffic speeds and flows through the network; and, where possible, expanding capacity at pinchpoint locations to address shortcomings in the service provided. The asset itself must be well maintained, following best practice, on a whole-life basis.
- **The safety management regime** for the network must be fit for purpose: this should include adopting over time predictive risk assessment to make the infrastructure safer and more forgiving, rather than relying only on data on past crashes to guide safety interventions.
- **Fitness for purpose of Major Roads in cities and conurbations** needs to reflect the more complex transport, planning and traffic management policies needed there, and the greater exposure and risk faced by vulnerable road users.

- **A fit-for-purpose planning regime** assesses performance against service level aspirations and other measures mentioned, and generates options for improvement or mitigation, to be evaluated for effectiveness and value for money.

These requirements for making a Major Road fit for purpose could be expressed in a high level Code of Practice,



developed in collaboration by all the network operators, and adapted as needed for the distinct tiers and other subsets within the MRN. Much is already reflected in Highways England's licence conditions and performance targets.

But achieving a fit-for-purpose MRN is not just down to the network operators. Alongside them, those authorities setting the strategy (the 'strategic clients') have a clear responsibility for making this fit-for-purpose framework effective, to ensure the MRN can perform its central role within the transport system.

The longer-term challenges

Technology and rising demand present two major longer term challenges for those collectively responsible for the Major Road Network – how best to monitor, adapt to and exploit broad and rapid technology-led change, and how to deal with rising demand for road space and consequent increasing congestion.

New technology provides network operators with much better, integrated information to manage traffic and maintain their assets, while influencing

how people and businesses make travel decisions as well as providing new choices; it brings rising penetration of 'greener' vehicles; and increasing levels of vehicle automation with prospects of improving safety, enhancing network capacity and increasing mobility. But it also brings many uncertainties, challenging network operators to judge when and how best to respond.

Given a growing population with rising mobility expectations, many of our major roads will be under ever more pressure. Investment will be needed – across the Major Road Network, not just the SRN – to address the most congested sections. But in the longer term, higher demand, in whatever form it takes, is likely to outstrip the acceptability and affordability of commensurate additions to capacity; it follows that more users will experience regular congestion as it spreads over the day and the week, with greater unreliability of journey times. Technology alone will not solve this problem – some means of demand management should, in time, feature as part of the toolkit for operating the network and maintaining service levels. There are no easy answers, but government should ensure that

it remains on top of the alternatives available.

And finally

Rather than a detailed blueprint for the future road network, this report presents instead a toolkit for taking forward the essential concepts of this report:

- the idea of the 8,000 mile Major Road Network as providing the vital accessibility and connectivity to underpin the economy at national and regional level.
- the need for a coherent and consistent approach for planning, managing and funding the whole MRN, enabled by collaboration of the key national, sub-national and local bodies.
- the need for the MRN to become fit for purpose, starting with being fit for the user.

We hope the report will help those responsible join forces to plan and deliver a better service from our major roads, that more closely matches the needs of users, business and communities.

Foreword

The Rees Jeffreys Road Fund has a long-standing interest in the future of Britain’s road system, recognising that the vast majority of travel takes place on roads. Both the health of our economy and our quality of life depend on the mobility provided by the road network – whichever modes of travel we use.

We can easily take our roads for granted – someone has to maintain them, to manage the traffic that flows on them, and to improve them when they get congested. What is far from straightforward, however, is the planning and evolution of our road system to meet future demand, to support new development, to play its part in the complex transport policies of our cities, and to provide the connectivity needs of business.

In commissioning this study, the Fund’s Trustees wanted to focus on the major roads that are so critical in supporting national and regional economies, as well as in meeting expectations about mobility and quality of life.

The focus of the study is England; over the 15 years since devolution of transport and roads to Scotland and Wales, the planning, funding and governance regimes for roads have diverged significantly between the three nations, and the Trustees did not wish to dissipate the team’s effort in trying to study three increasingly different sets of arrangements.

The Trustees endorse the report’s central idea that the definition of ‘Major Road’ must include the more important local authority ‘A’ roads as well as Highways England’s Strategic Road Network, and we agree that such a Major Road Network needs coherent and consistent planning and funding arrangements. In addition, the Trustees support the need for them to be made



‘fit for purpose’, geared to meet the users’ needs, safe, well maintained, able to make best use of capacity, and a good neighbour to the communities that they pass through.

We wanted to explore the extent to which new technologies could transform our major road system and how they might best be used in the decades to 2040. The Trustees believe that greater awareness of the challenges and opportunities ahead will make for better short- and medium-term decision-making.

This report is aimed at all those with a responsibility for or interest in England’s major roads. We believe it merits serious consideration by central and local government, the new emerging devolved bodies, Highways England and other organisations in the sector. At a time of great change, and

with the long-term commitment to infrastructure renewal, a consistent approach to the road network is much needed.

The Trustees join me in thanking our authors David Quarmby and Phil Carey for their hard work over the last two years and for this immensely valuable report.



**David Hutchinson, Chairman
Rees Jeffreys Road Fund Trustees**

October 2016



1

The Challenge

A new approach needed for planning and developing England's major roads

- England's economy, at both national and regional levels, needs a balanced network of major roads with good geographical coverage that meets the needs of business and society.
- Investment in the Strategic Road Network (SRN) is now being stepped up, but we need to determine if the focus should be extended, beyond the SRN to include a number of key local authority 'A' roads.
- Given the very different regimes between Highways England and the scores of local highway authorities (LHAs), the next challenge is to create a consistent framework for planning, managing and funding these major roads, and for facilitating effective collaboration between the different bodies to enable this to happen.
- Only in this way can the available resources be spent most effectively and the Major Road Network (MRN), as we call it, made 'fit for purpose'.
- Continuing devolution of powers to local authorities and sub-national bodies provides an opportunity to help make this collaboration work.
- Two further challenges over the longer term are:
 - to exploit to the full the capability of transformative changes in technology that will affect vehicles, travel options and infrastructure management; and
 - to find the right balance between managing traffic demand and enhancing capacity, so as to maintain reasonable levels of service on the network in the face of rising congestion.

1.1 The challenge of ensuring a well-performing road system that supports the economy

A well-performing road system meeting the needs of its users must be central to government's focus on strengthening England's economy. At a national and regional level, achieving and sustaining growth depends to a huge extent on good accessibility – and accessibility in turn is overwhelmingly provided by the road network: 89% of all personal travel and 86% of freight movement takes place by road.ⁱ And it is the main roads within that network that are the arteries for commercial traffic on which businesses across the country rely.

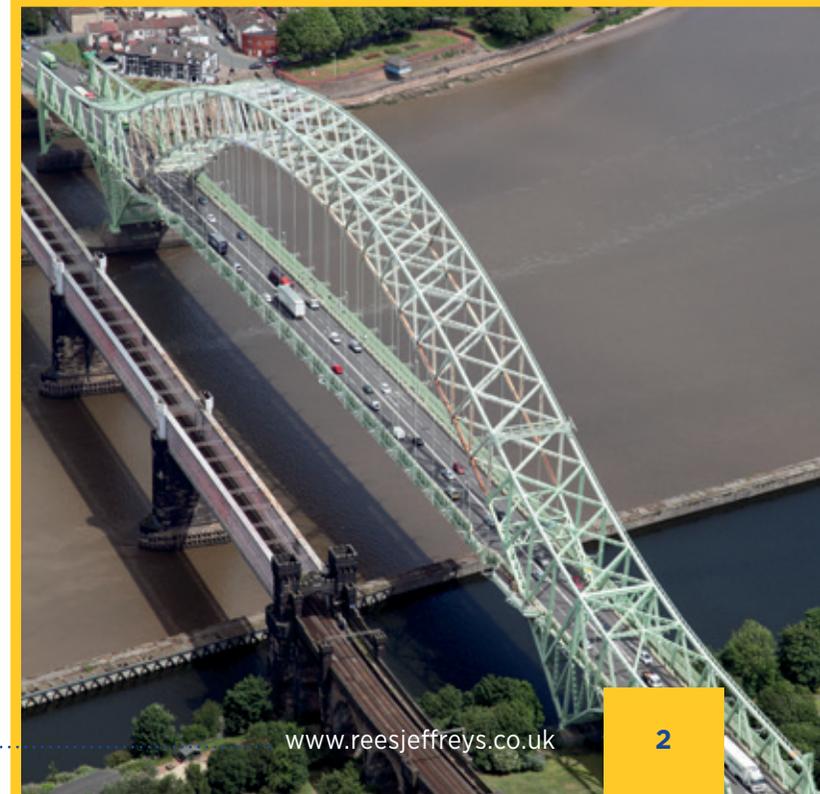
But roads can only perform well if managed as the core infrastructure within an overall transport strategy that delivers the desired objectives. This must recognise the wide range of transport modes which use roads, but must position that alongside rail, which also plays a crucial role for passengers as well as freight.

Road traffic is now at its highest level ever.ⁱⁱ Forecasting is difficult at this time, but the most recent forecasts estimate

further growth in the range 19–55% between 2010 and 2040ⁱⁱⁱ – at the higher end of this range for vans, and for traffic on motorways and rural 'A' roads – meaning that many of those arteries would be at risk of simply clogging up. Growth on urban roads is forecast to be rather lower, but chronic congestion is already a feature of some main roads in and around towns and cities – not merely in London.

Government recognises the challenge of ensuring that England's transport infrastructure overall is up to the task. A very substantial transport investment programme is well under way, with more than £70 billion having been committed to it over the six years to 2020/21, mostly to rail.^{iv} Of that expenditure, £15 billion is now being channelled into the SRN,^v through the newly autonomous Highways England. And a National Road Fund is expected to come into being in 2020, funded by Vehicle Excise Duty receipts, to support 'strategic roads' in England and consolidate that funding stability.

But this commitment addresses only part of the challenge. The 4,000 or so miles of the SRN, critical though they are in carrying a third of England's total traffic, fall well short of the full set of economically important roads, particularly at the regional level. Across the country, significant local authority 'A' roads play a crucial role as well, complementing the SRN to provide the network that matters.



1

And herein lies the nub of the problem: there exists a great gulf between the planning and funding regimes for the SRN and the less effective arrangements for the vast bulk of England's roads, managed by 153 LHAs. These local roads are significantly less well funded, on most counts, than the SRN, and are still for the most part subject to annual budget-setting, with declining revenue support and a patchwork of capital funding arrangements; what is more, they lack a comprehensive performance regime.

The challenge, therefore, is to:

- define the full network of significant roads that provide the backbone of England's economy, at a national and regional level, exploring how far beyond the SRN that network needs to go – that then constitutes our Major Road Network; and
- devise an integrated planning and funding regime for both the SRN and the local authority parts of the MRN, to maximise the potential of this MRN and to get best value for money from it; even a substantial roads investment programme, if it is focused largely on the SRN alone, will fail to provide the necessary support for economic growth.

To fulfil its potential, such an MRN needs to be planned and managed in such a way as to:

1. place current and prospective road users at the heart of investment and operational decisions – whilst requiring value for money at all times;
2. quickly become fit for purpose, and managed well so as to deliver a decent service to users and to meet the wider needs of communities and the economy;
3. ensure alignment with the objectives of sustainable growth in housing and business development, linked with spatial planning policies;
4. fully recognise the more complex, multimodal role that major roads play in our cities and conurbations; and
5. establish the consistency and long-term stability in planning and funding that infrastructure of this importance deserves.

The current momentum of devolution of powers to local government and new sub-national bodies in England may be relevant here: the emerging institutions seem well placed to exploit the MRN concept, helping to fulfil the above five conditions, and providing a basis for better and more accountable decisions that stand a chance of being taken on board owned locally.

This study takes the same 2040 horizon as the Strategic Vision underpinning roads reform^{vi} – which helps us focus on two major challenges for the longer term:

- The first relates to the effects of rapid and disruptive technology-led change on travel choices and demand, on the increasing automation of driving tasks, and on the way that road networks will need to be managed. The impacts

of autonomous vehicles are just one aspect – one that is particularly difficult to gauge – of the long-term transition to a more technology-led system of vehicle movement and management.

- The second challenge is how to deal with the expected rise in traffic congestion over this period. Whatever the uncertainties about future travel patterns, and the

prospects for growth in rail's share of total travel, the rising demand for movement due to population and economic growth may well outstrip the rate at which major road capacity can be affordably and acceptably increased. This requires a willingness over the longer term to consider methods of demand management.

1.2 How this study tackles these challenges

This report sets out how these various challenges can be best addressed, and to guide decisions about the designation, management and development of the MRN. It is not a blueprint for the future road network itself – that is for government, central and local, to determine alongside their partners and communities.

The report first analyses the growing gulf between the regimes for the SRN and for local authority roads; it then develops a proposal for an MRN designed to support

national and regional economies. We also explore the link between the processes of economic and spatial planning, and the planning of the road network.

At the heart of the report is a proposition for what a 'fit-for-purpose network' should provide – centred on what its users, and all of us in our communities, should reasonably expect.

We then consider how to make it work, creating a collaborative planning regime, and identifying the opportunity for a consistent approach to funding.

Finally, we survey the outlook for the longer term, given the technology and congestion challenges.

The mechanisms needed to put all this in place and to deliver what England needs lie within reach: an MRN that meets the needs of its users and society, serves the country's economy, and is sustainable for the longer term, through to 2040 and beyond.

2

The Growing Gulf

Roads reform is exacerbating the divide between the Strategic Road Network and local major roads

- The contrast between the planning and funding regime for the Strategic Road Network (SRN) and that for local roads is stark.
- The roads reform agenda has put in place an effective and well-resourced regime for planning and delivering successive five-year programmes of investment on the SRN, through Highways England, with associated user-focused performance targets.
- No such regime exists for local highway authorities (LHAs), who have had to cut routine maintenance as part of the Government's austerity programme, and who face complex capital funding arrangements, without the certainty of comprehensive five-year commitments.
- Greater maintenance backlogs exist on the local authority road network than on the SRN, and the quality of service to users is generally not as good.
- The coverage of the SRN varies considerably across England, exacerbating the consequences of the contrast in regimes.
- If some of the more important local authority roads are to be put alongside the SRN to create a more integrated and geographically coherent network of Major Roads, this gulf between the two planning and funding regimes needs to be addressed.



2.1 The regime for the Strategic Road Network

The Roads Reform agenda has put in place for the SRN a carefully constructed, well-resourced regime, one which makes the most of the autonomy now granted to the government-owned company Highways England. It has been given a clearly defined remit, and guaranteed funding over a five-year Road Investment

Strategy (RIS) period, which aligns well with the longer timescales entailed in delivering infrastructure projects. In addition to maintenance and operations, annual investment in improving the network alone will more than double over this first five-year period, reaching £2.2 billion in 2019/20.

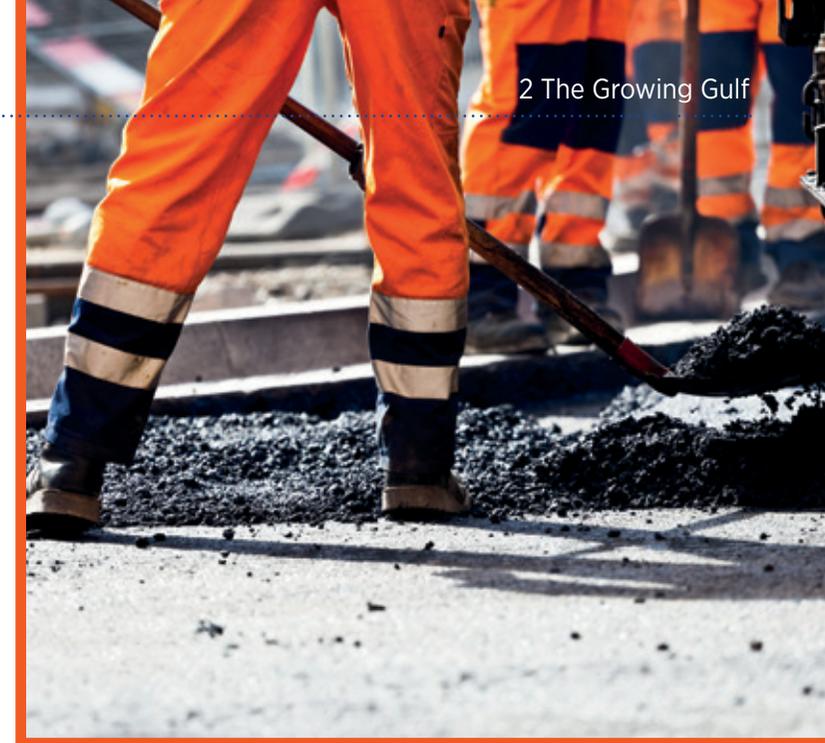
2.2 The regime for local roads

The governance and funding regime for local roads has had no such overhaul. It doesn't enjoy the same clear focus on outcomes, and has increased in complexity of late: there are now some 15 different funding pots, most determined year by year, and all having different criteria and business case requirements.^{vii}

In the 2015/16 year, outside London, only 4% of funding for capital expenditure was formally ring-fenced; little more than half is now allocated according to funding formulae, and this much is based mainly on road length and the

number of bridges needing works. The balance of funding is either scheme-led, or (increasingly) based on the LHA's performance. Total local authority capital expenditure on roads is set to change little over the period to 2019/20.¹

The revenue side of local roads is particularly difficult to assess, as only part of the funding comes from central government; receipts locally from Council Tax and parking services top this up, but the exceptional pressure on local authority budgets in recent years has pushed road maintenance revenue spend



down 16% in the three years to 2013/14; this decline is set to continue.

The uncertainty is growing: major institutional changes are emerging with the spread of combined authorities and of sub-national transport bodies, and new funding arrangements are being set up as part of the 'deals' negotiated in each case. The planned move to a regime under which local authorities retain 100% of business rate receipts by 2020 means a revolution in local government finance; its implications for central government grants are, as yet, unclear.

¹ See Supporting Document 1 (Appendix A) for the data and analysis behind this chapter.

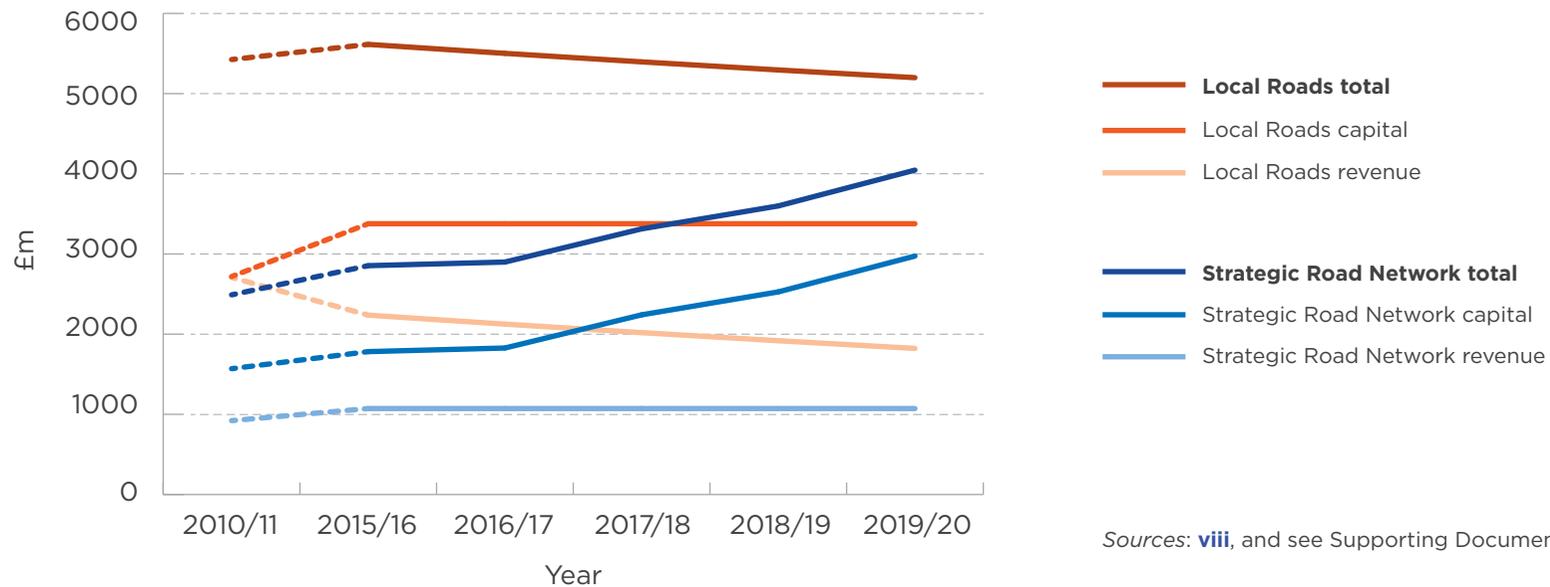
2

2.3 Comparing expenditure

The most prominent feature that comes to light when planned expenditure for the SRN and for local roads are compared is the contrast between the 67% increase in capital provision for

the SRN for the first Road Investment Strategy period (RIS1) through to 2020/21 on the one hand, and the squeeze on local roads funding on the other (Figure 2.1).

Figure 2.1: Current and forecast capital and revenue expenditure (£m) for the Strategic Road Network and all local roads



Sources: [viii](#), and see Supporting Document 1

The picture on total local roads expenditure, and on the share that goes on LHA 'A' roads (from which the subset of Major Roads will be selected), is complex. Supporting Document 1

attempts a comparison of spend, capital and revenue, between the SRN and LHA 'A' roads; this is summarised in Table 2.1.



Table 2.1: Summarised comparison of relative spend on the Strategic Road Network and on local highway authority 'A' roads

Total spend in 2015/16	£'000 per route-mile	£'000 per lane-mile	£'000 per million vehicle-miles*
Strategic Road Network	643	146	16
Local authority 'A' roads	117	51	12
Forecast spend in 2019/20			
Strategic Road Network	911	207	16
Local authority 'A' roads	108	47	11

*Per vehicle miles figures are for maintenance spend only

Source: Supporting Document 1, based on just over a third of 2014/5 maintenance-only spend for all LHA roads being on LHA 'A' roads and the small length of LHA motorway.

Total spend per SRN-mile, at £643k, is already more than five times higher than per mile of LHA 'A' road (or three times higher per lane-mile, taking account of the typically wider carriageways on the SRN). By the end of RIS1, planned spend by Highways England will have increased by more than 40%, whilst spend on local roads is more likely to have fallen. We estimate that spend per mile by then will be eight times higher on the SRN than on LHA 'A' roads.

The usual rationale for focusing resources on the SRN is the greater volume of traffic that it carries: whilst comprising only 2% of all roads, it carries 33% of all vehicle mileage (and 66% of heavy goods vehicle mileage). As an illustration, and focusing only on maintenance spend, which is the element most closely related to traffic levels, spend per *vehicle-mile* on the SRN and LHA 'A' roads is much less far apart (one third

higher on the SRN). But traffic volume is only one basis for comparing levels of spend: much of the need arises regardless of traffic flow, and local 'A' roads face additional costs arising from their more complex environment, having to:

- facilitate a wide range of non-motorised journeys not counted in traffic data;
- accommodate the consequences of utility services under their carriageways and footways; and
- provide a liveable street environment – supporting 'place' as well as 'movement' functions.

About a third of LHA A road mileage is located in towns and cities, where these considerations are most important, whereas this is true of only 7% of 'A' roads on the SRN.

2

2.4 Comparing outcomes

Despite the diversity of roads, we can draw some provisional conclusions on how lower relative funding feeds through into a poorer-quality network, or a worse experience for users:

- Asset condition:** the Department for Transport (DfT) recognises that with currently planned budgets it is not possible to clear the backlog of maintenance for local roads in England, estimated as requiring up to £8.7 billion; by contrast, plans for the SRN include fully meeting its maintenance requirement of £3.7 billion.^{viii} Whilst the headline indicator of carriageway asset condition shows approximate parity (4% of LHA 'A' roads should be 'considered for maintenance', compared with 3% of motorways and 5% of SRN 'A' roads²), this is only one part of the total road asset: account must also be taken of the more diverse legacy on local roads of bridges, foundations and general street furniture. The public certainly notice this: they see local highway condition as the second most important aspect of local transport (just surpassed by safer roads), but it causes by far the most dissatisfaction.^{ix}
- Safety:** the EuroRAP risk rating, based on accident records, is over 50% higher for LHA rural roads than it is on equivalent SRN roads that carry a comparable traffic mix (see section 5.6).

- Performance:** even allowing for the different standard of much of the infrastructure, the contrast in average delay experienced by users is striking: on the SRN as a whole, journeys take 14% longer on average than free-flowing traffic would permit;^x on LHA 'A' roads, the average delay is a 35% time penalty, on journeys that are already expected to be much slower.^{3 xi} The disparity is set to grow: average delay on trunk roads⁴ is forecast to increase by a little over a third by 2040, but by nearly half on the already slower LHA 'A' roads.^{xii}

So, the regime for local roads is more complex, less certain, and less well funded. There is evidence of poorer outcomes on LHA 'A' roads, but minor local roads may be the real losers, given that many local authorities feel obliged to concentrate their limited maintenance resources on their 'A' roads.

² This compares with 9% of B- and C-roads 'considered for maintenance', and 18% of unclassified roads, indicating how LHAs are focusing resources on their 'A' roads.

³ We have assumed average speeds of 55 mph on the SRN and 30 mph averaged across rural and urban LHA 'A' roads.

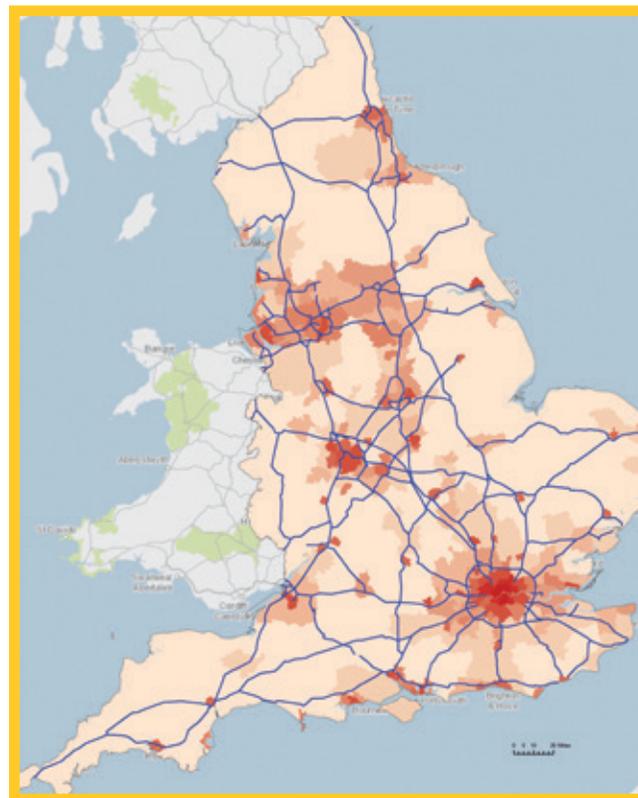
⁴ Trunk roads - 'A' roads which are the responsibility of Highways England - are part of the Strategic Road Network, alongside motorways

2.5 Uneven spread of the Strategic Road Network

The coverage of the SRN varies considerably across the country (Figure 2.2). The legacy of history, and the exemption of motorways when 30% of the total SRN was de-trunked after 1998, has left uneven coverage region by region. In South Lancashire, for example, it is a relatively dense network, almost all motorway; it is much thinner in West and South Yorkshire, and also to the south and west of London, where the development of the road network has not kept pace with economic and population growth. Highways England's Route Strategies exercise, reviewing needs across its network for the second RIS period, from 2020, might lead to recommendations for small-scale trunking or de-trunking, but there appears to be no work under way to assess more systematically whether the SRN is correctly determined.⁵

⁵ Some of the six Strategic Studies – notably on the Oxford–Cambridge Expressway – may result in some significant additions to the SRN, using corridors also picked up in our Major Road Network.

Figure 2.2: Comparison of Strategic Road Network with population density by district in England



It is this unevenness, and the fact that the SRN does not embrace all the major roads essential to underpin the national and regional economies, that makes this disparity of funding between the SRN and local authority 'A' roads so critical; it makes it all the more important to seek a definition of the network that can fulfil that task.

3

Defining our Major Road Network

Designating the roads that deliver most value

- An indicative Major Road Network (MRN) has been designated, applying objective criteria based on future traffic levels and vehicle mix to identify important main roads across England. These are the motorways and 'A' roads which most support economic activity, and provide connectivity for business and communities.
- The result is a network of some 8,000 miles, consisting of 4,200 miles of the Strategic Road Network (SRN) and a further 3,800 miles of the more important local authority 'A' roads.
- This MRN accounts for 4% of England's road mileage and 43% of all traffic.
- We have set three tiers of roads within the MRN, to reflect their different physical characteristics (limited-access highways vs common access roads), and the distinct roles they play in varying contexts (rural vs urban).
- The designation of this network does not imply that it has to be brought under the responsibility of a single body - but there will have to be an integrated and consistent regime for planning and managing it.



3.1 Introduction

A key feature of the service provided by roads is that, with the exception of a few toll roads, they form a single seamless national network, and road users are unaware of switching from the SRN to a local authority road. But they also expect a different driving experience on through routes from that on local access roads. It makes sense for users, as well as encouraging effective governance and accountability, to draw a line somewhere in that continuum of roads. The distinct, government-run 'trunk road' network (now the SRN) has its origins in the 1930s, and was supplemented by the growth of motorways, a distinct category of road. But since the 1990s it has been pared back, with the result that many major, formerly trunk, roads are now

treated in the same way as the great mass of genuinely local roads.

Road hierarchies in many other countries start with a proportionately much more extensive 'national' network: Germany has a federal network almost eight times larger than England's SRN, serving an economy that is only some 25% larger. The Netherlands' national road network is only around 20% shorter than the SRN, in an area less than a third of the size of England.

Designating our network of interest should be based on those roads that add most value, and provide greatest connectivity. This is not necessarily the same as being most heavily used by long-distance traffic, which doesn't

in itself add more value per mile than other journeys: even on motorways, only 28% of journeys (but of course a bigger proportion of total traffic) are longer than 25 miles.^{xiii} Instead, we should focus on road corridors that:

- (1) play the biggest role in local and regional economies, using the simple proxy of traffic volumes coupled with volumes of commercial traffic; and
- (2) connect the largest number of possible origin and destination pairs, also evidenced by volume of traffic, but also by ability to link up all key nodes – for example urban centres, ports and airports, and logistics hubs.

3

3.2 An objective approach

We have developed an analytical tool to test possible traffic thresholds in defining our MRN. This provides an objective basis for singling out a network of national interest. As explained in Supporting Document 2, we tested a range of options, but have settled on an intermediate level based on (a) motorway and A-road links with average daily traffic flow greater than 20,000 vehicles, along with (b) roads with as few as 10,000 vehicles, provided that at least 5% of that flow is heavy goods vehicles (HGVs) or 15% is light vans.

The raw output needed adjustments to: (1) produce a coherent network connecting all towns with population greater than 50,000; (2) remove isolated links; and (3) reflect the differential pattern of growth by region and road type that is forecast by 2040. This process of judgment has also brought in a small number of additional links, which, although falling just below those thresholds, increase the reach of the network to peripheral areas, or provide valuable resilience by backing up the most heavily trafficked corridors.

The resulting Major Road Network of just under 8,000 miles therefore puts 3,800 miles of local authority A-road alongside virtually all of the SRN, 4,200 miles⁶; it represents 4% of road mileage in England and carries 43% of all traffic (see Figure 3.1). This is significantly less than the 12,000 or so miles of Primary Route Network in England, connecting up the full set of 'primary destinations' defined by government, but not otherwise determined by traffic flow.

⁶ This is less than the 4,442 miles reported in DfT road lengths statistics, mainly because it excludes the length of slip roads and junctions; see Supporting Document 2.





Figure 3.1: The indicative Major Road Network

A key feature of the MRN is that it is determined at national level, based on objective criteria. Nonetheless, local knowledge will need to be applied across the country to validate the selection of some routes, and propose the inclusion of others. We do not envisage that this process will lead to any significant net change in the scale of the network: selected stakeholders have already expressed the view that this MRN, whose 'A' roads embrace some 30% of all 'A' roads in England, 'feels' about right.

We believe this is close to the optimal scale of network: large enough to incorporate flexibility to maintain service to users and take enough pressure off unsuitable local roads, yet small enough to concentrate investment and aspire to a clear set of standards and decent level of service.

The MRN as designated will need to be subject to periodic review, amongst other things validating the minor changes arising from differential traffic growth to 2040 by area and road type. And, as part of that dynamic process, the network should be seen as comprising corridors providing connectivity, rather than the specific alignments that the road links currently take.

Source: own analysis—see Supporting Document 2

3

3.3 Three tiers

We envisage three separate tiers within the network (plus a subset of the first), based on physical distinctions but focusing on the different function which each tier performs:

- **Tier 1: limited-access:** not restricted to motorways, and largely devoted to ‘movement’⁷; these roads provide links between major urban areas and facilitate the highest average speeds, so are well suited for longer-distance traffic in particular; there is a subset of:
 - **Tier 1A: limited-access – urban:** with more frequent junctions and very heavy traffic flows, which need to be more subject to the wider transport policy

⁷ See Section 5.5 for further discussion of ‘movement’/‘place’ conflicts on urban roads

framework and traffic management strategies set by the city or regional authority;

- **Tier 2: multiple-access – rural:** mainly all-purpose rural ‘A’ roads, with frontages and local access, providing links between secondary urban areas but also sometimes serving the ‘place’ needs of communities they run through; and
- **Tier 3: multiple-access – urban:** Major Roads in urban areas, with the greatest mix of user types and conflicting movements, and on some of which significant ‘place’ functions will need to be acknowledged.

Table 3.1, and the map at Figure 3.2, show an initial indicative classification of road links in the MRN.

Table 3.1: Summary statistics for composition and traffic flow on the Major Road Network

	MRN total	By SRN / LA MRN		By tier			
		SRN	Local authority MRN	Tier 1		Tier 2	Tier 3
				Non-urban	Tier 1A		
Approximate length in miles	8,000	4,200	3,800	2,900	800	3,300	1,000
Percentage of total	100%	53%	47%	36%	10%	41%	13%
Average daily flow (all vehicles)	50,032	76,068	32,439	78,613	89,576	29,913	38,804
Average % HGV	6.4	9.4	4.4	9.5	7.5	6.0	4.1
Average % vans	14.1	14.3	14.1	14.0	14.0	14.5	13.9
Indicative total traffic (billion vehicle-miles)	113	86	27	58	19	26	10

Source: Calculated using analytical tool, as described in Supporting Document 2



Figure 3.2: Indicative breakdown of the Major Road Network by tier



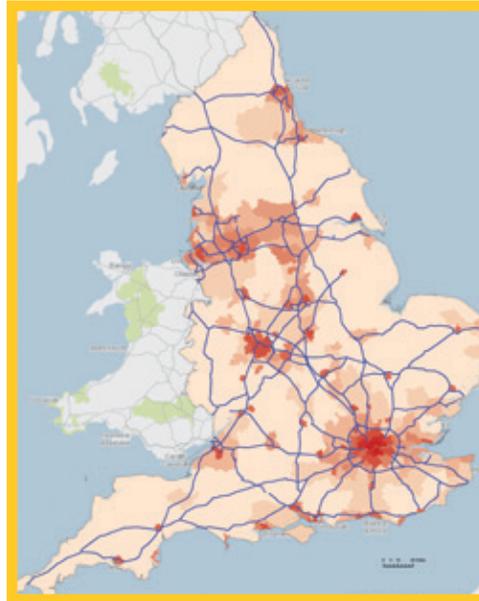
The Network has a significant presence in **urban areas** – Tier 3 combining with Tier 1A to make 23% of the MRN essentially urban, whereas little more than 10% of the SRN alone is urban.^{xiv} These urban major roads are the key connectors within conurbations, rather than main streets within cities and towns, but must still be subject to locally determined cross-modal transport policies; section 5.5 addresses how the MRN needs to adapt to this more challenging urban environment.

Source: own analysis – see Supporting Document 2

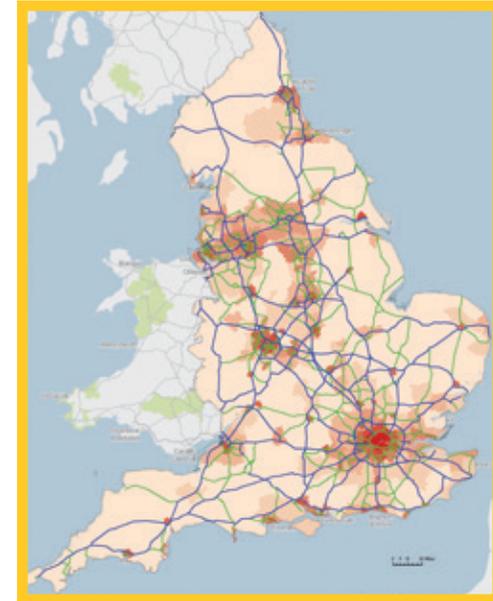
3

Figure 3.3: Comparison of coverage of Strategic Road Network and Major Road Network

And Figure 3.3 shows how the MRN serves the more densely populated parts of England much more comprehensively than can the SRN.



Strategic Road Network and population density



Major Road Network and population density

3.4 Multiple ownership

Defining a single MRN does not mean all those roads need to be under the responsibility of one body – we believe this isn't required. Most local authority roads on the MRN, as well as fulfilling national and regional roles, are embedded in their local networks and

communities, and local responsibility should be retained. We believe that achieving effective collaboration between Highways England and existing local highway authorities (LHAs) is the right and least disruptive way to proceed.

But the current levels of coordination between LHAs and Highways England do need to be stepped up – in terms of forward planning as well as day-to-day operation. Chapter 6 sets out how to meet the MRN's need for an integrated and consistent regime for its planning and management.

4

Supporting Growth

Spatial and economic planning and the Major Road Network

- Establishing connectivity and a good level of service from the MRN doesn't automatically generate economic growth: a process of 'joining the dots' of spatial planning, economic development and transport improvements is needed to capture the benefits.
- The process is not straightforward, especially in parts of the country where varying institutions - often with differing jurisdictions - hold the respective responsibilities.
- Local Enterprise Partnerships (LEPs) are tasked with bringing this together. Across the country their capabilities and degrees of integration with different parties vary; there are concerns about capacity and accountability, but the concept is valid and is already working well in many areas.
- On the basis of our consultations, the Major Road Network (MRN) - by integrating the Strategic Road Network (SRN) and important local roads - is seen as a logical tool for this planning process.
- With the establishment of combined authorities (CAs), and the prospective sub-national transport bodies (STBs), new regional mechanisms integrating spatial, economic and transport planning are beginning to emerge.
- Clear spatial planning policies are needed to head off adverse consequences that may result from transport improvements which, whilst promoting changes in the public interest, generate new pressures for development.

4

4.1 Roads and growth

The connectivity offered by major roads is crucially important in sustaining national and regional economies and in supporting economic growth, especially in peripheral areas where rail service is less able to play to its strengths. Major roads underpin productivity by helping firms and public enterprises reach the markets for their goods and services, receive supplies, access labour markets, ease journeys to work, and facilitate business travel.⁸ A higher proportion of this 'commercial transport' is carried on the SRN and on the local authority roads designated for the MRN than on the road network as a whole.

Equally, those locations with better connectivity and service provided by the MRN are likely – other things being equal – to offer better prospects for growth, both through existing firms and new development. Sustainable economic growth requires a good level of service to be available at locations on the MRN which are deemed both suitable for this growth in land-use planning terms, and suitable by business – for example, in allowing for possible clustering with similar or complementary businesses.⁹

⁸ Recent evidence of business user appetite for transport improvements includes *Going the Extra Mile: Connecting businesses and rural communities*, Federation of Small Businesses, May 2016.

⁹ See Supporting Document 3 (Appendix A).



4.2 The planning process

‘Joining the dots’ of spatial planning, economic development and transport interventions is best carried out as an iterative process, progressively identifying locations which meet land-use planning requirements, satisfy business location criteria and provide sufficient connectivity. This process will also reveal what transport interventions may be needed to make it all work, and which provide sufficient value for money.

The process is far from straightforward, especially in parts of the country where different institutions (often with differing jurisdictions) hold the different responsibilities. For example, in two-tier counties, districts hold the planning responsibilities, and counties hold the transport portfolio for their wider area; LEPs are tasked with bringing those responsibilities together with what will work for business, and leading the applications for funds to improve the infrastructure (usually transport) to facilitate growth. Many LEPs cover a wider area than individual local transport authorities, and most embrace several local planning authorities.

The LEPs’ geography had a chaotic start in 2011, and several local authorities still have to work with two overlapping LEPs. Inevitably LEPs’ capabilities and degrees of integration with their

partner local authorities vary across the country. Moreover, concerns have been expressed about their capacity to carry out the tasks assigned to them, and the effectiveness of the accountability arrangements for expenditure.^{xv} But we believe that the concept is the right one: they work well in many areas, and as the LEP movement matures it will grow in effectiveness, enabling conversations at local and regional level, getting agreement on priorities, and securing the required resources.

Separately, there is progress, too, in combined authority areas (now expanding considerably beyond the original six former metropolitan areas): all are different, but a more coherent and integrated process of aligning spatial, economic and transport planning is beginning to emerge. None yet have the statutory duty to prepare and ‘join

up’ plans of the kind that the Mayor of London is obliged to fulfil; it is the clarity and certainty of these plans over the last 15+ years that has helped to underpin London’s continuing success in business investment and housing delivery, and their integration with transport plans.



4

Informal consultation during our study with representatives of three different areas – usually involving the counties as Local Transport Authorities and one or more LEPs – has suggested that the MRN concept is relevant to them, and could help the required iterative process by bringing together their part of the SRN and the most important local authority roads.

We recognise that not all interventions to improve the MRN would necessarily lead to the intended economic growth – for example, if the barriers to growth in a particular area were not related to connectivity or decent service levels on the network. But we could be more confident of success if the planning processes were better ‘joined up’.

And it needs to be recognised that transport improvements may substantially change the patterns of travel and transport of *existing* households and businesses, as they respond to changes in accessibility; or successor occupants may be attracted who have a greater propensity to travel. This may cause more road traffic, and an increase in demand for development on the edges of towns, potentially leading to second-order consequences

of dispersal and yet more traffic. While the primary purpose of investing in major roads will be clear and justified – whether for the relief of congestion or to improve connectivity and support economic growth – clear spatial planning policies alongside it are also needed, to anticipate such second-order effects, and to head off their more adverse consequences whilst still promoting changes that are in the public interest.



5

The Fit-for-Purpose Major Road Network

What's needed for the Major Road Network to deliver its potential

- The Major Road Network (MRN) needs to be 'fit for purpose' to deliver its potential.
- First, it must be fit for all users - meeting their needs and their expectations for a decent and safe overall service, including aspirations for the speed and reliability of their journeys, varying according to tier.
- Fitness for purpose means making best use of capacity, expanding it where necessary, and maintaining the asset condition in the most cost-effective way.
- It also means fit for the communities that the network passes through, mitigating adverse impacts of noise, air pollution, severance and visual intrusion.
- Making Major Roads fit for urban areas means addressing 'movement'/'place' conflicts, and working with wider transportation policies for the urban area such as traffic and demand management measures, and priorities for certain modes.
- A fit-for-purpose safety management regime for the MRN should increasingly use predictive risk assessment methods to ensure that action and resources are focused in the most cost-effective way, with particular regard for the risks faced by vulnerable road users.
- A fit-for-purpose planning regime is one in which the network operator (or the 'strategic client') plays a lead role in generating options for improvement, identifying deficiencies in delivering the service proposition, and engaging in multi-objective assessment and evaluation.
- Highways England and the local highway authorities should consider working up a high-level Fitness For Purpose code suitable for the whole MRN, perhaps working through the UK Roads Liaison Group.

5

5.1 Fit for the user¹⁰

The MRN has to be consistently fit for purpose, enabling the effective service the country needs. It needs to operate safely, making the best use of its capacity; it needs to be a good neighbour to the communities it passes through; and it needs to be properly maintained over the longer term. But pre-eminently it must be fit for its wide range of users not just car users. The needs and characteristics of the Strategic Road Network's (SRN's) users are being increasingly understood, but local highway authorities (LHAs) have rarely been resourced to know their customers better. To bridge the gap we commissioned a literature review from the University of the West of England (UWE),^{xvi} recognising that users' characteristics don't change when they leave the SRN. This work, and other research findings around the SRN from Transport Focus and DfT^{xvii} leads us to propose six components of what users ought reasonably to expect from the MRN:

- a comfortable journey, minimising stress from, for example, a poor-quality road surface;
- a safe journey, with minimal risk of personal injury or damage to vehicles;
- reasonable expected journey time and reliability;
- accurate and relevant information on routing, hazards and delays, enabling the journey time to remain more or less predictable;
- availability of fairly priced rest and catering facilities along the road; and
- safe and seamless connection and signage to the rest of the local road network.



The priority attached to each of the above components will vary by journey length and user type, amongst other factors. The expectations of leisure users may lead to a different balance from that which is relevant to business users or commercial traffic. And the priorities and needs of the increasing proportion of older drivers¹¹ will make it essential to adhere to the highest standards of road design, needed to facilitate safe driving by all.

¹⁰ See Supporting Documents 4 and 6 (Appendix A) for more information on these issues.

¹¹ The Older Drivers Task Force report (Road Safety Foundation, July 2016) notes that there will be an 80% increase in the number of drivers in the UK over 70 between 2014 and 2035.

With the economy at the heart of the MRN's rationale, a fit-for-purpose network needs to serve the freight and service sectors well, recognising the distinction between the priorities of fleet operators and those of their drivers. Heavy goods vehicles in particular, representing only 6.4% of traffic on the MRN, have disproportionate importance and impact. They need a network that is:

- **robust** – ensuring adequate headroom at over-bridges and protection from cross-winds on exposed stretches, and maintaining across the MRN unrestricted access for vehicles up to 44 tonnes, as currently applies on the Primary Route Network;
- **reliable** – majoring on predictability of journey time, including overnight when freight flows are strong but maintenance work which closes lanes and roads is often scheduled; and
- **liveable** – given that the MRN is the 'workplace' for a substantial workforce of drivers, truck stop facilities need to be available by collaboration between the market and planning authorities.

The UWE review found that, the more defined the expectation that a road user has, the lower the resultant satisfaction subsequently reported. Currently, with no expectations set out, 89% of users report they were satisfied with their most recent SRN journey^{xviii}. But we believe road users should have clear and reasonable expectations of their journeys, so that they can plan their business activity or personal routine with some confidence – even if the reported satisfaction level then falls. Not all needs can be met, of course, and there will have to be trade-offs, particularly in respect of 'reasonable expected journey time', where the constraints are greatest.

We identify three components of journey time:

- **Expected average speed:** the average speed safely achievable over a length of road reflects both the inherent free-flow design speed and, for Tiers 2 and 3, localised speed limits, traffic signals, junctions and interaction with other traffic. As with journey times calculated by satnav devices, it is built up from the speeds normally achievable on individual sections of

the road, and forms the baseline for the journey time proposition.

- **Predictable variation from average speed:** the wide variations in traffic volumes over the course of the day, week and year are often known, and can generally be forecast, and hence the effects on journey times estimated. Thus the user's expectation would be qualified by an expected variation due to congestion.
- **Unpredictable variation from average speed:** irregular disruption (not solely accidents and infrastructure failings, but also planned roadworks and unexpected levels of traffic) also needs to be allowed for; many freight operators already make some additional provision to reflect the likelihood of unexpected delays.

This reliability standard could be quantified as the percentage extra time the user needs to allow in order to arrive on time for a set percentage of trips – a 'buffer time' index.

5

The three indicators combine to produce **a service proposition for the MRN**, but this must vary by tier; for example, the greater control which the network operator has over the limited-access Tier 1 and 1A roads means that unpredictable variation there should be much lower. We propose the following matrix of expected service levels for the four tiers, in respect of average speed (ranging from + to +++)¹², as then qualified by the extent of predictable and unpredictable variation (ranging from – to ---).

¹² The average speed banding of ‘+++/++/+’ could be expressed approximately as 60 mph/40 mph/20 mph, but more work is needed to develop the other indicators, exploiting valuable new analytical opportunities now arising from the wealth of mobile phone data on vehicle movements.

Table 5.1: Matrix of expected service level by tier

	Average speed baseline	Predictable variation: extent of congestion	Unpredictable variation: extra time needed
Tier 1	+++	–	–
Tier 1A	++	– – –	–
Tier 2	++	–	– –
Tier 3	+	– – to – – –	– – to – – –

Section 5.2 below provides an illustration of how actual performance – significant shortfalls against expected service levels in particular circumstances – may generate options for intervention.



5.2 Making best use of capacity¹³

Utilising existing capacity as efficiently as possible is a central task for the network operator, requiring 24/7 overview and engagement with users, to meet performance benchmarks derived from this framework. The performance regime set for the MRN should build on progress now being made for the SRN and should:

- recognise the complexity of traffic flow: on busy roads, flow falls once an optimum average speed is exceeded; in congested conditions the network operator should regulate speed down to the optimum to avoid instability and maximise traffic flow, as is already now well-established practice on Smart Motorways on the SRN; on multi-lane carriageways, there is scope to increase separation of traffic types moving at different speeds;
- apply primarily to area networks rather than individual stretches of road: the more extensive MRN makes greater resilience possible than can be found in the SRN alone, opening up more options for managing traffic

¹³ See Supporting Document 7 (Appendix A) for more information on this and other network operator responsibilities.

flow during disruption; this requires operating procedures, including traffic control centres, to be better integrated across the MRN; and the ability to deal with longer-term disruption caused by, for example, flooding or infrastructure defects; and

- develop a focus on maximising the number of people travelling or of total goods being transported, rather than just vehicle flow: network operators can, for example, support the development of bus and coach services through facilitating interchange hubs.

Demand for travel on the MRN – at least on Tiers 1 and 2 – is likely to increase over the longer term at a faster rate than capacity can be increased, even with a proactive approach to network development (see section 5.7 below). Network operators can still strive to meet the service aspiration by making full use of developing technologies, such as sophisticated information services for users, and by being geared up for the opportunity and challenge of

Connected and Autonomous Vehicles (see section 7.4).

Highways England's *Concept of Operations*^{xix} provides a valuable set of principles that should apply across the MRN; it aims to use the opportunities arising from technological developments to improve utilisation, availability and demand management on the SRN. Comparable guidance for the network management role of LHAs^{xx} is focussed more on the legal framework and operational responsibilities, rather than on effective capacity utilisation and the quality of the user experience. It will be important to ensure that guidance for MRN operation covers all the components of fitness for purpose that are covered in this chapter.



5

5.3 Maintaining the asset

The MRN concept is about service to the user, but underlying it all must be infrastructure that is fit for purpose – well managed so as to underpin safe, reliable and cost-effective operation. Good asset management focuses on the whole life of the asset and seeks the optimal mix of maintenance (both preventative and reactive) and improvement work.

Asset condition is about more than just carriageway quality, although that is a principle focus of user concern – it also concerns geotechnical works, drainage, structures and installed technology. This represents a complex challenge, particularly for hard-pressed LHAs.

Extensive best-practice guidance forms part of the Highways Maintenance Efficiency Programme (HMEP),^{xxi} helping all LHAs to build up their capability and achieve more with less. Self-assessment against HMEP efficiency principles is, increasingly, a criterion for allocation of maintenance block grant to LHAs

by the Department for Transport (DfT); adherence to the HMEP should in future be a precondition for an LHA operating part of the MRN.

Notwithstanding the above, guidance that is MRN-specific needs to be developed, centred on its distinctive feature of heavy traffic flow; this could bring together elements from Highways England’s forthcoming Integrated Asset Management Strategy with the HMEP guidance that already focuses on roads less likely to be purpose-built and having a broader mixture of structures and carriageway standards. Supporting Document 7 sets out some of the innovative approaches to maintenance management which could bring efficiency gains across the MRN.

Timely maintenance work would be required to sustain the quality of service from the MRN, but roadworks can significantly impair that service in the short term. Whilst LHAs have already

had to prioritise A-roads over the rest of their network, MRN status, with appropriate funding, would be expected to lead to more improvement work than has been possible so far. Users are generally tolerant of roadworks where they can see better outcomes ahead – but that doesn’t reduce the need for network operators to minimise the adverse impacts of roadworks where traffic flow is heaviest. Construction sites also increase the safety hazard: Highways England has recently trialled a response to this, seeking to change the mindset of drivers as they enter roadwork zones.^{xxii} If successful, such approaches, along with lessons from abroad¹⁴ could valuably be applied across all of England’s major roads.

¹⁴ One example is the Dutch ‘Minder Hinder’ (meaning ‘less delay’) approach, which boosts funding for selected major roadwork schemes by around 5% in order to minimise delays for users: a package of measures tailored for each scheme brings together more user-focused traffic management, joint working with adjoining highway authorities, and better communication with users throughout the process.



5.4 Fit for communities and the environment

Fitness for purpose entails more than just the user interest. The impacts of major roads and their traffic include noise, air pollution, severance, visual and landscape intrusion, and in some cases ecological impacts. There are also positive impacts of proximity to the MRN: greater accessibility is most relevant for businesses, and for the three out of four households with access to a private car; but the Major Roads will be public transport corridors too, particularly in cities. Nevertheless, for most people living or working adjacent to major roads, the negative impacts are perceived as outweighing the positive.^{xxiii} As a result there may be equality concerns in that poorer households are less able to afford the higher prices of a better environment located away from the major roads.

Noise is one of the most troublesome of the impacts directly related to traffic volume. The network operator can significantly mitigate its intrusion by the application of noise-reducing road surfaces, noise barriers and in some cases through noise insulation of adjacent buildings – all at a cost. Under the first Road Investment Strategy plan, Highways England is committed to a programme of action in over 1,000 designated ‘noise improvement areas’ of which half will be subject to ‘quiet noise resurfacing’.^{xxiv}

On roads maintained by local authorities, some noise reduction results as a by-product of using ‘thin surfacing’ proprietary products for road maintenance, but this does not achieve the maximum noise reduction possible with today’s materials. We believe that there should be a more concerted effort by LHAs to achieve substantial noise reduction in areas known to be particularly affected as a result of residential proximity and high traffic volumes, either by use of noise-reducing surfaces during maintenance or through noise insulation of adjacent buildings.

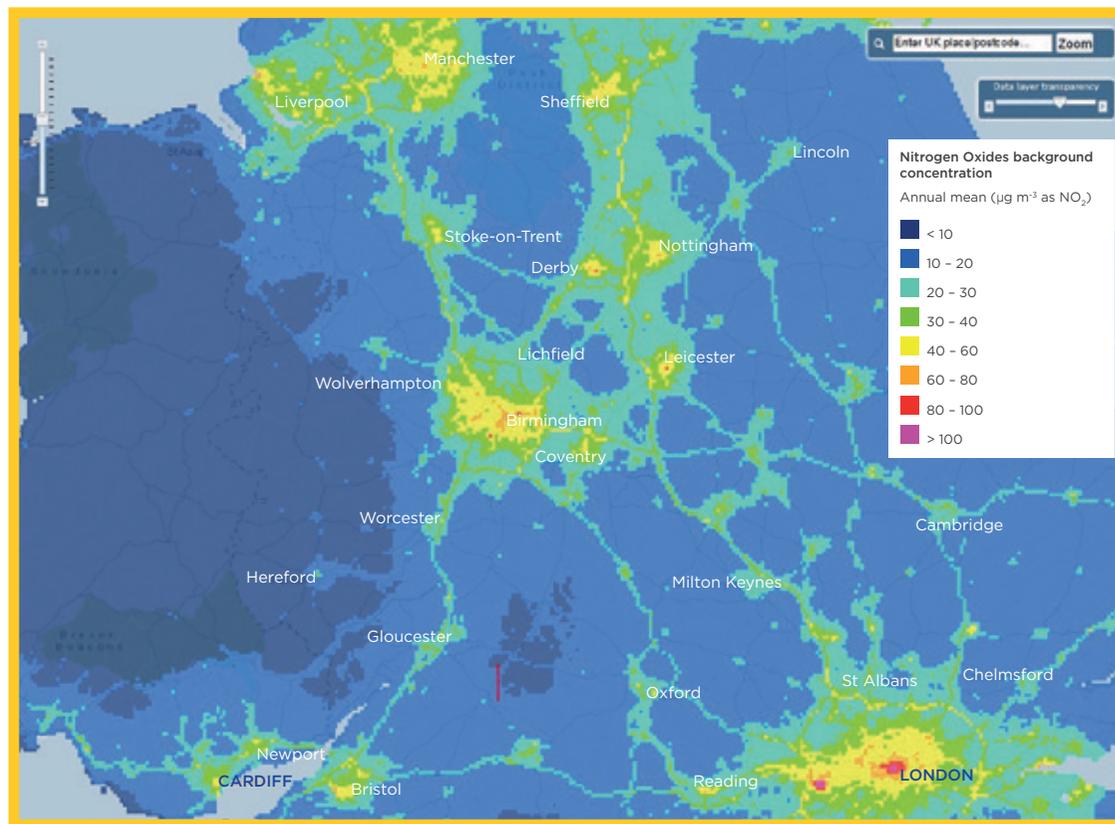


5

Air quality¹⁵ in larger cities and along some major road corridors is affected by emissions from diesel engines of NO_x (nitrogen oxides) – and NO₂ (nitrogen dioxide) in particular – and of fine particulate matter (PM_{2.5} – particulate matter of median diameter 2.5 microns or less), and is becoming the critical environmental hazard as better understanding is gained about the link between atmospheric concentrations of NO₂ and health. England currently experiences substantial breaches of the UK’s air quality regulations^{xxv} for NO₂ in London and several other cities (breach areas shown in yellow, orange and red in Figure 5.1); and some key SRN corridors (yellow in the map) are also just above the regulatory limit.

¹⁵ See Supporting Document 5 (Appendix A) for more information on this subject.

Figure 5.1: Background concentrations of NO_x London - Midlands - North corridor



Source: Annual mean NO_x (as NO₂) concentrations (background) 2014 England, Defra. Screen shot taken from <https://uk-air.defra.gov.uk/data/gis-mapping>. Breach level is 40 µg/m³

The UK Government's action plan in response to the breaches envisages that the combination of new vehicle emissions standards, coupled with the introduction of some exclusion zones for the more polluting vehicles in the most sensitive urban locations, will sufficiently lower background concentrations across the country by 2025.

Nevertheless, achieving compliance with the statutory limits by that deadline still presents a real challenge, especially in London, and given recent concerns about real-world emissions of diesel vehicles. However, the improvement in air quality expected to be achieved during the 2020s means that it is unlikely to be an issue in the evolution of the MRN over the longer term, to 2040. But in the meantime, network operators should be encouraged to mitigate localised concentrations through traffic management and speed limits, and if necessary by extending exclusion zones.

Severance is most acute for busy dual carriageway roads, especially those with high speeds, dividing communities and limiting mobility for those living adjacent to them. Mitigation of severance often involves bridges and underpasses for pedestrians and cyclists; in cities these can be grim for the user. The need for better solutions is now widely recognised, from less brutal design aimed at improving the sense of personal safety, to more frequent at-grade crossings, or even of building a deck over arterial roads, part-funded by housing or retail development on it.

On the related challenge of visual intrusion, there are several practical measures which can improve the visual impact of major roads at low cost.^{xxvi} The principles of fitness for purpose should go further, encouraging major roads to make a positive contribution to the landscape or townscape, and contributing to the well-being of users and those alongside the road.



5

5.5 Fit for urban areas

A distinct approach is needed for Tier 3 (and to some extent Tier 1A) roads in urban areas: they will need to reflect the following additional considerations not applying to Tier 1 limited-access roads or Tier 2 rural roads:¹⁶

- There must be recognition of the degree of place as well as movement that may apply to any section of a Tier 3 road, and which must guide interventions to make the road more fit for purpose in both respects.
- There must also be recognition of the wider transportation policies of the surrounding urban area, which for major roads may involve:
 - traffic management schemes which give priority to more efficient users of road space, including well-managed freight movement;
 - traffic management strategies – both individual schemes and area control systems – aimed at optimising the capacity and use of the local network; and
 - for demand management, control of parking supply and price, and the potential to charge for road use (see section 7.6 for the wider context).

A comprehensive approach for addressing the movement/place conflict is set out in the DfT's *Manual for Streets* series.^{xxvii} Subsequent to its publication, the London Mayor's Roads

Task Force^{xxviii} addressed this conflict on a network basis, establishing a 'typology' of streets and roads using a 3x3 'Street Types' matrix (Figure 5.2); the method analyses a road or street according to its relative degree of significance for movement and for place, and presents a toolbox of measures that may be applied in each box to mitigate the conflicts.

Figure 5.2: Street Types Matrix (Transport for London)¹⁷



Source: Transport for London

¹⁶ Some of these considerations may also apply where Tier 2 roads pass through smaller settlements.

¹⁷ See an explanation of street types and their use at <https://tfl.gov.uk/info-for/boroughs/street-types>



This method helps to systematically identify significant place functions of a Tier 3 Major Road – for example as a suburban ‘High Road’ – and can help justify traffic management measures, speed limits and public realm enhancements to sustain the quality and vitality of that centre, while ensuring that the movement function can still be fulfilled. It is a valuable tool, tested and refined in London, which could be used for addressing potential movement/place conflicts and improving public realm in other cities and conurbations.

5.6 Managing safety¹⁸

All these dimensions of fitness for purpose must not detract from the fundamental requirement to provide a safe service. The MRN – 4% of England’s road network – carries 43% of all traffic, but has only 16% of those killed or seriously injured (KSI) in crashes. The network includes the country’s safest roads – motorways and limited-access dual carriageways (Tier 1) – but also many busy single-carriageway A-roads, especially in rural areas, where users face much higher risks of crashes, deaths and injuries.

The risk of crashes on Tier 2 rural A-roads is related to aspects of road design and geometry as well as speed limits and the behaviour of drivers (including motorcyclists). The Road Safety Foundation’s annual reports^{xxix} highlight persistently high-risk roads, as well as featuring the most improved roads and how these results have been achieved. There are many ways in which

¹⁸ See Supporting Document 8 (Appendix A) for a more detailed treatment of this subject.

network operators can influence driver behaviour – road design, markings, signage, speed limits and enforcement; they can also make the infrastructure as ‘forgiving’ as possible to driver error, for example by installing barriers and removing the most hazardous trees.

Safety management action is informed mostly by data about collisions (mainly the STATS19 national database of police-reported injury road collisions in Great Britain), after the event (*ex post*); effective at addressing hotspots, this has brought down crash rates. But best practice is moving towards more predictive (*ex ante*) risk assessment, forensically assessing road infrastructure for its inherent crash and injury risk. The iRAP (International Road Assessment Programme) method¹⁹ is known in the UK, but little used except by Highways England, who have committed to assessing the entire SRN and acting to ensure that by 2020 more

¹⁹ See Supporting Document 8 (Appendix A).

than 90% of travel on the SRN is on roads with a 3-star iRAP rating or better. ^{xxx} A recent TRL report^{xxxi} has assessed 21 safety management models and made recommendations to DfT about encouraging and advising local authorities on using screening and predictive methods.

We believe that best-practice safety management should now be incorporating the use of predictive risk assessment methods, to help ensure that action and resources are focused in the most cost-effective way – with particular regard for the risks faced by vulnerable road users.



5

About a quarter of all KSI crashes on the MRN involve motorcyclists, who face exceptionally high risks – up to 40 times the average risk per mile faced by other road users; targeted measures, including installation of average speed cameras, can be effective.^{xxxii} On Tier 3 urban Major Roads, vulnerable road users – cyclists, pedestrians and motorcyclists – account for the majority of KSIs. Methods such as the Street Types nine-box matrix developed for London can, by framing the resolution of movement/

place conflicts, provide a rationale for protective measures even on Major Roads – such as road redesign, speed limits, segregated cycle lanes and signal modifications. With this methodology firmly in place in London, we believe that conurbations and larger cities should now be considering the use of the Street Types matrix to help frame their approaches to safety interventions, as part of the wider use of this method for addressing movement/place conflicts.

Automotive technologies already widely available in new cars, such as autonomous emergency braking, and a range of other driver-assist features, are likely to achieve significant reductions in crashes; these beneficial effects should become more significant as levels of vehicle automation increase, although we have not seen any quantified predictions of these benefits. See section 7.3 for a more detailed discussion of the latest autonomous vehicle technologies.

5.7 Developing the network

A fit-for-purpose MRN has to be a dynamic concept; investment in improving or expanding it should, as well as benefitting the user, also take opportunities to mitigate the wide range of impacts on non-users.

The network operator has the lead role in identifying options for enhancing the network. The matrix of expected service levels in Table 5.1 can provide the context for considering additional capacity or other measures to improve performance. Candidates for intervention should be brought forward where:

- there is an obvious bottleneck preventing even the average speed baseline from being met, and a cost-effective solution is practicable; or
- a high congestion factor on that stretch could be brought down through value-for-money investment to increase capacity – or perhaps by prioritising provision for usage types that maximise throughput; in such cases, and particularly on Tier 3 (urban) Major Roads, the network operator should consider possible localised demand management tools

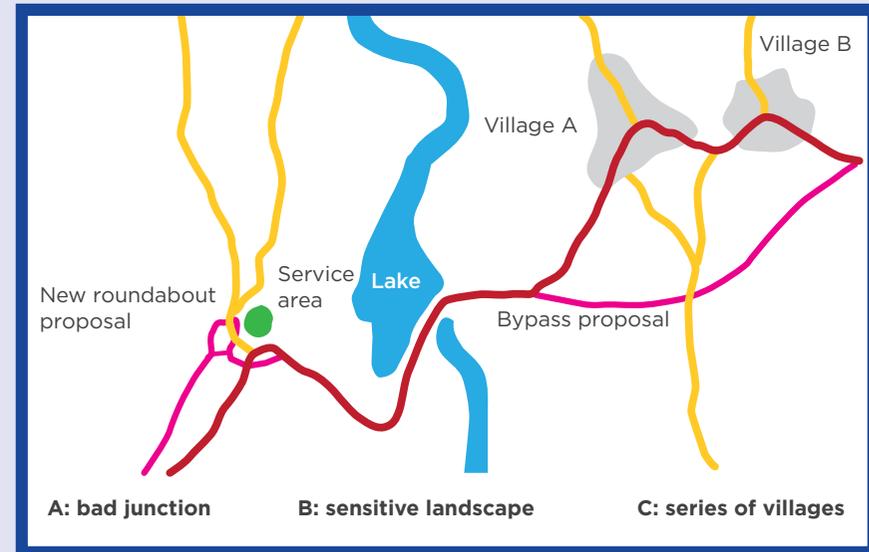
as well as improving integration (where appropriate) with rail services, and facilitating more sustainable modes where possible.

Where the strongest need for such investment in the network is identified, it could result in the upgrading of a link to Tier 1 or 1A, or exceptionally the addition of a wholly new link. More often, shortfalls below the benchmarks will persist, but users would at least be able to understand where this is the case, how large the shortfall from the benchmark is, and why it is persisting.



Example of where service level shortfalls can generate options for possible interventions

Let us take as an example a stretch of Tier 2 MRN road (in red), passing, from west to east, through (A) an overloaded junction with two local roads (in yellow) and added movements generated by a service area; (B) a scenic descent through protected countryside to cross a river near a lake; and (C) a stretch of more built-up road, through two large villages with multiple side roads. Intervention is feasible at (A), through construction of a new roundabout and a better-graded approach road from the west; and at (C), through construction of a bypass for the two villages. Both interventions would bring performance of that stretch up to the benchmark level for Tier 2. The existing road also performs below the benchmark at (B), but the protected landscape means that the only feasible intervention might be to address safety problems rather than improve traffic flow.



	A: Bad junction			B: Sensitive landscape			C: Series of villages		
	Average speed baseline	Predictable variation	Unpredictable variation	Average speed baseline	Predictable variation	Unpredictable variation	Average speed baseline	Predictable variation	Unpredictable variation
Current performance	+	---	--	++	-	---	+	---	---
Potential future performance	++	-	--	++	-	---	++	-	--

Red: road performing below benchmark for Tier 2; Green: road performing at benchmark for Tier 2

This is a logical process of option generation, to be considered within the usual business case evaluation for public capital investment.^{xxxii}

5

5.8 Fit for purpose – summary

- **Fit for the user** means understanding users' expectations for a decent level of service – and then setting out to deliver on aspirations for the speed and time taken for their journeys, and their reliability and predictability. Roads in the MRN will vary by topography and current standard – but we have grouped them into three tiers according to the function they perform and the standard they offer.
- **Fit for communities and the environment** means tackling noise, air quality and severance, and integrating mitigation measures into the ongoing management of the road.
- **Fit-for-purpose management** means making the best use of capacity and the resilience provided by the network; exploiting technology to give road users the information they need to make better decisions; controlling traffic speeds and flows through the network; and, where possible, expanding capacity at pinchpoint locations to address

shortcomings in the service provided. The asset itself must be well maintained, following best practice, and on a whole-life basis.

- **The safety management regime** for the network must be fit for purpose: this should mean adopting over time predictive risk assessment to make the infrastructure safer and more forgiving, rather than relying only on ex post data on crashes to guide safety interventions.
- **Fitness for purpose for Major Roads in cities and conurbations** needs to reflect the more complex transport and planning policies needed there, and the greater exposure and risk faced by vulnerable road users.
- **A fit-for-purpose planning regime** assesses performance against service level aspirations and other measures mentioned, and generates options for improvement or mitigation, to be evaluated for effectiveness and value for money.

This list of components of fitness for purpose of the MRN constitutes a demanding specification. In view of the firm foundations already in place for the SRN, we suggest that the network operators, perhaps under the auspices of the UK Roads Liaison Group, collaborate in developing a high-level Fitness For Purpose code appropriate for the broader Major Road Network. This could draw in particular on Highways England's knowledge and experience, given the firm foundation already contained in the company's licence conditions and performance targets.



6

Making It All Work

Planning, managing and funding the Major Road Network

- Fulfilling the potential of the Major Road Network (MRN) requires a consistent approach to its planning, management and funding.
- As we do not advocate changes of responsibility for the different parts of the MRN, delivering this consistency requires a strong collaborative approach between Highways England and the relevant local highway authorities (LHAs).
- On planning, Highways England's Route Strategies should evolve to adopt a genuinely network approach, embracing local authority Major Roads as well, and the consideration of needs and network options as a whole.
- Collaboration on network planning can be greatly assisted where devolved arrangements such as sub-national transport bodies, combined authorities (CAs) and Local Enterprise Partnerships (LEPs) are in place.
- Collaboration on network management is needed to put in place deliverable resilience strategies for managing the consequences of incidents and closures.
- Ensuring the MRN's 'fitness for purpose' falls primarily to the respective highway authorities, but there is a clear role for the 'strategic client' to translate users' expectations into service level targets and aspirations, and to plan capacity and manage demand so as to maintain that service – integrating with the surrounding network of local roads and rail as appropriate.
- The plans for a National Road Fund (NRF) raise the possibility of extending its 'strategic roads' remit to include contributions to local authority MRN roads, as well as funding the Strategic Road Network (SRN).

6

6.1 Introduction

This MRN will only fulfil its potential of supporting regional economies and enhancing accessibility for all if the *whole* of the network is fit for purpose and able to deliver the appropriate standards. This requires a consistent approach to the planning, management and funding of the whole MRN.

6.2 Planning

Collaboration on network planning on a regional basis is an essential foundation for an effective road system. Nowhere does the SRN operate in isolation from the A-roads which complement and feed it. Such collaboration would require future Route Strategies by Highways England (see section 2.5) ^{xxxiv} to evolve and adopt a true network approach, embracing the local authority Major Roads as well, area by area, and considering with the LHAs the needs and network options as a whole – rather than focusing only on the SRN route itself. The essential feature of this approach is to explore not only how improvements to local authority Major Roads can benefit the SRN, but also, conversely, how changes to the SRN can benefit local Major Roads and their users.

Current developments in the devolution of decision-making about economic, spatial and transport planning to local and sub-national bodies could make such collaboration between Highways England and LHAs more coherent and effective.

The two key types of new players are:

The **sub-national transport bodies** (STBs), enabled under Clause 21 of the Cities and Local Government Devolution Act 2016, bring together local authorities and other stakeholders to bid for transport powers – some, such as the planning of important roads, voluntarily ‘uploaded’ from the participating local authorities, or other roles added, for example the ability to address issues such as rail integration or smart ticketing.

The **combined authorities** (CAs), bodies created (under the Local Democracy, Economic Development and Construction Act 2009) by a group of local authorities for an area, who upload to them a wider set of powers than they would to an STB. Originally an initiative of leaders in Greater Manchester, the CA concept has been adopted across the English metropolitan areas, and the Government has been encouraging adoption of the CA model elsewhere in England too. CAs are the subject of ‘devo deals’ with government, most of which include the transfer of some transport powers and/or funding.



The MRN would be the logical network of regional and national roads for an STB to concentrate on, providing as it does a more broadly based connectivity than the SRN alone can. Each STB, on behalf of its local authorities, who remain the statutory highway authorities, would then lead the collaboration with Highways England on the operation and strategic planning of the MRN in their area.

One prospective STB – England’s Economic Heartland Strategic Alliance, running west and east across the South Midlands – is ready to adopt the MRN as the ‘strategic’ network for its area; and work with Highways England and the member counties on its future evolution.

Midlands Connect, another prospective STB, has been considering the MRN concept for roads in its area which runs east-west from the Welsh border to the North Sea, embracing the West Midlands Combined Authority.

Transport for the North (TfN), envisaged to become the first STB in 2017, is already designating what it calls a Key Route Network selected from the county ‘A’ roads across its area, closely based on the MRN concept. Working with the

combined authorities and counties, TfN is likely to lead the conversation with Highways England about the ‘strategic’ roads across the north of England. This partnership will oversee the strategic planning of roads, helping to ensure connectivity across the north of England, and guiding the development of priorities for investment.

The MRN, as proposed in this study, adds value as an objectively determined, nationally designated network of major roads across England. Were there to emerge special funding arrangements for the local authority parts of the MRN, alongside the SRN funding regime, then these could be accessed by STBs and by combined authorities.

Where there is neither an STB nor a combined authority, the LEP, or an appropriate grouping of local authorities, could provide an effective basis for regional transport planning. As described in Chapter 4, the MRN provides the essential main road connectivity at this level.

The five combined authorities in the north of England, and the West Midlands CA, are also designating their own Key Route Networks – a concept originally pioneered by Greater Manchester – which embrace the more significant roads within their conurbation. Each conurbation Key Route Network will be more granular and extensive than the MRN as we have defined it, as it serves a different purpose, but it will generally include the MRN roads.



6

6.3 Responsibility for ensuring the Major Road Network is fit for purpose

The dimensions of fitness for purpose for the MRN are set out in Chapter 5. The front-line delivery responsibility rests with the *network operator*, be it Highways England, a local highway authority or a combined authority. Each would ensure that their part of the MRN is:

- fit for the user, aspiring to meet specified levels of service – this means making best use of capacity, ensuring resilience and minimising stress for the user;
- fit for communities and the environment – leading to a distinct requirement to be fit for urban areas, meeting the particular challenges of Tier 3 and Tier 1A roads in the MRN;
- structurally fit – the asset maintained effectively for the longer term; and
- sufficiently safe – for users, neighbours and road workers.

In Greater Manchester, and potentially in other conurbations where the SRN is a vital part of the urban road network, the need for collaboration on the operational management of the network as a whole is being addressed in Memoranda of Understanding between Highways England and the relevant CAs. More generally, experience suggests that there is a need for stronger collaboration between Highways England and relevant LHAs on maintenance and, also with police, on the

management of incidents and major closures,²⁰ ensuring that resilience planning is more comprehensive.

But that is only part of the required regime: a higher-level body has to take the responsibility for setting the parameters for the network operator's work. Either the Department for Transport (DfT), an STB or a CA – or in some cases the local highway authority itself – fills the role of 'strategic client', responsible for securing funding, and completing fitness for purpose by ensuring that:

- user expectations overall are met and managed;
- target service levels are specified; and
- aggregate network capacity and demand are managed strategically.

Finally, and recognising that the MRN will not exist in isolation, the network operator and strategic client together need to ensure that service provided by the MRN is effectively integrated with that provided by other local roads and the rail network.

²⁰ See, for example, Highways England's statement about the M6 closure in the West Midlands in February 2016 <https://www.gov.uk/government/news/m6-junction-5-to-6-closure-4-feb-2016-highways-england-response> and the report on the same incident of the West Midlands Police and Crime Commissioner following an inquiry <http://www.westmidlands-pcc.gov.uk/media/423675/11-SPCB-07-June-16-M6-Inquiry.pdf>



6.4 Putting funding in place

A consistent approach to funding is needed, for both the SRN and the local authority parts of the MRN, to make a success of the more collaborative and integrated planning process. As Chapter 2 explains, we are a long way from that at present. Ideally, a funding regime would (a) enable prioritisation of need and value for money irrespective of administrative boundaries, and (b) provide certainty and continuity of funding over a reasonable planning period.



In 2015, the Government announced plans for the hypothecation of Vehicle Excise Duty from 2020 to create a National Road Fund, to fund ‘strategic roads’ in England.^{xxxv} So far that has been interpreted to refer to Highway’s England’s SRN. But it seems to us that the definition of ‘strategic roads’ could be extended; some flexibility already exists for Highways England, through their ability to fund “projects on local roads close to the SRN where it can be clearly demonstrated that this would help the SRN”.^{xxxvi}



With the broader MRN arguably better aligned than is the SRN to the investment objective of supporting England’s national and regional economies, there is some attraction in the idea of a future Fund more systematically contributing to the local authority parts of the MRN. It would be a logical adjunct to the integrated planning and management regime for the MRN – applying the same processes for the local authority parts of the MRN as for the SRN.

We suggest that, were a local authority’s Major Roads considered eligible for some funding contribution, either from a National Road Fund or from some other source, this should be conditional on the ability of the authority to demonstrate how it would meet the fit-for-purpose standards set for the MRN.

6

Our analysis suggests²¹ that there could be headroom in such a National Road Fund to contribute towards local authority MRN roads – if, that is, Highways England’s annual budget beyond 2020 (in the second Road Investment Strategy period, RIS2) remains similar to the level planned for 2019/20 (the highest year in the first Road Investment Strategy period). We have identified a possible surplus of £1.5 billion p.a., which would go a long way towards meeting the needs of local authority Major Roads. There may of course be several legitimate and large SRN claims on that headroom in the next road investment period, such as the Lower Thames Crossing, and other proposals arising from DfT’s Strategic Studies – but the NRF contribution to such major projects up-front could be much less than the total scheme cost given the potential for tolling and/or private financing.

²¹ England’s share of VED for 2020/21 is estimated at £5.7 billion, compared with £4.2 billion for Highways England’s annual budget for 2019/20, leaving a surplus of some £1.5 billion (from OBR Economic and Fiscal Outlook (July 2015) and Fiscal Sustainability Report (July 2014), Table 4.16 and Supplementary Data Series, plus HM Treasury Summer Budget 2015, Table 2.1.) .

In the end, it would be a policy decision by government as to whether to part-fund local authority roads on the MRN from the NRF, or whether to provide funding support for these roads from another source. Either way, the case for a systematic long-term funding commitment would recognise that the MRN:

- is the more balanced, objectively determined network, with the geographical coverage that supports the strategic goals for England’s economy better than can the SRN on its own;
- would provide a clearer and more systematic basis than the current approach of Highways England investing ‘beyond the SRN’ in preparing for the next road investment period;
- would help consolidate the role of STBs, as the MRN is the logical framework for their roads planning responsibilities; and

This move would provide a stronger basis for investment in the MRN as a whole in the coming decade, but may not necessarily provide a sustainable solution through to 2040. Section 7.5 considers policy responses to the longer-term challenge.



7

Ensuring A Sustainable Major Road Network

The challenges of technology and future demand

- There are two longer-term challenges for sustaining a ‘fit-for-purpose’ Major Road Network (MRN) for the next 25 years: first, how the huge – and in part unforeseeable – changes in technology over this period can best be exploited to help the MRN provide a better service to its users; and second, how best to deal with the expected rise in traffic congestion on the network.
- Technological change will continue to transform the travel and transport landscape – with potentially profound impacts on how people and firms make their journey decisions, on the options available in a world of ‘mobility as a service’, on how they use vehicles, and on how road networks are maintained and operated.
- Longer term prospects and timescales for autonomous vehicles remain highly uncertain. Meanwhile, with strong government support of R&D and regulatory adaptation, in the shorter term progressive implementation of ‘driver assist’ and related technologies will bring some capacity and significant safety benefits.
- Forecasting future traffic levels has become more challenging because of observed changes in personal travel behaviours and attitudes over the last 15 years which are difficult to comprehend and take account of, especially for shorter-distance travel in towns and cities.
- Meanwhile population is set to grow by 19% to 2040, and traffic volumes nationally are expected to increase in the range 19-55% on 2010 levels, according to DfT forecasts.
- Trends in traffic on inter-urban and rural roads are clearly diverging from trends on urban roads, with the former – more relevant for the MRN – showing more growth at this time.
- The demand for movement by road is likely to increase at a faster rate than capacity can be affordably and acceptably increased; congestion will therefore increase, and in time will strengthen the need to consider some form of demand management. There are no simple solutions, but government should remain informed about the alternatives available.

7

7.1 Outlook for a sustainable Major Road Network

We finish where we started – the two fundamental challenges at the heart of sustaining a fit-for-purpose MRN through to 2040. The first is how best to exploit the technology-led changes that are set to transform how people and businesses use the MRN, and how the network can be managed. The second is how best to deal with the expected rise in congestion on the network, given the likelihood that the demand for movement will increase at a faster rate than capacity can acceptably be increased.

There are great uncertainties as to how these changes will play out – and how fast – over the next 25 years, so this section goes on to consider how to embed the necessary flexibility in the regime for the MRN to ensure that it can continue to do the job required of it.



7.2 The impacts of technology

The pace of technological developments is increasing – in automotive technology, road and traffic management systems, information available to travellers and the greater focus on ‘mobility as a service’ – with the potential to bring about transformative consequences for travel choices, for the safety and capacity of networks and for network maintenance and management.

Table 7.1 considers five types of technology changes and briefly plots the transport system changes they are expected to cause, the likely effects on demand and travel behaviours, and the resulting effects on the road networks and the environment, together with a commentary on possible timescale²². It illustrates how all-embracing the effects of technology already are, with the scope of further change – particularly in the field of Connected and Autonomous Vehicles (CAVs) – being potentially considerable, but with much uncertainty attached to its end point and to its timing.

²² For further background to this table and to this topic as a whole see Supporting Document 10 (Annex A)

It is important to note that

- Most changes are likely to ease and de-stress the driving task over time (or even remove it); such changes will prove particularly responsive to the needs of an ageing cohort of drivers, and will perhaps make congested conditions marginally more tolerable. This in turn is likely to stimulate additional demand, and may increase the pressure for some form of demand management in some areas.
- Apart from a reduction in vehicle emissions (both greenhouse gases and pollutants), which is driven entirely by regulation, much of this change is being driven by the market, and regulated where appropriate. One area which depends on action by the public sector is the way in which technology is applied to the management of networks. There will in time be pressure on all highway authorities to ensure that CAVs can operate appropriately and safely (see section 7.3).

What are the implications for the Major Road Network?

Richer and more accessible information can improve the experience of road users, by optimising journey planning and increasing the predictability of journey times – as long as good-quality data, preferably soon through 5G connectivity, is available along the whole network. The opportunity for network operators to communicate in real time with vehicles on their networks, and for enhanced vehicle-to-vehicle communication, raises the prospect of a new, more sophisticated, concept of traffic management^{xxxvii}. The emergence of CAVs with differing but growing levels of automation may see the application of capacity-enhancing initiatives. But it is not clear at this stage how extensive these are likely to be, nor, taken in context, how beneficial they will turn out to be in practice.

Other developments are likely to have their greatest effects within urban areas, particularly in larger towns and cities where sufficient critical mass can be generated. These include the disruption of established means of access to car travel (owning a car, or hailing or booking a taxi) by web- and smartphone-based applications offering more flexible models (car-clubs, car-sharing, the Uber model of taxi service, and the like). And CAVs, when successfully introduced, are expected to provide new groups of users with their own access to car use – whether owned or not – as well as making it more attractive for existing user groups. This ‘mobility as a service’ concept could reduce the effect that parking scarcity has on demand, currently an important constraint which gives public transport alternatives the edge.



7

Table 7.1: Summary assessment of the impact of technology types

Technology changes	Changes in the transport system	Demand impact - travel choices and behaviours	Effect on the networks and environment	Timescale
Wide range of non-transport technologies reducing the need to travel or ship goods (eg video conferencing, 3D printing)	(No direct changes in system)	May remove some journeys altogether	Some reduction in traffic flow	Many of these technologies already well-established; further potential remains uncertain over coming decades
Better, more integrated information for travel choices, routes, journey-times, congestion, incl. for delays and incidents	Network operators can influence driver choices	Enables optimisation of travel arrangements and times; mitigates congestion effects; may stimulate new demand	May mitigate some delays and congestion, especially that related to incidents, and on interurban networks	Well established developments, continuing under market pressures
Levels of automation of vehicles (Connected and Autonomous Vehicles-CAVs)	Vehicles with progressively higher levels of automation entering into the UK vehicle parc. Uncertain rate of adjustment by network operators to accommodate change and realise benefits	Impact uncertain but probably positive response to increasing automation, raising demand especially in later stages of autonomy. Some demand likely to be stimulated by less stressful journeys, and eventually from non-drivers	Uncertain outcomes depending on how risk levels are set and the behaviour of drivers in mixed flows. Studies suggest some modest capacity benefits for urban and inter-urban roads. Big improvement in accident rates and road deaths.	Higher degrees of automation - but still with driver in control (up to Level 3) - may be widespread by 2025; Beyond that, uncertain rate of progress and market penetration, towards full automation. Governed by a range of behavioural, legal and other factors



Technology changes	Changes in the transport system	Demand impact - travel choices and behaviours	Effect on the networks and environment	Timescale
'Mobility as a service' – emergence of tailored transport, travel-on-demand	Digitally-facilitated new services emerging (eg Uber, car-2-go) which do not require car ownership. Change generally unforeseen and disruptive to existing markets	Evidence so far suggests increased use of new services, and may lead to reduced car ownership	Likely that supply will increase in response to demand where density is viable; mostly an urban effect, likely to worsen congestion	Innovation already visible today, mostly confined to larger cities. Likely to become more widespread in 2020s, but viability may be limited by population densities
Changing how road networks are managed	Optimisation of capacity, and influencing driver behaviour; improved efficiency of asset maintenance	Smoother network performance experienced by drivers: may stimulate demand; better driver information from network operators	Ability to increase capacity and throughput, reduce unpredictability, from influencing drivers' decisions. More cost-effective asset management	Network management methods are mature, but will be more widespread; extensive engagement with drivers from mid-2020s
Improved emissions of vehicles	Vehicles with reduced carbon emissions and emergence of hybrids and non-fossil fuel vehicles. Reduced NOx and particulate emissions, coupled with controlled access zones (CAZs) excluding or pricing out non-compliant vehicles	Pricing and regulatory measures will nudge drivers towards the take-up of these cleaner and less-polluting vehicles	Contribution towards greenhouse gas emissions targets; better air quality and compliance with air pollution limits, leading to better health outcomes	Some uncertainties still about the degree of carbon emission reduction by the 2030s. Air pollution limits expected to be achieved from 2025, conditional on effectiveness of CAZs

7

But the impacts go beyond demand and supply to service levels, safety and the effect on the environment:

- increasing levels of vehicle automation are already set to greatly reduce crash risk and consequential death and serious injury; and
- a steadily growing number of petrol-electric hybrid cars, and a growing but much smaller number of battery electric vehicles, along with a decade or more of regulatory squeeze, is continuing the trajectory of higher vehicle fuel efficiency with falling carbon emissions; and



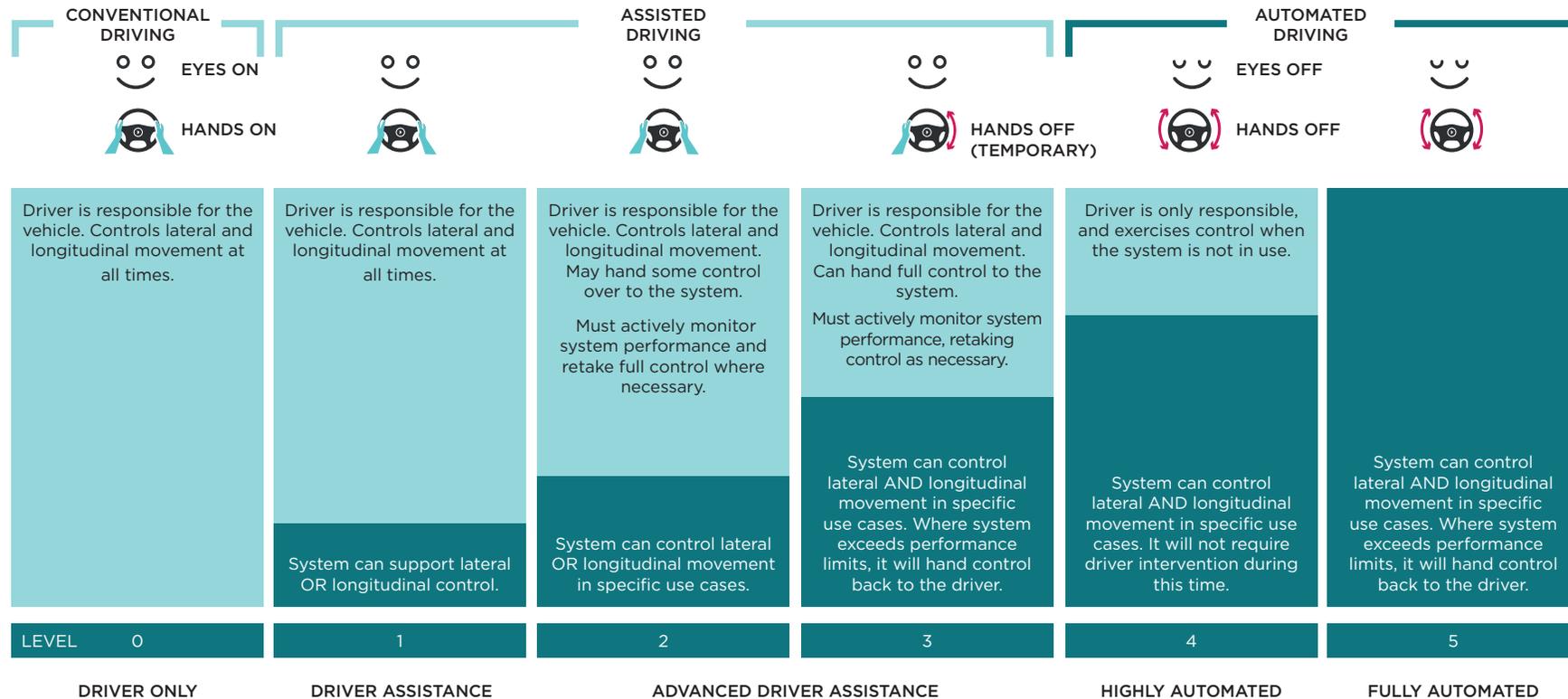
- innovation in the use of materials for road construction and surfaces is extending life and improving maintainability, with technology helping to improve intelligence about pavement condition and enabling maintenance to be planned more efficiently.

Of all the issues addressed in this report, technology is the one which is changing the fastest, in directions – and with impacts and consequences for major roads – which we cannot forecast with any confidence more than a few years ahead.

7.3 Connected and Autonomous Vehicles (CAVs)

There is currently widespread expectation that the progressive automation of vehicles, together with their connectivity, may in the long run have the most pervasive effects on travel demand and traffic behaviour, on network capacity and on users' attitudes to travel.

Figure 7.1 Defined levels of vehicle assistance and automation



Driver control
 System control

The levels of assistance and automation are adapted from the Society of America Engineers J3016 Standard "Taxonomy and Definitions for Terms Related to On-Road Motor Vehicle Automated Driving Systems" (http://standards.sae.org/j3016_201401/). While these are not formally recognised by the UK Government or the United Nations World Forum for Harmonisation of Vehicle Standards, they are seen as a helpful guide to the technology.

Source^{xxxviii}

7

Figure 7.1 is adapted by the government's Centre for Connected and Autonomous Vehicles (CCAV) from the international standard determined by the Society of American Engineers (SAE), and sets out the discrete steps towards fully autonomous vehicles. It describes the ways in which an automated system is able to cover an increasing share of the driving and vehicle control tasks.

Already low levels of automation (1 and 2) offering various forms of driver assistance are commonplace in new vehicles. Automatic Emergency Braking Systems (AEBS) – a level 3 system – are increasingly available. Such features are already having a beneficial effect on road safety, and by reducing collisions will also mitigate the occurrence of unpredictable delays and congestion, particularly on Tier 1 and 2 Major Roads. These levels of automation will also deliver safety benefits in urban networks, particularly for vulnerable road users.

A report by KPMG for SMMT^{xxxix} suggests that vehicles offering level 3 may achieve significant penetration in the UK by 2025. Level 3 is a form of very advanced driver assistance, sometimes called

'conditional automation'. While drivers may hand over control to the vehicle for short periods of time, they do not hand over *complete responsibility*, and are required to take back control of the vehicle quickly if needed. Questions have been raised about the practical implications in human factors terms of this intermediate level 3, requiring as it does the driver to remain vigilant and to constantly monitor the driving environment while the system is in control of the vehicle. The requirements and timing of the critical 'handback' process from vehicle to driver is still under close consideration by regulators. Genuine driver disengagement may only be realistic at the more ambitious levels 4 and 5 of automation, for which there is currently little consensus about timescale for large scale market penetration.

The UK government recognises the potential of automated vehicle technology (AVT) to improve road safety, enable better road capacity utilisation, and ultimately enhance mobility by giving access to those who cannot drive. The pace of development is being driven by the automotive industry,

taking an incremental approach reflected in the levels of automation in Figure 1 (although some players outside the industry, such as Google, are promoting a step-change approach).

Government policy^{xl} is to position Britain as an attractive test-bed for real world developments in AVT – for practical benefit on our congested roads, but with potential advantage for British industry too. The DfT is facilitating progressive but proportionate reform in vehicle and traffic regulation, in insurance and liability issues, and in the education of drivers; and they have recently consulted on the next steps of this reform.^{xli} Government is also actively supporting technical development in AVT sponsored by the Transport Systems Catapult and through the new Intelligent Mobility Fund, as well as promoting a range of real-world trials.

As new developments come to market, reflecting progress up the levels of automation, there is likely to be a long transition period in which many different levels of vehicle automation co-exist on the road network. This brings to the fore the need to understand real-world



behavioural and other non-technical issues. Up till now there has been little study so far of the practical implications of this for network management and capacity, nor for pedestrians, cyclists and motorcyclists – especially in urban streets—who will be navigating this mix. We urge DfT to continue to research these issues and to publish their results.

On Tier 1 limited-access roads in the Major Road Network, AVT and vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications have the potential to bring significant net benefits. With sufficient penetration they could increase capacity and safety by facilitating more intensive network operation by the infrastructure manager. This could include the use of real-time communication, with and between vehicles or drivers, to optimise outcomes

in the event of congestion and other disruptions. The scope for platooning of vehicles on longer limited-access corridors – particularly HGVs with their professional drivers and similar performance characteristics – is to be investigated as part of the DfT's current programme.

In the context of making the MRN fit for purpose, network operators too will need to comprehend their role in maximising the potential of CAVs, in particular the reduction in collisions. They will need early clarity on how far CAVs will have to rely principally on 'reading the road' rather than 'reading the map'—the former requiring very high standards of marking and signing on the road; the latter an up-to-date database of the network to a much higher level of detail and definition than is required for satnavs.

Current thinking suggests that on-board computational limitations will lead to the latter approach, now being developed as 'HAD' (highly automated driving) maps.

The DfT's positive and comprehensive approach is to be commended. But the pace and direction of development and real-world application beyond the next 5 to 10 years remains uncertain. As progress is made towards higher levels of automation, resolving the non-technical and behavioural issues – user acceptance/adoption, the wider policy and regulatory environment, digital infrastructure – may well limit the pace of implementation beyond the time when the technology is fully deliverable, especially away from Tier 1 limited-access roads.



7

7.4 Long term demand forecasts and traffic congestion²³

Congestion already imposes substantial costs on users across many parts of the MRN at particular times of day—£2bn p.a. on the Strategic Road Network (SRN) alone.^{xliii} For the SRN, the current Road Investment Strategy (RIS) programme and the prospective RIS2 (the second Road Investment Strategy period) programme are designed to address the more significant deficiencies in capacity, both on links and at junctions. Before accounting for road improvements after the current RIS, congestion on the SRN would increase steadily as traffic demand is forecast to grow by 30-60% to 2040. Even with more ambitious schemes possible in the next decade, which could greatly improve connectivity and resilience, it is not yet clear whether congestion on the SRN as a whole could be kept in check.

The planning of major improvements on the local authority sections of the MRN is generally far less systematically structured, and without any changes to the planning and funding regime the user experience on those roads is likely to worsen. Outcomes may well differ between urban areas, where there is a wider range of policy options for influencing traffic demand, and interurban roads.

Forecasting future travel demand on major roads The context is set by the Department for Transport’s (DfT’s) Road Traffic Forecast (RTF) through to 2040,^{xliiii} the latest version having been published in 2015. Uncertainties surrounding forward forecasts have grown, as changes have become evident in

the last ten to 15 years in people’s lifestyles, attitudes to car ownership and their travel behaviours. These changes are not easy to comprehend and it is difficult to forecast their implications for car travel over the longer term—particularly for journeys in larger cities in many of which travel options have been changing most quickly. However, one of the most important drivers of future traffic growth is the forecast 19% increase in population from 2010 to 2040. Nevertheless, recent events may have increased uncertainty about macro-economic trends as well as forward population forecasts.

It is for this reason that DfT presented a wide range of traffic forecasts in the 2015 RTF (Figure 7.2), each of the five Scenarios reflecting different assumptions about future household travel behaviour or external economic factors. DfT advises against using any specific scenario as a core forecast for travel by car, and that the range of possible outcomes should be acknowledged.

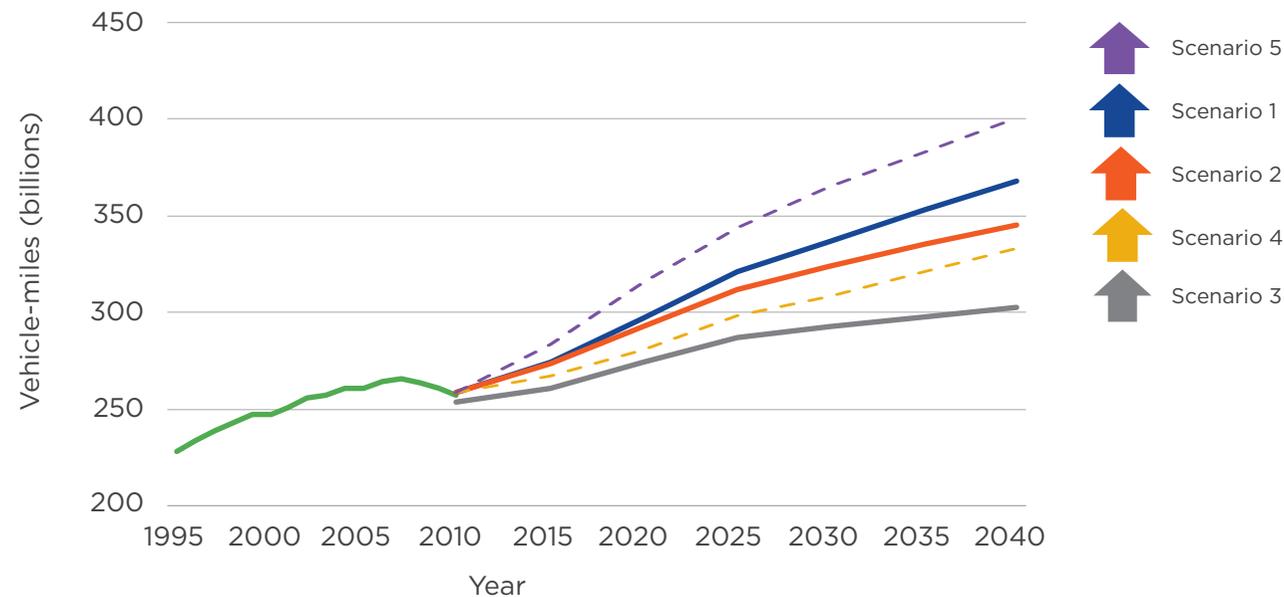
There are also particular challenges in forecasting future freight and light van volumes: HGV traffic has historically tracked GDP, but discontinuities in the trend have arisen since 2008 and remain unexplained. Light vans have shown consistently and surprisingly strong growth, and this is forecast to continue, evenly across road types and areas.

Figure 7.2 shows the range of forecasts of road traffic – all vehicles on all roads—by scenario.

²³ See Supporting Document 9 (Appendix A) for more detailed treatment of this subject



Figure 7.2 Traffic growth by scenario (billion miles, all vehicles)



Source: Road Traffic Forecasts, DfT, March 2015.

Comparison with recent traffic trends

The 2008 recession caused noticeable discontinuities in trends, and any longer-term impacts on travel behaviours will take time to comprehend. But it seems from the latest data that familiar trends may have re-emerged since then. Traffic statistics for 2015^{xliv} confirm that growth has continued to pick up consistently

since 2010: car traffic growth has averaged 0.7% per year a over the last five years, HGVs 0.4% per year and light vans 2.7% per year. These are within the range of the scenarios, resembling most closely Scenario 2 which suggests car traffic growth at 0.8% per year, HGVs 0.6% per year and light vans 2.0% per year.

Critically important for the MRN is how forecasts vary between road type (motorway/A road/ minor road) and by area type (London/conurbation/ urban/rural). While the RTF publication and supporting data contain such disaggregation by scenario, DfT again advises using ranges rather than specific scenarios.

7

Forecast growth ranges of traffic demand on SRN and local authority A roads are illustrated in Table 7.2. The figures for the SRN are based on no further network improvements beyond the RIS1 programme.

Table 7.2 Forecast traffic demand growth by road type (billion miles, all vehicles)

	SRN (motorways and trunk roads)	Local Authority 'A' roads
% Forecast growth 2010 to 2040	+29% to +60%	+13% to 51%
Average % per annum	0.9% to 1.6%	0.4% to 1.4%

Source ^{xiv}

In this table, local authority 'A' roads include both urban and rural roads. Actual traffic statistics for 2015^{xlvi} show growth of 9% on motorways over the five years 2010 to 2015 and 5% growth on rural 'A' roads. These contrast strongly with flat-lining on urban 'A' roads (and a

9% fall in London), which continues the urban trends which have become evident since the millennium.

The RTF breakdown by area type shows much less growth in urban areas than rural, but only at the bottom of the ranges. DfT recognises the concern that

has been expressed by the transport planning community at the realism of the higher urban forecasts, particularly for London; we would strongly urge DfT to continue to research this, so as better to comprehend the well-established growth differentials between types of area.

Table 7.3 Forecast traffic demand growth by area type (billion miles, all vehicles)

	London	Conurbation	Urban	Rural2
% forecast demand growth 2010 to 2040	+13% to 47%	+14% to 54%	+6% to 50%	+29% to +59%
Average % per annum	0.4% to 1.3%	0.4% to 1.5%	0.2% to 1.4%	0.9% to 1.6%

Source ^{xlvii}



Such wide ranges of forecasts at the national level make it difficult to be precise about the levels of demand likely to be faced on the Major Road Network over the coming years; in any case specific routes and local networks would always be the subject of local studies and analysis to develop the case for particular interventions.

The range of forecasts of traffic growth for the SRN reflect the fact that 90% of it lies outside urban areas. A similar, though lower, range could be imputed to the rural Tier 1 and Tier 2 roads on the local authority parts of the MRN, given the prominence of commercial transport on the MRN as a whole.

We note the uncertainty whether the traffic forecasts at the national level take sufficient account of the factors underlying the different trends in urban areas. We believe that the urban roads on the MRN (Tier 3 and Tier 1A), which are the most congested today, will see significantly less growth; it will continue, however, in those areas where population growth is strong, and with the forecast rise in van traffic.

Delays and congestion Average delays on motorways are currently low and account for a reduction from free-flow speed of only a few miles per hour – although with substantial and regular delays continuing to be a feature of certain motorways such as the M25 and the M6. Overall, however, forecast delays on motorways are set to double by 2040. Congestion on trunk roads – currently increasing journey times by 12% on average – is set to worsen delays by half as much again on average; similar patterns are to be expected on the local authority Tier 1 and 2 roads.

The existing levels of congestion on urban Major Roads – particularly in larger cities – mean that even with lower expected growth, the delays due to congestion will be significantly increased over the period to 2040, possibly by as much as 50% on average.

And as noted above, it remains uncertain how far increasing levels of vehicle autonomy may change effective capacity—or indeed may generate additional demand.

In summary, in spite of the uncertainties of travel projections in urban areas,

congestion is expected to worsen significantly across much of the MRN to 2040 if no effective measures are taken to combat it. Some mitigation will come from enhancement schemes to increase capacity or make better use of the existing capacity, and by the greater opportunities to influence travel behaviours in larger towns and cities. But if a serious impact is to be had on congestion, other demand management approaches will have to be considered.



7

7.5 The policy response – sustainable funding and demand management

The governance regime for the MRN has to be robust enough for it to become – and, most importantly, remain – fit for purpose through to 2040 and beyond. The regime has to deliver four components:

1. sufficient funding for operation of the existing network, and for improvement or extensions which are agreed to be worthwhile – without diverting resources from the rest of the local road network;
2. certainty in that funding and the specification, so that efficient, cost-effective planning and procurement is supported;
3. accountability to the user, as the key mechanism for driving service improvements by the network operators; and
4. an ever clearer strategy for demand management, one that provides longer-term solutions to congestion and avoids undesirable dispersal of economic activity and housing.

The regime now in place for Highways England and the SRN fulfils (1) and (2), and has made a good start on (3); little has been achieved yet on (4), demand management. The funding regime envisaged for the SRN from 2020 – hypothecating Vehicle Excise Duty (VED) receipts to a National Road Fund (NRF) – should provide stability and sustainability of a kind not seen since the original Road Fund, defunct since 1936. We have made the case in this report for the NRF to make a systematic contribution towards the local authority parts of the MRN as well, once the needs of the SRN have been met; the scale of that contribution would in part be determined by government decisions on VED rates. This would help to fulfil the first two requirements for the local authority parts of the MRN.

This hypothecation arrangement also potentially strengthens accountability by creating a customer-provider relationship between the user of the SRN and the organisation responsible for

its safe and effective operation and its development. But because VED payment doesn't depend on the use made of the roads, there is no price signal to the user about the cost of an individual journey, so this arrangement cannot support demand management.

The alternative approach of hypothecating a proportion of *fuel duty* instead of VED would mean the amount paid is related to the amount of road use (and the fuel efficiency of the vehicle). But to the average road user fuel duty is a largely hidden charge, and so doesn't provide much in the way of a price signal; fuel efficiency (and thus the fuel duty charge) is not sufficiently affected by congestion to make it a strong demand management tool either. Nevertheless, this is a progressive and easily collected tax that falls exclusively on road users.

However the tax base for fuel duty is set to decline as vehicles become more energy-efficient and a slowly growing proportion use alternative energy



sources: non-hydrocarbon energy sources are not currently subject to any fuel duty equivalent – a desirable policy incentive for a while, but not necessarily equitable in the longer term. Government is reluctant to raise the level of fuel duty or its reach, and so, if we accept that there are other overriding pressures on the Exchequer, hypothecating fuel duty is unlikely to provide sufficient longer-term certainty for planning the MRN or raising finance.

In the short term there is no reason for us to advocate any change from the use of VED receipts to feed an NRF – but that doesn't mean that current opportunities to explore alternative approaches for the longer term should not be explored

A direct form of road user charging – applying on all roads to avoid unintended distortions – could in theory raise sufficient funds, and also be used to manage traffic demand, subject to the pricing structure adopted. It could replace part of fuel duty, depending on how far the scheme needs to be fiscally neutral. And more finely tuned pricing could provide the impetus for

greater uptake of 'mobility as a service' solutions for personal and business transport. The proposals for road pricing in the 2000s fell in the face of public opposition: there was resistance to the perceived undermining of privacy and to the imposition of further burdens on motorists. There was also a lack of clarity about how charging would be set and where the revenues would be applied.

Major advances in charging technology since then could now enable such a system to be more reliable and less intrusive, with lower set-up and running costs; moreover, the public now seem to be used to the spread of tracking apps, such as telematics-based insurance, and large volumes of movement data are now being collected without apparently impinging on driver privacy. But there remain crucial questions as to practical policy on the acceptability of differential charging based on congestion, the extent of fiscal neutrality, and how pricing would be set and revenues used.

Alternative ways of ensuring that the MRN offers acceptable levels of service in the longer term are, if anything, less attractive. Managing demand through

physical constraints, such as controlling access to limited-access (Tier 1) roads, would have adverse consequences on other roads. Conceivably, congestion might be more readily tolerated if well-managed technology provided better information on what to expect and what to do, and enabled time spent in congested traffic to be used more productively – but this doesn't solve the underlying problem.

We are not offering a view as to which – if any – of these approaches might be adopted at some time in the future. It is important, however, that government keeps up to date in its understanding of the tools now available, and of public attitudes to change. The congestion problem is not going to go away, and neither will technology let us off the hook. The MRN will still need to be managed and developed to meet emerging needs, and made increasingly safe and environmentally benign. And the economy and our quality of life will continue to need a properly functioning Major Road Network that is fit for purpose.

8

Conclusions and Next Steps

8.1 Conclusions

- 1.** The Major Road Network (MRN), at nearly twice the length of Highways England's Strategic Road Network (SRN), provides a balanced and coherent network of motorways and 'A' roads with the geographical coverage to support England's national and regional economies, in a way that the SRN alone does not.
- 2.** Designated using objective criteria, the MRN cuts across the existing boundaries of highways responsibilities. No changes to those responsibilities are proposed, partly because of the upheaval it would cause and partly because there is a good case for the local authority parts of the MRN retaining - and increasing - local accountability.
- 3.** To be most effective in supporting economic growth and quality of life, the whole MRN needs to be planned, managed and funded in a consistent way. Therefore making the MRN concept work would require a high degree of collaboration in the planning and management of operations between Highways England and local highway authorities (LHAs) across England; the advent of sub-national transport bodies could make such collaboration both easier to achieve and more effective.
- 4.** The contrast in the current planning and funding regimes for the SRN and for local roads is stark. While there is an effective and well-resourced regime for Highways England to plan and deliver successive five-year programmes of investment on the SRN, no equivalent exists for LHAs. They have had to cut maintenance spending as part of the Government's austerity programme, and work with complex capital funding arrangements without sufficient certainty through five-year commitments.
- 5.** One approach to consistent funding could be for the

Government to use the prospective National Road Fund mechanism to part-fund Major Roads on the local authority network, as well as for the SRN.

6. The MRN provides a logical focus for integrating spatial and economic planning at a regional level, facilitated by Local Enterprise Partnerships working in partnership with local planning authorities and local transport authorities.
7. The MRN must be 'fit for purpose' – putting service for its users, as well as the wider needs of communities and the environment, at the heart of its planning and management. 'Fit for purpose' means making the best use of capacity and maintaining the asset effectively so as to achieve target service levels; keeping safety paramount; and adapting to the more complex transport and planning policies needed in cities and conurbations.
8. The licence requirements and performance metrics now in

place for Highways England capture much of what we set out as fitness for purpose; if the company delivers on these it will provide a vivid demonstration of how progress can be achieved. Formulated as best practice, it would help LHAs – in their own way – to aspire to similar standards. The UK Roads Liaison Group could have a role to play in supporting the network operators develop the 'fit for purpose' concept into a high-level code for the MRN.

9. Technology is having broad and transformative impacts: for example, on how people and businesses make their travel choices, on the emergence of 'mobility as a service', on the autonomous capabilities of vehicles, and on how network operators manage their traffic and asset maintenance.
10. The rising levels of automation in vehicles should significantly improve safety on the MRN, as elsewhere; but the potential for realising major increases in

capacity remains uncertain, as does the extent to which more stress-free driving may actually increase demand. The introduction of higher levels of vehicle automation on public roads depends on resolving a range of practical, legal, regulatory and other issues, and may hold back the pace of implementation for a long time after the technology itself is fully deliverable.

11. Over the longer term, and driven in part by 19% forecast population growth, we accept that the demand for movement by road is likely to increase 19 - 55% on 2010 levels by 2040 (but by less on urban roads). This is a faster rate than can be matched by affordable and acceptable increases in capacity; delays and traffic congestion will thus increase. Technology will not on its own solve this problem; there will be a need to consider demand management. There are no simple solutions, but government should remain informed about the alternatives available.

8

8.2 Next steps

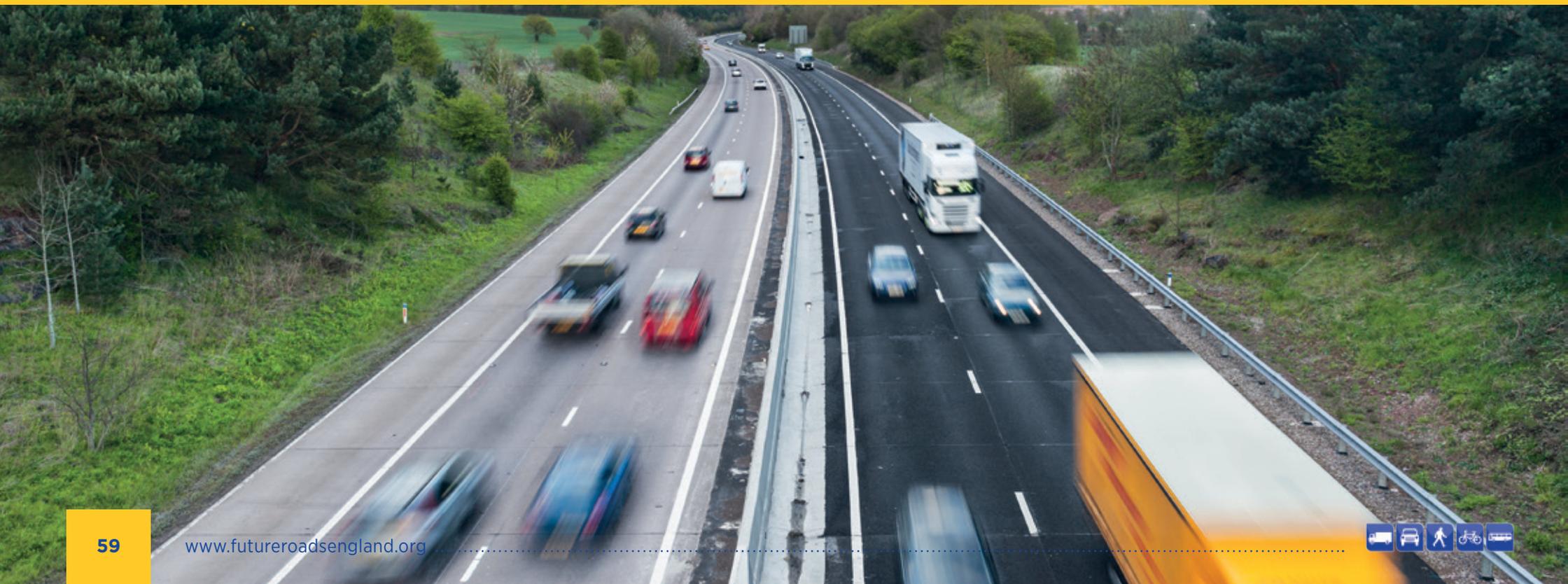
Progressing this proposition will require:

- Government, Highways England and local authorities to embrace the concept of the MRN and its rationale – and for it to be adopted for their areas by the new STBs;
- Highways England and local authorities to take on the task of collaboration on a network basis, on planning, management and operations – with government incentivising this into the next decade, including possibly

incorporating it into the remit for Highways England for the second Road Investment Strategy period; and

- Government to consider whether the prospective National Road Fund could part-fund qualifying expenditure on local authority parts of the MRN.

We also suggest that the network operators collaborate in developing a high-level fitness-for-purpose code for the whole MRN.



A: List of Supporting Documents

SD1: The Gulf between National and Local Roads Regimes

SD2: Defining the MRN

SD3: Spatial and Economic Planning and the MRN

SD4: The Needs of Users

SD5: Air Quality

SD6: Service Levels and MRN Variation by Tier

SD7: Network Operator Responsibilities

SD8: Safety Management on the MRN

SD9: Demand in the longer term

SD10: Opportunities and Challenges of Technology

Available at www.futureroadsengland.org and www.reesjeffreys.co.uk/transport-reports

B: Acknowledgements

Over the two-year course of this study, we have benefited greatly from the expertise and constructive advice of a wide range of individuals, and organisations, in the field of transport policy, planning and delivery. We are particularly indebted to all the members of our Advisory Panel, past and present, who have steered us to a balanced report and have ensured that we remained focused on all key issues:

Paul Bird, formerly Director for Commissioning – Transport and Infrastructure, Essex County Council

Dr David Bizley, Chief Engineer, RAC Motoring Services

Prof Alan Braithwaite, Executive Chairman, LCP Consulting

James Byles, Asset Development Manager, Asset Management Directorate, Transport for London

Tony Gates, Director for New Business, Major Projects, Balfour Beatty

Steve Gooding, Director, RAC Foundation

Andy Graham, White Willow Consulting, and Chair ITS UK, Cooperative Vehicle Highway System Group

James Hookham, Managing Director, Membership and Policy, Freight Transport Association

Stephen Joseph, Chief Executive, Campaign for Better Transport

Prof Glenn Lyons, Professor of Transport and Society, University of the West of England

Sue Percy, Chief Executive, Chartered Institute of Highways and Transportation

Steve Salmon, Director, Policy Development, Confederation of Passenger Transport

Susan Sharland, President, CIHT and former Chief Executive, TRL

Martin Tugwell, Programme Director, England's Economic Heartland Strategic Alliance

Alan Wenban-Smith, Urban and Regional Policy Consultant

We are grateful to many others who gave us freely their time, knowledge and advice. John Dowie, Paul O’Sullivan, Graham Pendlebury and many others from the Department for Transport have been especially helpful as the study has progressed, as have, from Highways England, Nigel Edwards, Martin Fellowes and (until her retirement and subsequent appointment as a trustee of Rees Jeffreys Road Fund) Ginny Clarke. We have also much appreciated the guidance from Geoff Allister and Matthew Lugg, along with others whom we have met during the course of the Study.

The Steering Group of Rees Jeffreys Road Fund Trustees has worked hard to keep us on track: our thanks to David Bayliss, Stephen Glaister, David Tarrant and to the Chair, David Hutchinson; and to all the Trustees, for their advice and for making the study possible, and to the Chartered Institute of Highways and Transportation for providing meeting room facilities for the Steering Group. Finally, we give a special thank you to Sanjay Rana, who has provided invaluable GIS (geographic information system) expertise throughout, and to our administrator, Frances Leong, for keeping the study on the road with her unfailing support.



C: Sources

ⁱ *Transport Statistics Great Britain 2015 (Tables 0101 and 0401)*, Department for Transport, 2016; personal travel figure excludes walking

ⁱⁱ *Road Traffic Estimates: Great Britain 2015*, Department for Transport, , Centre for Transport and Society May 2016

ⁱⁱⁱ *Road Traffic Forecasts*, Department for Transport, March 2015

^{iv} *Investing in Britain's Future*, Table 1A, HM Treasury, June 2013

^v *National Infrastructure Delivery Plan 2016-2021*, Infrastructure and Projects Authority, March 2016

^{vi} *Road Investment Strategy: Strategic Vision* Department for Transport, December 2014

^{vii} *The Condition of England's Local Roads and how they are funded*, David Bayliss, RAC Foundation, November 2015

^{viii} *Delivery Plan 2015-2020* Highways England, March 2015, and data used in Spending Review 2015.

^{ix} National Highways and Transport Public Satisfaction Survey 2014

^x *Highways Monitor-Annual Assessment of Highways England's performance*, ORR, July 2016

^{xi} *Analysis of travel times on local 'A' roads, England, 2014*, DfT, March 2016

^{xii} *Road Traffic Forecasts*, Department for Transport, March 2015

^{xiii} *Strategic Road Network Statistics*, Department for Transport, January 2015

^{xiv} Estimated from *Road Length Statistics* (Table RDL0101), Department for Transport, May 2016

^{xv} *Cities and Local Growth*, 6th Report of the House of Commons Public Accounts Committee, June 2016

^{xvi} *Network Users and their Characteristics, and Users and Community Expectations* Centre for Transport and Society, University of the West of England, February 2015:

^{xvii} *Road User Priorities for Improvement: Car and van drivers and motorcyclists*, Transport Focus, July 2015; *Road User Priorities for Improvement: heavy goods vehicle drivers*, Transport Focus, January 2016; *Understanding Strategic Road Network users' experiences and needs*, Department for Transport, November 2013

^{xviii} *National Road Users' Satisfaction Survey*, Highways England, November 2015

^{xix} *Strategic Road Network Concept of Operations*, Highways England, July 2015)



^{xx} E.g. *Well Maintained Highways* UK Roads Liaison Group (last update 2011)

^{xxi} *Highway Infrastructure Asset Management Guidance* HMEP / UK Roads Liaison Group (2013)

^{xxii} *A new approach to roadworks*, Highways England (website, June 2015) <http://webarchive.nationalarchives.gov.uk/20120810121037/http://www.highways.gov.uk/traffic-information/a-new-approach-to-roadworks/>

^{xxiii} *User and community expectations of the Major Road Network*, Centre for Transport and Society, University of the West of England, January 2015 (commission for this study)

^{xxiv} See <http://www.bre.co.uk/pdf/NIS.pdf> and <https://data.gov.uk/dataset/noise-exposure-data-england> Retrieved 30 July 2016

^{xxv} The Air Quality Standards Regulations, 2010 http://www.legislation.gov.uk/uksi/2010/1001/pdfs/uksi_20101001_en.pdf Retrieved 30 July 2016

^{xxvi} *Better not Bigger: why strategic roads need a green retrofit programme*, Campaign for Better Transport and the CPRE, September 2014 <http://www.bettertransport.org.uk/sites/default/>

[files/Roads_Retrofit_Proposals_FINAL_Sep2014.pdf](#) Retrieved 30 July 2016

^{xxvii} *Manual for Streets*, 2007; *Manual for Streets 2*, 2010, Department for Transport

^{xxviii} <https://tfl.gov.uk/corporate/publications-and-reports/roads-task-force> Retrieved 30 July 2016

^{xxix} E.g. *How much do road crashes cost where you live*, British EuroRAP results 2015, Road Safety Foundation, September 2015

^{xxx} Highways England (March 2015) *Delivery Plan 2015–2020*

^{xxxii} *Road Safety Models*, Report PPR 70, Transport Research Laboratory, 2015

^{xxxiii} See Page 7: British EuroRAP results 2015, *op. cit.*

^{xxxiii} *The Green Book: appraisal and evaluation in central government*, HM Treasury, July 2011

^{xxxiv} *Route Strategies*, Highways England, April 2016

^{xxxv} *Summer Budget 2015*, July 2015

^{xxxvi} *Road Investment Strategy post-2020: planning ahead*, Department for Transport, January 2016

^{xxxvii} *Traffic Management 3.0–Progress towards Utopia?* TomTom Maps paper for ITS Europe Congress, June 2016

^{xxxviii} *Pathway to Driverless Cars: Proposals to support advanced driver assistance systems and automated vehicle technologies*, Centre for Connected and Autonomous Vehicles, Department for Transport, July 2016

^{xxxix} *Connected and Autonomous Vehicles – the UK opportunity*, KPMG for the Society of Motor Manufacturers and Traders, March 2015

^{xl} *Pathway to Driverless Cars, op.cit.*

^{xli} *Pathway to Driverless Cars, op.cit.*

^{xlii} *National Policy Statement for National Networks*, Department for Transport, December 2014

^{xliii} *Road Traffic Forecasts*, Department for Transport, March 2015

^{xliv} *Road Traffic Estimates: Great Britain 2015*, Department for Transport, May 2016

^{xliv} *Road Traffic Forecasts, op.cit.*

^{xlvi} *Road Traffic Estimates, op.cit.*

^{xlvi} *Road Traffic Forecasts, op.cit.*



Rees Jeffreys Road Fund

The **Rees Jeffreys Road Fund** has, since its inception in 1950, provided support for education and research in all forms of transport. It helps to fund projects that improve safety, the roadside environment and rest facilities for motorists and other road users. The Fund has nine Trustees, all with considerable transport experience. This study has been overseen by a Steering Group drawn from the Trustees, comprising David Bayliss, Stephen Glaister and David Tarrant, and chaired by David Hutchinson. For further information, please see www.reesjeffreys.co.uk

The study has been led by **David Quarmby**, with **Phil Carey** as co-author. Sanjay Rana provided GIS expertise, and the study administrator was **Frances Leong**.

This study report should be read in conjunction with the series of Supporting Documents, listed at Appendix A. All are at www.futureroadsengland.org and at www.reesjeffreys.co.uk/transport-reports, where the Report Summary may also be found.

October 2016



RESPONSE FROM THE RSA SUSTAINABILITY NETWORK TO THE NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE

The RSA (Royal Society for the encouragement of Arts, Manufactures and Commerce) is a social change organisation whose mission is to enrich society through ideas and action.

The RSA Sustainability Network is led by Fellows of the RSA with professional interest and expertise in sustainability issues. Should you have any questions or require further information, please contact the Network Chair, Susan Harris, at susan@srssustainablebusiness.co.uk.

The RSA Sustainability Network recognises the importance of the National Infrastructure Assessment, not only for infrastructure itself, but also for the prospects for environmental sustainability, housing, and social inclusion.

We are providing responses here to some of the questions raised in the Commission's 'Call for Evidence'. The questions to which we are providing a response are indicated below.

In addition to the specific responses in this submission, we highlight the forthcoming final report of the RSA Inclusive Growth Commission for its consideration of issues that are relevant to the National Infrastructure Assessment, in particular broadening measurement criteria from narrow GVA to 'quality GVA', and for understanding the interplay between physical and social infrastructure for creating better places to live and work.

Question 1: What are the highest value infrastructure investments that would support long term sustainable growth in your city or region

We advocate a broad, nationwide approach rather than a regional or city-based approach. It is vital to develop at the outset a broad nation-wide strategy setting out which types of infrastructure development should be given priority before attention is paid to individual projects.

We are concerned with the assumption apparently underlying this question, namely that individual cities and/or regions should determine infrastructure projects that they would favour, and then the government/Commission would choose from the resulting list the ones that they approve of and are prepared to support. There may be some cases where broad regional priorities have already been agreed and where that approach is sufficient, but generally we strongly recommend that, before considering the detail of any specific project, the Commission (or relevant appointed body) must determine which areas of particular value to the United Kingdom as a whole need government input and support, at least in initial stages, if they are to flourish.

Specifically, deciding we want to build something – say HS2 or Hinckley C – because we believe it will promote “economic growth” as measured by conventional GDP accounting, and then testing it to see whether its environmental costs are too high, would be wrong. The first stage in the process should be deciding what to build, not just to make the

economy more efficient and productive (however that may be assessed), but also, and in our view more importantly, how to make it more sustainable and more circular, and then examining whether those investments would be viable and affordable.

Do we need, for example, a smart electricity grid; a truly comprehensive high bandwidth internet and extensive electricity storage more than we need a new high speed rail line? And before considering any new high speed rail line, there should be a review of likely technological developments in each of road, rail and air travel, in the short and medium terms, having particular regard to their relative impacts on resource use, environmental damage, and long term sustainability. What relative priorities should be set for road as against rail travel? Similarly, with power generation: this must inevitably in the long term become entirely renewable – how should this goal be achieved and over what timescale, including maybe what R & D facilities need to be established to support that goal, and what are the best investments to make in the meantime?

Question 3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Planning in the UK is often blamed for our failure to meet economic, environmental and social objectives. Our cities have sprawled, despite green belt policies, our main roads are clogged up, and our societies are increasingly unequal. Much of our transport and energy infrastructure is worn out, as studies by McKinsey and Company and The Policy Institute have highlighted, and the government's new Industrial Strategy stresses the need to 'better align central government infrastructure investment with local growth priorities'.

Reports such as *The State of the Cities 2016* by the European Union reveal that outside London our cities are lagging behind, in part because of relatively low levels of investment compared with countries such as Germany and France. However the explanation is not just lack of expenditure. Despite sensible policies such as the Treasury's Green Book and the National Planning Policy Framework, we fail to 'join up' public and private investment.

The NIC's National Infrastructure Assessment presents a unique opportunity to reform the way decisions on planning strategic development and infrastructure are made and implemented. We here provide our insights on why spatial planning has failed, what is wrong with funding, where we can best learn from, and what the NIC should be doing to close the gaps.

Why spatial planning has largely failed

- Provincial cities were built on the industrial revolution in the 19th century
- Cities sprawled in the 20th century into low density suburbs and villages
- Employment is fragmenting in the 21st century
- But our transport infrastructure is still largely radial and inter-city
- Transport and development are planned in silos, the regional dimension has been lost, along with the people who can join them up
- Over-dependence on short-term profit has caused both quality and quantity to suffer
- Planning disputes drag on at great expense for many years and sap our capacity to compete internationally
- We are creating Combined Authorities, without the funds to fill the gaps.

What is wrong with infrastructure funding in the UK

- We have invested too little for decades (outside London)
- Public funding is far too centralised and out of touch
- Cost Benefit Analysis neglects social and environmental impacts
- Our procurement system is antiquated, stifles innovation and probably raises costs
- Consumers are not happy at what they get for what they pay
- Private institutions will be investing in resilient cities outside the UK
- The property owners (who are the main beneficiaries) get windfall gains
- We cannot double housing output (which all parties agree is needed) without providing better infrastructure – and in the right places.

Where we can best learn from?

- Swiss cities like Zurich operate like ‘clockwork’ and are rated highly by investors
- French provincial cities like Lille and Montpellier have out-stripped Paris in population and economic growth
- German conurbations such as the Ruhrgebiet towns are models of collaboration with integrated urban transport systems eg Stadtschnellbahnen
- Scandinavian cities such as Copenhagen keep housing costs down through planned expansion along transport corridors, which is funding their new metro
- Some American cities, such as Portland Oregon, have copied European models successfully through Transit-Oriented Development

What the NIC can do

1. Publicise ‘model’ projects that offer replicable lessons
2. Bring experts and practitioners together to review findings from research into better infrastructure decision making
3. Require major investment in infrastructure such as in Oxfordshire to respond to 30 year Spatial Growth Plans
4. Evaluate strategic projects in terms of environmental and equity (social) as well as economic criteria
5. Promote new private funding sources eg infrastructure bonds to share in the uplift in land values from development
6. Set up demonstration projects to test the feasibility and cost of applying better models.

For further information on the issues raised in this response to Question 3, contact Dr Nicholas Falk nicholas@urbed.com, www.urbed.coop

By designing integrated, low carbon infrastructure we have the opportunity to achieve climate change mitigation and a healthy, prosperous society.

Question 10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The achievement of consensus through thorough consultation and investigation of the relevant issues as early as possible in the planning process is the key to avoiding inefficiencies later on. A basic problem is that the initiative for development schemes almost always comes from either

developers or government, leaving others (local authorities, local communities, environmentalists, etc) to respond at a later date, when they should have been involved in the process much earlier on.

The Commission should avoid the political rhetoric which brands opposition to proposed developments as “nimbyism”. Clearly there are people who are principally concerned with their own local areas (although that is not necessarily a bad thing), but there are also environmental concerns which are widely shared, and often underpinned by international agreements and a substantial natural science evidence base, which currently are not given sufficient attention. For example, a great deal of the frustration about the possibility of Heathrow airport expansion could have been avoided if at early stage proper consideration had been given to carbon emissions and air quality issues, and alternatives found in order to reduce demand for air flights. Not tackling these issues early on has led to outcomes which are unsatisfactory for all concerned.

Similarly now, urgent attention needs to be given to flood defence arrangements in order to prepare for an increasingly unstable climate. These should not have to be added in to plans at a later stage when the need is already obvious.

The National Infrastructure Commission should make mitigating and adapting to climate change a core element of its work. An early study should be carried out as to how the Commission will carry out its Assessment in a way which is line with the requirements of the Climate Change Act.

In order to address issues about social equity and inclusion, the Commission should also make provision, as part of its methodology for assessing infrastructure needs, for a system for analysing the distributional impact (as between different income groups) of different infrastructure options. This perspective should become a routine part of the Commission’s work as it considers different infrastructure sectors.

Question 12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

We highlight the importance of accurately incorporating sustainability considerations into cost-benefit analysis. Assessment methods must be robust and holistic in order to be “credible, tractable and transparent”. Many of the techniques that ensure inclusion of sustainability also help to ensure better decision making overall.

The method must consider whole-of-life. To illustrate, one of the great barriers to some “green investments”, such as tidal lagoons, has been the discount rate applied to future earnings. If the discount rate is taken to be 6%, for example, earnings arising after more than around 7 years are normally disregarded, even though one of the great advantages of tidal energy is that it will produce regular predictable renewable energy for far longer.

Whole life costing or life cycle costing (rather than simple snapshot cost-benefit analysis) is advocated throughout the sector for a variety of reasons in addition to the sustainability argument. It helps to give a realistic picture of the cost of the asset over its life, and in doing so can also aid more accurate predictions as to the likely actual lifetime. This in turn can significantly improve upon planning and maintenance, both at an individual asset level and from a national infrastructure planning perspective.

Holistic methods also help to avoid the “CapEx-OpEx divide” where capital expenditure and operational costs are considered separately, a common problem bemoaned throughout the

sector, which can lead to a “specification gap” and choices that provide less value in the long term.

Appropriate cost benefit analysis should give a “triple bottom line” (social, environmental and economic) assessment of both costs and benefits. Whilst this is necessarily complex, it is by no means unusual or prohibitive. There are a variety of tried-and-tested techniques for options appraisal and cost-benefit analysis which enable an efficient, robust assessment that effectively incorporates these considerations. For example, we direct the Commission to the work by UCL for the Institution of Civil Engineers and UK Actuary Profession on the OMEGA 3 project (<http://www.omegacentre.bartlett.ucl.ac.uk/research/omega-3/>), which examined how better to incorporate social and environmental criteria into the planning and appraisal of major infrastructure projects. Its proposals for policy-lead multi criteria analysis are detailed in the final report (<http://www.omegacentre.bartlett.ucl.ac.uk/wp-content/uploads/2014/10/OMEGA-3-Final-Report.pdf>).

As was demonstrated in the 2013 National Infrastructure Carbon Review (<https://www.gov.uk/government/publications/infrastructure-carbon-review>) cutting carbon also cuts cost – a principle advocated by the many key industry players who signed up to the Infrastructure Carbon Commitment (<http://www.greenconstructionboard.org/index.php/resources/infrastructure>). We would argue this is also the case for many other sustainability factors, where the same innovation that brings good environmental outcomes can also bring financial and operational benefits.

In addition to these considerations, we highlight that cost-benefit analysis must be conducted at the right point(s) in the process. A key sustainability issue for assessment of infrastructure is consideration of whether an asset needs to be built in the first place. Early consideration of the sustainability costs and benefits is necessary, as is ongoing revision at appropriate points in the options appraisal process as designs and needs change.

Question 28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

We direct the Commission to the key bodies within the UK (both governmental and non-governmental) that are working on Circular Economy such as the Ellen MacArthur Foundation, WRAP, the Environmental Audit Committee. POST note Number 536 September 2016 also provides some useful aggregated insight.

Given responsibility for circular economy policy at a governmental level is divided between different bodies, including: Defra, BEIS, the Treasury, local authorities and devolved administrations, it may be prudent to appoint a special advisor or representative to assist the NIC in ensuring circular economy considerations are included in decision making.

National Infrastructure Assessment call for evidence

Response to the National Infrastructure Commission, 10 February 2017



The Royal Academy of Engineering welcomes this opportunity to submit evidence to the National Infrastructure Commission (NIC). As the UK's national academy for engineering, we bring together the most successful and talented engineers from across the engineering sectors for a shared purpose: to advance and promote excellence in engineering.

The views described in this response have been developed based on a workshop and contributions by Fellows who are expert in infrastructure, systems engineering, construction, digital systems, civil and structural engineering, energy, transport, flooding and water supply. Their expertise spans research, policy making, regulation and practice, including the management of major projects. This response also builds on a number of major policy studies that the Academy has undertaken.

Through its Fellowship, the Academy has access to highly qualified individuals in the sector. Systems thinking and modelling is a particular area of expertise of the engineering profession and the Academy stands ready to offer expertise to assist the NIC with understanding interdependencies and resilience, and in particular in supporting a systems-based approach.

It is also recognised that this work is closely linked to the government's Green Paper on industrial strategy which the Academy will be responding to in collaboration with the professional engineering institutions. It is clear that business and industry rely heavily on all types of infrastructure and that underperforming infrastructure can impinge seriously on productivity. The Green Paper also highlights a marked disparity in productivity between regions of the UK. An assessment of the impact that infrastructure has on industrial performance and on regional variations will be included in the response on industrial strategy.

Primary messages:

1. **A 'system-of-systems' view is vital for ensuring the UK's infrastructure is sustainable and resilient:** A whole-system approach, alongside a whole-life cost approach, is particularly critical to the planning and delivery of the UK's infrastructure. The NIC is well placed to develop a more informed and coherent approach, based on evidence and rigorous assessment of benefits and costs, the primary focus of which should be an overview of national needs.
2. **Non-infrastructure approaches should also be considered:** Infrastructure is only one possible solution out of many for achieving the desired outcomes for the UK. It is necessary to ascertain what the UK is aiming to achieve more broadly over the next few decades, and where infrastructure, alongside other interventions, can play its part.
3. **Maintaining and operating existing infrastructure at highly resilient levels is vital:** It is critical for the NIC to focus on improving the resilience, security and reliability of existing infrastructure, as much as new infrastructure. Reuse or repurposing of existing assets will in many cases carry lower financial and environmental costs – including impacts on CO₂ emissions, air quality, noise, destruction and fragmentation of habitats and visual impact - than provision of new.

Other key messages include:

4. Infrastructure has great potential to improve individual and collective wellbeing, not only economically, but also in terms of social inclusivity, healthy lifestyle choices, and personal and national safety and resilience. Evidence-based cases for individual projects need to demonstrate direct and wider benefits and impacts.
5. There are many different interpretations of the value of infrastructure, whether it is the value society places on infrastructure, or the value that clients place on individual projects. Cost-benefit analysis provides an important tool for prioritisation, but if cast too narrowly can overlook important values (both benefits and impacts) that are associated with infrastructure projects and can neglect systemic interactions. The UN's Sustainable Development Goals could provide a basis for this assessment. The role of infrastructure as

an enabler or for releasing tension around other parts of the system also needs to be recognised and captured in the analysis of value.

6. Infrastructure is a broad and complex part of an interdependent system that cuts across sectors, and requires all its component parts to operate effectively. It is vital that sectors pull back from their silos and find ways to collaborate. A whole-system approach recognises the very significant interdependencies between classes of economic infrastructure, and to a lesser degree between economic and social infrastructure.
7. Siloed thinking will lead to abortive or poor value expenditure. UK infrastructure also cannot be considered in isolation from its connections to broader global infrastructures upon which the UK is dependent.
8. It is important to question what regulatory and non-regulatory levers are available for ensuring that outcomes are achieved. A joined-up regulatory environment is important for incentivising innovation and breaking down barriers between silos – as well as appropriate procurement and standards that enable innovation, and good definition of requirements. An understanding of performance in-use is also necessary.
9. It is a challenge to predict the future, and indeed confidence levels in forecasts for 2050 such as travel patterns must be low, due to uncertainties in the impact future disruptive technologies and other external factors that can drive change. There is no doubt that the future will be different, for whatever reason, and therefore the UK needs an infrastructure that is as adaptive, flexible and resilient as it can possibly be. The industry will need to think imaginatively and build in capacity for change, whatever that change might be.
10. Resilience, whether to extreme events, component failure or to malicious activity, is critical. We welcome the NIC's focus on resilience, and emphasise that it is vital to consider interdependencies between sectors and the risk of cascades of failure across sectors, and the importance of rapid recovery following failure. All sectors are dependent on electricity and increasingly on the internet, although much infrastructure was designed prior to the internet's existence.

Cross-cutting issues:

Question 1. What are the highest value infrastructure investments that would support longterm sustainable growth in your city or region?

11. An important role for the NIC should be to create a broad definition of value to enable the assessment of the highest value infrastructure investments. A pan-sector assessment regime is needed to allow sustainable value capture to be assessed and all risks to be placed where they are best managed. The value proposition must include economic, environmental, social and political factors and should be assessed at a range of scales – international, national, city, local and community¹. The NIC should be the champion of an improved process of project evaluation to capture the wider benefits of infrastructure. The UN's sustainable development goals could provide a basis for assessing value.
12. Improved physical connectivity, if carefully designed and implemented, can catalyse a diverse range of human activity – economic and social – that ultimately leads to raised living standards. Historically, well-targeted transport investments have contributed to GDP growth, although digital communications are now playing a greater role in GDP growth than transport.
13. There are risks associated with long-term forecasting using trend extrapolation. Historically, infrastructure has evolved through a number of technological step-changes, or disruptions – for example, railways overtaking canals, the invention of the internal

¹ See for example the HS2 Design Vision and the HS2 Balanced Scorecard for the evaluation of suppliers. A similar balanced scorecard should be developed for establishing relative values of different investments.

combustion engine and of powered flight – none of which were predicted 10 years before their invention.

14. Infrastructure assets tend to be long-lasting. The challenge today is to design with maximum adaptability, flexibility and resilience for the unforeseeable changes that will occur within the lifetime of the infrastructure. In the past, ingenuity has addressed this – for example, the railway was electrified without requiring significant rebuilding – but ingenuity applied to adaptable infrastructure could pay even greater dividends as the pace of change increases.
15. Future-proofed digital strategies should accompany all major investment projects. A digital communications strategy for UK transportation – which is not mode-specific – would improve utilisation of the transportation network through real-time information. Cross-sectoral sharing of data is vital for enabling collaboration between sectors.

Question 2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

16. International competitiveness is best achieved through:
 - good international gateways for freight and for passenger traffic
 - robust national strategic transport networks that provide good transport links between those gateways and centres of production and consumption²
 - infrastructure that attracts the skilled people to the area and enables them to work most efficiently
 - resilient infrastructure, so that investors can be sure of reliable and secure services
 - competitively priced fares and tariffs.
17. National strategic transport networks are arguably the most significant factor in international competitiveness, and their perceived efficiency is of importance to external investors. Networks need sufficient flexibility to accommodate changes in transport flows, particularly freight, driven by competition between port and airport operators and by changing source or supply markets. Road capacity is generally more flexible than rail in adapting to changes in freight movement flows.
18. When assessing improvements to international links, the approach should consider current access costs, identify the extent to which they could reasonably be reduced, and then develop schemes which can achieve this cost-effectively.
19. The UK should put in place actions to position itself as a safe and secure repository for data and provide the legal and professional structures for the secure sharing and controlled trading of non-personal data. The UK will need to build on its considerable existing capabilities in multidisciplinary innovation around data by addressing barriers that otherwise might reduce the UK's international competitiveness in this field, including the need to ensure that data sharing and the operation of data-driven systems can occur across international, as well as sectoral and organisational boundaries³.
20. Establishing the UK as the lead provider of secure cyber-physical systems would have substantial economic benefits across a wide range of sectors. Indeed, the UK has the inherent academic and industrial strengths, drawing on expertise in software engineering and systems engineering, to become the key global centre in which to design, develop and deploy the next generation of highly secure cyber-physical systems.
21. The UK should always benchmark itself against other leading nations and act on the findings. Ofcom does benchmarking well for communications infrastructure but the cross-

² In particular, such a network would help to reduce transport costs for industry and trade, by reducing congestion and increasing reliability.

³ Royal Academy of Engineering and IET, November 2015, *Connecting data: driving productivity and innovation*, www.raeng.org.uk/connectingdata

government working required to act on the issues that emerge is a challenge. Many large UK projects are lauded as having been delivered 'on time' and 'on cost' but, compared with similar projects worldwide, often take longer and cost more. On-budget performance is often achieved with large contingencies in cost and time. The NIC could help improve productivity by addressing this.

22. The link between infrastructure investment and competitiveness is poorly understood and the evidence is not as strong as sometimes asserted. More research is needed based on good data, including international data, although we recognise that this is hard to acquire.

Question 3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

23. Infrastructure must provide a service to society. There is a risk that infrastructure providers (and their engineering advisors) consider infrastructure in isolation from its role in creating better places, and also do not consider the benefits beyond the boundary of the project. Physical infrastructure should be integrated with housing and workplaces in such a way as to create high-quality environments and to avoid linear infrastructure such as railway lines or busy roads creating a physical division between communities.
24. Dedicated upfront resource would allow infrastructure to be better integrated into the wider context, and the necessary steps taken to derive best value from a new asset. Whole-life performance monitoring (for example through extensive use of sensors and shared data) will allow real life performance to be assessed and optimised.
25. Housing, workplaces and infrastructure (both physical and digital) should be considered as a single, integrated system, with the planning system as the enabler. A systems approach that considers housing and workplaces alongside infrastructure will help unlock future development potential, particularly where the housing crisis is most severe⁴.
26. It has long been known that a lack of basic infrastructure services contributes to poor physical health. Increasingly there is an understanding that improving the quality of the built environment can significantly enhance health, wellbeing and personal productivity of those who live and work in urban environments. This includes mental as well as physical wellbeing^{5,6}.
27. An aging population will require greater accessibility to and connectivity of homes. Infrastructure plans need to address the future need for health and social care to be delivered in the home using digital infrastructure, in both urban and rural communities.
28. Changing technologies, such as local energy generation and distributed storage, will change the boundary between public and private infrastructure. The design of next-generation infrastructure and buildings needs to anticipate these changes.
29. Many of the most important innovations in demand management require changes within houses and other buildings: smart meters, water saving devices, solid waste recycling etc. It is important that these innovations are built into new housing and that more attention is paid to retrofitting existing housing.

⁴ Crossrail 2 is one example of a transportation scheme enabling housing growth. Viewing housing and transportation as an integrated system would provide additional benefit to this project.

⁵ Royal Academy of Engineering, Arup and ESRC, July 2015, *Built for living: understanding behaviour and the built environment through engineering and design*, www.raeng.org.uk/builtforliving

⁶ The World Health Organization (WHO) attributes 12.6 million global deaths to unhealthy environments in 2012 with factors such as air pollution (3.7 million deaths) and physical inactivity (3.2 million deaths) playing a significant role. The UK is not immune to such effects. WHO, March 2016, *Preventing disease through healthy environments: a global assessment of the burden of disease from environmental risks*.

30. Effective land-use policy is critical. There is much to be learned from continental cities that achieve lower journey distances and a lower share of travel by car by requiring higher density mixed development and building in public transport routes from the start. A critical issue is deciding dispositions of future bulk housing to facilitate anticipated growth, which currently happens in a largely unplanned way. Better planning is needed in order for the growth to occur in such a way as to create successful places. Housing and transport need to be considered together in national space planning, and housing in its bulk form should be the basic ingredient of the National Infrastructure Plan. A statement could be required for all major infrastructure schemes demonstrating how they contribute to housing growth⁷.

Question 4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

31. Demand management is a valuable tool in sustaining existing infrastructure, effectively making existing infrastructure more productive by spreading additional demand across a longer peak or managing demand in a manner that maximises throughput.
32. Demand management is achieved by pricing and by quality of service delivered, among other measures. For infrastructure where capacity is constrained, such as transport, quality of service becomes a demand regulator. One such example is the movement of road freight that is managed around the morning and evening peak hours. Better real-time information to users helps manage demand, as users change their behaviour to avoid congested routes.

Demand management in the transport sector

33. In the rail sector, many commuter routes have significant capacity issues despite some of the highest fares in Europe. On long distance routes, train operators use techniques similar to the low cost airlines to 'smooth' loadings. High 'turn up and travel' prices are unpopular but are an essential part of that smoothing.
34. On the roads, efficient road pricing is potentially the most effective way of managing demand⁸. It is technically feasible now, but there are significant political and public barriers to implementation.
35. Demand-side measures – including demand management – are vital, as the existing supply pipeline of new infrastructure is unlikely to meet the task of keeping pace with demand growth in the near- to medium-term future⁹. An integrated strategy is needed from government that includes continued infrastructure investment in conjunction with capacity-maximising technologies and demand-side policy levers.
36. Demand management should not be considered separately from other measures, but packaged together to achieve a particular goal for a particular system since packaging can produce synergistic gains. Packaging can also allow the barriers to one measure to be compensated for by another¹⁰.

⁷ This assumes that infrastructure provision is occurring ahead of population and housing growth.

⁸ Royal Academy of Engineering Challenge Paper, November 2015, *The transport congestion challenge: getting the most out of the UK's road and rail networks*, www.raeng.org.uk/congestion. (Note: a challenge paper is not a formal policy position; it aims to promote further discussion).

⁹ Ibid.

¹⁰ For example, in London, congestion charging revenues were used to enhance the bus network which both provided synergistic gains and improved public acceptability.

Demand management in the energy sector

37. Demand side measures are as important as supply side measures in achieving a resilient energy system for the future that meets climate change obligations¹¹. Demand management needs to be considered alongside other demand side measures such as increasing efficiencies.
38. Demand management in the energy system involves controlling demand to better match energy supplies, mainly to reduce peaks in demand or take advantage of surpluses in supply. This can help to optimise the use of energy system assets and avoid local network issues as well as delivering better value for consumers.

Challenges around demand management in the energy sector

39. If well implemented, demand side measures can deliver a more efficient, lower carbon, cost-effective system with the same level of service for lower bills — a win-win situation. However, they can be difficult to implement. Large-scale, regional or local pilot schemes are critical to understanding how to unlock the potential of demand side measures, as is learning from successful initiatives in the UK and abroad. Whilst household electricity demand is declining, efforts at household energy efficiency and conservation have been rather weak. The Green Deal made very little contribution to achieving the considerable potential for reducing household energy demand, which saves households money as well as reducing the need for new supply capacity.
40. The introduction of smart meters will provide a means of managing demand, but these are just one necessary component of a 'smart grid' that is still some way off. Much more work is needed to understand better the potential of demand management in the electricity sector and ensure a reasonable and equitable return on the significant investment that will ultimately be paid for by consumers.
41. Behavioural constraints and rebound effects are two important factors that could influence the effectiveness of demand management. Other factors that should be considered include the relationship between demand management and the capacity mechanism, and the impact of demand management on fuel poverty.

Future steps to achieve effective demand management in the energy sector

42. In the immediate short term, effort is needed to bring through demand management, as well as other demand side responses, into the capacity mechanism and to learn how demand can effectively be included in markets traditionally designed for supply.
43. In the medium term, more research is needed to assess how tariffs will function best, providing a fair balance of benefits and costs between utilities and consumers, without which participation levels will be low or customers will lose out on potential savings. In particular, more needs to be understood about consumer attitudes and behaviour around time-of-use tariffs and dynamic tariffs, including consumer acceptance of automation of energy use and the impact of the price differential¹². In addition, more needs to be known about how demand management will affect fuel poverty and more general issues of equity.

¹¹ Royal Academy of Engineering, October 2015, *A critical time for UK energy policy: what must be done now to deliver the UK's future energy system*, A report for the Council for Science and Technology, <http://www.raeng.org.uk/publications/reports/a-critical-time-for-uk-energy-policy>

¹² Royal Academy of Engineering, April 2016, *Response to the House of Commons Science and Technology Select Committee inquiry on Smart Meters*, www.raeng.org.uk/publications/responses/smart-meters

Question 5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The importance of existing assets

44. A substantial proportion of the infrastructure that will be in use in 2050 and beyond has already been built. Much of it is already a considerable way through its intended design life. This means that the maintenance, rehabilitation and enhancement of existing infrastructure must be recognised as one of the core infrastructure challenges facing the UK across all sectors. The challenge ranges from improving the energy efficiency of buildings to managing the bridges, embankments, tunnels and cuttings upon which transportation networks are totally reliant¹³. It is important to understand whether the condition and functionality of the UK's existing infrastructure is improving, stable or in decline.
45. In line with NIC's role to provide the government with impartial, expert advice on major long-term infrastructure challenges, it is vital that NIC provides a strong voice in support of making efficient and effective investment in keeping the UK's existing infrastructure working. This requires stable and well-targeted spending, coupled with research to enable the performance of existing infrastructure to be better monitored and interventions to be optimised over the lifespan of assets to minimise disruption, environmental impacts and costs.

The decision to replace or renew existing assets

46. Where an entirely new function or service is proposed, provision of new infrastructure is a reasonable assumption. However, where the capacity appears insufficient for an existing function, or the service level does not meet current expectations, then maintenance or capacity upgrade of existing infrastructure should be regarded as the base option. Reuse or repurposing of existing assets will, in many cases, carry lower financial and environmental cost than provision of new.
47. Decisions on whether to maintain existing assets, to replace components, or to adopt wholesale replacement are generally well made in regulated infrastructure businesses. In the regulated sectors, the regulatory process has in most cases incentivised infrastructure companies to make their retained infrastructure as productive and as reliable as practicable through revised operating regimes, planned lifecycle maintenance, and wholesale asset replacement. Outside the regulated sectors, there are fewer incentives to reduce the size of asset base to the minimum necessary. Furthermore, declining asset performance is tolerated because there is insufficient financial capacity to invest in non-essential short term maintenance. Examples are the substantial non-PFI elements of the defence and health estates where redundant assets are retained and other assets deteriorate, affecting the productivity of users.
48. Balancing investment in repair and maintenance with construction of new assets is best achieved by moving to a 'total expenditure' (TotEx) view of long term asset cost, rather than driving decisions based on short-term availability of capital. Regulatory authorities should keep their policies under review to ensure that they set user charges on the basis of lowest whole life system cost, and that they move to TotEx models where they have not already done so. In unregulated sectors, government should use such levers as tax regimes and planning regulations to incentivise asset owners to optimise whole-life cost through asset maintenance and planned renewal.

¹³ For example, Network Rail's planned funding for enhancement projects in England & Wales to be delivered during 2014-2019 was £11.8 billion (in 2012-13 prices). Network Rail, November 2015, *Report from Sir Peter Hendy to the Secretary of State for Transport on the replanning of Network Rail's Investment Programme*.

49. Cost-benefit analysis with sufficiently broad focus should be used to decide which interventions offer the best value for money. If maintenance is deferred, the longer term costs of asset deterioration should be considered.

Determining the true cost of an asset and its changing value over time

50. Every asset goes through a cycle of changing value. In the early stages, funds are spent in advance of the asset benefits, and the project is in deficit until it starts to function. Thereafter it yields the benefits, hopefully as planned, subject to the continuing prudent 'investment' of ongoing operating and maintenance costs. As long as those are not excessive, the asset returns value greater than cost.
51. Meanwhile, the wider economic impact of the asset is also changing progressively. Developers may take advantage of the asset to invest in a cluster around it. Public services may come to rely on the asset in planning the distribution of those services – for example, health and emergency services. The asset should therefore be revalued at regular intervals to obtain a progressive view of its true value to society, taking account of the economic, social and environmental benefits it confers. A perspective on this may be to define the full set of impacts if the asset were to be lost at short notice. The asset's value as the lynchpin of a resilient infrastructure system may turn out to be of far greater value than the asset considered in isolation.
52. Once the true value of the asset is understood, the appropriate investment in maintenance and repair can be assessed. When that spend starts consistently to exceed the true value of the asset, it is time to plan for replacement with a new asset, perhaps accompanied by repurposing of the original asset to avoid total write-off.

The impact of external factors on maintenance

53. Effective maintenance requires constant review in the face of changing circumstances. These include the effects of climate change (such as changing sea levels and extreme weather events), changes in the level and type of loading and changes in interfacing systems. Failure to do so can lead to a situation where increasing levels of defects accelerate the rate of deterioration ending in asset failure with the subsequent cost of replacement being many times that of an effective maintenance regime. Once again, a 'whole system' approach is needed and analysis and monitoring must be rigorous with due consideration of possible unintended consequences¹⁴.
54. The Digital Railway initiative and any road traffic capacity improvement measures like the 'fleeting' of trucks and/or self-driving, communicating, cars will increase the loading of existing infrastructure and thus change maintenance requirements; in most cases meaning that maintenance levels will need to be increased. In many cases, there may be a choice between increasing maintenance or renewing an asset with one that is more resilient or has higher capacity. It is vitally important that the right tools are developed to allow those choices to be well made.

Governance of maintenance and renewal

55. The boundary between maintenance and renewal is immensely important if the two fall to different entities. This was a major problem in past, with the contracting out of railway maintenance that led to Network Rail bringing maintenance back in-house¹⁵. During the railway privatisation process, Department of Transport lawyers amended the proposed

¹⁴ As an example, one of the root causes of the Hatfield derailment was the introduction of new and better riding passenger trains and a reduction in freight traffic both of which led to significant reductions in rail wear; on the face of it a benefit. Unfortunately, Rolling Contact Fatigue (RCF) which had previously been worn away before it could develop into cracks was then able to develop to the point of catastrophic failure. Network Rail's maintenance regime now includes significant rail grinding to remove RCF.

¹⁵ Railway Gazette, June 2004, *UK brings infrastructure maintenance back in-house*.

contract between Railtrack and the maintenance units to reduce the risk to the companies purchasing those units. This unintentionally led to an incentive for contractors to under-maintain and thus be able to designate assets as needing renewal, passing responsibility back to the client. NIC must be careful not to create such perverse incentives.

Question 6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

56. The ability to collaborate is partly determined by regulatory structure and partly by clients' procurement strategies. Both need radical overhaul if better collaboration and competition are to co-exist, thereby stimulating innovation and growth simultaneously. Collaboration has generally been discouraged by UK regulators in favour of competition¹⁶, while other countries take different approaches to collaboration. If incentives to collaborate are present, this will help to improve infrastructure services in the UK, and increase the potential to export services abroad.
57. Clients need to properly embrace the collaboration agenda – many clients pay lip service to collaboration, but under pressure revert to type. Clients also need to consider consultants and contractors as equals, with differing skills that are brought to bear in the best interests of project delivery. Early engagement of contractors is vital¹⁷.
58. Much of our national infrastructure, whatever the sector or geographic area, is under the ownership or stewardship of a monopoly client organisation – one such example is Network Rail. Third party investors and those who deliver projects are thus inadvertently discouraged from competing with the monopoly organisation. The result is the inefficient delivery of new and upgraded infrastructure. Barriers to contestability should be identified and removed to encourage competition. For example, the Network Rail Board has commissioned an independent review to address this issue¹⁸. Similar consideration could be given to other sectors.
59. Extensive use of Building Information Modelling (BIM), both to manage information and to enable collaboration must be mandated on all publicly-funded projects, not just central government projects.
60. The UK's future infrastructure will be driven by some major decisions – such as those to embark on major new projects – but also by many smaller decisions taken locally or on a project-specific basis. There are levers available to policy makers to positively influence local and project-specific decisions, including regulations and standards.
61. The scale of many infrastructure projects means that it is not possible to prototype solutions. This is in stark contrast to the development of products in other sectors of industry, where trials are possible in research laboratories or manufacturing facilities. For this reason, Design Standards play a vital role in the construction sector by providing the means against which the adequacy of designs is verified prior to construction.
62. The NIC should therefore maintain specific interest in the impact and adequacy of relevant regulations and standards. NIC should engage with BSI, as the UK national standards body, to review how the UK should support future standards development, particularly in the context of Brexit and the importance of the UK remaining active in European standardisation organisations, including CEN¹⁹.

¹⁶ Sector regulators such as Ofcom, Ofgem, Ofwat and the Office of Rail Regulation all have a duty to promote competition in the interests of consumers. See for example: Competition and Markets Authority press release, December 2013, *Network launched to help drive competition in regulated sectors*, <https://www.gov.uk/government/news/network-launched-to-help-drive-competition-in-regulated-sectors>

¹⁷ Transport for London's Innovative Contractor Engagement procurement of Bank Station Capacity Upgrade is an example that has led to a gradually increasing benefit cost ratio.

¹⁸ The Hansford Review, <http://thehansfordreview.co.uk>.

¹⁹ CEN is the European Committee for Standardisation.

Question 7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

63. Government funding policy often operates on too short a time scale to be compatible with infrastructure projects. It is not untypical for organisations such as the Catapults (a number of which are focused on infrastructure) to be funded for five years and then subject to review and reapplication. Businesses need to see longer term commitment to funding and strategic direction to have the confidence to commit their share of investment.
64. Funding is accompanied by restrictions – for example, a requirement that it is spent on capital. Insufficient priority is given to the need for funding for operation, maintenance and sustaining existing infrastructure.
65. Consistent funding decisions are needed for all possible solutions. A major weakness of current policy is that infrastructure is financed from one budget, while maintenance comes from another, and lower cost management measures from a third. This makes it harder to select the most cost-effective solution, and often results in an over-emphasis on less cost-effective infrastructure-based solutions.

Question 8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

66. In the case of digital communications, there has been considerable controversy over a perceived conflict between the policy of promoting competition in broadband telecommunications service provision and the desire for universal service provision. It is recognised that a degree of state support, within the parameters of existing State Aids rules, is required and this continues to be provided through Broadband Delivery UK. New entrants in rural telecommunications infrastructure markets need to be encouraged and supported through better and more practical access to existing infrastructure such as ducts, poles and backhaul. Subcontracting arrangements should be encouraged for infrastructure delivery by the larger operators drawing on the smaller lower cost providers and local community self-help initiatives should be supported.

Question 9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

67. There is a body of research around valuing resilience and interdependence that has contributed to HMT guidance in the Green Book, and continues to be a valuable resource for NIC and industry²⁰.
68. Infrastructure systems are heavily interdependent. Most visibly, this is through the reliance of one system on another system. For example, the flood protection system is reliant on the electricity system for pumping water. Systems are interdependent as part of overall process flow – for example, rail needs road or urban transport for passenger dispersal at rail termini. Systems are also interdependent as users migrate from one system to another in the event of failure, such as when telecommunications systems or data networks are subject to heavy local demand if transport systems fail.
69. A key resource is the emerging national infrastructure systems modelling capability being developed under the Infrastructure Transitions Research Consortium²¹. This will support

²⁰ HM Treasury, Valuing infrastructure spend: Supplementary guidance to the Green Book https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/417822/PU1798_Valuing_Infrastructure_Spend_-_latest_draft.pdf

²¹ NISMOD (National Infrastructure Systems MODel) is the UK's first national infrastructure systems-of-systems modelling platform and database.

the design and development of infrastructure systems based on a better understanding of availability and performance. An important aspect of that research is demonstrating the potential consequences of scenarios of infrastructure failure and disruption. Quantification of potential for disruption and systemic risks helps to justify the case for investment in resilience.

70. The degree of system planning and quality of incident management needs to be improved, both within individual infrastructure systems and between system operators. Understanding and communications between systems operators is limited, but there is potential to improve cross-system performance through more consistent operating standards and strengthened operating protocols. This could include better links between transport jurisdictions - for example, TfL and Highways England - between modes, and between infrastructure system types.
71. Infrastructure is vulnerable to failure of individual components or sub-systems, as a result of age and wear, leading to broader impacts as a result of interdependencies. The growing interconnectedness of physical infrastructure with digital systems also means that parts of the infrastructure system are increasingly interdependent and vulnerable to cyber attack or to failures in digital components, which again could lead to cascade failure²². There is a need to ensure that systems have adequate levels of cyber safety and resilience.
72. The resilience of the infrastructure systems must be considered within a changing context, including climate change, demographic change and technological change.
73. A study on interdependencies in the infrastructure system by Engineering the Future²³ concluded the following:
 - Increased technical efficiency of the infrastructure should be valued, but a focus on economic efficiency can lead to reduced redundancy and diversity, thus reducing resilience. Increased resilience comes at a cost, so given that there are limits on the extent to which government and the public are likely to be willing to pay for resilience, failures cannot be completely avoided. 'Redundancy' is often taken to be a pejorative term, but in engineering terms, redundancy is essential to ensure resilience, so that service continuity is provided even when networks are disrupted. If networks are being run at 100% efficiency then there is zero redundancy. It is important that the benefits of redundancy and surplus capacity are properly valued.
 - As infrastructure systems are exposed to different and more extreme conditions, it is highly likely that degradation and interruption of vital services will occur at certain times. Therefore, there is a need to limit the consequences of failure and accelerate restoration capabilities, both through engineering solutions and managing consumer expectations.
 - All users of these services must be consulted on acceptable service levels and the cost that consumers are willing to pay for service at a given level. Communicating to the public the limits of resilience, and the need to modify demand on infrastructure, is a major challenge for industry professionals and politicians alike.
 - Methods for prioritising vulnerabilities in the infrastructure systems are needed for effective planning. Not all parts of the country face similar risk levels or similar impacts. A resilient energy infrastructure is a priority given the interdependence of all other sections on power.

²² The Royal Academy of Engineering is currently involved in a programme of work on the cyber safety and resilience of the digital systems that support critical infrastructure.

²³ Engineering the Future, February 2011, *Infrastructure, engineering and climate change adaptation – ensuring services in an uncertain future*, www.raeng.org.uk/adaptation

The cost of insufficient resilience – energy system

74. Any significant interruption to electricity supply in the UK will have severe economic consequences²⁴. The UK is becoming rapidly more dependent on electricity, and networks, processes and value chains are becoming increasingly complex and interdependent. These trends are magnified by increasing reliance on electronic communications technologies and the internet. The potential economic and social impacts of electricity shortfalls will, therefore, only continue to increase in the future.
75. The pace of change means that our understanding of the potential magnitude of these impacts is limited. Future shifts in the energy system may further increase the UK's dependence on electricity, particularly if heating and transport become more electrified. This could heighten the detrimental impacts of electricity outages in the future.

Learning from events

76. The impact of Storm Desmond on Lancaster in December 2015 illustrates how cascade failure can occur, with wide-reaching consequences. There is much to be learned from this event²⁵:
- Different models for locating responsibility for resilience will need to be considered, whether with individuals or service providers or some combination. It is clear that additional resilience is needed; where it is located in the overall systems requires more analysis.
 - There is considerable cost associated with providing standby arrangements that may be used only a fraction of the time, and also practical challenges in achieving this, including ensuring that standby assets are effectively maintained so that they work when needed. In the transport system, there may be a need for redundancy so that there is an alternative if one particular facility is out of commission. This is now a major part of infrastructure planning in earthquake prone countries such as Japan.
 - Another option is for regulators to allow greater rates of failure in the electricity or communications systems, but to ensure that there is a rapid-response mobile back-up system allowing services to be restored on a temporary basis. It is not clear whether this responsibility should fall to the privatised telecoms sector.
 - The complexity of the infrastructure system is increased by the large numbers of participants sharing responsibilities and with different incentives to optimise their own part of the system, and the wide geographical and organisation distribution of each single critical system. Commercial or regulatory incentives – to maximise profit or minimise the regulated asset base – may work against total system resilience.
 - The UK needs to decide where it wants its infrastructure systems to sit on the resilient-efficient spectrum and to bear this in mind when changing the engineering, regulatory or management structures of the industries concerned.

The resilience of digital systems

77. Cyber security (and physical security) must be treated as a fundamental system design issue from inception and must be kept under constant review throughout the life of the asset. Multiple layers of protection are essential.

²⁴ Royal Academy of Engineering, November 2014, *Counting the cost: the economic and social costs of electricity shortfalls in the UK*, A report for the Council for Science and Technology, <http://www.raeng.org.uk/publications/reports/counting-the-cost>

²⁵ RAEng, IET and Lancaster University, May 2016, *Living without electricity: one city's experience of coping with loss of power*, www.raeng.org.uk/livingwithoutelectricity

78. Safety-critical systems using software often involve long and complex validation processes leading to approval whereas emerging cyber threats require very rapid actions to combat them. To reconcile these different requirements, a good system architecture is essential.
79. The assumption that everything should be connected to the internet should be challenged, and both the benefits and risks explored. Each connected object can add to vulnerability from cyber attacks. In this context, whole system design is again very important.

Role of the regulators, CPNI and others

80. Each national regulator should appoint a lead person to lead on infrastructure resilience and related interdependencies. Each regulator should accept a duty of resilience and work with other regulators in a more joined-up way. Resilience audits could be considered as part of the reporting required to fulfil licence obligations. The activities of regulators and the Centre for the Protection of National Infrastructure also need to be more integrated, particularly in dealing with the risks of cybersecurity. OECD or a similar body should introduce international benchmarking for resilience.

Question 10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

81. Infrastructure projects are planned and viewed too narrowly. The strategic aim needs to be clear and stated at the outset. A condition of planning consent should be the requirement for project sponsors to:
- *Set out a clear project definition*: the definition must encompass the totality of the project as well as each separate phase of the project, so that each phase can be judged on its own merits. It must also clarify where the boundaries of responsibility lie between the different stakeholders involved in delivery.
 - *Identify the "intelligent" client*: the client needs to take decisions, or take responsibility for making others take decisions where they matter very much to the success of the project. Independent oversight is needed, accountable to the client, but with the robustness to be able to challenge the client as well as the delivery team.
 - *Ensure shared objectives across the team*: cohesive and collective objectives should be shared across the client and delivery partners, as part of a no-blame culture.
 - *Minimise complexity*: This requires understanding and minimising the interfaces with different stakeholders and other components of the system in which the infrastructure project is being delivered.
 - *Impose strong systems architecture and standards*: this involves early definition of a common approach and language.
 - *Demonstrate a robust approach to innovation*: clarity is needed on when technological innovations should be considered and when the technology should be frozen so as not to cause delay.
 - *Adopt a whole-life cost approach*
 - *Ensure that the right skills and learning are in place*: it is important to ensure that people in the team have the right competencies, noting that requirements may change over time. Strong succession planning, good retention of corporate memory and organisational learning are all important.

Project Boards should include appropriate non-executive members to hold the project executive to account in relation to the above requirements.

Question 11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

82. The full impact of infrastructure assets on the environment needs to be understood. This would allow better assessment of the current impact of infrastructure assets on the environment, both positive and negative, and would provide a baseline for modelling the impact of infrastructure interventions. The carbon impact of infrastructure projects is a central concern, the reduction of which remains one of the key environmental statutory duties imposed on the UK through the Climate Change Act.
83. The focus should be not just on damage limitation but positive improvements to the natural environment. This should be achieved by adopting appropriate standards and use of assessment methodologies, including benchmarking against best practices (globally as well as UK wide) in such aspects as land use and value; soil and vegetation management; remediation of land contamination and ecological impact. A whole-life cycle approach would allow a focus on sourcing of materials and material efficiency; and reuse and recycling²⁶.
84. It should be recognised that the natural environment is not just in need of 'protection' but requires proactive management and can provide, and substitute for, infrastructure services. A systems view that uses concepts of natural capital and ecosystems services would help to ensure that the natural environment was protected and improved. One such ecosystems service is the use of floodplain storage to reduce downstream flood of wetlands to improve water quality and reduce the need for costly water treatment.
85. Each regulator needs an environmental policy basis and a means of ensuring consistent advice provision across areas and regions. Furthermore, advice, priorities and measures need to be debated and coordinated between regulators. Key cross-cutting measures could be identified.
86. Effective consultation and engagement with the public and environmental stakeholders is needed from early stages of infrastructure development, to maximise environmental opportunities through the options and design stages. Targeted and robust Environmental Impact Assessment would positively and pragmatically influence infrastructure design and construction.
87. Release of infrastructure data would facilitate research and innovation by third parties.

Question 12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

88. Cost-benefit analysis (CBA) is frequently misused in decision-making. Typically, a scheme is designed, assessed using CBA, and accepted if the benefit/cost ratio (BCR) exceeds a current threshold. This only tells us that the scheme was potentially worth building, but not whether it was the most appropriate solution to the problem. It also encourages exaggeration of benefits. There is a strong case for adopting an alternative, problem-based, approach. In this, the problem is identified, the potential benefit to be gained by overcoming the problem assessed, the maximum project cost determined as that which achieves at least a given BCR, and solutions sought within that cost ceiling.
89. Current cost-benefit techniques are focused on stand-alone economic infrastructure. While current evaluation techniques assume future reliable performance, they should be much stronger in validating the realistic future cost of operation, maintenance and component

²⁶ Methodologies such as BREEAM Infrastructure provide a framework for such an approach and encourage ongoing innovation and collaboration.

replacement. Furthermore, cost-benefit techniques do not recognise the value of infrastructure that is essentially enabling infrastructure, with limited or occasional use. This includes failure to value spare system capacity that will enable future maintenance or system reconfiguration to be done without impacting on service levels.

90. Cost-benefit techniques do not support investment in enabling infrastructure for sectors that contribute to overall national performance but do not in themselves earn revenue in an economic sense. Skills training, defence provision, and social and welfare provision are all areas that support the wider economy and have their own infrastructure requirement but that are poorly evaluated in their contribution to the performance of the economy.
91. A serious weakness in the use of CBA is that can be used too late in the design process to justify schemes that have already been designed. This leads to post hoc justification rather than identification of alternatives or enhancement of scheme design. It would be preferable to use CBA to determine the cost ceiling for a scheme designed to achieve potential benefits, and then consider the full range of alternatives that are feasible within that cost ceiling²⁷.
92. There is a growing concern in the transport sector that CBA focuses too much on travel time savings, and too little on wider economic, environmental and social benefits. Many of the solutions that contribute most to creating better places to live and work would not pass a current CBA test.
93. In transport projects, on the cost side, there is a tendency to over-design, which can result in unnecessary costs, while environmental costs are often overlooked. On the benefit side, considerable care is needed in assessing and interpreting wider economic benefits, which often result from the relocation of economic activity rather than generation of increased productivity.
94. Much could be learned from examining exemplar projects to identify real benefits achieved – especially wider benefits, which are difficult to quantify at the cost benefit analysis stage.

Transport:

Question 13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Anticipated changes in travel patterns

95. With the pace of development, it is almost impossible to predict with any certainty the changes in travel patterns over the next 30 years. The advent of disruptive technologies will change things in ways that we cannot currently predict. We can only extrapolate current trends and make provision for disruptions. It is reasonable to expect that travel patterns will reflect increasing urbanisation leading to increased metropolitan travel, greater need for safety, reliability and resilience, and greater need to protect against security threats.
96. Future generational differences in transportation requirements need to be recognised, as do social trends such as an increase in leisure travel.
97. Examples of specific changes include:
 - Heavy freight is reducing, and there are opportunities around alternative 'hub and spoke' models of freight.

²⁷ The successful Train Protection Warning System (TPWS) in use on Network Rail's Infrastructure was conceived and selected in this way.

- The shift of retailing from 'the high street' to 'online', with a subsequent increase in local parcel delivery services and consolidation into large distribution centres. A number of companies are experimenting with novel delivery techniques such as the use of drones, and a breakthrough could be a game changer.

98. Future projections should be accompanied by design strategies that mitigate the risk emanating from such uncertainty. As illustrated below in Figure 1, suitable design strategies can include: design for adaptability; design for robustness/resilience; and design enabling accurate performance measurement.

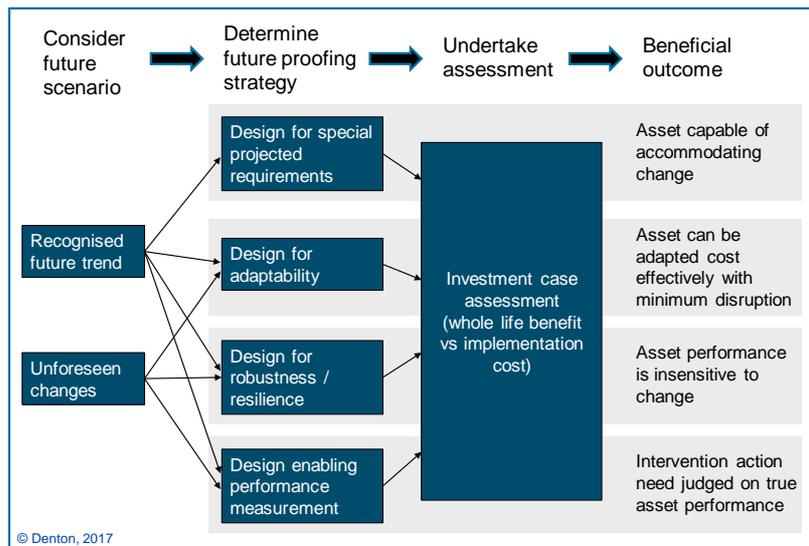


Figure 1: Design strategies for adaptability, resilience and performance measurement (Copyright: Denton, 2017)

Impact of the adoption of new technologies

99. The Transport Data Initiative (TDI) provides a very helpful focus for the many opportunities that data analytics offers across the transport sector. Data stores with the necessary data and metadata standards - interoperable across different modes of transport - remain vital. Equivalents to the resources of Transport for London (TfL) do not exist in every city.
100. The development of autonomous vehicles may make some of our current technologies redundant, while requiring newer technologies to be developed. The rapid development of self-driving road vehicles may see a shift back from rail to road, both for passengers and freight, if costs are competitive.
101. Remote video conferencing has not led to a reduction in the need for travel, despite predictions that it would. However, with the significant improvements in connectivity and bandwidth, it could be a more realistic alternative to travel in the future.
102. New technologies provide a range of means for improving the performance of the transport system²⁸, alongside regulatory or governance measures, either through maximising capacity, to make the most of available infrastructure; demand management designed to reduce congestion, especially at peak times, by displacing traffic to other

²⁸ Royal Academy of Engineering Challenge Paper, November 2015, *The transport congestion challenge: getting the most out of the UK's road and rail networks*, www.raeng.org.uk/congestion.

times of the day or less congested parts of the transport network or new technologies that offer new forms of travel or alternatives to travel.

103. A 2015 Challenge Paper by the Royal Academy of Engineering considered a range of measures that rely on new technologies²⁹, such as efficient pricing, smart motorways, connected cars, control, command and communication (CCC) technologies, and driver advisory systems (for the rail sector). Each measure was assessed on the basis of cost of implementation and potential to reduce congestion, allowing overall value for money to be determined. The main barriers to implementation were also considered.

Question 14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

104. For transport into, out of and around major urban areas infrastructure investment should first be targeted towards transport flow pinch-points. Small improvement schemes across each network make very large increases in performance as well as a wider user perception of a generally better operating network.
105. Government-supported investment in freight consolidation centres to support delivery to urban areas is essential. Consolidation of the many competing parcel delivery services would improve inefficiency both in terms of road use and energy consumption terms.
106. A number of cities such as Portsmouth and Southampton have been looking at trams following their successful re-introduction in Manchester, Sheffield, Birmingham and Nottingham. There is evidence that these are more acceptable and attractive as public transport than buses as well as being clean, and energy- and space-efficient. Rapid-bus transit is an alternative³⁰.

Question 15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

107. A comprehensive approach to multi-sectoral modelling will help to identify plausible schemes that meet social and business needs across a range of mid- to long-range mobility services. Good data sets will be a prerequisite to assessing value in an holistic manner, as will convening mechanisms for open and frank conversations about the compromises necessary for any solutions to be practicable.
108. Outside single urban areas, government support to deliver passenger modal interchange is essential. Ease of use is a major barrier, and would benefit from the introduction of common payment systems. Journey planning tools that work across systems are developing, but greater operator collaboration is needed.
109. The advent of autonomous electric cars potentially offers a major shift in transport system capability. The road transport problem could rapidly move from environmental to congestion, with electric cars being seen as a very efficient means of high quality personal mobility from dispersed areas into transport hubs.
110. Whilst Hyperloop has not yet been proven, the UK should consider this as a potential disruptive technology in future and one that has the capacity to enhance the coherence of the UK by linking Edinburgh, London and Cardiff.
111. Infrastructure to support new forms of transport such as autonomous vehicles and electric cars will be needed. The technical feasibility and cost-effectiveness of motorways with inductive loops for charging and powering electric vehicles on the go should be investigated.

²⁹ Ibid.

³⁰ Ibid.

112. Improvements in reliability, capacity and interconnectivity of intercity rail are possible provided that the links at either end provide seamless interconnection to other modes. The costs of passing through highly populated areas and high levels of environmental protection need to be de-coupled from the business case for high speed lines when making comparisons with other countries³¹.
113. The need for additional airport capacity in the South East has been analysed and debated many times. Delay is one of the biggest risks to business.

Question 16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

114. It may be easier to justify vehicle charging as part of the cost base of shared vehicles. With the advent of autonomous taxis, there may not be a significant reduction in the number of moving vehicles and congestion but clearly there would be a better utilisation of vehicles and a significant reduction in those that spend much of their life parked. A shift away from systems such as vehicle licensing towards a more use-based charge thus seems highly likely.

Question 17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

115. The highest value infrastructure investments to secure digital connectivity across the country are the antenna towers, sites, ducts, poles, local fibre access and street furniture necessary to deploy modern digital technologies including 5G. Technology trends are relatively stable in these areas. However, the policy issues are complex and likely to be controversial. Policies are needed to significantly bring down the cost, promote competition and extend reach. Even when the essential policy reforms have been made, the implementation lead times can be long. For these reasons, they should be a priority for the NIC.
116. Developments in technology are rapidly removing the historic distinctions between fixed and mobile communications services. The regulatory regime should be reformed to reflect this new reality.
117. Recognition should be given to the need to establish improved minimum standards for availability and resilience of the communications infrastructure, particularly in the context of back-up power. The role of a provider of last resort should be recognised and rewarded accordingly. Mobile and fixed communications have a vital role in containing cascade failures of infrastructure.
118. Other important steps in the UK securing digital connectivity across the country include: the introduction of 4G, including 4G spectrum releases in 2017; the introduction of fibre to the home during the period 2017 to 2019; phased releases of 5G spectrum in the years 2017, 2018, 2019 and 2020 and analog television switch-off dates, phased between 2018 and 2025.

Question 18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

119. Provision of pervasive high performance broadband access, both fixed and mobile, to both urban and rural areas, is an economic imperative for a 21st century data-enabled

³¹ Japan, Italy, France, Germany, Spain and latterly China have all benefited from high speed rail.

economy. The government, following Ofcom recommendations, is moving towards a Universal Service Obligation at a minimum of 10Mbits/sec download speed by 2020. There should be a commitment to regular review, with the possible potential upgrade of this minimum. Government should place greater emphasis on supporting local initiatives and smaller providers.

120. 5G has the potential to transform digital connectivity across the UK in the near future but only if the regulatory regime is also transformed. The need for access to enabling physical infrastructures must be addressed at an early stage. There has been a failure to resolve some of the underlying regulatory issues that will enable the benefits of modern communications to benefit all in society, although the issue of radio spectrum has had much attention. The vision and plans for 5G and the ongoing evolution of communications infrastructure needs to break down the silos between fixed and wireless communication technologies and regulatory models.
121. The release of radio spectrum at the 3.6 GHz band offers a huge opportunity for data transfer 'on the move'. A combination of measures will be needed to deliver the leap in performance including exceptionally wide radio channels, spectrum sharing, policies to reduce small cell costs, better access to sites and a framework for aggregating public and private 5G small cell coverage. Significant regulatory innovation will be needed.
122. Policy makers must embrace the entire 5G fabric - including optical fibre backhaul and the integration of new 5G components with the existing 4G and WiFi - to unlock really high performance. Coverage and its quality will be the single biggest issue for policy makers in the 5G era.
123. There is a view that if digital connectivity is viewed as a utility, there is a risk that price pressure may deter investment. Pricing needs to reflect demand, and some areas may have lower demand or lower levels of fibre backhaul. Economies of scale are needed for capital expenditure. At the operational expenditure level, there is growing choice in service providers such as mobile virtual network operators (MVNO's), service providers, Internet of Things specialists and retail distribution.
124. The shape of the market will change over time, with key players including not only providers of network coverage, but also providers of billing and customer care, data security and devices. Currently regulation tends to favour international internet players at scale versus network investors.

Energy:

Question 19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

125. Over the next decade, the UK needs to invest in testing and proving key 'next step' options for low carbon heating ahead of major infrastructure roll-out in the 2030s and onwards. There is no 'silver bullet' solution for replacing current domestic gas boiler arrangements as economics, effective technical performance and consumer value propositions are all driven by local factors including the specifics of the building fabric, occupancy and use and the availability of heating sources whether electricity, gases (including hydrogen), waste heat (district heating networks) or biomass. Critically, there will be significant economic benefit from seeking opportunities to integrate heating systems with the rest of the UK energy system – particularly utilising waste heat from industrial installations (including power stations) and linking to central hydrogen production facilities which can service power, heat and transport demands.
126. While the widespread delivery of decarbonised heat only needs to be implemented post 2030 to meet UK climate change goals, considerable effort is required pre-2030 to build

consumer and investor confidence and industrial capability. The Energy Technologies Institute (ETI) has identified practical steps in this period as including:

- gradual deployment of heat pumps and biomass boilers particularly for off-gas grid homes
- continued development of district heating solutions in suitable localities, particularly where a waste or another cost-effective heat source is available
- continuing emphasis on building energy efficiency measures, including cost-effective retrofits, actions to ensure thermal efficiency in new buildings (for example, building codes) and development of consumer-friendly controls and installations
- investigation of repurposing the gas grid to carry hydrogen and the necessary retrofits required in homes and to the gas system, noting that hydrogen at this scale can only realistically be supplied in combination with carbon capture and storage (CCS)
- progressing a range of solutions for industrial heat (at a range of scales) including biomass, combined heat and power and CCS.

127. As set out in the 2015 report by the Royal Academy of Engineering, political decisions must take account of long technical and investment timescales³². Large-scale changes in the system must be carefully planned and based on solid evidence, ideally from community- and regional-scale pilot schemes. Clear, credible and costed strategies need to be laid down against which industry can deliver.

128. The physical, decontamination and human costs of decommissioning the existing petro-chemical supply chain need to be addressed, if successful de-carbonisation is achieved.

Question 20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

129. The most effective 2050 'zero carbon power sector' will be integrated with the national and local heat, transport and industrial sectors so as to maximise the synergies and opportunities from effective operation of an integrated set of systems – reducing costs and increasing the resilience of all these critical sectors and operations.

130. The effective integration of the various systems is of greater value than setting definitive goals for the make-up of the individual elements. For example, the widespread deployment of a CCS network allows continued use of gas for power generation, provides the platform for large scale economic production of hydrogen (for power, heat and transport) and offers a route to decarbonising major industrial emitters – overall saving around 1% of GDP per annum. Effective decision making in support of such an integrated system implies a need for considerable expertise in system-level modelling, planning and analysis – capabilities being developed and implemented increasingly effectively through the UK's engineering and academic base.

131. Within an effectively integrated structure, the power sector would most likely be based on a balanced mix of generation approaches - primarily:

- nuclear (large and potentially smaller modular reactors)
- gas or biomass fuelled plants linked to CCS
- wind (on and offshore), and
- further interconnectors.

In addition, hydrogen-fuelled turbines can offer vital flexibility in the medium term (with hydrogen storage providing large-scale energy storage) noting that the most efficient route to production of large volumes of hydrogen is from natural gas linked to CCS. Other renewables are likely to play supporting roles limited by resource availability and distribution, such as solar and marine, including tidal lagoons.

³² Royal Academy of Engineering, October 2015, *A critical time for UK energy policy: what must be done now to deliver the UK's future energy system*, A report for the Council for Science and Technology, <http://www.raeng.org.uk/publications/reports/a-critical-time-for-uk-energy-policy>

132. There are currently serious risks in the delivery of the optimal energy system for the UK. The whole energy system faces massive changes to deliver against all aspects of the 'trilemma' — cost, security and decarbonisation. Time is of the essence, with decisions taken now affecting what the system will look like in 2030 and beyond³³. The Royal Academy of Engineering ³⁴ has recommended urgent actions for policy makers to take.
133. Real-world demonstrators are vital for understanding how technologies will integrate and, most importantly, how different options will function effectively for all stakeholders. Failure to carefully plan the development of the whole energy system will result, at best, in huge increases in the cost of delivery or, at worst, failure to deliver.
134. There could potentially be transformative technologies that would result in a step-change in delivery up to 2050 or beyond, such as nuclear fusion.

Question 21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

135. The primary impacts of greater penetration of low carbon vehicles are likely to be a continuing reduction in the need for liquid fuel supply infrastructure and a steady increase in the demands placed on the electricity distribution network for power supply to recharge vehicles – both full electrics and hybrids.
136. Powertrain efficiency improvements alone continue to deliver a ~1% p.a. improvement in fuel efficiency; coupled with additional innovations this should lead to a reduced liquid fuel demand irrespective of the feedstock being fossil or biofuel based. This has implications for the refining sector as well as the fuel supply infrastructure needs.
137. Perhaps more than in any other sector of the UK energy system, there remain major uncertainties in the rate at which consumers and operators will elect to take-up low carbon vehicles and infrastructure solutions need to be aligned to this uncertainty with a focus on delivering optionality and flexibility across the system rather than a specific, single solution. Prior to trials, it is difficult to predict whether the combination of smart control and vehicle-to-grid (V2G) strategies will be sufficient to avoid the need for significant distribution network upgrades.
138. Managed charging of plug-in vehicles will be critical to mitigate the need for major distribution network upgrades and additional peak demand generation capacity. This needs to be trialled at large scale and the economic benefits case to be developed. Similarly, the benefits that V2G release of stored energy could bring need to be evaluated through real-world trials.
139. Hydrogen fuelled vehicles may also form part of the UK mix but their widespread introduction will be primarily driven by manufacturer decisions on vehicle development and the availability of fuelling infrastructure. The former cannot be controlled at a national level; it can, however be influenced through clear, long-term policy signals. These could address the nature of a low carbon transport system post 2030 and the mechanisms by which this could be delivered most efficiently as part of an integrated, system-wide approach to energy delivery and demand management. Should hydrogen be adopted at scale for generation, industrial or domestic heating then the necessary distribution system would also serve as the major part of a hydrogen vehicle refuelling infrastructure.
140. Electrification is already well underway on the railway system, but large scale EV roll-out could result in an overall doubling of current electricity demand levels (averaged over the year) and would require substantial upgrades in the distribution system³⁵. It would also

³³ Ibid.

³⁴ Ibid.

³⁵ Ibid.

require a step change in battery performance, in terms of storage capacity, cost, lifetime and recharging time.

141. Beyond private passenger transport, other areas of transport, such as long haul and heavy duty transport remain the most difficult to decarbonise and will likely rely on the establishment of sustainable biofuels or hydrogen.

Water and wastewater (drainage and sewerage):

Question 22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

142. There is a growing risk of drought as a result of population growth and increase in per capita consumption, environmental drivers that reduce abstractions and the changing climate, with possible consequential effects on households, businesses and the economy more widely. The environment suffers if too much water is abstracted.
143. The 2014 Water Act introduced a duty of resilience for the sector, but there is still a need to understand the level of resilience required in relation to droughts and extreme events and floods. Various actions are needed to make the sector more resilient: reducing or shifting demand, reducing leakage and increasing supply. The latter would require new infrastructure and new technologies such as new reservoirs, desalination, reuse of waste water or large-scale inter-basin transfers.
144. A systems view is needed of the whole water cycle, in order to address the following opportunities and challenges:
- cross-sector collaboration – for example, this would be of benefit in reducing energy use by the water sector. Future solutions such as desalination, reuse of waste water and bulk transfers all have an energy use associated with them, and therefore integrated solutions which benefit both sectors will be becoming increasingly valuable
 - differing perspectives of the various stakeholders, including water companies, government, the regulators and customers.
 - the need for environmental protection - the environment itself is a national asset, and the value of maintaining it in a clean, resilient state is an important consideration
 - the interactions between water supply and wastewater – waste water can be viewed as a resource.
145. A national solution is required that accounts for regional and local variations in resilience, and provides a clear course of action for delivering long-term resilience. It should take into account the condition of assets, customer expectations, climate change and demographic change. It would also need to consider the structure of the industry, the role of the regulator and business planning cycles.
146. A national adaptive plan - recommended in a study on resilience by Water UK³⁶ - would support ongoing water resource management plans and provide a broader view of requirements. This approach would require cooperation between companies that are operating in a competitive market. There is more work needed in establishing how such a plan would function in practice.
147. A combination of interventions is required; there are no universal solutions. Interventions need to be chosen on the basis of their cost-effectiveness at reducing risk to water supplies and their robustness and adaptability in the face of future uncertainties. There is potential for further action to reduce water use and reduce leakage.

³⁶ Water UK, September 2016, *Water resources long-term planning framework (2015-2065)*.

148. Further strategic supply resources are likely to be required at some point in the future, depending on changes in demand and climate. Supply options like inter-company transfers may help to improve resilience, but their effectiveness at reducing risk in widespread droughts needs to be carefully analysed.

Question 23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

149. Design of drainage systems is highly place-specific. Enlargement of existing systems in urban areas is very expensive – as has been seen in the Thames Tideway tunnel system. Therefore, measures that can keep storm water out of sewers are likely to be cost-effective, such as Sustainable Drainage Systems (SuDS) or dual systems that take foul waste and rainwater in separate sewers.
150. Regulatory arrangements governing the uptake of SuDS are weak. A dual system would be more efficient and adaptable – but retrofitting such a system would be very costly and would require a long-term commitment. The NIC should consider whether a long term commitment to a dual system is desirable.

Question 24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

151. A whole catchment approach is required because interventions at one point in the catchment can have impacts elsewhere. Whole catchment approaches have been promoted for example through River Basin Management Plans and Catchment Flood Management Plans. For the time being however, the different catchment functions have not been dealt with in an integrated way. Promoters of infrastructure have not worked in an integrated way, which means that opportunities for multi-purpose infrastructure have not been accessed. Modelling, simulation and optimisation methodologies now provide the opportunity for catchment management to be effectively analysed and optimised.

Flood risk management:

Question 25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

152. The level of resilience should depend on the value of the assets being protected and the potential for disruption. A national perspective is required. When analysed at that scale, extreme floods are not at all rare. For example, analysis conducted for the National Flood Resilience Review³⁷ demonstrated that the probability of a flood that is so severe that it reaches or exceeds the Extreme Flood Outline (roughly a 1:1000 year return level) occurring on a river somewhere in England or Wales during a 10-year period is approximately 90%. The probability of a flood of this severity occurring on a river somewhere in England or Wales in any given year is approximately 20%.

Question 26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

153. Natural Flood Management (NFM) has been shown to have some effect on reducing flood peaks in small catchments in small- to medium-sized floods. The evidence of effectiveness is weak for large floods and large catchments. That is not just because large enough NFM experiments have not yet been carried out – it is also the case that the effectiveness of NFM tends to diffuse downstream. NFM does however bring significant co-benefits, notably habitat creation/restoration and improvements in river water quality, which may reduce water treatment costs.

³⁷ HM Government, September 2016, *National Flood Resilience Review*.

154. The National Flood Resilience Review, and Property Level Flood Resilience Action Plan, were published by Government in September 2016. These reviews – created in partnership with stakeholders from the public, private and third sectors – show that for the short, medium and longer term, it is critical to embrace the whole system in a joined-up way, and to consider national flood management schemes alongside permanent and temporary defences, river dredging and other interventions. For this, system modelling and system design work is key.
155. A combination of measures will be critical for meeting the challenge of climate change. Whatever measures are put in place, it is inevitable that a proportion of buildings and critical assets will be at risk of flooding. Therefore, embracing resistance and resilience at a property or asset level is essential, requiring a change in culture and behaviour by government, business and the public.

Solid waste:

Question 27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

156. The main financial incentive in the solid waste sector is the landfill tax. This has been very successful in incentivising the development of recycling and recovery infrastructure, and could be seen as an exemplar of using taxation to achieve environmental outcomes. The landfill tax rate increased rapidly under the 'escalator' scheme, but has now stabilised. At present, the tax rate appears to be a sufficient incentive to recycling and recovery, but this should be kept under review as the costs of various waste management routes vary over time. Any dilution in proximity principle³⁸ and producer pays principles could threaten efforts to drive innovation in recycling and recovery.
157. Lack of clarity on renewable energy (heat and power) incentives is a big obstacle to funding of large scale waste infrastructure. Clear financial incentives and commitment to them based on sound strategies are key to delivering funding. For example, regulatory and financial incentives could be better aligned to drive recovery of heat from waste. Policy places emphasis on schemes that will deliver power AND heat but financial incentives for heat supply no longer exist.
158. Improvement in recycling performance from commercial and municipal waste will likely require intervention to help drive recycling of difficult materials such as mattresses, plasterboards, light fittings etc. This could interface with circular economy objectives.
159. There needs to be a closer alignment of the regulatory drivers and opportunities for improvements in sustainable commercial and industrial waste management alongside municipal waste management to promote opportunities for local authorities and businesses working in synergy.
160. Measures to eliminate uncertainties in market economics and regulatory frameworks through clear end of waste criteria and statutory certainty (especially in the run up to Brexit) would kick start infrastructure funding, including funding for innovation.
161. It is unclear how the move to further devolution will affect the waste management sector. Opportunities for improvement in waste management funding and infrastructure development across the public and private sectors should be at the forefront of objectives and target setting for devolved bodies. Opening up opportunities for further prudential³⁹

³⁸ The Proximity Principle highlights a need to treat and/or dispose of wastes in reasonable proximity to their point of generation.

³⁹ Local authorities can borrow to invest in capital works and assets so long as the cost of that borrowing is affordable and in line with principles set out in a professional Prudential Code.

borrowing for devolved bodies or innovative public financing mechanisms would provide the necessary kick-start in funding.

162. The scale of infrastructure for waste is generally best suited to development control at a local authority level but the network of infrastructure available to deliver on a national level needs national government (or a national body) oversight and facilitation to deliver a cogent and strategic network of facilities. National imperatives are not always apparent, or given enough weight, at the local level.
163. The availability of excess energy-from-waste capacity in Europe has incentivised export of UK waste in recent years (thereby reducing waste landfilled), at the expense of developing UK-based treatment capacity. Whether or not this situation persists depends on regulatory factors (particularly post-Brexit) as well as the capacity of the European market.
164. Most waste operators still see there to be a 'capacity gap' in the UK, particularly for commercial/industrial waste treatment. Most municipal waste streams are already contracted, and the commercial/industrial market is less predictable, with fewer long-term contracts. This makes it more difficult to secure financing for new facilities.
165. The landfill tax incentivises innovative technologies, insofar as they represent alternatives to landfill, but does not explicitly support innovation as opposed to proven technologies. In most cases, the constraints on innovation are technical and financial, rather than regulatory. Regulations need to permit innovation and allow alternatives to landfill, but at the same time manage the risk to the environment. Increased landfill tax may also lead to waste producers seeking to maximise the use of exemptions and other low-cost, non-landfill disposal and recycling routes.
166. Waste producers have a legal duty of care to ensure that their waste is managed lawfully, although formal 'producer responsibility' schemes apply to only a limited number of sectors. Increasing the amount of waste falling within such schemes could improve recycling rates and also contribute to the circular economy, although this may impose additional costs on business and consumers.

Question 28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

167. One of the greatest barriers to establishing and driving a more circular economy is that the UK's measures of success are built upon a linear model. Measures of 'growth' are linked to consumption of good and services. Greater reuse and recycling of goods, which lies at the heart of a circular economy, will by definition reduce demand for new goods and will deliver negative economic growth as currently measured. A major rethink of the UK's (and the world's) economic model is required if a circular economy is to be encouraged.
168. A more circular economy could be achieved if the following were in place:
 - *Better data to understand 'material' flows* – government and business need much better data to understand how raw material and products track through into wastes and by-products. A more systematic approach to gathering data is needed across UK.
 - *Better data to understand the costs and benefits* – many models are unproven, while emerging models are still evolving, alongside the costs and benefits. Greater sharing of outcomes from projects would help business and society understand the potential.
 - *Awareness of various circular economy and practical business models* – there needs to be greater awareness of the models that exist, the success factors and lessons

learned. The infrastructure sector has much to learn from the manufacturing sector, for example.

- *Business Innovation and agility* - global leaders such as Unilever are driving innovation and have the resources to achieve this. SMEs struggle with resources to develop concept, test, build business model, engage wider business community and market product.
- *Financial support* – is needed to help start-up/SME companies move conceptual models through to commercial delivery. For example, small start-ups with a strong concept may need support in aligning products and services to Tier 1 companies to address quality assurance, supply chain requirements and market engagement.
- *Quality protocols* – replacement of new products with materials and goods that include re-used or recovered components must be able to demonstrate 'like for like' environmental, quality and safety requirements. In some cases, this challenge is perversely affecting new CE materials from making progress into established markets.
- *A consistent approach to developing CE across UK* - devolved governments and the UK government are pursuing different programmes of implementation, whereas many businesses and their supply chain span the UK. This can discourage action.

169. In relation specifically to infrastructure, the following are barriers to the circular economy:

- There are established ways of delivering key infrastructure when it comes to materials and resources and waste. Many of these approaches are starting to accommodate CE models, such as for example, deploying innovative materials like cement-free or low-carbon concrete and redeploing cut-and-fill spoil across projects. However, making the transition from delivering a construction product to a construction service will take time as current commercial models perpetuate themselves and downcycling is still prevalent. A material loses more value each time it comes to the end of its life and ends up in a lower value application.
- A common misconception is that infrastructure lifecycles are too long – for example, 120 years – to consider end of life. However, many infrastructure components have much shorter lifecycles, and can be monitored and replaced, recycled or refurbished. For example, most modules may have a 20-30 year lifecycle, like an electric line or a steel barrier or a road surface pavement. It is the infrastructure footprint that has a long life-cycle and that can stretch to hundreds of years, though may have different applications in that time period – for example, roman roads and viaducts.
- One barrier to wider implementation and scaling up of circular economy approaches is the current lack of an effective programme or corporate-level measurement or metric of success, although these are currently in development.
- There is a belief that statutory design guidelines are sometimes inflexible and procurement rules can inhibit innovation – this is true to some extent, but innovative approaches do get piloted. A more serious problem is corporate inertia and risk appetite preventing pilot scaling beyond project trial.
- Infrastructure-specific cost benefit models for the deployment of the circular economy approach are still work-in-progress, however, the benefits are numerous, and include: significant reduction in raw material extraction; better productivity from existing resources; smaller amounts of waste to landfill; competitive advantage; decongestion of logistics pathways; avoidance of the need for remediation; broader environmental benefits.

Appendix

We gratefully acknowledge the contribution of Fellows of the Royal Academy of Engineering to this response, who attended a workshop and/or provided written contributions:

[Names of contributing Fellows redacted].

Royal Institute of British Architects response to National Infrastructure Commission Call for Evidence

The Royal Institute of British Architects champions better buildings, communities and the environment through architecture and our 40,000 members. We provide the standards, training, support and recognition that put our members – in the UK and overseas – at the peak of their profession. With government and our partners, we work to improve the design quality of public buildings, new homes and new communities.

1. The RIBA welcomes the opportunity to respond to the National Infrastructure Commission's (NIC) National Infrastructure Assessment Call for Evidence.
2. The RIBA's response to this consultation is focussed primarily on adding detail to the issues we raised at the NIC's two initial workshops on energy and flood risk management.
3. Our evidence additionally addresses the cross-cutting issues identified in the Call for Evidence relating to designing, planning and delivering infrastructure to create better places to live and work, and how the interaction between infrastructure and housing can be incorporated into this.

Energy

4. **An ambitious national energy efficiency scheme represents the best investment for achieving a sustainable balance between energy demand and supply.**
5. The RIBA is very pleased the NIC has recognised housing as a key infrastructure issue. However, the only way to make our built environment fit for the future is to fully integrate built environment energy efficiency within the UK's Infrastructure Plan.
6. We hope that the NIC will use this opportunity to set out an ambitious national energy efficiency scheme of buildings to be embedded within the National Infrastructure Plan, which represents the best investment for achieving a sustainable balance between energy supply and demand.
7. No other investment can stimulate as much economic growth and create jobs in every constituency in the UKⁱ. A programme to make UK domestic stock energy efficient would provide net economic benefits of £8.7 billion. This is comparable to the economic benefits of investments in HS2 Phase 1, Crossrail and new roadsⁱⁱ.
8. Deploying infrastructure funds to support a national energy efficiency programme could create up to 108,000 new jobs, doubling the number of jobs in the sector to 260,000ⁱⁱⁱ. Apart from generating significant economic growth in all regions of the UK, energy efficiency investment would also boost Britain's energy security by reducing gas imports by 26%^{iv}.

-
9. The benefits of investing in energy efficiency could go deeper and further than other more visible infrastructure schemes that are already being financially supported by government. The large net economic benefits outlined above excludes the added value of this approach through many of its social benefits, such as health and wellbeing improvements; and its critical ability to address national challenges of safeguarding energy security and tackling climate change.
 10. By investing in energy efficiency building stock, Government can substitute for expenditure on more visible elements of energy investment like power stations, energy storage and the grid, through more effectively reducing demand.
 11. The private sector is already paving the way towards a low carbon future. The RIBA would like to see the implementation of a very successful large scale retrofit scheme in the UK based on the successful Energiesprong model which is currently benefiting 111,000 properties in the Netherlands^v.
 12. The innovative whole house retrofit scheme helps homes achieve net zero energy levels through clicking on off-site manufactured building envelopes onto existing properties. It is a market driven initiative funded by savings delivered via a contractor-guaranteed energy performance contract. Plans are underway for housing associations and local councils in London, Birmingham and southern England to pilot the large scale carbon neutral retrofit of at least 1000 properties by January 2018.
 13. Despite its knowledge, expertise, and established business models, the private sector is not able to implement large-scale roll out of energy efficiency measures without Government intervention. The success of Energiesprong in the Netherlands relied on central Government starter capital which has helped develop economies of scale and enabled the business to work through any teething problems to achieve higher energy savings in energy costs than initial costs of the retrofit^{vi}.
 14. Other reasons for Government intervention in driving a national energy efficiency programme are long-established. Many energy efficiency installations have a long asset life, while the private sector looks for shorter-term payback. Much of the private sector also does not consider externalities such as carbon benefits, and struggles to secure business without long term policy for energy efficiency.
 15. Over £100 billion had been allocated to support infrastructure projects over the next 5 years under the Spending Review 2015^{vii}. The publicly funded investment programme should prioritise the upgrade of existing building stock, minimising the energy demand of new buildings through maximising fabric energy efficiency, and driving up standards and quality control to ensure buildings perform as designed.
 16. Research has shown that if a refurbishment incorporates advanced energy-saving techniques, designed and administered by suitably trained architects, this has the potential to reduce overall energy usage in retrofitted domestic and non-domestic buildings by up to 90% with as little as 3% additional cost over a standard refurbishment that would have a relatively poor impact on energy use.^{viii}

17. There is a clear case that energy efficiency delivers value for money and added value. By accepting and embracing domestic energy efficiency as infrastructure the benefits could potentially go further and deeper than those offered by more visible infrastructure schemes that are already being financially supported by government.

Flood Risk Management

18. **Existing investment in flood risk management can be better utilised if a holistic approach to water management and flooding was supported.**
19. Flooding, droughts and watercourse pollution are all signs of stress where developed areas have a troubled interaction with the natural water cycle. The way places and drainage systems are planned and designed can either exacerbate or mitigate these issues by either facilitating or disrupting the natural water cycle.
20. This basic relationship between cities and water is often overlooked in planning and design decisions, leading to costly investments in flood defences that have limited effectiveness, and in outdated urban water and sanitation infrastructure that perpetuate the problem.
21. Green infrastructure, water resilient design, and spatial planning are the raw ingredients of ‘future-proofing’ infrastructure and cities against excess water and flooding, as they harmonise the built environment with its water cycle.
22. Sustainable Drainage Systems (SuDS) are a more cost-effective and environmentally friendly alternative to our current sewage infrastructure. There is widespread evidence that SuDS can efficiently deal with surface water, and can already be delivered cost-effectively^{ixx}. During the passage of the Housing and Planning Act, the Government committed to a review into the use of SuDS in new developments.
23. However, we need to go further than green infrastructure and start joining the dots between flood risk management and water resource management, and start putting water at the heart of discussions about what makes places great to live.
24. Water Sensitive Urban Design (WSUD) supports healthy ecosystems, lifestyles and livelihoods by creating buildings and public spaces that can utilise the most appropriate source water for their use. This helps take pressure off existing infrastructure by limiting the amount of water entering sewers and the need for water abstractions.
25. WSUD features bring additional social, economic and environmental benefits – e.g. helping to reduce energy demand of cities through water features that help cool buildings down. Its successful and growing application in the UK and various countries around the world (Australia, Singapore, New Zealand) demonstrate WSUD can be applied at all scales, from a single house to an entire city, and retrofitted to existing developments as well as built in from the start^{xi}.

26. Through its multi-functional benefits to communities WSUD could link flood defences with urban regeneration and development. This approach could help to increase private sector investment in flood risk management, which in turn could help to address the estimated £1bn shortfall in flood defence barrier funding. Many of our members are already pioneering such approaches and we would welcome a meeting with the NIC to explore WSUD's potential to drive infrastructure investment value for money further.

ⁱ<http://www.ukgbc.org/sites/default/files/A%2520housing%2520stock%2520fit%2520for%2520the%2520future%2520-%2520Making%2520home%2520energy%2520efficiency%2520a%2520national%2520infrastructure%2520priority.pdf>

ⁱⁱ Based on Governments own economic analysis <http://www.frontier-economics.com/publications/energy-efficiency-an-infrastructure-priority/>

ⁱⁱⁱ Based on estimate of 136,000 sector jobs in 2012 and the creation of up to 130,000 jobs by 2027 through recycling of carbon taxes: Department of Energy & Climate Change, Energy Efficiency Strategy: 2013 Update, Dec 13; Consumer Futures, Jobs, growth and warmer homes, Oct 1

^{iv} According to Building the Future: The economic and fiscal impacts of making homes energy efficient, published by Verco and Cambridge Econometrics

^v <http://energiesprong.nl/transitionzero/>

^{vi} <http://energiesprong.nl/transitionzero/>

^{vii} HM Treasury Spending Review 2015 <https://www.gov.uk/government/publications/spending-review-and-autumn-statement-2015-documents/spending-review-and-autumn-statement-2015>

^{viii} <https://connect.innovateuk.org/web/building-performance-evaluation/articles>

^{ix} [The largest independent survey on SuDS in the UK](#)

^x CIRIA Susdrain *Demonstrating the multiple benefits of SuDS- a business case – Literature overview* (2014) http://www.susdrain.org/files/resources/ciria_guidance/ciria_rp993_literature_review_october_2013_.pdf

^{xi} Abbott et al (2013) in CIRIA C724

http://www.ciria.org/Resources/Free_publications/Creating_water_sens1.aspx



RTPI

mediation of space · making of place

ROYAL TOWN PLANNING INSTITUTE:

RESPONSE TO THE NATIONAL INFRASTRUCTURE COMMISSION CALL FOR EVIDENCE

10 February 2017

Introduction

The Royal Town Planning Institute champions the power of planning in creating prosperous places and vibrant communities. Our 24,000 members are from the private, public, academic and voluntary sectors. Using our expertise and research we bring evidence and thought leadership to shape planning policies and thinking, putting the profession at the heart of society's big debates. We set the standards of planning education and professional behaviour that give our, wherever they work in the world, a unique ability to meet complex economic, social and environmental challenges. We are the only body in the United Kingdom that confers Chartered status to planners, the highest professional qualification sought after by employers in both private and public sectors.

Two Overarching Points

We thank the NIC for the opportunity to respond to this consultation. We provide answers to selected questions in the call for evidence are set out below (at page 3). But we also have two overarching points to make regarding (A) the need for high-level agreed outcomes and (B) the nations of the United Kingdom.

A. The need for more detailed high-level outcomes

We touch on this in further detail under question 1. But addressing the questionnaire to the needs of individual cities and regions can only go so far. We appreciate the NIC call for evidence was issued in October 2016, but now with the UK Government's draft proposals for an Industrial Strategy, the emerging 25 Year Plan for the Environment (and to a rather lesser extent also the Housing White Paper) there is a need for much stronger *coordination* between these strategies, and also. We explored the issue of the lack of coordination between major government strategies in our [Map for England](#) research and pilot project in 2012, and have made the argument for more coordinated spatial decision-making in [previous RTPI papers](#).

In the past, national infrastructure choices have been sub-optimal in part because:

- the consultative processes have been unnecessarily confrontational because of the *ad hoc* nature of the project justification;

- there has been no real basis for taking account of cumulative national or city-regional impacts and benefits, because of the project-based (and trend-based) assessment processes involved (as exemplified by the decisions on an estuarine airport);
- investment has tended to reinforce the problems of “peripheral” regions and areas, which is to say their relative neglect in investment and consequently lower growth and productivity;
- opportunities for growth by creating new markets and new demands **where the return on investment may be higher** have been overlooked.

The solution of these problems is made more difficult by the limitations on the NIC’s formal role, which is limited to making an Assessment, rather than identifying, through helping central government to coordinate its various key strategies (industry, housing, environment etc) so as to reach **more detailed agreed national outcomes**. The NIC could then recommend how these can be achieved through infrastructure investment. Unless this challenge is addressed there is a continued risk of *ad hoc* selection on a project by project basis, which would in all likelihood tend to replicate some of the problems of the past.

We do not consider that the three objectives of the NIC (on economic growth across all regions, competitiveness and quality of life) really provide a sufficiently detailed steer to overcome past weaknesses in decision-making.

One way then that these objectives could form a more useful basis for assessment is to develop them such that they make reference to the *spatial* dimensions of infrastructure investment decisions, in two main respects: how infrastructure could help to achieve the objectives set out in government strategies; and (relatedly) how infrastructure could generate the greatest returns on investment including by being directed to areas and regions that might benefit most (for example in terms of improved productivity and quality of life). This would provide a much stronger rationale for infrastructure decisions which might help to resolve some of the issues noted above.

B. Nations of the UK

The UK NIC consultation refers to the Commission has having a remit for the whole of the UK. However, a recent consultation considered proposals to create a National Infrastructure Commission for Wales (NICfW) to provide independent and expert advice about infrastructure investment in Wales. We have assumed that the National Infrastructure Assessment for Wales will fall within the remit of the NICfW. We are trusting that the way that the two commissions work together will be clarified. We note that the UK NIC Call for Evidence makes no mention of the NICfW where it refers to how projects and submissions will be considered and assessed. If the NICfW and the UK NIC is to have a role appraising the merits of submitted evidence and projects in Wales then its work programme needs to be closely co-ordinated with that of the NDF. (An example of the issues at stake is given in our response to question 10.)

A similar issue arises with Scotland. The Scottish Government is consulting on a [White Paper for Planning](#). This has objectives around 3.31-3.31 national level infrastructure coordination (at 3.31), especially the final bullet under 3.33, ‘encourage better coordination of development plan strategies and infrastructure capital investment plans and programmes.’

However there is no reference in the Scottish White Paper to the UK National Infrastructure Commission.

Therefore we consider the UK National Infrastructure Commission should provide a clear guide to where decision making powers lie for initiating and regulating the different forms of infrastructure at the level of the UK, the devolved bodies and regional/local authorities plus private companies. This will help make it clear where co-operation arrangements are needed.

Consultation Questions

Cross cutting issues

Q1 What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Whilst the needs of any *particular* city or region is a matter that needs to be taken into account it does not reflect following:

- the competitive future of the nation needs to relate to the networked system of cities, and not cities acting in isolation;
- there are issues that can only be addressed at a national scale in terms of identifying needs and aspirations e.g. the implications of rebalancing the economy and social opportunities. The NIA cannot be founded on a bottom-up set of proposals alone. It needs a clear set of national spatial priorities;
- Whilst these matters are in part reflected in the post hoc evaluative methodologies, it is in fact an *ex ante* consideration in developing the strategy – i.e. it is integral to the option formulation and strategy making process.

Therefore, there is a higher order and overarching question:

“What potential ranges in distribution of people and jobs in 2050 needs to be planned for and supported by new infrastructure investment?”

Q3 How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Planning for infrastructure should be done at a wider than local-authority level; at city region scale. This is because people and goods cross local boundaries very regularly, and few of our towns and cities are self-contained entities. Our paper on [Strategic Planning](#) sets out general principles on how this should work and specific recommendations for UK nations.

Planning for infrastructure, and in particular its relation with housing, is rendered difficult by the high level of fragmentation in infrastructure provision. While local planning authorities have a pivotal role in housing provision, their attempts to coordinate infrastructure agencies (including even other departments of their own councils) are frequently frustrated by:

- Reluctance or refusal to engage (especially in the face of huge day to day pressures)

- Agencies following single-issue agendas set by far-away Whitehall departments or company boards

We touch on this further in our responses to Question 23 on water but it applies across the board.

The single simplest answer to this problem is for control of local infrastructure to be devolved to cities and counties so that the necessary *local* connections can be made and “heads banged together”. We refer to Hamburg below (Q7). Hamburg is interesting in the citizens voted in 2014 to remunicipalise the energy sector.

Recommendation 8 of our policy paper on [delivering large scale housing](#) suggests using incentives (rather than just sticks) for local areas to deliver large scale housing. Guarantees over transport infrastructure would be a good example of such an incentive. Not only this, but infrastructure can be used to unlock suitable sites by providing certainty to house builders, who can contribute to paying back the infrastructure costs from the gain in uplift in land value.

There is frequently-held view that infrastructure should be provided to *support* housing. This is usually expressed (e.g. by transport planning organisations) as “tell us where the housing is going and we will provide transport for it”. Whilst this approach is undoubtedly appropriate in the case of infrastructure which is not location-specific, to take this view for transport infrastructure is to miss serious opportunities for synergy and to regard the territory of the country in a curiously “flat-earth” fashion. It also places undue reliance on the ability of developer contributions to pay for transport investment.

The almost unique attributes of transport infrastructure are such that it should often be **leading development location choices, not following them**. The outplay of this approach is to say “where are we providing additional infrastructure capacity [anyway, for wider national considerations], and how can the best use of those locations be made for homes and jobs? It is beginning to emerge in some of thinking around Crossrail 2 and the Oxford-Cambridge corridor.

Integrated housing and infrastructure plans need to be long-term and flexible enough to cope with uncertainty – using a managed adaptive approach (see Chapter 5 of the Thames Estuary 2100 plan). The plan should be tested using sustainability appraisal.

Q7 What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Linking decisions on infrastructure spending to local commitments on housing delivery (see above) would be one way to improve.

Another way would be assisting public authorities to acquire land or make use of their own land in order to capture the land value uplift that arises from development, to fund infrastructure. Whilst a number of examples of this type of model exist for bespoke projects in the UK (e.g. Stratford and the Olympic Park), we have previously drawn attention to a number of other international examples, not least in our 2015 report [planning as a market enabler](#).

As an example, the financing of HafenCity in Hamburg depended upon the passing of a law by the city state parliament that allowed for the creation of a 'City and Port' special fund for the development of both HafenCity and a new container terminal. Publically-owned land in HafenCity was transferred as an asset into this fund, which was subsequently borrowed against in order to finance the construction of the container terminal. HafenCity is thus directly linked to the construction of new port facilities, a relationship seen as being important in securing political consensus.

While major public investments such as a tube line extension, schools, a new university, a concert hall and museums are financed by various City State government departments, the special fund is used to finance the infrastructure road building, bridges, public spaces, flood defences, marketing and the relocation of businesses where necessary essential as a condition for further private sector investment. Land sales are used both to finance the running of HafenCity GmbH and to pay back loans raised against the City and Port fund. Total public expenditure of approximately €2.4B has been complemented by private investment totalling approximately €8.4B.

Q10 What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

We have stated in our work on [delivering the value of planning](#), that constant changes to the planning system are hampering planners' ability to carry out their work effectively. They can also tend to benefit the groups in society able to afford to understand them. So any change should be fully justified and proportionate to the disbenefits.

A dedicated system for national infrastructure was established in the 2008 Planning Act. Its performance since has been a mixed one. On the one hand a lot of projects have gone through the time-bound process and have been expertly reported on by the Planning Inspectorate. On the other hand (until some recent changes were made) the threshold for some projects seemed to be very low, forcing short lengths of railway through the process; whilst HS2 (and South East airport capacity to date) have not used this process. Further weakness in the current system is the division of infrastructure into very small segments (e.g. rail divided from road; air divided from both). The creation of national policy statements – originally intended to follow the 2008 Act closely – has been long drawn out.

Further consideration should be given to whether housing is defined as national infrastructure.

Arrangements for infrastructure planning across the borders of the UK Nations have not worked in all situations. For example a bypass of Pant-Llanymynech on the A483 south of Oswestry has been repeatedly identified as a key priority for the Welsh Government but not by the DfT. The issue of such cross border links was addressed in detail a few years ago by the Select Committee on Welsh Affairs and their report with recommendations (and subsequent follow up work) should be of interest to those preparing the new UK wide strategy.

Q11 How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

A Natural Capital / ecosystems services approach could be explored to ensure that benefits to the natural environment are assessed properly. The work of the Natural Capital Committee should be integrated or more closely linked with the National Infrastructure Commission.

National infrastructure should contribute positively to the Government's 25 Year Plan for the Environment and provide net gains in biodiversity. For flooding, the Government should accelerate its whole catchment approach.

Green and blue infrastructure can deliver some of the benefits traditionally achieved by 'hard' infrastructure (such as flood defence and air quality management), while providing additional benefits and fewer risks.

Q12 What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

There should be a level playing field in funding assessment methodologies, so that one type of infrastructure (e.g. roads, railways) isn't given more weight or have a lower public funding threshold than another (e.g. climate resilience). The Commission should also take account of the embodied carbon of infrastructure, including decommissioning, in order to fully consider the costs and benefits of proposed projects.

We have said in our response to DfT consultation on the [Wider Economic Guidance Impact update](#) that methodologies should enable a better connection to be made between the economic and strategic case for transport investment setting out exactly what local, regional and national objectives the scheme is trying to solve.

In considering various demand management options (e.g. road pricing, restrictive parking, and smaller projects to encourage sustainable travel and modal shift) there should be consideration of how these should be valued when compared to investment in major new infrastructure including the opportunity costs not investing. Similarly, public health impacts should be factored into the appraisal process, e.g. the benefits of investment in walking and cycling infrastructure versus and the costs of motorised travel.

Transport

Q13 How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

The role of autonomous vehicles (AVs) needs evaluation in a range of different contexts, and is probably an under-researched area as far as its relationship to urban planning is concerned. Much of the research has seemed to be influenced by developers of AV, rather than by cities themselves.

Where the problem is city congestion, will simply changing the driving method reduce congestion? Careful analysis is needed to understand the role of "tidal" flows at peak times. AVs would need to travel back to suburbs empty where there are strong tidal flows, but where multiple orbital movements are in play, AVs might be used in both directions. Nevertheless in this scenario there would be a greater impact on land needed for car parking than on congestion.

In a motorway context AVs could mean greater throughput of vehicles.

In a rural context AVs could assist with the problems of public transport access – but only if ownership and control is strongly constructed in the community interest.

Q14 What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Investing in intra-urban walking, cycling and clean public transport (electric / hydrogen powered buses or light rail), and investing in inter-urban rail.

Consolidated freight / logistics hubs. We could see a useful return to the Victorian principle of break of bulk at key locations in the city. Large inter-city movements of freight by either rail, road or AV, could be broken up into small loads suitable for penetration into dense urban environments by electric vehicle or cargo bike.

Congestion in major urban areas is a serious constraint on economic productivity and leads to air pollution and poor quality living spaces. Policies that reduce car use in urban areas so that freight can move around more effectively. Congestion charging, low and ultra-low emissions zones, walking and cycle infrastructure, public transport that can shift large volumes of people.

Q15 What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Light rail / rapid transport bus. Investments that reduce car use again. We would advise against thinking simply in terms of “connecting people” if this is viewed as connecting existing people. Infrastructure investment is a way influencing where *future communities live*. **In general we would say infrastructure needs to lead, not follow.**

Energy

Q20 What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

This has been set out in the [Zero Carbon Britain report](#) from the Centre for Alternative Technology (CAT).

It is critical to note that - whatever the generation mix – a zero carbon energy sector will only be feasible if coupled with strong demand reduction policies in the buildings and transport sectors. This will need to include robust policies and financial mechanisms to drive the energy efficiency retrofit of existing buildings, and energy efficiency and low-carbon standards for new buildings, which enable an increase in housing supply while meeting the emissions reductions objectives of the 2008 Climate Change Act.

Renewable energy is playing an increasing role in meeting UK energy demand. However, changes to renewable energy policy and subsidy have created uncertainty for developers. Delay and conflict can be reduced by creating an indicative framework of preferred development areas for renewable and other energy supply and infrastructure.

We need a mix of renewable energy technologies including tidal lagoons, offshore and onshore wind and solar. These should be connected via a smart grid which incentivises domestic energy use during off-peak hours with preferential rates, and includes storage in electric vehicles.

R&D in storage technologies a key component.

Q21 What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Vehicle electrification would be likely to place additional pressures on the energy sector and increase the need for demand reduction in other sectors of the economy. The electrification of vehicles will need to be coupled with land use policies that continue to resist sprawl and promote compact settlement patterns which reduce the need to travel, and support public and active travel. Compact settlement patterns also permit new electric vehicle charging infrastructure to be provided more efficiently.

Water and wastewater

Q23 What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Wastewater re-use should be clearly prioritised before new reservoirs, groundwater abstractions or desalination is considered. Sustainable Drainage Systems (SuDS) reduce strain on drainage and sewerage systems, while delivering a range of additional benefits.

Better arrangements are needed to align planning for water and waste water capacity and housing growth. At present the regulation arrangements of OFWAT militate against forward provision of infrastructure ahead of housing delivery because the regulator insists on very high levels of certainty before being prepared to sanction investment by water companies. Since funding arrangements are only set once every 5 years, unless schemes already have full planning permission in the short window available, all the costs of providing capacity fall on developers. It is not possible for local authorities to run their local plan processes to coincide with a national time table dictated by the regulator. This at best causes delay in getting housing permitted, while developers seek to reduce such costs. OFWAT should have an obligation to

- a) Be involved in the local plan process
- b) Fund any sites allocated in local plans

The current risk averse behaviour contributes to delay.

This issue is equally applicable to providing gas and electricity distribution capacity for new housing growth.

Q24 How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Integrating the various plans that water companies and the Environment Agency make, perhaps on a statutory basis at the scale of catchment areas. Consider combining with devolved flood risk management spending.

Reference should be made in the section on water and sewerage to the new arrangements set out in the Wales Bill, currently awaiting consent. These arrangements include a new protocol to be agreed by the UK and Wales Governments.

Flood risk management

Q25 What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

The UK should consider flood risk over a 80-100 year time period, which aligns more closely to the life-span of major flood defence infrastructure and the impacts of climate change. With our long coastline, dispersed development pattern and multiple sources of flooding, it is inappropriate to have one standard of protection. However, we should adopt a more formal targets of protection for different types of land use and development e.g. 1 in 100 years (annual probability) for essential infrastructure, 1 in 200 (sea flooding) and 1 in 100 years (river flooding) for housing, based on current definitions in the NPPF and guidance. An appropriate target for surface water and groundwater flooding should be agreed, perhaps 1 in 30. These targets should take climate change into account using the latest projections.

In addressing flood risk management, options around changes to upland management of land to reduce the speed and volume of run-off need to be able to be evaluated against the building of new flood defences. This issue is of particular significance as a cross-boundary issue between Wales and adjoining regions of England.

Provisions to help relocation and adaptation of existing communities and infrastructure in vulnerable places.

Transparency on how the sequential and exception tests are being applied by local planning authorities, and monitoring/enforcement of development to make sure that stated flood mitigation measures are in place.

RESPONSE FROM THE RSA SUSTAINABILITY NETWORK TO THE NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE

The RSA (Royal Society for the encouragement of Arts, Manufactures and Commerce) is a social change organisation whose mission is to enrich society through ideas and action.

The RSA Sustainability Network is led by Fellows of the RSA with professional interest and expertise in sustainability issues. Should you have any questions or require further information, [job title redacted], [Name redacted], at [email address redacted].

The RSA Sustainability Network recognises the importance of the National Infrastructure Assessment, not only for infrastructure itself, but also for the prospects for environmental sustainability, housing, and social inclusion.

We are providing responses here to some of the questions raised in the Commission's 'Call for Evidence'. The questions to which we are providing a response are indicated below.

In addition to the specific responses in this submission, we highlight the forthcoming final report of the RSA Inclusive Growth Commission for its consideration of issues that are relevant to the National Infrastructure Assessment, in particular broadening measurement criteria from narrow GVA to 'quality GVA', and for understanding the interplay between physical and social infrastructure for creating better places to live and work.

Question 1: What are the highest value infrastructure investments that would support long term sustainable growth in your city or region

We advocate a broad, nationwide approach rather than a regional or city-based approach. It is vital to develop at the outset a broad nation-wide strategy setting out which types of infrastructure development should be given priority before attention is paid to individual projects.

We are concerned with the assumption apparently underlying this question, namely that individual cities and/or regions should determine infrastructure projects that they would favour, and then the government/Commission would choose from the resulting list the ones that they approve of and are prepared to support. There may be some cases where broad regional priorities have already been agreed and where that approach is sufficient, but generally we strongly recommend that, before considering the detail of any specific project, the Commission (or relevant appointed body) must determine which areas of particular value to the United Kingdom as a whole need government input and support, at least in initial stages, if they are to flourish.

Specifically, deciding we want to build something – say HS2 or Hinckley C – because we believe it will promote “economic growth” as measured by conventional GDP accounting, and then testing it to see whether its environmental costs are too high, would be wrong. The first stage in the process should be deciding what to build, not just to make the

economy more efficient and productive (however that may be assessed), but also, and in our view more importantly, how to make it more sustainable and more circular, and then examining whether those investments would be viable and affordable.

Do we need, for example, a smart electricity grid; a truly comprehensive high bandwidth internet and extensive electricity storage more than we need a new high speed rail line? And before considering any new high speed rail line, there should be a review of likely technological developments in each of road, rail and air travel, in the short and medium terms, having particular regard to their relative impacts on resource use, environmental damage, and long term sustainability. What relative priorities should be set for road as against rail travel? Similarly, with power generation: this must inevitably in the long term become entirely renewable – how should this goal be achieved and over what timescale, including maybe what R & D facilities need to be established to support that goal, and what are the best investments to make in the meantime?

Question 3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Planning in the UK is often blamed for our failure to meet economic, environmental and social objectives. Our cities have sprawled, despite green belt policies, our main roads are clogged up, and our societies are increasingly unequal. Much of our transport and energy infrastructure is worn out, as studies by McKinsey and Company and The Policy Institute have highlighted, and the government's new Industrial Strategy stresses the need to 'better align central government infrastructure investment with local growth priorities'.

Reports such as *The State of the Cities 2016* by the European Union reveal that outside London our cities are lagging behind, in part because of relatively low levels of investment compared with countries such as Germany and France. However the explanation is not just lack of expenditure. Despite sensible policies such as the Treasury's Green Book and the National Planning Policy Framework, we fail to 'join up' public and private investment.

The NIC's National Infrastructure Assessment presents a unique opportunity to reform the way decisions on planning strategic development and infrastructure are made and implemented. We here provide our insights on why spatial planning has failed, what is wrong with funding, where we can best learn from, and what the NIC should be doing to close the gaps.

Why spatial planning has largely failed

- Provincial cities were built on the industrial revolution in the 19th century
- Cities sprawled in the 20th century into low density suburbs and villages
- Employment is fragmenting in the 21st century
- But our transport infrastructure is still largely radial and inter-city
- Transport and development are planned in silos, the regional dimension has been lost, along with the people who can join them up
- Over-dependence on short-term profit has caused both quality and quantity to suffer
- Planning disputes drag on at great expense for many years and sap our capacity to compete internationally
- We are creating Combined Authorities, without the funds to fill the gaps.

What is wrong with infrastructure funding in the UK

- We have invested too little for decades (outside London)
- Public funding is far too centralised and out of touch
- Cost Benefit Analysis neglects social and environmental impacts
- Our procurement system is antiquated, stifles innovation and probably raises costs
- Consumers are not happy at what they get for what they pay
- Private institutions will be investing in resilient cities outside the UK
- The property owners (who are the main beneficiaries) get windfall gains
- We cannot double housing output (which all parties agree is needed) without providing better infrastructure – and in the right places.

Where we can best learn from?

- Swiss cities like Zurich operate like ‘clockwork’ and are rated highly by investors
- French provincial cities like Lille and Montpellier have out-stripped Paris in population and economic growth
- German conurbations such as the Ruhrgebiet towns are models of collaboration with integrated urban transport systems eg Stadtschnellbahnen
- Scandinavian cities such as Copenhagen keep housing costs down through planned expansion along transport corridors, which is funding their new metro
- Some American cities, such as Portland Oregon, have copied European models successfully through Transit-Oriented Development

What the NIC can do

1. Publicise ‘model’ projects that offer replicable lessons
2. Bring experts and practitioners together to review findings from research into better infrastructure decision making
3. Require major investment in infrastructure such as in Oxfordshire to respond to 30 year Spatial Growth Plans
4. Evaluate strategic projects in terms of environmental and equity (social) as well as economic criteria
5. Promote new private funding sources eg infrastructure bonds to share in the uplift in land values from development
6. Set up demonstration projects to test the feasibility and cost of applying better models.

For further information on the issues raised in this response to Question 3, contact [Name redacted] [[email address redacted](#)], www.urbed.coop

By designing integrated, low carbon infrastructure we have the opportunity to achieve climate change mitigation and a healthy, prosperous society.

Question 10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The achievement of consensus through thorough consultation and investigation of the relevant issues as early as possible in the planning process is the key to avoiding inefficiencies later on. A basic problem is that the initiative for development schemes almost always comes from either

developers or government, leaving others (local authorities, local communities, environmentalists, etc) to respond at a later date, when they should have been involved in the process much earlier on.

The Commission should avoid the political rhetoric which brands opposition to proposed developments as “nimbyism”. Clearly there are people who are principally concerned with their own local areas (although that is not necessarily a bad thing), but there are also environmental concerns which are widely shared, and often underpinned by international agreements and a substantial natural science evidence base, which currently are not given sufficient attention. For example, a great deal of the frustration about the possibility of Heathrow airport expansion could have been avoided if at early stage proper consideration had been given to carbon emissions and air quality issues, and alternatives found in order to reduce demand for air flights. Not tackling these issues early on has led to outcomes which are unsatisfactory for all concerned.

Similarly now, urgent attention needs to be given to flood defence arrangements in order to prepare for an increasingly unstable climate. These should not have to be added in to plans at a later stage when the need is already obvious.

The National Infrastructure Commission should make mitigating and adapting to climate change a core element of its work. An early study should be carried out as to how the Commission will carry out its Assessment in a way which is line with the requirements of the Climate Change Act.

In order to address issues about social equity and inclusion, the Commission should also make provision, as part of its methodology for assessing infrastructure needs, for a system for analysing the distributional impact (as between different income groups) of different infrastructure options. This perspective should become a routine part of the Commission’s work as it considers different infrastructure sectors.

Question 12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

We highlight the importance of accurately incorporating sustainability considerations into cost-benefit analysis. Assessment methods must be robust and holistic in order to be “credible, tractable and transparent”. Many of the techniques that ensure inclusion of sustainability also help to ensure better decision making overall.

The method must consider whole-of-life. To illustrate, one of the great barriers to some “green investments”, such as tidal lagoons, has been the discount rate applied to future earnings. If the discount rate is taken to be 6%, for example, earnings arising after more than around 7 years are normally disregarded, even though one of the great advantages of tidal energy is that it will produce regular predictable renewable energy for far longer.

Whole life costing or life cycle costing (rather than simple snapshot cost-benefit analysis) is advocated throughout the sector for a variety of reasons in addition to the sustainability argument. It helps to give a realistic picture of the cost of the asset over its life, and in doing so can also aid more accurate predictions as to the likely actual lifetime. This in turn can significantly improve upon planning and maintenance, both at an individual asset level and from a national infrastructure planning perspective.

Holistic methods also help to avoid the “CapEx-OpEx divide” where capital expenditure and operational costs are considered separately, a common problem bemoaned throughout the

sector, which can lead to a “specification gap” and choices that provide less value in the long term.

Appropriate cost benefit analysis should give a “triple bottom line” (social, environmental and economic) assessment of both costs and benefits. Whilst this is necessarily complex, it is by no means unusual or prohibitive. There are a variety of tried-and-tested techniques for options appraisal and cost-benefit analysis which enable an efficient, robust assessment that effectively incorporates these considerations. For example, we direct the Commission to the work by UCL for the Institution of Civil Engineers and UK Actuary Profession on the OMEGA 3 project (<http://www.omegacentre.bartlett.ucl.ac.uk/research/omega-3/>), which examined how better to incorporate social and environmental criteria into the planning and appraisal of major infrastructure projects. Its proposals for policy-lead multi criteria analysis are detailed in the final report (<http://www.omegacentre.bartlett.ucl.ac.uk/wp-content/uploads/2014/10/OMEGA-3-Final-Report.pdf>).

As was demonstrated in the 2013 National Infrastructure Carbon Review (<https://www.gov.uk/government/publications/infrastructure-carbon-review>) cutting carbon also cuts cost – a principle advocated by the many key industry players who signed up to the Infrastructure Carbon Commitment (<http://www.greenconstructionboard.org/index.php/resources/infrastructure>). We would argue this is also the case for many other sustainability factors, where the same innovation that brings good environmental outcomes can also bring financial and operational benefits.

In addition to these considerations, we highlight that cost-benefit analysis must be conducted at the right point(s) in the process. A key sustainability issue for assessment of infrastructure is consideration of whether an asset needs to be built in the first place. Early consideration of the sustainability costs and benefits is necessary, as is ongoing revision at appropriate points in the options appraisal process as designs and needs change.

Question 28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

We direct the Commission to the key bodies within the UK (both governmental and non-governmental) that are working on Circular Economy such as the Ellen MacArthur Foundation, WRAP, the Environmental Audit Committee. POST note Number 536 September 2016 also provides some useful aggregated insight.

Given responsibility for circular economy policy at a governmental level is divided between different bodies, including: Defra, BEIS, the Treasury, local authorities and devolved administrations, it may be prudent to appoint a special advisor or representative to assist the NIC in ensuring circular economy considerations are included in decision making.

National Infrastructure Commission
The National Infrastructure Assessment Call for Evidence
February 2017

Name and Position: [name redacted]

Name of Organisation: The RSPB

Address: The Lodge, Sandy, Bedfordshire SG19 2DL.

Tel: [telephone number redacted]

E-mail: [email redacted]

SUMMARY

The natural environment and green infrastructure must be considered alongside grey infrastructure. In taking decisions on new infrastructure the Commission must firstly look for demand reduction solutions to avoid the need for new infrastructure. Opportunities to make use of natural solutions should be sought before delivery of new built infrastructure. If new infrastructure is required, biodiversity must be conserved and enhanced through rigorous application of the mitigation hierarchy. In addition, the Commission should consider all opportunities to deliver enhancements to biodiversity and the green infrastructure network and consider green infrastructure as an essential type of infrastructure in its own right. It is difficult to divorce strategic decisions on infrastructure from development locations. As such, we believe a spatial approach to infrastructure planning at a national and sub-national level is essential – helping to avoid impacts whilst planning for enhancements at the right spatial scale – this could include ecological network mapping.

These principles form the basis of the overall approach the Commission should take to the National Infrastructure Assessment and they provide the context for our response to specific questions.

We have responded to questions covering planning and governance, transport, energy, water and wastewater, flood risk management, and solid waste.

INTRODUCTION

1. The Royal Society for the Protection of Birds (the RSPB) is the charity that takes action for wild birds and the environment. We are the largest wildlife conservation organisation in the country with over one million members. We own or manage 151,954 hectares of land for nature conservation on 213 reserves throughout the UK. We believe that sustainability should be at the heart of decision-making. The RSPB's policy and advocacy work covers a wide range of issues including planning policy, climate change, energy, marine issues, water and agriculture.
2. The RSPB previously provided comments on the National Infrastructure Commission's The National Infrastructure Assessment Process and Methodology Consultation in August 2016, and consultation on the National Infrastructure Commission in March 2016 which formed the basis for this response. Our recommendations in these responses form the basis for our comments below.

RESPONSE TO QUESTIONS

Q3 How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

3. The NIC's objectives to 'support sustainable economic growth' and 'to improve quality of life' will be particularly important here. We provided a proposed definition for these objectives in our August consultation response. For example, long term sustainable economic growth must include meeting our climate change targets as well as our biodiversity commitments and 'quality of life' should include scope to protect and restore biodiversity, provide adequate high quality green infrastructure alongside development, ensure new infrastructure supports individual health and wellbeing as well as considering the needs of future generations.
4. Decisions on new infrastructure should start from the premise of whether there is a need for new built infrastructure or whether a demand reduction solution would be more suitable. All new infrastructure should be designed to avoid impacts on our most important sites for wildlife (see our response to Question 11) – rigorous application of the mitigation hierarchy will be key. Furthermore, in designing and planning new infrastructure, opportunities should be taken to deliver improved green infrastructure of benefit to both people and wildlife. Delivery of enhancements alongside new linear built infrastructure provides scope to connect to existing and create improved ecological networks – new infrastructure must deliver a net gain in biodiversity. This could be achieved through a spatial mapping approach – identifying ecological networks and using these to support decisions around infrastructure (details in Q20). The ecological datasets used as part of our Energy Vision Report could support decision-making, helping to inform a non-statutory national spatial strategy for infrastructure.

Green Infrastructure

5. Green infrastructure is a critical component of infrastructure that helps to create better places to live and work. Opportunities to implement wildlife-rich green infrastructure, either as part of new infrastructure or through retrofitting, can help tackle biodiversity loss, climate change and improve human health. High quality green infrastructure – which is accessible and wildlife-rich – benefits both the natural environment and maximises the health and well being benefits for residents.
6. For example, obesity is a growing burden on the NHS and it has been shown that those with easy access to nature are three times more likely to participate in physical activity and 40%

less likely to become overweight or obese¹. The Monitor of Engagement with the Natural Environment's (MENE) Annual Report from 2013-14 survey highlighted that 45% of people asked stated that one of the main reasons they went into the natural environment was for health or exercise. A further 29% said they visited the natural environment to relax and unwind². This highlights the importance of having accessible natural environments around housing developments to both support exercise regimes but also to support people's mental health and wellbeing. Thus new built infrastructure and new housing developments must account for the existing stock of green infrastructure and ecological networks and look to provide enhancements where possible.

7. The benefits of nature on people's mental health are widely reported within scientific literature; however, recently it has become apparent that the quality of the natural environment may be more important than the quantity of it. People are twice as likely to report low psychological distress when living close to quality green space compared with those living near low quality green space³. Therefore, it is important not only to plan for easy access to green spaces in our living environment but also to improve the quality of these green spaces – incorporating greater levels of biodiversity in our green spaces could be one way to achieve this. This will not only improve mental health outcomes and general wellbeing but it will help to create new habitats for biodiversity across the UK and in particular in our urban areas.
8. Accessibility to green spaces around housing developments is not only important for reducing health inequalities but there are links between economic deprivation and limited access to nature, which could then lead on to health inequalities⁴.
9. Green infrastructure is also important in ensuring the UK is resilient to extreme weather by reducing rainfall run off rates and overall temperature. It contributes to tackling air quality, and supports regenerative, resilient green cities. Green infrastructure enhances the resilience of 'grey' infrastructure networks as well as improving reliability and reducing risk.
10. Examples of the benefits of including green infrastructure with linear infrastructure include (from the Linear Infrastructure Network [LINet]):
 - Storm and flood prevention by attenuating water flow.
 - Bank stabilisation, as low water using vegetation stabilises soil.
 - Perceived noise attenuation and visual barriers.
 - Shading and cooling.
11. The Government has committed to release of funding to support housing and new infrastructure, including through the £2.3billion Housing Infrastructure Fund. **The Commission should advocate for a proportion of this money to be made available to deliver new and improved green infrastructure and support demand reduction measures** (such as designing and constructing highly energy efficient new buildings) to reduce the need for new infrastructure.

¹ Wells, N.M., Ashdown, S., Davies, E.H.S., Cowett, F.D. and Yang.Y. (2007) Environment, design and obesity.

² Bowler, D.E., Buyung-Ali, L.M., Knight, T.M., and Pullin, A.S. (2010). A Systematic review of the evidence for the added benefits to health of exposure to natural environments. MENE: Annual report for the 2013-2014 survey v2.

³ Francis, J., Wood, L.J., Knuiman, M., and Giles-Corti, B. (2012) Quality or Quantity? Exploring the relationship between Public Open Space attributes and mental health in Perth, Western Australia. *Social Science and Medicine* 74: 1570 – 1577.

⁴ Allen, J. (2013) Health Inequalities and Open Space. Presentation. UCL Institute of Health Equity.

Sustainability Standards in new housing

12. The Commission should promote the highest standards of energy efficiency in new buildings, which will reduce the need for new energy infrastructure. This is particularly important for large-scale housing proposals such as Garden Towns and Villages, which should be planned to be sustainability exemplars, including a significant component of green infrastructure.
13. The Commission should also highlight the role that integrated urban design such as Sustainable Urban Drainage Systems (SuDs) could have, including on reducing pressure on urban wastewater treatment (for example, through upgrading the status of SuDs to critical infrastructure). This would complement the Government's commitment (through the Housing and Planning Act 2016) to undertake a review of SuDs.

Housing Delivery

14. Understanding the different mechanisms for housing delivery and how these fit together will be essential – e.g. through local and neighbourhood plans, strategic spatial plans prepared by combined authorities, release of land by public sector bodies, growth points and large-scale housing such as Garden Cities. We have previously recommended that the Commission prepares a 'light-touch', non-statutory UK-wide spatial strategy or framework for future infrastructure priorities – this could be used to view housing and infrastructure priorities in a national context (maps could be used to overlay major housing proposals alongside infrastructure to ensure the right infrastructure is being targeted to areas of greatest need). The spatial strategy should incorporate environmental constraints and opportunities such as important sites for wildlife (e.g. Natura 2000 sites, nationally designated sites and locally important sites) and identify potential areas where new networks of green infrastructure could be delivered. Strategic spatial plans (or sub-national plans) prepared by combined authorities offer particular opportunities to plan for new housing and infrastructure, whilst protecting and enhancing ecological networks in a strategic way. Opportunities to 'use and improve' the UK's stock of natural capital (as outlined in the Industrial Strategy Green Paper) should also be taken when planning for housing and new infrastructure – making use of 'natural infrastructure' in place of hard, engineered solutions. **A spatial mapping approach is essential if opportunities are to be fully realised.**

Sustainable Transport

15. Providing a range of sustainable transport options will help people make more sustainable travel choices. The NIC should work with housing providers to support housing developments which are located to reduce the need to travel by car and through maximising accessibility to public transport, reallocating road space to pedestrians, cyclists and public transport, improving public transit connections and embracing real-time travel information to support public transport users. Building a more robust, accessible, low-carbon transport system will help to deliver health improvements and reduce carbon emissions and pollution and ultimately deliver better places to live and work.

Q4 What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

16. Whilst we recognise that there is potential for behavioural constraints and rebound effects to reduce the success of demand management, we do not consider that these should be seen as inevitable barriers to substantial progress. Technological solutions and policy options are, and will become, available to minimise the impact of such issues. As such, when developing our recent 2050 Energy Vision, which used the UK DECC 2050 Calculator to model future energy scenarios, we opted for the maximum level of energy savings

improvements available⁵. The assumptions that the Government made in respect of the maximum potential for demand management are explained in associated documents that can be accessed via the [‘classic calculator’ interface](#)⁶, by selecting the question marks.

17. Q22 provides additional information on options for water demand management, including water metering, water reuse and greater efficiencies in agricultural use. Additional evidence on water demand management is provided in the Blueprint response, of which RSPB is a signatory.

Q10 What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

18. The planning process (both under the Town and Country Planning Acts and the Planning Act 2008) enables public engagement and the consideration of environmental issues in the development process, so that development takes place in the public interest. These features are fundamental to planning systems in the UK.
19. We understand that the NIC will not have a planning role and is not subject to planning processes and procedures. However, as set out in the recent Housing White Paper, the recommendations of the NIC will be given careful consideration by the Government and when endorsed will be a statement of Government Policy (this will be made clear through revisions to the National Planning Policy Framework). Where recommendations have wider implications for planning regimes, the Government will highlight any further steps needed to take forward the recommendations into the planning process.
20. Whilst we understand the desire to ensure infrastructure is delivered as efficiently as possible and on time, this must not be at the expense of due planning process. In particular:
 - The public should have an opportunity to respond to Endorsed Recommendations and the revision of or preparation of new National Policy Statements.
 - The Commission should fully engage the public with decisions on infrastructure proposals to be determined at a local level and public consultation should begin as early as possible.
 - The Commission in preparation of the Vision Report, NIAs and specific infrastructure studies should clearly set out what planning regime is anticipated and how the public will be consulted.
21. The role of high level appraisal techniques such as SEA and HRA and the evaluation and appraisal of infrastructure priorities will be key, however, to be effective, appraisal must start as early as possible in the process (i.e. form an integral part of the NIA and visioning document) and be used to appraise proposals (including any of a spatial nature). We reiterate earlier recommendations – SEA, HRA and public consultation must take place before Endorsed Recommendations are published. Furthermore, SEA and HRA should be used as ongoing tools to inform and support the NIAs and priority/specific infrastructure studies.
22. However, we recognise there could be better use made of spatial planning (at every scale, but particularly national and sub-national) to assist with the optimal location of infrastructure, both grey/built and green infrastructure. Through processes such as the UK National Ecosystem Assessment and the development of the Marine and Coastal Access Act (2009) the UK has developed a greater understanding of the potential delivery of multiple benefits

⁵ Except for average home temperature where we opted for reduction in temperature to 17°C rather than the minimum available of 16°C

⁶ <http://classic.2050.org.uk/pathways/>

from land use decisions. In the UK, spatial data on land cover, environmental features and socioeconomics is available at ever improving resolutions. This information is already being used to help determine the location and importance of natural capital. It should become routine, when considering development decisions, to consider spatial information and the interaction between both complementary and competing uses. As mentioned in our response to Q.3, we see a role for the NIC in preparing a light-touch non-statutory UK-wide spatial strategy/framework for infrastructure and for the NIC to work closer with combined authorities preparing strategic spatial plans. Clearly there must be scope for public consultation on and assessment of key decisions emerging from any national strategy/framework.

23. The RSPB is a member of LINet, which is submitting a more detailed response to Q10 outlining the importance of green infrastructure as a tool for enhancing the resilience and reducing the whole life costs of national and local linear infrastructure assets. LINet sees green infrastructure as of over-arching strategic importance and a current gap, or missed opportunity in the NIA approach and have thus chosen to respond to Q10. LINet recommends that valuation of the multiple benefits derived from incorporating well maintained and designed green infrastructure should be taken into account as an important part of infrastructure investment, such as quality of place, flood risk and air quality management, enhanced physical and mental health, energy and pollination. We recommend that the Commission maps high level green infrastructure priorities as part of any national strategy/framework and works closely with combined and local authorities as they develop their own strategic spatial plans to ensure green infrastructure is properly considered.

Q11 How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

24. The NIC should ensure that demand reduction is central to its vision for each infrastructure sector to minimise the need for infrastructure in the first place. It is crucial that infrastructure is delivered in a way that avoids harming wildlife (as mentioned earlier, application of the mitigation hierarchy will be essential), and where possible opportunities to enhance biodiversity are maximised. This requires strategic spatial planning to identify locations with the least impact (avoiding impacts as a first principle), and through expert-informed ecological network and habitat management plans to maximise the biodiversity gains at infrastructure project sites. We believe that the NIA has an important role to play in supporting the outcomes in the forthcoming Defra 25 Year Plan, helping the Government to fulfil its commitment to restore biodiversity in a generation.
25. At a time when biodiversity is in trouble, with over half (56%) of UK species assessed have declined since 1970, while more than one in ten (1,199 species) of the nearly 8000 species assessed in the UK are under threat of disappearing from our shores altogether⁷, we cannot afford to give any form of development a “free pass” to damage our environment. Poorly planned built infrastructure can seriously harm wildlife, adding to existing pressures, including those caused by climate change. Developments should avoid the most important sites for wildlife such as Natura 2000 sites, which are protected under the EU Birds and Habitats Directives, as well as nationally designated sites such as SSSIs, ASSIs and locally important wildlife sites.
26. All infrastructure should have a goal of net gain for biodiversity. Many infrastructure companies, including LINet members (such as Network Rail and Highways England), have adopted policies for securing ‘net gain’ from development (or are considering adopting this, such as Transport for London). Net gain projects deliver quantifiable and measurable

⁷ State of Nature Partnership (2016). State of Nature report. <http://www.rspb.org.uk/our-work/conservation/conservation-projects/details/363867-the-state-of-nature-report>

benefits for biodiversity as well as providing a range of wider environmental enhancements, such as flood risk mitigation, enhanced air quality and opportunities for public engagement with the natural environment.

27. Mapping exercises like the one undertaken for the [RSPB's 2050 Energy Vision](#)⁸ help to give an indication of the low-ecological risk areas for potential development which can inform strategic planning. However, thorough environmental assessment of potential site-specific impacts (alone and in combination with other developments) should always be carried out, and relevant stakeholders consulted. Whilst we did not include network infrastructure in the scope of our Energy Vision mapping, it is important that the impact of different grid solutions are also mapped, in conjunction with generation developments. We consider that those responsible for grid development should be encouraged to commit resources to environmental protection and enhancement, in addition to existing work on visual amenity. Further details on how to avoid or minimise impact of grid infrastructure on nature are provided in the recently updated Birdlife Position statement on Powerlines and Grid Development (provided with this response).
28. To take the example of energy infrastructure (such as onshore wind and solar farms or grid substations), there are often opportunities on suitable sites to provide new or improved habitats for wildlife, whilst power lines can be managed to support wildlife corridors. More research is needed to identify best management techniques, and site appropriate actions. However, there is potential for land used for energy infrastructure to be managed to boost insect numbers, provide feeding and nesting opportunities for birds and small mammals, and enhance other ecosystem services such as carbon storage, pest control and pollination. We are currently working with Anesco to enhance our understanding of bird usage of solar farms compared to surrounding agricultural fields. National Grid's [Natural Grid](#) project is exploring how biodiversity enhancements can be achieved on land around substations that is otherwise neglected.⁹ Some examples of best practice grid infrastructure that are being progressed across Europe are provided on the Renewables Grid Initiative [website](#).¹⁰ We are part of the Renewables Grid Initiative aiming to encourage infrastructure development that facilitates emission reductions whilst avoiding or mitigating impacts on wildlife.
29. From the European context, the following are useful case studies of ecological enhancements of grid infrastructure. We would like to see this approach to grid network development and maintenance in the UK.
- 'Creating Green Corridors' Belgian best practice case study¹¹
 - Green Corridor Projects - see the Life Elia website¹²
 - 50 Hertz (Germany) case study of their work on Ecological Aisle Management – see separate document attached to the submission email.
30. Other examples include:
- Ecological management and butterflies¹³
 - Landscape connectivity and bats¹⁴
31. Perhaps some of the greatest opportunities to contribute to enhancing the natural environment through infrastructure can be seen in flood risk management. There are

⁸ RSPB. <https://rspb.org.uk/energyfutures>

⁹ <http://nationalgridconnecting.com/the-natural-grid/>

¹⁰ <http://renewables-grid.eu/topics/nature-conservation.html>

¹¹ http://renewables-grid.eu/activities/best-practices/database.html?tx_browser_pi1%5BshowUid%5D=139&cHash=c60b34ae28ba458c031734fa3b34f8dc

¹² <http://www.life-elia.eu/en/Projects-sites>

¹³ https://www.jstor.org/stable/40835698?seq=1#page_scan_tab_contents

¹⁴ <http://onlinelibrary.wiley.com/doi/10.1111/1365-2664.12034/pdf>

abundant examples of schemes that make a significant contribution to flood risk, whilst also providing homes for wildlife. This is not a new concept: the Ouse and Nene Washes provide essential flood storage at the same time as being internationally important sites for breeding and wintering water birds. The RSPB helps to manage active washland sites on behalf of the Environment Agency in the Dearne and Aire valleys. The RSPB, UK Coal and Leeds City Council also worked together to transform the St Aidans opencast coal mine into a flood storage area and country park.¹⁵ It now supports breeding bittern and black-necked grebe amongst other species.

32. Opportunities to build habitat for wildlife through green and blue infrastructure in towns and cities are abundant. Sustainable Drainage Systems (SUDS) as part of a wider green infrastructure network can be designed to provide green spaces for recreation, commuting and enjoying natural space during normal conditions but protect homes, businesses and infrastructure from surface water flooding and overloaded drains following heavy rain. The RSPB and WWT produced a guide for local authorities and developers on how to design SUDS to maximise benefits for people and wildlife – The Commission should encourage adoption of SUDs to maximise multi-functional benefits, including for wildlife.¹⁶ The new Housing White Paper proposes increased densification in urban areas – all opportunities to enhance biodiversity, including through use of SUDs should be promoted.
33. It is important to note, that if not carefully designed, new infrastructure can provide a pathway for non-native invasive species to colonise new habitat. This risk is particularly acute for the water environment. Examples include water voles, which often hang on in isolated urban wetlands because they are less accessible to American mink and native white-clawed crayfish, which have been lost from most of our waterways due to disease and competition from non-native crayfish. As a general rule, the opportunities and advantages of improving connectivity will outweigh the risks but poorly designed schemes can offer little to our native wildlife while carrying the risks described above. Examples of where the recommendations of the NIC need to consider these risks would be around inter-basin water transfers where there remains a significant risk of aiding the dispersal of harmful non-native species between currently isolated catchments.

Q12 What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

34. The UK government already has good guidelines on cost benefit analyses. We have several key recommendations to improve the existing the cost-benefit analysis process.
 1. Ensure that experienced environmental economists are engaged.
 2. Commission some work to refresh the extant evidence base.
 3. Use all available data-sources for non market benefits with appropriate caveats and sensitivity testing.
 4. Augment incomplete assessments up front with narratives and visual data representations which provide the decision maker with an understanding of the scale of the data-gap and its potential impact.
35. Problems found in the implementation of the UK government's guidelines, are often from inconsistent consideration of environmental issues. This is usually caused by:
 - A lack of usable data or;
 - A lack of the necessary skills and knowledge in those carrying out the work (particularly outside of DEFRA).

¹⁵ <http://www.mineralandwastepanning.co.uk/st-aidans-intelligent-recovery/article/1184827>

¹⁶ https://www.rspb.org.uk/Images/SuDS_report_final_tcm9-338064.pdf

36. The skills problem is readily solvable by engaging an experienced environmental economist (suggestion 1), but data-gaps can be more complicated. In some cases more regular investment in monitoring and research could help plug the gap. Much of the primary valuation work relied on is now getting old and is in need of updating (suggestion 2).
37. HM Treasury green book guidance provides good guidance on the incorporation of environmental values when considering the full range of social costs and benefits of any project. A key challenge remains the limited practical application of this guidance across Government. A major challenge remains valuing important, but frequently hard to measure (and price) non marketed impacts (externalities and pure and partial public goods). The approach is often to ignore hard to evaluate impacts. One alternative is to use CBA as part of a broader multi-criteria decision framework which incorporates qualitative factors. A second is to use sensitivity analysis and explicit presentational means of reflecting uncertainty around impacts which are highly significant but hard to measure precisely (i.e. the carbon flux of land use change). With policies, as well as projects, it is frequently easier to measure the costs, however, this can disadvantage environmentally beneficial projects where the financial, or economic impacts are more certain than the environmental impacts. Green book guidance is currently being updated to include natural capital and, we hope, to provide additional guidance on environmental impacts. **This guidance needs to be adopted across Government.**
38. In the past (such as for Marine Conservation Zones) commissioned valuation data was entirely ignored. Environmental valuations are sometimes considered too thin and we would also contend that similarly questionable assumptions regarding standard economic estimates are used regularly. Questionable assumptions regarding markets are maintained since they enable some estimate to be made rather than none. Failing to offer the same terms to environmental estimates implies a hierarchy of importance which could not be supported if stated explicitly. We recognise that at times a great deal of uncertainty is involved in building a cost benefit analysis but instead of ignoring important estimates they should be used alongside an explicit expression of uncertainty and with relevant caveats. Rather than presenting simple average cost benefit results, the summary should engage directly with a range of possible values and some estimate of the certainty which comes with them (suggestion 3). Clever use of visual presentation could help the reader to engage with this complexity.
39. Finally, in some cases significant impacts, such as floods or biodiversity change, cannot be appropriately valued and included in a cost benefit analysis. More careful presentation can help ensure that important impacts are not simply lost. By highlighting missing information at the front of any reports and providing context for the impacts these gaps can be made salient to the reader. For instance - if biodiversity is not valued then quantitative negative or positive impacts on biodiversity and how that will in turn impact on obligations such as the Aichi targets could be used. Infographics can also be used to progress the narrative and ensure that where a CBA is incomplete the reader understands the importance of that missing information. NEF attempted to do this for the Marine Conservation Zones.¹⁷

TRANSPORT

Q13 How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

40. The RSPB supports demand and emissions reductions within the transport sector. In order for these to be achieved, changes will be required to the types of transport used and the behaviour of transport users. The focus on low emissions vehicles in the recently published

¹⁷ <http://www.mseproject.net/infographic-ia>

Industrial Strategy is a positive signal. In the forthcoming Emissions Reduction Plan Government can set out some of the changes that will be required to reduce both demand and emissions.

41. Analysis undertaken for RSPB shows that a shift to high-speed rail could deliver significant carbon savings relative to road transport¹⁸. However, these savings vary depending on the policy framework that is applied. The highest level of savings can be delivered if the top speed of HS2 is limited, if city centre stations are favoured over parkway stations and if full use is made of the freed up capacity on conventional railway lines, particularly if this is used for freight rather than commuters.
42. On roads, there will need to be a rapid shift to low emissions vehicles. Transport has been identified as one of two areas where emissions reductions have not been sufficiently delivered¹⁹. Analysis has identified that progress in the 2010s (investment in charging infrastructure and declines in the costs of batteries) has been positive, but that policy certainty is lacking for the post-2020 period²⁰. New policies to support this sector will be required. The use of electric (and other low emissions) vehicles represents an exciting opportunity for the UK to lead the way. However, electrifying the vehicle fleet could place a burden on the power grid and will require that the UK's power grid be decarbonised as much as possible, as fast as possible, in order to deliver emissions savings in the transport sector.
43. The RSPB is concerned that future decarbonisation of road transport might be delivered by a reliance on biofuels. Experience and evidence have shown that due to direct and indirect land use change biofuels, in particular crop-based biofuels, can result in impacts on the natural environment and can fail to deliver greenhouse gas emissions savings²¹. Therefore, the contribution of land-based crops should be phased out to zero by 2020 and the overall contribution of biofuels should be at most a limited one.
44. All transport infrastructure developments, like energy developments, pose a potential risk to the natural environment. Measures should be taken to ensure that demand reduction is prioritised so that impacts on the natural environment are avoided and minimised. Otherwise inappropriate development could result in lengthy and costly delays for developers.

ENERGY

Q19 What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

45. Compared to power, heat has been identified as one of the areas where sufficient decarbonisation progress has not yet been made²². The forthcoming Emissions Reduction Plan is an important opportunity for Government to set out measures to achieve this. The RSPB considers that delivering technologies to decarbonise heat is an important requirement. However, decarbonised heat solutions need to rely on the most sustainable fuels and technologies in order to deliver the best value.
46. For example, bioenergy should play at most a limited role in the decarbonisation of heat, whether used in domestic boilers, in combined heat and power boilers for local heat networks or as biomethane injected into the grid. This is because many types of biomass used for energy can result in significant adverse impacts on the natural environment and also fail to

¹⁸ <http://www.greengauge21.net/wp-content/uploads/The-carbon-impacts-of-HS2-final-2012.pdf>

¹⁹ <https://www.publications.parliament.uk/pa/cm201617/cmselect/cmenergy/173/173.pdf>

²⁰ http://www.green-alliance.org.uk/resources/Future_low_carbon_investment.pdf

²¹ <http://www.birdlife.org/europe-and-central-asia/black-book>;

https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf

²² <https://www.publications.parliament.uk/pa/cm201617/cmselect/cmenergy/173/173.pdf>

deliver their promised emissions savings; some types of biomass can even result in emissions increases relative to fossil fuels²³. Evidence produced by the UK Government has shown that some types of biomass can result in emissions up to three times greater than those of coal, even forty years after combustion²⁴. There is only a limited supply of sustainable biomass available and heat is one of the most efficient ways of using this limited supply²⁵. Only the most sustainable types of bioenergy should be used (for example wood should be restricted to FSC only-wood) and all biomass for energy needs to fully account for all of its emissions, including those released upon combustion.

47. Government also needs to take a strategic overview of the different demands being placed on this supply (from the transport sector, the power sector, the wider bioeconomy and the heat sector) in order to determine the most efficient use. This overview will help to deliver the highest value decarbonisation of heat and the highest value use of this limited biomass resource. The recent call for evidence on the bioeconomy was a welcome step.
48. The Committee on Climate Change has identified that other measures are required in the coming years in order to deliver the best value decarbonisation of heat²⁶. The use of local heat networks for dense urban areas, and the deployment of heat pumps for homes off the gas grid make sense. Any electrification of heat will provide best decarbonisation value when they rely on a decarbonised power sector. In addition, measures to deliver low-carbon heat will, the Committee concludes, work best when combined with energy efficiency measures for homes (this is particularly true of heat pumps). In order for hydrogen for heating to be delivered, CCS will be required for the production of that hydrogen. Government intervention may be necessary in order to support the initial roll-out of CCS installations. Locating these near existing industrial areas may make sense, and would fit with the 'clustering' approach identified in the Government's recent draft Industrial Strategy.

Q20 What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

49. Establishing an effective zero carbon power sector will include vastly increasing the proportion of energy that we use from renewable and zero carbon sources, as well as greatly reducing our overall energy demand, combined with a substantial restructuring of our grid network. However, it is crucial that this energy revolution is delivered in a way that avoids harming wildlife. With biodiversity in trouble, we cannot afford to allow development to damage our environment (see Q11).²⁷ Poorly planned energy infrastructure can seriously harm wildlife, adding to existing pressures, including those caused by climate change²⁸. A power sector which does not take into account impact on biodiversity, and therefore consequently damages the health of the UK's natural capital, would not be an effective or sustainable power sector in the long-term.
50. In the RSPB's [2050 Energy Vision](#) we set out how a low carbon energy future could be achieved in the UK, whilst limiting impacts on sensitive wildlife and habitats. We have done this using pioneering, peer-reviewed mapping techniques to assess where renewable energy

²³ <http://www.birdlife.org/europe-and-central-asia/black-book>

²⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/349024/BEAC_Report_290814.pdf

²⁵ <https://europeanclimate.org/wp-content/uploads/2014/02/WASTED-final.pdf>

²⁶ <https://www.theccc.org.uk/wp-content/uploads/2016/10/Next-steps-for-UK-heat-policy-Committee-on-Climate-Change-October-2016.pdf>

²⁷ https://www.rspb.org.uk/Images/stateofnature_tcm9-345839.pdf

²⁸ Pearce-Higgins J & Green R (2014). Birds and Climate Change: Impacts and Conservation Responses. Cambridge University Press, Cambridge.

can be located with low ecological risk, based on current understanding and available data. For technologies not mapped as part of this project, we have analysed key ecological risks and estimated the capacity that could be achieved with low risk for wildlife. Based on this research, we have developed three 2050 energy scenarios using the DECC 2050 Calculator, that meet UK climate targets with low ecological risk – as well as maintaining energy security and costing a similar amount to other decarbonisation pathways, showing that this can be done.

What does this look like?

51. Our research sees both onshore wind and solar energy playing a major role: these technologies have substantial potential for growth in harmony with nature. Whilst there are real challenges with siting fixed offshore wind turbines due to high ecological sensitivities in shallower waters in addition to a lack of sufficient data on the risks in some areas, particularly further offshore, up to 115 TWh/year could be generated at low ecological risk if sited carefully, with much of this capacity off the coast of England. Further significant capacity could also be unlocked through the commercialisation of innovative new technologies such as floating turbines. Tidal stream and wave power could unlock further renewable energy potential and provide a reliable, sustainable source of energy if commercialised in harmony with nature.

52. The following table outlines the maximum annual energy output that we estimate can be produced by the renewable technologies we have mapped, at low ecological risk:

Renewable energy technology	Annual energy output at low ecological risk in terawatt hours per year (TWh/year)
Onshore wind	140
Solar farms	246*
Bioenergy crops	23*
Offshore wind (fixed)**	69 – 115
Offshore wind (floating) **	5,044 – 5,558
Wave energy	42
Tidal stream**	17 – 176
TOTAL	5,558 – 6,277***

*Precautionary estimate taking account of land-use change and potential impacts on food production of using agricultural land for energy. Bioenergy figure includes electricity and heat generation.

**Figures presented as a range to take account of the increased uncertainties surrounding offshore renewable energy development.

***This total does not include bioenergy crops, as they would require land also assumed to be available for solar farms. Solar farms are prioritised in this table, as they generate more energy per unit area. See the full Technical Report²⁹ for more details of our approach to each of these estimates.

****A previous version of this table contained in our August 2016 NIC Consultation response had incorrect units. This update should clarify all units in TWh/yr, GW equivalent figures are available upon request.

53. To enable the transition to zero carbon energy, the UK’s grid network will require significant investment in new and upgraded connections, alongside smarter system management to integrate new sources of renewable electricity. More connection between UK countries and interconnection with other nations will be needed, to optimise how we use renewable energy.

²⁹ https://www.rspb.org.uk/Images/energy_vision_technical_report1_tcm9-419581.pdf

Distribution networks will need to become smarter to integrate more decentralised generation and enable demand-side response.

How could this be achieved - generation?

54. In order to achieve an effective zero carbon power sector in harmony with nature we would need to see the UK Government and Devolved Administrations set a bold target of 100% low carbon energy by 2050, including high levels of renewable energy. Clearer policy on renewables could mobilise nearly £57 billion of investment from 2021 to 2026³⁰. For this target to be delivered in harmony with nature we consider onshore wind and solar to be crucial, as well as new technologies such as floating offshore wind. Installing solar on the available 147 million square metres of London's rooftops could generate 23 per cent of London's power and support an estimated 6,400 full time jobs a year until 2030³¹. We want to see Government continue to support these industries and stop supporting fossil fuels, so that economic incentives work for nature and the climate. We will also need to eliminate energy waste, as this will reduce the need for new energy infrastructure that poses risks to wildlife. and to transform low carbon heat and transport for instance by shifting to electric vehicles and electric heating. The overall economic and social benefits of electric, connected and autonomous vehicles could be in the region of £51 billion per year by 2030, with the potential for the creation of 320,000 industrial jobs³².
55. We also need to ensure that bioenergy supplies are sustainable and do not impact on important habitats, Evidence suggests that many types of biomass can result in harmful impacts on the natural environment caused by both direct and indirect land use change. See Q19 for concerns on biomass. Thus the cost-effectiveness of biomass as a carbon reduction strategy should be reviewed. A study undertaken for the Natural Resources Defence Council shows that, by 2020, biomass will be a more expensive renewable choice than onshore wind or solar, even when the grid balancing costs of these less flexible renewable technologies are taken into account³³.
56. To facilitate the roll out of technology changes in harmony with nature, the UK Government, the NIC and devolved administrations need to identify suitable sites for renewable energy development with low risk for wildlife, in a similar way that we have with our pioneering and peer-reviewed mapping techniques. This would help Government to understand the capacity of different technologies that can be achieved without damaging important areas for nature conservation, and could use this to develop roadmaps for decarbonisation in harmony with nature. This process could be aided by the help of a task force bringing together experts from industry, Government and civil society organisations.
57. **To ensure that this process is scientifically robust, we urgently need to improve the ecological evidence base – particularly in the marine environment –** so that we better understand the most important sites for wildlife and the impacts of renewable energy infrastructure. New technologies such as floating offshore wind turbines could unlock significant renewable capacity with low ecological risk, and Government should promote low carbon, low ecological impact innovation to advance these solutions (accompanied by robust environmental monitoring).

³⁰ Green Alliance, 2016, Beyond subsidy: how the next levy control framework can cut carbon at least cost

³¹ Greater London Authority, 2011, Decentralised energy capacity study + Green Alliance analysis using data from, www.solar-trade.org.uk, 'Solar powered growth in the UK'

³² SMMT, 2015, 'Connected and autonomous vehicles: the UK economic opportunity'

³³ <https://www.nrdc.org/sites/default/files/uk-biomass-replace-coal-clean-energy-ib.pdf>

How could this be achieved - transmission?

58. To enable an effective transition to zero carbon energy, the UK's grid network will require significant investment in new and upgraded powerlines, alongside smarter system management to integrate new sources of renewable electricity. More connection between UK countries and interconnection with other nations will be needed, to optimise how we use renewable energy. Distribution networks will need to become smarter to integrate more decentralised generation and enable demand-side response.
59. Where transmission issues cannot be resolved with upgrades or smarter system management, any new transmission lines deemed as essential must be carefully progressed to minimise impact on wildlife to avoid degradation of our natural capital. The length of new powerlines should be minimised, whilst also ensuring that routing of the lines avoids sensitive areas. Appropriate assessments through the use of SEA, HRA and EIAs should be carried out, and powerlines should be designed and constructed in line with national standards and international agreements.

Q21 What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

60. Increasing use of low carbon (in particular electric) vehicles means that decarbonising the power grid is an important priority in order to ensure that vehicles run on genuinely low carbon electricity. However, if the demand for electric vehicles is a driver for decarbonising the electricity grid, then the renewable energy to achieve this decarbonisation will need to be delivered in harmony with nature.
61. Investment will be required in order to deliver the infrastructure that is needed for this transition to electric or hybrid vehicles. The former Energy and Climate Change select committee identified that the greatest need for expansion in charging points could be in rural areas.³⁴ In addition, they identified that better understanding is needed of the burden on the electricity network, in particular where clustering could occur (this would be where electric vehicles become popular in a local area, creating a pressure point on the power grid). However, electric vehicles may also provide an exciting opportunity to deliver a more flexible energy system. Electric vehicle batteries that are connected to the grid can provide storage during low-demand troughs, while providing excess capacity during peak periods. Such a smart approach could actually help to better balance the power grid. But, the environmental impacts of certain types of battery production should not be ignored: some of the materials required to produce electric batteries for homes, vehicles or the power grid can require minerals (such as lithium) and other materials that, when mined, risk significant environmental damage.
62. Some vehicles may rely on hydrogen. However, for this hydrogen to be delivered in a low carbon way could require carbon capture and storage (CCS) infrastructure to be delivered. CCS could be most efficiently delivered, with least impact on the natural environment through its footprint, if it is clustered in existing areas where there is industry already. Therefore it could serve existing heavy industry or power infrastructure, while also creating a byproduct of hydrogen for use in the transport (or heat) sector.
63. The RSPB is concerned that low carbon vehicles could result in an increase in the use of unsustainable biofuels. Coupled with demand for a limited sustainable biomass resource from other parts of the energy sector (for heat or power) unsustainable pressure could be placed on the natural environment. Evidence shows that biofuels can result in significant

³⁴ <https://www.publications.parliament.uk/pa/cm201617/cmselect/cmenergy/173/173.pdf>

harm to the natural environment and that many types of biofuels deliver meagre emissions savings or even result in increases in emissions relative to conventional fuels³⁵.

WATER AND WASTEWATER (DRAINAGE AND SEWERAGE)

Q22 What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

64. The Water UK [Water resources long-term planning framework](#) looked at the resilience of long term water supplies and concluded that significant effort and investment was needed to ensure droughts did not impact on consumers, businesses and the freshwater environment.³⁶ One of the most effective tools they identified to boost resilience is rigorous demand management through household metering.
65. Currently, only half of the households in the country pay for water based on the amount they use. The percentage of metered households needs to increase significantly if we are to empower consumers to control their own water bills, and incentivise water efficiency. Under current legislation, water meters cannot be introduced on a universal basis in large parts of the country, even when it is clear that they could go a long way to securing long term resilience of regional and national water supplies. Water companies should be able to introduce universal metering if, after consultation with customers through the existing Water Resources Management Plan and Business Plan processes, it is found to be the most affordable option for customers overall, as well as being the best option for water resources management and resilience.
66. We refer the NIC to Waterwise's recent water efficiency strategy document for further ideas and case studies around demand management ([Water efficiency strategy for the UK](#)³⁷).
67. The UK now lags behind other countries such as Germany in the deployment of water reuse technology. Rainwater harvesting has the potential to form a component of Sustainable Drainage Systems (SUDS) as well as reducing pressure on potable supplies. Despite technology being widely available, it is not routinely installed in new developments. Addressing the lack of regulatory drivers behind Sustainable Drainage Systems would provide a greater incentive for developers to incorporate rainwater harvesting systems.
68. Improved water efficiency measures on farms, including but not limited to storage, could make a significant contribution to reducing water demand in some of our most water stressed environments. The Environment Agency produced Rainwater Harvesting: An on-farm guide.³⁸
69. Securing reform of the abstraction system, ensuring that water use better matches water availability and that the needs of the environment are properly accounted for, will prove the strongest driver of investment in improved water efficiency. It may also drive a reassessment of crop choice in many locations, with aquifers in many drought prone regions, including those underpinning internationally important wildlife sites such as around the [Norfolk Broads](#)³⁹, under pressure to supply water demanding crops such as salads.

³⁵ www.birdlife.org/europe-and-central-asia/black-book; https://ec.europa.eu/energy/sites/ener/files/documents/Final%20Report_GLOBIOM_publication.pdf

³⁶ <http://www.water.org.uk/water-resources-long-term-planning-framework>

³⁷ <http://www.waterwise.org.uk/news.php/85/consultation-on-a-water-efficiency-strategy-for-the-uk>

³⁸ www.swarmhub.co.uk/index.php?drid=4291

³⁹ <http://freshwaterhabitats.org.uk/news/catfield-fen-ea-minded-refuse-damaging-abstraction-licences/>

Q23 What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

70. Water companies are required to produce long term (at least 25 year) [Water Resource Management Plans](#) to ensure that water supply systems are sufficient to meet future demand and resilient to climate change and other pressures.⁴⁰ While rivers and groundwater sources are still over abstracted and water companies need to do much more to ensure they secure adequate resources without harming the environment, the WRMP process is beginning to drive a more forward looking, collaborative and innovative approach to ensure the needs of people and the environment are met in relation to water supplies. We believe a similar process for wastewater is essential to address the outstanding and significant problem of sewage pollution in rivers and streams. The Government should require water companies to produce, consult on and publish statutory long term wastewater management plans that secure the delivery of resilient wastewater services.
71. The RSPB is a strong advocate of the use of Sustainable Drainage (SUDS) techniques in new and existing development. The NIC is encouraged to refer to the recent CIWEM review which we have supported.⁴¹ The Ciria's Susdrain website provides a library of useful resources and guidance including a report jointly produced by the Lead Local Flood Authorities for South East England.⁴²
72. Whilst we certainly sign up to the broad consensus that national legislation around SUDS is not working and needs to be revised, we believe schemes will only meet their full potential in contributing to more attractive, greener and wildlife-rich towns if Local Planning Authorities set out in guidance what additional benefits they want to see from SUDs.

Q24 How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

73. This is a very broad ranging and challenging question and deserving of a consultation in itself. It is certainly one of the areas that we think the NIC could make the greatest contribution to as we still see issues of water quality, water availability, flood risk management and nature conservation treated separately with insufficient scrutiny of whether land use policy is adequately incentivising outcomes that could contribute to all of these. Whilst it is widely recognised that the catchment is the ideal scale at which to undertake and integrate water management activities to achieve more for less (see Defra 2013 [Catchment Based Approach](#)⁴³ or Dieter Helm, 2015, [Water Catchments](#)⁴⁴) it can be argued that, to date, we have failed to make it happen, and certainly to make it happen effectively.
74. Strategic plans, such as [River Basin Management Plans](#)⁴⁵ (RBMPs) and [Flood Risk Management Plans](#)⁴⁶ (FRMP) have been seen by Government and statutory agencies as a requirement to report on progress towards meeting obligations under the relevant directives, rather than the strategic planning tools they were originally intended to be. RBMPs report that we are failing to reduce diffuse pollution, especially from agriculture, and make use of derogations available under the Water Framework Directive (WFD) to push back deadlines but fail to critically assess whether the right tools are being used and whether we have

⁴⁰ <http://www.water.org.uk/policy/water-resources/water-company-plans>

⁴¹ <http://www.ciwem.org/suds/>

⁴² http://www.susdrain.org/files/resources/other-guidance/water_people_places_guidance_for_master_planning_sustainable_drainage_into_developments.pdf

⁴³ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204231/pb13934-water-environment-catchment-based-approach.pdf

⁴⁴ <http://www.dieterhelm.co.uk/natural-capital/water/water-catchment/>

⁴⁵ <https://www.gov.uk/government/collections/river-basin-management-plans-2015>

⁴⁶ <https://www.gov.uk/guidance/flood-risk-management-plans-what-they-are-and-whos-responsible-for-them>

achieved an effective balance between depending on voluntary land use change and the use and enforcement of existing legislation. This results in a widespread failure to manage water effectively because those who pollute are rarely paying the cost of that pollution. This failure has been recognised by the water sector, with companies increasingly attempting to intervene, on behalf of their customers, at a catchment scale to address a range of issues.

We believe what it needed is:

- **Better integration of governance around water management.** The RSPB is concerned that the frequent focus on reform of flood risk management agencies can be a scapegoat for wider failings. There is no doubt that ongoing cuts to the Environment Agency budget has left it unable to properly fulfil its role as an environmental regulator but we have seen little evidence that a different body with access to the same resources would have done any better at getting value out of its flood risk management budget. If you were starting from scratch today then we might support splitting the regulatory and flood risk management functions but complex restructure now risks diverting resources away from delivery and attention away from a broader and more urgent need for policy reform. One option to achieve better integration without wholesale reform is offered by [Dieter Helm's Catchment Operator Model](#), which could aid greater integration without pre-empting a question around the value of wider structural reform.
- **Better integration of planning at a catchment scale.** As mentioned above, we currently have multiple plans covering the catchment area but insufficient integration. The key plans are River Basin Management Plans and Flood Risk Management Plans. These can and should be better or fully integrated with a view to them better informing where investment would achieve benefits across multiple outcomes. This is critical, not only to guide effective land use planning but also to facilitate an approach to cost benefit analysis that is able to consider all of the benefits a project could deliver, rather than being seen through a single lens of water quality enhancement or flood risk management.
- **A stronger regulatory baseline that is adequately enforced** by our regulators to tackle inappropriate and illegal activities within a catchment. The Urban Wastewater Treatment Directive has been one of the most effective pieces of legislation to come out of the European Union. It has driven a transformation of urban waterways to the extent that many beneficiaries are unaware of the proportion of water in their river that is treated effluent. Since confirmation that we will be leaving the European Union some sectors have questioned the value of core elements of the Directive. Conversely, successive governments have failed to address diffuse pollution from rural land use. This has been because the presumption that the polluter should pay the cost of addressing pollution has not underpinned agricultural policy. Farmers, able to pass the cost of dealing with diffuse pollution on to water companies, have not been faced with any meaningful incentive to change. In our opinion this represents a clear market failure. Several Government reports⁴⁷ back up our view that the current system is failing and resulted in WWF and Angling Trust instigating a Judicial Review of whether the Government's dependence on measures that its own analysis showed were not working meant that it was in breach of its obligations under the Water Framework Directive.
- **Better targeting of funding so that it can, and does, deliver multiple benefits and addresses problems at their source rather than dealing with their consequences.** More funding should be diverted to solutions that deliver flood attenuation, water quality and biodiversity benefits at source rather than separate funding streams that deal with consequences, such as providing enhanced water treatment or ever higher flood walls.

⁴⁷ <http://adlib.everysite.co.uk/resources/000/264/031/diffuse-consult-govresponse.pdf>

That is not to say that full integration of funding is possible or even desirable. Countryside Stewardship is an effective way of recognising the contribution that many farmers make to improved biodiversity and recognises that these outcomes are not rewarded through normal market mechanisms. However, agri-environment schemes are limited in only compensating farmers for income foregone and for that reason, work well when farmers share the ambition of the scheme but fail when outcomes are more dependent on the scale or location of deployment. Farmers interested in agri-environment schemes are often not those responsible for the greatest contribution to pollution – here proper enforcement of existing regulation would work best.

- Action to reduce flood risk, beyond avoiding practice that increases risk, could be funded to a greater extent by beneficiaries of that action through the facilitation of Payment for Ecosystem Services (PES) schemes. Core flood risk grant in aid is generally allocated efficiently according to the certainty that the intervention will work and the value of the benefit derived. However, there is a failure to look beyond those core outcomes at whether changes to the design of schemes intended to benefit wildlife, reduce pollution or alleviate flood risk could make a wider contribution. For example, woodland planting can provide a natural flood management and wildlife benefit but only if those outcomes are built into the initial design of the scheme.
- Catchment measures to reduce downstream flood risk often fail to attract funding from core grant in aid because there is a greater degree of uncertainty around the outcome. Because projects based on catchment interventions are generally cheaper than hard engineering schemes, the cost of modelling to increase certainty makes up a much larger proportion of the overall project cost. However, requiring the Environment Agency to assess where natural flood management could contribute to the effectiveness or longevity of engineered schemes whenever such a scheme is funded could bring significant benefits for a small fraction of the total project cost. Achieving improved outcomes through mechanisms such as those described above involves a wide range of stakeholders and potentially draws funding from multiple sources. A carefully designed facilitation fund helps to cover the initial costs incurred by organisations willing to work with multiple landowners and funders to deliver those outcomes.
- **Greater partnership working at a catchment scale.** As noted above, involving local communities and stakeholders in planning, decision making and delivery is critical. Catchment Partnerships already exist through the [Catchment Based Approach](#)⁴⁸ (CaBA) but their effectiveness varies widely. So far they have been able to access a small amount of funding from the Environment Agency but this has been confirmed on a year by year basis and usually towards the end of the financial year. A very modest amount of dependable core funding to cover the secretariat costs would go a long way to ensuring those partnerships can look beyond their short-term security to drive greater stakeholder engagement and longer term planning.

FLOOD RISK MANAGEMENT

Q25 What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

75. Whilst not wanting to detract attention from the critical need to reduce the impact of flooding on people's lives, it is worth noting that, despite serious flooding in the UK over the last two decades it has caused very little loss of life. We rightly focus on the need to improve our resilience in the face of a changing climate but it is worth recognising that, compared with

⁴⁸ <http://www.catchmentbasedapproach.org/>

historic floods in the UK and the current situation in many countries in the world, we are good at addressing the biggest threats posed by floods.

76. Whilst we are aware that many attendants to the recent NIC workshop on flood risk management thought that the Government should aspire to deliver a set level of resilience to future flooding, in practice we think that will be difficult to achieve without a significant shift away from current policy, which is to deliver the maximum flood benefit from a defined budget, to one where the level of resilience is defined and budget and policy are set to meet that standard.
77. However, we welcome the shift from a sole focus on flood defence to a broader view that recognises the importance of making communities, businesses and infrastructure more resilient to flooding.
78. This recognition that universal flood defence is not attainable has, in our opinion, not been matched by sufficient recognition that not all floods are equally damaging. Indeed, many of our most important wildlife sites are associated with regular shallow winter floods. These have been farmed landscapes for many generations. In places like the [Lyth Valley](#)⁴⁹ in Cumbria, a failure to make adequate distinction between investment in protecting homes and essential infrastructure and investing in agricultural land drainage results in suboptimal decisions being made about where public investment in flood risk management should be directed. Much of this investment is through special levies on local communities, rather than central Government grants, but it is our view that those communities are often not given the information they need to make informed choices. There is valuable learning from the Netherlands 'Room for the River' programme where farm buildings have been relocated to higher ground in recognition that fields will periodically flood.
79. Similarly, whilst we accept that river maintenance is needed in some circumstances, to improve conveyance around critical pinch points, much of the discussion in the media continues to react to a call for river maintenance rather than the more important debate about whether land use planning incorporates enough room for water during and after extreme rainfall events. This principle is fundamental to the '[Room for the River](#)'⁵⁰ programme in the Netherlands and the '[Blue Green City](#)'⁵¹ principles in the UK. This will require difficult decisions around where to invest in defence, where to provide support in improving resilience and where to remove or step back defences.

Q26 What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

80. The evidence around the effectiveness of natural flood management is growing and our ability to incorporate it into our arsenal of approaches to reduce flood risk will increase.⁵²
81. There is an important distinction to be made between upstream measures designed to 'slow the flow' of water and downstream measures designed to make 'room for the river' and increase capacity to store flood water. Reconnecting rivers with their floodplains, new washlands, stepping back embankments and incorporating green infrastructure in urban areas to take flood water are all forms of natural flood management but we know they work and they will be critical if we are to avoid the worst impacts of future floods.

⁴⁹ <https://www.rspb.org.uk/our-work/our-positions-and-campaigns/campaigning-for-nature/casework/details.aspx?id=tcm:9-295709>

⁵⁰ <https://www.ruimtevoorderivier.nl/english/>

⁵¹ <http://www.bluegreencities.ac.uk/>

⁵² <https://www.gov.uk/government/publications/working-with-natural-processes-to-reduce-flood-risk-a-research-and-development-framework>

82. When commentators talk about the lack of evidence that natural flood management works, they are usually referring to upstream measures. There is a growing body of evidence that they can be very effective but that the effect depends on a complex array of factors, including the size of the catchment, topography, geology, soil type and critically the duration and magnitude of the storm. Specific interventions such as installing in-stream features to stretch the storm hydrograph and reduce its peak need to be carried out in the right place and in sufficient quantity if they are to be effective. They will prove invaluable in certain catchments, when sufficient thought can be put to their design, location and maintenance (see [Pickering](#)⁵³ and [Belford](#)⁵⁴) but we are unconvinced that an unplanned approach to their deployment as part of an agri-environment scheme would be able to deliver that.
83. We believe that the greatest gains could be delivered by preventing damaging practice and recognising the role of land use change in slowing flows into streams and rivers and making use of 'natural infrastructure'. The creation of new native woodland and scrub, the restoration of blanket bogs and restoring rivers can contribute to flood management objectives but they will do so alongside restoring biodiversity, sequestering carbon and improving water quality. Because they deliver a wide range of benefits, there are a wide range of organisations and landowners interested in building the shared evidence base, delivering projects and contributing to ongoing costs.
84. There is much that can be done by removing perverse incentives for managing land in a way that increases flood risk. For example, landowners who allow scrub to regenerate on their land or intentionally take flood water are ineligible for basic payments under current CAP rules. Measures to conserve soils, such as banning high risk crops such as maize on vulnerable slopes, maintaining broad hedgerows and buffer strips, can also contribute to reducing flood risk by slowing the rate at which water flows of hillsides and preventing silting up of watercourses.

Q28 What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

85. The RSPB is a founding member of the Aldersgate Group and our thoughts on this are in line with their report Resilience in the Round.⁵⁵ A major barrier is the current over- reliance on voluntary approaches to deliver policy outcomes. RSPB research demonstrates that voluntary approaches in practice are very rarely effective⁵⁶. We believe that the current drive for deregulation and using regulation only as a last resource will undermine the Government's ability to achieve aspirations around the circular economy, increasing resource efficiency or engineering waste out of productive systems.

⁵³ <http://www.forestry.gov.uk/fr/slowingtheflow>

⁵⁴ <http://www.parliament.uk/documents/post/QuinnPOST.pdf>

⁵⁵ <http://www.aldersgategroup.org.uk/our-reports>

⁵⁶ http://www.rspb.org.uk/Images/usingregulation_tcm9-408677.pdf



RWE Generation UK
Electron
Windmill Hill Business Park
Whitehall Way
Swindon
SN5 6PB

10 February 2017

National Infrastructure Assessment Call for Evidence: Response of Behalf of RWE Generation UK plc

Dear Sir/Madam,

This response is made on behalf of RWE Generation UK plc ("RWE Generation"), which owns, operates and maintains a portfolio of gas, coal and biomass power stations together with a portfolio of smaller open cycle gas turbine and combined heat and power generation assets in the UK. RWE Generation UK plc also owns a number of closed power station sites in the UK which may be redeveloped for electricity generation or other purposes.

Our response to the call for evidence questions is attached. If you have any queries on our responses then please contact the undersigned in the first instance.

Yours faithfully

[name redacted]

[job title]

RWE Generation UK



National Infrastructure Assessment Call for Evidence - RWE Generation response

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?
Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.
2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

The international competitiveness of all economies is underpinned by that economies' relative cost of energy, such that those countries with a relatively higher cost of energy will be disadvantaged internationally. That cost of energy is highly influenced by the regulatory frameworks and market structures that surround energy production, transportation and supply. Competitive market structures provide the most efficient means of ensuring that the costs of the UK energy infrastructure do not inhibit the international competitiveness of UK industry. These costs can be minimised, to the benefit of the UK economy, by reducing the burden of regulation and policy on the energy sector. Unfortunately both current and previous governments have tended towards poorly constructed piecemeal interventions that have unintended consequences, which in turn propagate further piecemeal interventions, as evidenced by the abundance of policy changes introduced in reaction to the volumes of new build reciprocating engines, fuelled by gas and particularly diesel, that have proliferated in the first few capacity auctions. These ad hoc interventions are the result of hasty policy formulation and implementation and lead to market inefficiencies such as inappropriate investments, stranding of assets and potential failure to meet targets for e.g. de-carbonisation and energy efficiency. The cost of these inefficiencies will be borne by either the energy consumer and / or the tax payer, making the UK less competitive internationally. A more holistic approach to policy formulation and implementation, for example looking at whole system impacts rather than small segments in isolation, supported by honest and open consultation with both the energy sector and academia should ensure that any inefficient use of assets and resources is minimised, and international industrial competitiveness is not unnecessarily impeded.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?
4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?
Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

We have no view on the maximum potential for demand management, however we believe that extensive reliance on demand management is symptomatic of a poorly performing economy that is not competitive. Demand management in the context of energy is fundamentally a form of efficiency, either through time-shifting of economic activity such that the same level of output can be achieved at a lower cost, which is to be encouraged, or acknowledging that the value of that economic activity is effectively less than the cost of production. As stated above in answer to Q2, international competitiveness is underpinned by the cost of energy. If demand management has value then, by implication, the cost of energy is high, and that production will almost by definition be less competitive internationally. Consequently reliance upon demand management within an industrial sector should be seen as an



indicator that that sector is likely to be less internationally competitive than similar sectors overseas that aren't reliant on demand management.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

This will depend upon the types of assets in question, since technological advances do not affect all assets equally. Those assets that are technologically immature will have a relatively high initial capital cost and may have higher maintenance and repair costs. As technologies mature, their capital costs decrease through time as efficiencies and economies of scale are discovered and implemented. This can clearly be seen in the costs of photovoltaic cells over the last decade, which reduced by ~60% within 3 years.

UK solar PV cost reduction, 2010-2014 (4kW system)



Source: "UK solar beyond subsidy: the transition" July 2015, Renewable Energy Association http://www.re-a.net/resources/pdf/206/UK_Solar_Beyond_Subsidy_-_The_Transition.pdf

It may be more efficient to replace such assets earlier in their lives to take advantage of the rapidly reducing capital costs. However, as technologies mature, efficiencies, innovation and economies of scale are developed within the maintenance and repair cycles of those assets. Hence it is more efficient to maintain and repair existing assets for the bulk of their economic life.

However, externalities such as de-carbonisation need to be taken into consideration when making the economic choice between maintaining existing assets and construction of new. The most efficient way to ensure that those externalities are taken into consideration is to ensure that efficient markets are developed to allow participants to price them appropriately in to their economic choice between maintain / repair or replacement, thus striking the most efficient balance between the two.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by "funding", the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that "can be funded" but "will not be financed" refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties.

General government financing policy (i.e. the issuance of gilts) is out of scope.



9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

We believe that the most effective way of ensuring resilience is to ensure that planning within and across sectors is done over an appropriate planning horizon. In sectors such as energy generation and water, even 30 years is far too short for strategic infrastructure planning when considering the impact of a project individually and in combination with others. For example, the potential for multi-sector 'water assets', such as major reservoirs or major water transfer systems, that will last for decades will also very likely affect major power station operations or future developments and so the full impacts need to be addressed through cross-sector collaboration and understanding at all stages of a project.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The Planning Act 2008 has established an efficient new process for the consenting of major infrastructure projects (NSIPs). The existence of a clear statutory timeframe for decision making in particular represented a major positive shift, leading to the consenting of projects with greater certainty. Further improvements could be made to this process if statutory timeframes were introduced for post consent variations, such as non-material changes to a Development Consent Order, and if the requirements for the post consent variation process were, as a whole, simplified. Additional benefits would result from promoting the use of the Rochdale envelope and the building of flexibility in the wording adopted in Development Consent Orders.

In relation to environmental assessments linked to planning consents, we consider that is particularly important for the Environmental Impact Assessment processes under the national infrastructure planning and town and country planning regimes on the one hand, and the marine licensing regime on the other to be made compatible, so that marine licensing concerns and information requirements are understood on the screening and scoping procedures initiated under the planning regimes. This would avoid unnecessary delays and duplication. In relation to other environmental assessments, such as the Habitats Regulation or the Water Framework Directive Assessments, it is paramount to strike an appropriately balance between sustainable development (and the need for major energy infrastructure) against potential impacts which could be minimized via mitigation or compensatory measures.

It is also essential that the NIC recommendations leading to the future review of the Energy National Policy Statements, and in particular of EN-1 and EN-2, recognise the need for diversity in the UK energy mix and the vital role of fossil fuels (and specially the role of new gas power plants) in providing reliable and flexible electricity during the UK transition to a low carbon economy.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: "credible" improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. "Tractable" improvements are those that can generate usable quantitative outputs. "Transparent" improvements are those that do not rely on 'black box' modelling and assumptions.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: "travel patterns" include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.



14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Digital communications:

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing "regime" refers to the current market, competition and planning frameworks. "Digital communications" includes both fixed and mobile connectivity.

Energy:

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Without the correct valuation of the carbon content of heat, traditional methods of providing heat will always be less costly than providing decarbonised heat. Any move towards the bulk decarbonising of heat needs to be done in the context of the international competitiveness of the UK economy, as such the UK should be promoting appropriate international carbon markets such that the UK's efforts to decarbonise heat, transport and electricity, which are to be applauded, do not disadvantage the UK economy as a result.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.

We believe that properly designed and internationally supported carbon markets are the only the route by which all sectors of the economy can efficiently decarbonise. Furthermore, the fact that such a market will be difficult to implement does not mean it's the wrong thing to do. We do not currently have a vision of what a zero-carbon power sector in 2050 looks like, as it is likely that it will include technologies of which we are as yet unaware, but we are sure that properly designed markets will provide the right incentives for the appropriate innovation and investments to take place to deliver the necessary decarbonisation.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

The consequences of decarbonising the transport sector will depend upon the form of decarbonisation, be it via hydrogen fuel cells, as being seen in the Far East, or by electrification and decarbonising electricity generation, the current chosen route of the US and Europe. Both these decarbonisation vectors will likely require significant investment in transmission and distribution networks, given that hydrogen production is only likely to be economic at scale, renewable electricity sources are by necessity remote from large population centres, and refuelling of cars is inherently a decentralised activity. However the investments in these parts of the value



stream will differ significantly – one being the transportation of a highly volatile gas, the other being wires for the transmission and distribution of electricity. Whilst much of current US and European interest and investment has focused on electric vehicles, very few electric vehicles are currently active on the roads, so in truly strategic timeframes it is difficult to predict which technology choice will be adopted at large scale, and as such there is a significant risk of embedding economic inefficiency through asset stranding. Ultimately this will be decided by consumer behaviour and preference, so to understand which technology is likely to fare better, one needs to understand how each technology is viewed by consumers.

Water and wastewater (drainage and sewerage):

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

Abstraction reform is a welcome initiative. However, the delay in developing detail creates uncertainty for potential developers of water dependent infrastructure and needs to be resolved. It will drive much creative thinking, particularly on how to resolve the competition for scarce water resource in low flow or drought (and these are different). Given the vital importance of thermal power plant dependent on water in contributing to power sector resilience we would be looking for comfort on relaxation of regulatory constraints on abstraction (either through 'hands-off flows' or standard catchment rules) in power sector system stress events. In general we are looking for the rules for operation of reform to be such as to provide sufficient confidence in sufficient volumes of water with sufficient reliability to make the next generation of freshwater thermal power plant investable. The role of well-established and 'firm' discharges in underpinning low flows in major lowland rivers needs to be recognised, effective control of any potential for them to be rerouted or withheld that would affect dependent users or the environment need to be established, and the EA approach to the EC Water Framework Directive relating to low flows needs to be clear and consistent with the aquatic environment to which society has evolved over several decades.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

In our view the 'whole catchment' approach is one means of breaking down the traditional siloed approach to planning. However, this runs the risk of bottom-up driven decision making. This is illustrated by the downgrading of the role of the 'regional' River Basin District Liaison Panels which have the potential to consider more strategic approaches. Whilst there is certainly an important role for catchment level approaches, this does not mean that river basin district scale considerations are not important. Thermal power plant represent very large point influences (when considered at catchment scale) whose societal contribution needs to be recognised at the national level. This may render them potentially difficult to deal with in catchment scale assessments.

Water Planning is currently done primarily through Water Company Water Resources Management Plans, though initiatives such as Water Resources East are attempting to promote a multi-stakeholder approach. There are many difficulties to overcome to make such approaches effective, not least being the different regulatory structures applying to different sectors, such as public water supply, power and agriculture.

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?



26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

Solid waste:

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A "circular economy" is an alternative to a traditional 'linear economy' (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

Open letter to the National Infrastructure Commission to accompany input by Resources & Waste UK to the National Infrastructure Assessment “Call for Evidence”.

Thank you for this opportunity to provide early input to development of your first National Infrastructure Assessment. Resources & Waste UK is a collaboration between the Chartered Institution of Wastes Management and the Environmental Services Association – the professional institution and trade association at the heart of the sustainable wastes and resources management industry. We identified this Assessment, alongside the Defra 25 year Environment Plan and the UK Industrial Strategy as key steps in development of this sector and a more “Circular” or resource efficient economy for the UK. We are therefore pleased to note that “Solid Waste” is recognized as one of the 6 key sectors in this first Assessment.

Our response to your call for evidence is attached as Annex 1 to this letter, and follows the framework of questions in your call for evidence. However, we also recognize that waste and resources management is complex, especially in the way that it affects businesses in all sectors as well as households, local authorities and not-for-profit organisations. Therefore, while we have addressed the specific questions you have raised regarding this sector and delivery of a more circular materials economy, we want to stress four main points: the rapidly developing role of this sector; our need for new generations of infrastructure, services and technologies; current trends in infrastructure; and our developing relationships with partners and customers both up-stream and down-stream in complex resource flows.

i). **The developing role of the industry.** This is an industry in transition. Efficient collection, and removal of wastes from businesses and households – to protect local environmental quality - remains as important as ever, but the objective has changed quickly in 2 decades from safe and efficient waste disposal to one of keeping resources working and putting wastes back to work wherever possible. We have become a critical step in supporting resource efficiency and resource security in an increasingly resource-constrained world. If we are to maximise our value to the UK in environmental, social and economic terms this industry will need new technologies and infrastructure to manage end of life products and materials.

ii). **The main drivers.** Patterns of consumption and production continue to change, involving modern and often complex materials and a shift away from ownership to services. Product and process design will also be driven by the need to be more resource efficient in the future to protect feedstocks and costs of inputs as well as to reduce overall environmental costs of outputs. Our industry has to follow these changes carefully and work with supply chain partners to help present resources and energy back into the market and to stimulate uptake of those resources by businesses. However, rather than technologies and population or economy growth, the most important driver in solid wastes and resources management is policy. The EU has provided long term vision and stability for environmental and resources policy whose next phase will be driven through the Circular Economy package. Scottish and Welsh resource management policy has developed in line with – and sometimes beyond – likely EU objectives. English policy has not, and the status of the Circular Economy package under the UK’s exit from the EU and how the Government’s ambition to “leave the environment in a better state than it found it” will be delivered, is uncertain. Unfortunately, that uncertainty comes at a time where change is necessary but where lead times for new services and / or infrastructure stretch well beyond the current 2019 and 2020 policies in place. The Commission will need to consider both market pulls and pushes as well as likely future policy in anticipating future infrastructure needs in this industry.

iii). **Current Trends.** Current UK investment in new recycling and treatment capacity for solid waste is low. This is a particularly pressing concern for the treatment of residual, non-recyclable, waste. High landfill tax levels have led to pan-industry plans to steadily move away from landfill, and we anticipate around 80% of existing landfill capacity to close between 2015 and 2020. We also currently export over three million tonnes (and rising) of refuse-derived fuel to treatment plants in other parts of Europe – a trade that this industry believes is now approaching saturation and which could be frustrated by the UK's exit from the EU. Meanwhile, investment in recycling infrastructure is also low – faced with uncertain future policy and weak materials markets, and we estimate that around 15% of existing recycling capacity is likely to close by 2020 as it ends its planned life. Investment in new domestic waste treatment capacity is therefore crucial.

New energy from waste plants have lead in times of at least four to six years, other technologies at least 2 years and often more. We must make decisions now about new treatment capacity or else we will unwittingly enter a situation where the only viable option for treating much of our “residual” waste – ie that left after re-use and recycling - in the 2020s will be by opening new landfills. This would reverse the policy direction of the past two decades and put us out of step on waste management policy with much of the rest of the developed world.

iv) **Relationships with other resource cycle partners.** In assessing future needs for waste processing infrastructure the Commission will need to take industrial demand into account for secondary (ie recycled) materials and waste-derived energy in all of its forms. In the long run – but within the time-frame of this Assessment - virgin resources will be increasingly constrained as a business feedstock. Under these conditions a more circular materials economy should create its own demand for the outputs from this industry. In the short term however, those demands will need to be stimulated – hence the importance of policy in shaping the future of resources management, and the need for whole-cycle engagement in resource efficiency and security.

The links between this Assessment and the Defra 25 year Environment Plan and the UK Industrial strategy are therefore especially important. Between them, these initiatives add up to more than a waste and resource management strategy and we urge the Commission to work across other Government Departments to make and maintain those links.

Thank you again for the opportunity to present this initial input to development of the Assessment. We look forward to continued close working with you.

On behalf of Resources & Waste UK

[name redacted]
[title redacted]

National Infrastructure Assessment Response by Resources and Waste UK

Cross-cutting issues	
1	Not covered
2	<p>Q: How should infrastructure most effectively contribute to the UK’s international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?</p> <p>A: Efficiency and security of resource management in the future is a key element to the UK Industrial Strategy and R&WUK wishes to see a strong link between this Assessment and the Industrial Strategy and Defra 25 year plan. We highlight two issues of interest:</p> <p style="text-align: center;">1. The importance of wastes and secondary resources as a “catalyst for Growth”</p> <p>The value to the UK economy gained and to be gained through more efficient and effective waste and resource management is recognized in the Defra publication “Resource management: a catalyst for growth and productivity” (February 2015) [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401453/resource-management-catalyst-growth-productivity.pdf].</p> <p>This report concludes:</p> <p><i>(p 3). Over the past decade the value we extract from managing our waste resource has increased significantly - The GVA/tonne of waste managed by the sector has risen from £32 in 2004 to £43 in 2012 (after adjusting for inflation), representing a 33% increase in real terms over the 8 year period. There has been a significant reduction in waste arisings and relatively stable GVA over the period. And</i></p> <p><i>(p 6). Domestic reprocessing, where commercially viable, could add further value in the UK, supporting jobs and growth, and contribute to improving the UK trade balance – Where commercially viable domestic reprocessing allows value to be added to recovered material in the UK. This provides a source of jobs and investment; improves the UKs trade balance (compared to not collecting/recycling the material) by reducing the need to import raw and recovered materials from overseas; and contributes to UK resource security. The tight economic climate in the recycling sector at present highlights some of the challenges faced by domestic reprocessors, but also the value of supply chain collaboration, which gives industry the confidence to invest.</i></p> <p>R&WUK welcomed this analysis of the sector. UK Governments should commit to a full periodic review of this analysis to complement future work of the Commission for this sector.</p> <p style="text-align: center;">2. Export potential</p> <p>The UK has a significant potential for export of expertise in sustainable resources and waste management. The 4 UK nations were recognized as the fastest improvers in municipal waste recycling in the EU in the first decade of this century, and this experience is valued in many other countries around the world where a similar transition to more sustainable waste and resource management is needed. This potential is recognised by UK Trade and Investment and we will be</p>

working with them to develop case studies and opportunities to showcase UK competence in this area as a priority sector for export growth.

3. Strategically Important Materials

Both UK Government and the EU have identified materials which will be key to future industrial and economic development but which for reasons of scarcity or unstable supply chains could be a rate or success-controlling factor. See for example The EU Commission list, extended to 20 materials in 2014: https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en. R&WUK advises both this Infrastructure Assessment and the Industrial Strategy to note the importance of these materials - and others less critical but still important in economic development terms which could and should be outputs from the waste and resources management sector of the future. "Other" outputs would include materials ranging from secondary aggregates to plastics and paper plus energy in all its forms including heat. Competition for strategically important materials will intensify over the period covered by these two plans making resource efficiency and resource security key concerns for many sectors and technologies.

4. Secondary Resources: Quality, Quantity and Location

The UK should benefit from the economic and trade potential from its wastes. That requires infrastructure and technologies capable of presenting materials back into the economy at the quality and quantity demanded by customers rather than continued reliance on export of materials – part processed or wholly re-processed.

3

Q: How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

A: The individual facilities required for more sustainable management of UK wastes and resources are likely to be much smaller scale than those required for other sectors included in this assessment eg transport networks or energy generation and distribution. Landfill sites typically attract economy of scale in their operation and grew steadily in size and annual input throughout the second half of the 20th century. Many were – and are – many millions of tonnes total capacity and receive(d) wastes at a rate of many hundreds of thousands of tonnes per year. Waste treatment facilities tend to be small and have smaller annual capacities to receive wastes. A-typically, a very large energy from waste facility might accept 300 to 400 thousand tonnes of waste per year. Many facilities such as for materials sorting or for biological treatment will accept much less – sometimes only 20 thousand tonnes per year. As we move rapidly away from our reliance on (and availability of) landfills in England we will need a sophisticated network of waste sorting and treatment infrastructure, with materials moving between more than one facility in its transformation from waste to resource, and designed to meet both waste and secondary resource objectives.

Such smaller plants may lend themselves to be planned for provision of a service across a smaller area – possibly serving a single local authority or an individual customer. However, our wastes need to be viewed more as valuable resources and an input to UK industries in the future. R&WUK therefore believes the provision of services and infrastructure to manage our wastes economically and effectively needs to be matched with planning for use of the secondary resources they generate including materials and energy. The economic and employment importance of these resources should mean that the infrastructure needed should be matched with business demand for resources

and land allocated for them. This would be better done at a regional or sub-regional level within England rather than allowing a sub-optimal network to be developed through a large number of very local plans. The system also needs to recognize that high transport costs – especially for heat but also for many lower value materials – means there is a strong argument for co-location of facilities generating secondary resources with industries wanting to use them as a feedstock. This is a tier of planning currently missing from the English planning system. The Commission should note that a duty to co-operate exists between local authorities and preparation of their local plans but this is no substitute for planning for resources and economic development at a larger scale.

The Commission should note, for example, the rapid growth of “refuse-derived-fuel” exports to other EU Member states (see below under Q 28) which represents a negative value to the UK with costs of export and treatment typically £60 to £80 per tonne for a fuel which has roughly 50% of the calorific value of coal and a high biogenic (ie non-fossil) carbon content. See Defra’s “Energy from waste A guide to the debate” (February 2014) (revised edition): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284612/pb14130-energy-waste-201402.pdf .

The Commission should also note the reliance of this sector on good design of the built environment and of housing in particular, allowing space for storage, separation and collection of waste materials in a condition suitable for re-processing into high quality secondary materials. Too many developments consider waste collection requirements at the very last stage of design, if at all, making contamination between waste streams and lower quality outputs more likely.

4

Q: What is the maximum potential for demand management, recognising behavioural constraints and rebound effects? Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage

A: R&WUK believes there is significant potential for demand management for waste services and infrastructure for municipal and for industrial and commercial wastes through:

- Better design of products and processes including increased secondary material content and design for end-of-life reprocessing
- Design and skills / infrastructure for managing wastes further up the Waste Management Hierarchy including maintenance, repair and re-use
- Improved separation and presentation of waste materials for processing.

These are recognized in the EU Communication on the Circular Economy and in the February 2016 Scottish Government “Making Things Last” strategy [<http://www.gov.scot/Resource/0049/00494471.pdf>]. The Scottish Government identify barriers and potential solutions at each stage in the product life cycle and are exploring development of regulations and further interventions to deliver a more circular materials economy, starting later in 2017.

	<p>R&WUK has identified a number of priority interventions needed by UK or national governments – often best planned implemented and monitored at a pan-EU level to provide businesses with a level playing field – and these are set out in Qn 27 below.</p> <p>We particularly highlight the potential of</p> <ul style="list-style-type: none"> • Extended producer responsibilities which are relatively under-developed in the UK compared to other EU Member states • Direct charging for municipal wastes (so-called “pay-as-you-throw” or “save –as-you-recycle” schemes) – unused in the UK and actually prohibited even for pilot schemes. The Commission should note that local government is seeking full clarification regarding which waste services could be subject to charging as a direct result of budgetary constraints. • Fiscal instruments including variable VAT to encourage secondary materials use or re-use and repair • Product standards including longevity and minimum secondary materials content. <p>UK and English governments have introduced demand-side measures especially the single-use carrier bag 5p levy which retailers report has cut consumer demand for bags by 80%, and with an immediate impact in beach litter by bags. Defra is reported to be considering a deposit and refund system for drinks packaging – both plastic and glass – and is currently consulting on a product prohibition through a ban on plastics micro-beads in cosmetic and similar products. They have at the same time ruled out a levy on disposable coffee cups, despite their clear impact on littering and waste generation. Rather than an ad-hoc approach to individual products and materials we need to see a clear strategy for materials efficiency and waste prevention / better management through the EU Circular Economy strategy. We remain committed to support Defra and the UK Government in development and adoption of that EU level policy and strategy.</p>
5	Not covered
6	Not covered
7	Not covered
8	<p>Q: Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets? The National Infrastructure Assessment Call for Evidence 9 Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.</p> <p>A: The financing of sustainable resources and waste infrastructure and services is currently too focused on the public sector, and on local authorities in particular. This has arisen because of the long term reliability of public sector waste management contracts – collection contracts typically run for 7-plus years (often tied to the serviceable lifetime of collection vehicles involved in these contracts), treatment and infrastructure contracts can run for 25-plus years dictated by the high capital cost of infrastructure and its serviceable life-time. Industrial and commercial wastes management contracts are often much shorter-term, usually renewed annually or even ad-hoc, especially for small or non-steady-state arisings.</p> <p>R&WK wishes to highlight three important infrastructure funding issues to the Commission:</p>

1. The role of extended producer responsibility (EPR)

R&WUK advocates (see below) a shift towards extended producer responsibility such that businesses responsible for design, manufacture and sales of products and materials accept a greater responsibility for those products and materials at the end of their useful life – ie when they become waste. This would represent a significant shift away from strong reliance on local authorities who – for example – currently shoulder roughly 90% of the end of life costs for managing packaging wastes. This is in stark contrast with other EU Member states and EU objectives for the future of extended producer responsibility in their Circular Economy” policy and regulation package (proposed Waste Framework Directive Article 8(a)) currently under negotiation.

2. The role of the Green Investment Bank

R&WUK has welcomed and supported the role of the Green Investment Bank and their potential to encourage investment in waste and resources management infrastructure by others. We await the conclusion of the Bank’s privatisation and note the concern expressed by the Environment Audit Committee and others (January 2017) regarding the future focus and operation of the Bank. Our meeting with the Bank on 23rd January 2017 confirmed that despite continuing uncertainty relating to the privatization it continues to operate, and has invested in waste related projects in all 4 UK countries in 2016 and continues to manage a pipeline of projects for further investment.

3. Barriers to investment

Policy and regulatory uncertainty

Clear and medium to long term policy clarity and direction is need to support future investment in the waste and resource management sector, particularly as much of investment (aside from the collection of municipal waste) is now expected to come from the private sector. However, England currently lacks a formal strategy for waste, and any policy objectives still applicable from the 2007 Waste Strategy and the subsequent 2011 review (such as the 50% recycling target in the EU Waste Framework Directive) only extend to 2020. The 2011 review also removed statutory recycling targets on local authorities, weakening the case for public sector investment in recycling infrastructure.

The impact of policy uncertainty is acknowledged by government; as Defra notes in its 2015 ‘Resource Management: a catalyst for growth report’

(https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401453/resource-management-catalyst-growth-productivity.pdf):

“...Decisions on investment in new infrastructure are made by market participants based on their assessment of future demand and supply and financial viability. Expectations about future Government policy, including in relation to waste and resource management, affects those assessments and therefore influence investment decisions. A key source of policy uncertainty concerns the framework for policy determined at European Union level.”

While there is now more clarity on the policy framework likely to come from the EU in the shape of the EU Circular Economy package, Brexit has introduced a new source of uncertainty about the long term future of waste and resource policy in the UK. This is likely to impact on an investment landscape that was already constrained (see below); an assessment made by the trade body the

	<p>Environmental Services Association (see 27.3 (iv) below) suggests that there is almost no new public sector procurement of recycling infrastructure through their members currently in the pipeline for England.</p> <p>Risk and return on investment</p> <p>Increased price volatility in secondary materials markets in recent years (see R&WUK priority under Q27) is also undermining the potential return on investment for recycling infrastructure and discouraging private sector companies from investing. Appropriate risk mitigation or risk-sharing mechanisms have yet to be developed.</p> <p>A further factor, as noted in the 2011 report ‘Rubbish to resource: financing new waste infrastructure’ by Associate Parliamentary Sustainable Resource Group (http://www.policyconnect.org.uk/apsrg/sites/site_apsrg/files/report/332/fieldreportdownload/apsrg-rubbishtoresource.pdf), is the “complexity of the inherent risks associated with waste infrastructure, including technology, planning, construction, policy, off-take and input tonnage”.</p>
9	Not covered
10	<p>Q: What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?</p> <p>A:</p> <p>Development control and Permitting</p> <p>ESA member companies confirm that development control planning through local authorities generally delivers well-founded decisions in individual planning permission applications, and Environmental permits through the Environment Agency, although both are subject to delays and slow decisions.</p> <p>Planning permission applications for waste management infrastructure can be complicated and there are examples of serially-delayed decisions and where decisions have been frustrated by differing objectives of authorities in two-tier areas. Examples of both are well known across the industry and details can be provided separately to the Commission is needed.</p> <p>R&WUK is clear that planning authorities and the environmental regulators must be properly resourced to be able to complete their roles efficiently and effectively. We have repeatedly voiced our concerns over the level of resourcing of the Environment Agency and our concerns re the recent suspension of their “end-of waste” panel is such a case. The panel helped businesses with often very difficult decisions as to when materials are “waste” and therefore subject to full waste controls – or where they can be managed in the same way as any other raw material. The panel was originally reported as “suspended” for 3 months but now appears to be fully withdrawn.</p> <p>Strategy development</p> <p>England has an out-dated “Waste” strategy (2007) and no regional or sub-regional planning for wastes or resources and their link to economic development. Rather than calling for development of an England Resources Strategy R&WUK sees significant potential in this Infrastructure Assessment especially if it is fully co-ordinated across Government with other key strategies also under development, and particularly:</p> <ul style="list-style-type: none"> • The UK Industrial Strategy

	<ul style="list-style-type: none"> • The Defra 25 year Environment plan • The BEIS Bio-Economy Strategy • The forthcoming Carbon Reduction Plan to complement the 5th Carbon Budget. <p>R&WUK urges the Commission to co-ordinate its work with that of other departments as above as a powerful way of recognising and realising the potential for economic, social and environmental benefits achievable through improved wastes and resources management. We would also like to see monitoring and reporting frameworks for all of these strategies, and their formal review cycles to coincide with the UK parliamentary term.</p>
<p>11</p>	<p>Q: How should infrastructure most effectively contribute to protecting and enhancing the natural environment?</p> <p>A: The whole objective of wastes and resources management are:</p> <ol style="list-style-type: none"> 1. To protect health and environmental quality locally 2. To protect the broader environment including impacts of resource use and waste management on issues such as climate change, carbon / climate change gas (ccg) emissions, water use etc 3. To improve resource efficiency and resource security especially in strategically important materials as well as energy and other materials, and to reduce demand on primary raw materials which often have high environmental and/ or social costs which are not internalized in prices paid for goods or services.. <p>The objectives of a more “circular” materials economy are identified clearly in the EU Circular Economy Communication issued by the EU Commission in December 2015 [http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52015DC0614&from=EN]</p> <p>The Government has stated its objective of being the first to leave the environment in a better state than it found it and R&WUK urges the government to confirm its commitment to the future of a more circular materials economy through the EU Circular Economy package and by making clear that there will be no diminution of environmental standards or weakening of environmental law as a result of the UK exit from the EU.</p> <p>This call for evidence also highlights key sectors with infrastructure needs which are likely to be important markets for secondary materials in the UK. Transport infrastructure and much of the built environment should be important in generating demand for secondary aggregates, metals etc. This assessment should encourage those markets through promoting development of procurement guidance, specifications and standards in those industries. The demolition industry in the UK has a good and improving performance in materials recycling and this may be an aspect of resource efficiency the Commission will want to explore more fully.</p>
<p>12</p>	<p>Q: What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent? Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.</p>

A: Cost benefit analysis for wastes and resources management is poorly developed at both UK and EU levels. Infrastructure and service provision is predominantly policy-driven with analysis applied at that level. Various models have been developed including by the EU, Scottish Government, the Mayor of London and others for life-cycle assessment of plans and strategies especially for carbon accounting. Outputs from different LCA models are often difficult to compare. They often rely on different assumptions, rely on very detailed information input and analysis, and often still exclude potentially important considerations such as “embodied water” in products and services. Development and adoption of standardised approaches to life cycle costing and reporting are included in the Action Plan associated with the EU Circular Economy package and we urge UK government to support LCA development at that level.

At a strategic policy level, there are also question marks over the Treasury’s approach to cost-benefit analysis in the context of sustainability. This issue is considered in detail in the Environmental Audit Committee’s 2016 Sustainability and HM Treasury inquiry report (<https://www.publications.parliament.uk/pa/cm201617/cmselect/cmenvaud/181/181.pdf>), which concludes that:

“The Treasury’s technical and political framework for assessing environmental interventions is geared towards favouring short-term priorities at the expense of long-term environmental sustainability, even when it could lead to higher costs to the economy in the future. In part, this is because its framework does not take account of long-term benefits adequately. Ministers cannot make well-informed decisions unless they have access to all relevant information including long-term costs and benefits.

“The Treasury needs to improve the way it captures and takes account of long-term environmental costs and benefits. It must ensure that it has the best available evidence when making decisions about specific interventions, for example, by including wider costs and benefits and establishing a consistent framework with which departments can provide supplementary evidence in addition to NPV calculations. It should also make more use of relevant independent advisory bodies during spending reviews to scrutinise bids and green-check – a systematic environmental stress test – initial high-level assessments prepared for Ministers to inform their decision-making.”

Solid waste

27

Q: “Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?”

A: NO

Resources & Waste UK (R&WUK) is a partnership created by The Chartered Institution of Wastes Management (CIWM) and the Environmental Services Association (ESA) in 2014 because of the absence of the right policy framework for delivery of a more circular resources economy in the UK.

27.1 R&WUK priorities and progress 2015 - 2016

The first publication by R&WUK (May 2015) was our “Sustainable resources and waste management: priorities for the incoming UK Government” report:

[http://www.resourcesandwasteuk.co.uk/docs/RWUK_Priorities_for_the_new_UK_government.pdf]

R&WUK considers that there are 6 priority areas where policy and performance need to be aligned to successfully deliver a more circular materials economy:

1. **Support and improve waste collection/recycling performance**
2. **Improve the climate for investment in circular economy infrastructure to deliver sustainable growth and jobs**
3. **Boost domestic demand/markets for recyclates**
4. **Create the right regulatory balance between hitting waste criminals hard and reducing burdens on legitimate business**
5. **Greater government co-ordination of resources and waste policy**
6. **Engaging positively in policy development for resources and wastes at a European level**

All 6 priorities are inter-linked and progress will be needed in all areas to ensure that secondary materials are captured at the right cost, that treatment infrastructure is available to manage them in the right places to present materials of the required quality back into the market(s) – in order to meet current and likely (policy and market-driven) future objectives. Progress in these areas will hopefully drive innovation at all points in the materials cycle – from product design and manufacturing processes through to end-of life re-processing, and will shift responsibility for funding future infrastructure and services more fairly to those who gain benefit from making and selling them and to consumers.

R&WUK has prioritised its work across all 6 priority areas. Of these, the fight against crime unites all parts of the industry. It undermines all aspects of responsible resources management, including the business case for new and improved infrastructure and services. The cost of waste crime was estimated to be over £500Million per year in ESA's "Waste Crime: Tackling Britain's Dirty Secret" report (2014)

[\[www.esauk.org/reports_press_releases/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LI_VE.pdf\]](http://www.esauk.org/reports_press_releases/esa_reports/ESAET_Waste_Crime_Tackling_Britains_Dirty_Secret_LI_VE.pdf) and we urge the Commission to recognize the impact it has on planning and investment for future resource efficiency and security. Important cross-sector work is underway to fight waste crime including government support, the regulators and the industry itself, but more remains to be done.

Drawing on our analysis of our 2015 priorities we would also highlight work in 3 areas in particular:

27.1.1 The need to stabilize markets for secondary materials. This includes our September 2015 report: "Managing the Risk From Secondary Materials Price Movements" [http://www.resourcesandwasteuk.co.uk/docs/Eunomia_RWUK_SRM_Price_Risks_Report_Sept_15.pdf] and an on-going working group exploring best practice and case studies in public / private sector waste contracts., This work complements the WRAP-led Collection Harmonisation programme and Food Waste Action Plan, all of which draw on aspects of waste management contracts.

We conclude that stable secondary materials markets and prices are essential to support performance and future infrastructure and services, and that they in turn must be supported by stimulated demand for secondary resources including materials and energy. However, the best contracts practice work we leading can only promote commodity price

risk sharing between public and private sector partners. At best this is a coping mechanism. Longer term solutions are needed including the use of extended producer responsibility schemes designed to reflect market conditions and / or schemes such as the Scottish materials brokerage scheme [<http://www.zerowastescotland.org.uk/brokerage>] which would require government intervention at either an England or whole-UK level.

In the meanwhile price volatility in secondary materials markets, especially for some plastics, has been an important factor in failure of some waste re-processing activities and poor performance in post-consumer plastics collection and recycling (See Guardian article October 2016) [<https://www.theguardian.com/environment/2016/oct/15/british-households-fail-to-recycle-a-staggering-16m-plastic-bottles-a-day>]

27.1.2 The role of extended producer responsibilities (EPR) in the future management of end of life products and materials. Our work to date on this subject includes:

- ESA research “The Role of Extended Producer Responsibility in Tackling Litter in the UK” (September 2016):
[http://www.esauk.org/esa_reports/20161011_The_Role_of_Extended_Producer_Responsibility_in_Tackling_Litter_in_the_UK.pdf]
- ESA research “ a Discussion of the UK PRN/PERN System for Packaging Waste and Possible Alternatives” (September 2016)
[http://www.esauk.org/esa_reports/20161018_A_discussion_of_the_UK_PRN_PERN_system_for_packaging_waste_and_possible_alternatives.pdf]
- ESA convened stakeholder day to discuss EPR for packaging November 2016.
- CIWM research: “Packaging Waste Recovery, a European Comparison” (July 2016)
[<http://www.ciwm-journal.co.uk/downloads/Packaging-Waste-Recovery-A-European-comparison.pdf>]

The Board has also noted the value of the Green Alliance report “Recycling reset: how England can stop subsidising waste” (January 2017) [http://www.green-alliance.org.uk/England_recycling_reset.php], which also highlights the importance of the role of extended producer responsibility in transferring the cost and responsibility for managing end of life products and materials away from the public sector and onto manufacturers and retailers.

We conclude that extended producer responsibility is relatively under-developed in the UK compared to many EU Member States as shown in the comparison included in a report published by Eunomia: “A Resourceful Future – Expanding the UK Economy” (Sept 2016). The cost of EPR schemes in the UK falls disproportionately to the public sector, with many other EU Member State schemes requiring full end-of-life costs to be borne by businesses responsible for placing those goods on the market in the first place. This will be a requirement of the EU Circular Economy package currently under negotiation under Art 8(a) of an amended Waste Framework Directive if approved. We have urged UK Governments to

support this move to ensure that the cost of future service and infrastructure for resources and wastes management fall more fairly to businesses in future.

27.1.3 The importance of data, monitoring and forecasting especially for future infrastructure and service design and delivery. Our work in this area includes:

- CIWM research “ EU Recycling Rate Harmonisation” (October 2015)
[<http://www.ciwm.co.uk/Custom/BSIDocumentSelector/Pages/DocumentViewer.aspx?id=QoR7FzWBtisamYEcWSfL6SxAJRLAPT9vt6uxsHjHU7ByWoeYsllctad7OZaPM7fU%252fxM46wVw%252bYA%252bHKKEszcQzSWI9o7Hb%252fdN%252fu5HymgvSsk686sGxFrGOKK6SnNaS99IVIm%252f66R8v%252fjCr87Np6h5YY7aw1O8fJ1q3QS0Q561wNoh0fAZ2hWvQ%253d%253d>] which has emphasized the importance of standardized definitions and data / reporting standards across all EU Member States to avoid misleading comparisons between reported recycling, landfilling or recovery performance for wastes.

Welsh Government municipal waste recycling statistics include recycling of “incinerator bottom ash” whereas England statistics do not. While this would only make a roughly 2% difference in the superior Welsh recycling performance reported (64% June 2016 cf England’s 44%) due to relative under-reliance on EFW for waste treatment in Wales – this does serve as an example of the importance of standard data and reporting requirements both within the UK and across the EU. Without it comparisons in recycling or other waste / resources management are difficult and / or mis-leading.

We are pleased to note early progress made by the EU under the Dutch and Slovenian presidencies in this area.

- CIWM research “Commercial and Industrial Waste in the UK and Republic of Ireland” (October 2013)
[<http://www.ciwm.co.uk/Custom/BSIDocumentSelector/Pages/DocumentViewer.aspx?id=QoR7FzWBtisamYEcWSfL6SxAJRLAPT9vf9UOxY7TX%252bRvV%252ffsIKIsqU2EtUq%252bj7oCo87Wof%252fbs9PqCytSgZ5tfRfy2%252bBshoiDu7f882AjZtqLLztRjeHBL8ywUdWYhRgk>] which concluded there could be a waste treatment capacity shortfall in the UK of between 5 Million and 15 Million tonnes by 2020 without early action.
- CIWM research report: “[Waste on the Front Line - Challenges and Innovations](#)” (February 2015):
[<http://www.ciwm.co.uk/Custom/BSIDocumentSelector/Pages/DocumentViewer.aspx?id=oS0dqUqTFI59be4ZqTMWn2qeSjzQKkOO%252f3x9%252bb3eWbE0k4f7wJMLwzV7kdIOwHthWKsgwQ1RSnpNThqCj18a8EUVb7KTzrb1C8XdktfOCJZ9M7SQdQu3hqf3u%252by49u837kGcfEQxBQywrhx0Wkl8cV7p9ErbkOaq0ow%252bhsD4gUBoaip8oMvlchj2OEJdFDewJSEBNy713%252fk%253d>] This report highlighted the impacts to date and forecast to 2020 on waste services in local authorities. Local government budgetary constraints since that time have cut even deeper into local waste services contributing to the first recorded decline in the UK recycling rate since records have been kept and makes R&WUK increasingly concerned that current recycling targets for municipal waste (50% by 2020) are now unlikely to be met without significant investment in services and infrastructure or changes to definitions and

reporting standards (See Defra digest of 2016 waste data)

[https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/577716/FINAL_Stats_Notice_Nov_2016.pdf].

The Board also note research undertaken by individual ESA member companies exploring forecasted waste arisings and availability of infrastructure to treat it in the UK, including:

- SUEZ research report “Mind the Gap, UK Residual Waste Infrastructure Capacity Requirements 2015 – 2025” (2014) [<http://www.sita.co.uk/downloads/MindTheGapReport-SITAUk-1402-web.pdf>].
- Veolia / Imperial College Research report “Waste Infrastructure Requirements for England” (March 2014) [https://workspace.imperial.ac.uk/environmentalpolicy/Public/NV%20Veolia/IC2014_waste%20report.pdf].

These studies concluded a similar likely waste treatment infrastructure shortfall to that identified in the CIWM / Ricardo AEA study – SUEZ reporting a 5.7 Million tonne capacity gap for residual waste treatment by 2025, Veolia / IC reporting important regional under-capacities.

The Green Investment Bank also reported in “The UK Residual Waste Market” (July 2014) [<http://www.greeninvestmentbank.com/media/25376/gib-residual-waste-report-july-2014-final.pdf>] that “merchant” treatment capacity (ie catering for C&I waste arisings) of between 4 million and 7.7 Million tonnes would be needed by 2020.

These reports need to be considered in the light of the rapid growth of “refuse-derived-fuel” (“RDF”) exports to other EU member states from the UK in the last 5 years to energy recovery plants especially in the Netherlands and Denmark. This trade has now grown to over 3 million tonnes of RDF per year (see Letsrecycle.com report January 2017) [<http://www.letsrecycle.com/news/latest-news/rdf-exports-three-million-tonnes-2016/>] Continued long term export of this material may be frustrated by trading arrangements with the EU post-Brexit. Alternative – preferably UK based – infrastructure may be needed to manage that waste in future, albeit waste that presents a potential benefit to the UK either as materials or as energy. Whilst industry led analysis as above concludes that the UK faced(s) important waste treatment infrastructure gaps over the next 5 to 10 years, DEFRA has also concluded that no further support for infrastructure development was needed for local authorities in order to meet the 2020 Landfill Directive target. R&WUK agrees that the Landfill Directive target has been successfully met, but that this is specifically for municipal wastes only. Uncertainties regarding continued RDF exports and likely closures of existing waste recycling capacity, coupled with likely higher future targets for landfill diversion and improved management of wastes further “up” the waste hierarchy leaves R&WUK clear that the additional UK waste treatment infrastructure is needed – even in the short to medium (10 years) term.

Analysis and forecasts of wastes arisings and infrastructure needs for all wastes will be a major concern for this Assessment.

27.2 R&WUK Priorities for 2017 onwards

Over the next two years R&WUK will focus on 3 particular priorities:

27.2.1 This industry urgently needs medium term clarity on objectives / policy. Current policy objectives for waste and resources management generally only reach to 2020 in England (longer term objectives have been set in both Scotland and Wales). Planning and procurement cycles in waste and resources infrastructure are relatively long in the UK. Relatively simple and small scale infrastructure such as an anaerobic digestion plant typically takes 2 to 3 years to gain planning permission, an environmental permit and to be constructed / commissioned. Larger and more complex plant such as EfW facilities can take up to 10 years to deliver into operation, and sometimes much longer (see cross-cutting Q 10 above).

As noted in the Defra “Resource Management: A Catalyst for Growth” report:

“...Decisions on investment in new infrastructure are made by market participants based on their assessment of future demand and supply and financial viability. Expectations about future Government policy, including in relation to waste and resource management, affects those assessments and therefore influence investment decisions. A key source of policy uncertainty concerns the framework for policy determined at European Union level”

Defra confirm that they remain fully committed to negotiations at a European level on the Circular Economy Package. Their understanding is that this package and the amendments it will make to waste-related EU Directives including the Framework and Landfill Directives will be completed and adopted by the EU before the completion of UK “exit” negotiations under Article 50 of the Treaty of Rome. If that is the case then the status of those changes and their treatment under the Great Repeal Act will be crucial. R&WUK remains committed to working with Defra as the UK representative in those negotiations as this is likely to be the most important driver of UK waste and resource management policy and the planning and delivery by this sector.

Most recent advice from Defra regarding these negotiations (at their stakeholders meeting on 23rd January 2017) confirms progress made in fundamental issues such as definitions and recording / reporting, as well as negotiating positions regarding objectives such as municipal recycling rates and limits on future landfilling.

Given the uncertain timing of the circular economy package and its status under the Great Repeal Act – and the long lead times involved in this sector – we are calling on the Government to make a clear statement that it will not seek to cut existing waste management targets after EU exit, in line with their recent statement regarding their climate change commitments ie no diminution of standards post EU exit.

Concerns regarding the status of UK environmental legislation post EU-Exit were raised in the report of the Environment Audit Committee (4th January 2017) and echoed by an R&WUK press statement [<http://www.resourcesandwasteuk.co.uk/news.php>], although the Defra Minister Therese Coffey confirmed in the Commons debate on packaging on 23rd January 2017 that the Government assumes that negotiation and adoption of the Circular

Economy package will be completed before the end of the Article 50 EU exit process – and that they are engaging in that negotiation accordingly.

Defra Minister for waste Therese Coffey has suggested in response to a written question in the House (16th January 2017) that waste policy and legislation in the UK may need to be “re-shaped”. We anticipate further detail may be included in development of the Defra 25 year Plan, and we await consultation on the framework for that plan early this year. R&WUK advises that any such “re-shaping” should be sensitive to the need to develop policy continuity across the UK wherever possible in this sector and of the development of policy at an EU level under the Circular Economy Package.

27.2.2 The UK and English Government must co-ordinate and deliver on its plans for the development of this National Infrastructure Assessment, the Industrial Strategy and Defra 25 year Environment plan. The timing of consultations and development work on those strategies appears to have been frustrated by the demands on government resources under the EU exit preparations. Our sector recognises the importance of these plans and of their co-ordination. Between them these could be more important than the “resources strategy” called for by R&WUK in its 2015 priorities document. In particular we see that the delivery of secondary resources at the right quality from this sector should be a key consideration in the Industrial strategy as an economic development advantage for UK businesses and to strengthen future resource security. We therefore see clear links between this National Infrastructure Assessment and the UK Industrial Strategy.

The Commission should note that both Scotland and Wales have more up-to-date and ambitious waste and resources (“Circular Economy”) strategies than does England. The Scottish strategy “Making Things Last” was published in February 2016 and Scottish Government have signaled an intention to begin work on regulations under that strategy later in 2017. Welsh Government is currently engaged in a review of their waste and resource management policy. The latest Waste Strategy for England was published in 2007 with a policy review in 2011.

27.2.3 The importance of Extended Producer Responsibility (EPR) R&WUK are calling on all 4 UK governments to explore the development of extended producer responsibilities at both UK and EU levels. The Scottish circular economy strategy [<http://www.gov.scot/Publications/2016/02/1761>] recognised the potential importance of EPR and the fact that such schemes are better planned and operated at least at a UK level rather than in the individual countries.

R&WUK calls for:

“All 4 UK governments should work together to design and implement UK-wide Extended Producer Responsibility schemes for packaging and additional materials / products which:

- Incentivise better design/use of secondary raw materials/longer product life
- Shift the burden of end-of-life product management more fairly across the value chain
- Increase the level of recycling and recovery for materials / products covered

- UK Governments should set out the overarching objectives, monitoring and reporting frameworks, and formal review cycles to coincide with the UK parliamentary term.

27.3 Early R&WUK Inputs to the Commission

R&WUK has been pleased to work closely with the Commission team regarding waste and resources data and potential metrics for sustainable resources and wastes management across sectors. We are working with the team to help design and deliver the waste sector workshop on 28th February 2017.

In our presentation to the Commission in November 2016 we highlighted:

- the strategic importance and value - in social, environmental and economic terms - of developing a more “Circular” economy, including resource efficiency of products and services, and resource security.
- the importance of policy in shaping this industry and the circular economy in general and the need for interventions at all points in the materials cycle
- The importance of interventions including market “pull” mechanisms - designed to increase industry demand for secondary materials / resources well as “push” mechanisms designed to improve output quality and quantity of secondary materials from this industry
- Current trends in English waste and resources infrastructure under the current policy framework including:

- LANDFILL:** The number of available sites is dropping rapidly. There were over 1,000 in England & Wales mid 1990’s (pre Landfill Directive); ESA member companies now estimate there will be just a few dozen within 3 years – leaving some areas of the country without any landfills at all. Total landfill capacity was around 20m tonnes in 2015. This is anticipated to almost halve by 2020, before dropping further to just 6 million tonnes in 2025 and 4 million tonnes in 2030. This is a predictable response to a policy framework designed to move waste away from landfill and further “up” the waste hierarchy. However, alternative waste and resources infrastructure has not been delivered at the rate required to fully accommodate waste being diverted from disposal for all reasons noted above including policy uncertainty and a lack of strategy and strategic planning. If this is allowed to continue landfill gate fees will rise sharply as capacity falls faster than demand.

The Commission should also note that number and age of closed landfill sites will continue to rise. These represent a significant long term monitoring and management responsibility for both public and private sectors

- INCINERATION / ENERGY RECOVERY:** projects under PFI / PPP are in construction to 2018/9 and Defra’s annual waste management statistics show an important increase in energy recovery from waste over the last 5 years in the UK. There is a growing reliance on export of refuse derived fuels to other EU Member States but the continued viability of that market financially and legally hinges on many factors including EU exit negotiations.

- iii. **COMPOSTING / ANAEROBIC DIGESTION:** development of infrastructure in the UK has slowed as a result of factors such as feedstock availability (eg through low growth in separated food waste collections by local authorities as a response to spending constraints) and uncertainty over energy policy and future tariffs.
 - iv. **RECYCLING:** There is currently no public procurement underway for recycling plants through ESA members and this is expected to continue for the next 3 to 5 years. ESA estimates that without action, by 2020 waste could cost local authorities and businesses an extra £260 million - £485 million per annum, depending on the value of recyclates and cost of landfill. 15% of the UK's current recycling capacity will close during this timeframe as it comes to the end of its life and is not replaced. This would further reduce household recycling rates by 5% and lead to the loss of eight thousand jobs. This would almost certainly result in the UK missing its recycling targets.
 - v. **MARKET INSTABILITY** and plants currently unprofitable and / or closing. UK has a strong reliance on export of secondary materials which is likely to continue even if demand for secondary materials in the UK is stimulated.
 - vi. **REUSE:** This is the hardest part of the hierarchy to measure and report on but has important social and environmental benefits. Much of the re-use industry and infrastructure is relatively immature and represents a potential for the future.
 - vii. **PREVENTION:** significant potential exists in prevention of Industrial & Commercial waste through improved product and process design. Consumer product design needs to be driven with resource efficiency and end-of-life management in mind through voluntary and mandatory schemes including Extended Producer Responsibility.
- The importance of planning for resources management and security of supply alongside economic development at a larger-than-local scale ie regional / sub-regional.
 - The importance of data, information and metrics standardization and provision through readily-accessible means. Our conclusion is that data are readily available and reliable for municipal wastes (approx. 10% of the total UK waste) but not so for industrial and commercial (I&C) wastes. Various sample surveys of I&C waste have been completed by the 4 UK Governments but these are highly “granular” and do not allow direct comparison or time-series analysis of changes. R&WUK support all aspects of improved waste data collection and reporting including through electronic means such as the EDoC (Electronic Duty of Care) system: [<https://www.edoconline.co.uk/>] We believe this will continue to be an early priority for the Commission under the EU Circular Economy policy package.
 - The Relatively small scale and dispersed nature of future waste and resources management infrastructure, using a range of different technology options – compared to other sectors under this infrastructure assessment.

We look forward to more detailed input to the Commission's work in this assessment

(i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process

A: R&WUK have identified the most important barriers to delivery of a circular economy under Qn 27 above. In addition we would point to:

1. Circular Economy Strategies

Barriers to delivery of a more “Circular” economy are clearly identified in the EU Commission Communication “Towards a Circular Economy” (Dec 2015) [https://ec.europa.eu/priorities/jobs-growth-and-investment/towards-circular-economy_en]

They are also addressed in the “Making Things Last” circular economy strategy for Scotland (February 2016) [<http://www.gov.scot/Publications/2016/02/1761>] and we would recommend that the Commission take note of proposals from the Welsh Government in their policy review in 2017.

2. REBUS Project

The Aldersgate Group report “Amplifying ACTION ON Resource Efficiency (EU Edition) (January 2017) [file:///C:/Users/Steve_I/Downloads/EU%20Edition%20-%20Amplifying%20action%20on%20resource%20efficiency.pdf] explores the economic and environmental benefits for the EU if circular economy practices were adopted on a large scale across three separate scenarios: no new initiatives; current trajectory; and “transformational change”. They conclude that:

“With transformational change, there is the potential for a total of €324bn gross value added (GVA) created, a reduction in material demand of 184 million tonnes, an additional 172 million tonnes of material use avoided and a reduction in emissions of 154 million tonnes CO2 eq by 2030” [across the EU]

The report estimates UK GVA gains by 2030 to be worth £86B.

3. Employment Opportunities arising through a more circular economy

The employment opportunities which could be realised within the UK through a more circular economy are covered in the Waste and Resources Action Programme (WRAP) / Green Alliance report: (January 2015) “Employment and the Circular Economy – Job creation in a more resource efficient Britain”

[<http://www.wrap.org.uk/content/employment-and-circular-economy>]

Their report concludes that by 2030 moving to a more circular economy could:

- require an extra 205,000 jobs;
- reduce unemployment by around 54,000; and
- offset 11% of future losses in skilled employment.

Alternatively, under a transformational scenario where there was a more extensive expansion of circular economy activities, by 2030 adoption of a more circular materials economy could create over half a million jobs, reduce unemployment by over 100,000 and potentially offset around 18% of the expected future losses in skilled employment.

With regard to the waste and resources management sector itself – the Defra “Resource management: a catalyst for growth and productivity” report includes an estimate from David Palmer-Jones, Chairman of the Environmental Services Association (2013) – “Going for Growth – A Practical Route to a Circular Economy”:

“A circular economy, where the UK increasingly re-uses and recycles the resources it already has, could help generate 50,000 new jobs with £10bn investment, boosting GDP by £3bn”.

We are clear, therefore, that resource efficiency and security through feedstock provided by this sector should be a key priority under the UK Industrial Strategy, and we urge the Commission to recommend that through this Assessment.

4. Re-use and Repair

Most infrastructure issues associated with waste and resource management will concentrate on recycling and recovery activities in the “waste hierarchy”. The hierarchy is transposed into UK law through the [The Waste \(England and Wales\) Regulations 2011](#) in Regulations 12, 15 and 35. Waste prevention and preparation for re-use sit higher in the hierarchy. The infrastructure for these activities are unlikely to be the concern of this Assessment due to their small scale, simple technologies, and almost uniquely local service delivery. However, the Commission should take account of the social as well as environmental and business advantages of these steps in the hierarchy and the impact that they could have on the need for other waste treatment and disposal infrastructure in the future. Recent work in this area includes CIWM research: “Re-use in the UK and Ireland” (2016) [<http://www.ciwm-journal.co.uk/downloads/Reuse-in-the-UK-and-Ireland-WEB.pdf>].

Energy:

19 Q: What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

A: Energy recovery from wastes to generate electricity only cannot exceed roughly 30% energy efficiency. However, the export of heat from such process – with or without electricity generation - can improve energy recovery from the waste fuel to greater than 80%. Waste to energy plants with an overall fuel efficiency above 65% can be classed as a “recovery” operation under the EU Waste Framework Directive (for calculation see CIWM technical note : <http://www.ciwm.co.uk/ciwm/knowledge/the-r1-energy-efficiency-formula.aspx>), or Defra’s “Energy from waste A guide to the debate” (February 2014) (revised edition): [https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/284612/pb14130-energy-waste-201402.pdf] .

Only a sub-set of UK EfW plants are classed as a “recovery” (“R1”) operations. Many are designed and built ready for heat export but have no convenient and reliable heat customer within

practicable reach – practicable because of the technical and financial difficulty in transporting heat over any distance. We recommend that EfW infrastructure should be planned alongside other industrial development with customers for heat and secondary materials developed at the same or adjacent sites to take advantage of these outputs (see response to Q 3 above).

The Commission should also take note of the potential for generation of biogas from organic wastes which can be used to generate electricity (and of course heat) as well as for injection to the grid, subject to stringent quality standards or used as a transport fuel. All of these depend on the biogenic fraction of wastes from municipal as well as commercial and industrial waste sources which are a renewable rather than fossil form of carbon, and – as in the case of replacing diesel with biogas as a transport fuel – have other associated emissions advantages. The Commission may wish to consider biogas generation infrastructure needs in the light of feedstock availability, especially post-consumer food waste, as well as the UK Carbon Reduction Plan under the 5th Carbon budget and plans for air quality improvement.

We urge the commission to consider de-carbonisation and other environmental quality advantages achievable through collection and biological treatment of these biogenic waste fractions.

Priority 1: Support and improve waste collection/recycling performance		
Government should:	Response	
Consult on the potential benefit of reintroducing statutory local government household waste recycling or landfill diversion targets	No action	
Review potential opportunities for efficiencies to be achieved through increased harmonisation of collections services	Picked up by previous Minister Rory Stewart. WRAP-led harmonization report launched at RWM 2016, 6 associated Action Plans still with WRAP – now seeking approx. 10 funded pilot collection projects with authorities.	
Introduce meaningful pilot schemes of ‘pay as you throw’ for household waste to test the validity and potential impact of its broader introduction	No Action but has been included in early 2017 Chief Govt Scientist report through drafting of Municipal Waste chapter by CIWM.	
Support the increased roll-out of separate food waste collections and improvement in capture rates	Supported as part of the Harmonisation programme – now seeking up to 10 pilot schemes via WRAP-led Foodwaste Action Plan. Business case for savings crucial issue for most local authorities. BEIS Bio-economy consultation launched Dec 2016.	
Provide targeted support for the worst performing local authorities to help them overcome specific challenges in increasing recycling rates in urban environments	No action	
Amend the UK’s Packaging Regulations to ensure that the polluter pays principle applies and Obligated Businesses pay fully for the recycling of their materials	Consultation underway on targets but no fundamental review – could be covered as part of the Defra 25 year plan. UK lobbying for “lighter touch” EPR including voluntary schemes in discussions re Art 8(a) at EU level.	
Maintain funding for WRAP and other relevant organisations to deliver information and advice on waste and resource efficiency to businesses	Government funding specific WRAP projects. WRAP has moved onto charitable status.	
R&WUK and the industry will:	Action	
Work with WRAP and other partners to develop a new national-level communications strategy aimed at householders	Communications included as part of all work elements under the Harmonisation programme and as a specific working group under the Foodwaste Action Plan. CIWM and ESA fully engaged in both processes. CIWM input via advisory group to refreshed “Recycle Now” campaign and Recycle for Wales Advisory Group Full R&WUK social media support for all WRAP programmes.	

Strengthen relationships with other parts of the supply chain to boost resource efficiency in all parts of the UK economy	RWM event being developed to be increasingly relevant / attractive to “customer” sectors, plus expansion of “Ambassadors” Group to cover customer sectors RightWasteRightPlace project expanded to include “Ambassadors” from customer sectors eg construction.	
Continue to support the objectives outlined in the Responsibility Deal agreed in 2011 to help businesses to manage their waste more sustainably	ESA completed all of its actions under the Responsibility Deal, including changes to its code of practice and embedding information on its web site. Defra has also completed many of its actions through e.g. introduction of MRF regs and ongoing work on EA and waste crime. Most actions completed on both sides but progress no longer monitored by Defra.	
Priority 2: Improve the climate for investment in circular economy infrastructure to deliver sustainable growth and jobs		
Government should:	Response	
Strengthen strategic planning for waste and all secondary materials (including the energy embedded in residual waste) at a national level, for example by including waste in the National Infrastructure Plan	Waste included as a priority in the National Infrastructure Assessment – but confined to England as it is a devolved policy area – forthcoming Defra 25yr plan and BEIS Industry Strategy. Scotland: Circular economy strategy published Feb 2016 Wales: policy review underway.	
Support planning for waste and resource management at a larger-than-local level by linking it to economic development planning and strengthening the ‘duty to co-operate’ requirement on local authorities	No action	
Issue a Call for Evidence on the design, operation, costs and benefits of landfill bans or restrictions across the EU to inform policy development on this style of intervention across the UK	No action	
Recognise the potential risk, articulated by a number of leading industry stakeholders, for future gaps in waste treatment infrastructure and ensure that a robust monitoring process is in place such that need and provision can be assessed in a reliable and timely way	Waste recognized as a priority in the National Infrastructure Assessment (England-only). R&WUK input to assessment of possible metrics and to waste / resources data strengths and weaknesses.	
Explore additional financial support and de-risking mechanisms to encourage service and infrastructure provision to meet any capacity shortfalls – including a full review of the role, funding and performance of the Green Investment Bank	Green Investment Bank review underway but unlikely to address de-risking objective. Widespread industry concern over privatization of the Bank. R&WUK attended March 2016 briefing and has asked for another briefing (January 2017).	

Use its first Finance Act to introduce new tax allowances for waste infrastructure expenditure to offset the loss to the industry of Industrial Building Allowances	No action	
Amend the Energy Act to equalise support under the Contracts for Difference regime for all technologies which use residual waste or waste-derived fuels	Energy tariffs turbulent including Dec 2016 changes to RHI No appetite to remove the distortion caused by differential support to different technologies.	
Amend the CRC Energy Efficiency Scheme to exempt recycling, sorting and reprocessing industries	No action– proposal is to abolish the scheme in 2018/19.	
Introduce a planning obligation on new developments to use local area heat networks	No action	
R&WUK and the industry will:	Action	
Co-operate with Government in generation and provision of waste and resource flow data and forecasts to support assessment infrastructure and services needs for waste	R&WUK engagement with National Infrastructure Assessment for waste – seeking opportunities for further input. Priorities document expected June 2017. ESA has ongoing discussion with Defra about data issues and has sanity checked Defra data prior to publication to ensure estimates are based on sound assumptions.	
Fully engage with the review of the GIB's impact to date and its future role	Meeting arranged January 2017	
Undertake and publish research into mechanisms to support the UK reprocessing sector	R&WUK research report re secondary materials market instability published May 2015 – public / private sector contracts “best practice” group convened (CIWM-led). ESA research into extended producer responsibility for litter published September 2016. ESA research into extended producer responsibility for packaging published October 2016. ESA convened stakeholder day to discuss EPR for packaging November 2016.	
Work with public bodies to improve data mapping of material flows and support and promote the continued uptake of the Electronic Duty of Care (edoc) system	CIWM direct support for EDoC Management Board and Technical Advisory Group plus promotion of up-take. Case studies include Hereford Council. Up-take of EDoC by industry limited.	
Priority 3: Boost domestic demand/markets for recyclates		
Government should:	Response	

Increase the specifications for recycled content and products in Government Buying Standards	commitment (through the Waste Prevention Plan) to seek to <u>reuse</u> furniture etc before buying new, reflected in the relevant GBS.	
Lobby our EU partners to support amendments to the Principal VAT Directive to lower rates for products which contain higher recycled content	No action	
Issue a Call for Evidence to explore options for varying Excise Duties on products depending on their recycled content	No action	
As part of reforms to the PRN system, introduce measures to incentivise the use of recycled content in packaging (i.e. by reducing the size of the obligation for those packaging manufacturers which use recycled content)	Some action proposed re materials targets but no measures to promote increased secondary materials use. This may be considered as part of any forthcoming EPR review under the Defra 25 year plan.	
Support mechanisms to provide more stable secondary materials markets and to spread future materials price risks across the supply chain to encourage development of infrastructure, services and markets	Role of local authority collection and recycling contracts under the WRAP Harmonisation, WRAP Foodwaste and R&WUK secondary materials price stabilization – working group set up, led by CIWM.	
Review the effectiveness of Voluntary Agreements as a mechanism for driving sustainable behaviour in the supply chain	No action although DEFRA have proposed a greater role for voluntary EPR schemes in Circular Economy discussions at EU level.	
R&WUK and the industry will:	Action	
Undertake and publish research into mechanisms to reduce exposure to volatile commodity markets	R&WUK report “Managing the Risk From Secondary Raw Materials Price Movements published June 2015. Working Group on local authority contracts set up and led by CIWM.	
Provide best practice examples in tendering, partnership working and collaborative approaches to markets and procurement	Full CIWM and ESA input to working group above.	
Priority 4: Create the right regulatory balance between hitting waste criminals hard and reducing burdens on legitimate business		
Government should:	Response	
Maintain and build on the progress that has been made to date by making waste crime a policy and funding priority	Waste crime recognized as a priority in all 4 UK governments.	
Explore measures to shift the cost of regulation firmly towards persistent poor performers in the industry, reward good	Permit charging schemes increasing range of charges to reward good performance and penalize poor performance.	

<p>practice and raise standards through monitoring, compliance and permit charge schemes</p>	<p>Scotland: SEPA's new charging scheme aims to penalize poor performers but offers little reward to good performers.</p> <p>Wales: similar to EA.</p> <p>N Ireland: fees and charges scheme under consideration by DAERA allied to measures designed to deliver 'Better Regulation'. No further details available.</p>	
<p>Continue to financially support waste crime units within UK regulators, which would provide a strong return on investment</p>	<p>England: Medium term funding secured for the Environment Agency.</p> <p>Scotland: SEPA's waste crime team funded through SEPA's overall budget. EU LIFE+ funding secured to improve approaches to tackling waste crime. SEPA lead role in Interpol waste crime group.</p> <p>Wales: Natural Resources Wales has received some additional funding from Welsh Government. Funding figures not published.</p> <p>N Ireland: To continue with dedicated Environmental Crime Unit. The specialist services of a crime analyst to support the work of NIEA on waste crime. Continue with close liaison and cooperation with partner enforcement agencies throughout the UK and ROI.</p>	
<p>Empower regulators with full cost recovery abilities</p>	<p>Enhanced package of regulatory powers for Environment Agency and Natural Resources Wales introduced October 2015.</p>	
<p>Strengthen local authority powers to address waste crime, including fixed penalties and surveillance powers</p>	<p>Fixed penalties for flytipping introduced for England May 2016 now used by 50% of authorities plus powers to seize vehicles used in flytipping.</p> <p>Scotland: local authorities have long used powers under the 1990 EPA to issue penalties for flytipping.</p> <p>Wales: 6 week consultation on FPNs for flytipping launched Jan 2017.</p> <p>N Ireland: Status Quo. No further progress to report.</p>	
<p>Strengthen the Fit and Proper Person requirements and enforcement for waste management including technical competence and explore the use of targeted financial assessments and guarantees to protect the environment and public purse from illegal waste management and abandonment</p>	<p>2016 consultation delayed several times – now anticipated in 2017....latest proposals not visible to R&WUK.</p>	
<p>R&WUK and the industry will:</p>	<p>Action</p>	

Share intelligence with environmental regulators to assist them in targeting illegal activity	<p>ESA has shared intelligence with EA on ongoing basis. Feedback from Members suggest not always satisfied that this is followed up on appropriately.</p> <p>ESA up-date to “Dirty Secret” report underway.</p>	
Work to promote best practice and raise standards of compliance across the industry through the provision of appropriate training, seminars and other learning opportunities	<p>CIWM / WAMITAB technical competence scheme expanded and updated March 2016.</p> <p>CIWM / ESA scheduled training programme maintained and improved.</p> <p>CIWM / ESA joint funding and ESA management of the RightWasteRightPlace project.</p> <p>CIWM support for EDoC Management Board to help reduce crime / raise awareness.</p> <p>Cross-industry collaboration in major resources and waste management events throughout the UK.</p> <p>CIWM working with Chief Fire Officers Association to launch new fire prevention planning and response training / competence.</p>	
Priority 5: Greater government co-ordination of resources and waste policy		
Government should:	Response	
Introduce a co-ordinating unit, such as an Office of Resource Management, led by a senior Minister to ensure strategic cross-department policy making on waste and resources	<p>No Action</p> <p>Potentially superceded by:</p> <ol style="list-style-type: none"> 1. BEIS Industrial Strategy 2. NIA (England-only) 3. Defra 25 yr Environment plan 4. Govt Chief Scientific Advisor report <p>merger of EPR team from BEIS into Defra.</p> <p>N Ireland: Waste team cut hard.</p> <p>Clear Government lead in Wales and Scotland.</p>	
Commit to a full review of the 2007 Waste Strategy for England, informed by commissioning an independent Stern-style review on resource efficiency and security	No Action	
Develop and expand the national Waste Prevention Plan to strengthen the policy focus at the top of the hierarchy, including re-use and remanufacturing	<p>No action by Defra</p> <p>Scottish Government launched “Making Things Last” Feb 2016 plus funding for initiatives.</p>	
R&WUK and the industry will:	Action	
Map the sector’s future skills requirements and potential gaps	ESA Members have worked with EU Skills through its RISKI forum and have completed this exercise at a high level.	

	This has not been widely disseminated.	
Work with public bodies to improve data mapping of material flows and support and promote the continued uptake of the Electronic Duty of Care (edoc) system	CIWM support for WasteDataFlow and EDoC including 2016 webinars.	
Priority 6: Engaging positively in policy development for resources and wastes at a European level		
Government should:	Response	
Confirm that regardless of any renegotiated of terms with the EU, it fully acknowledges and supports the role of EU-level environmental policy and regulation and will actively engage in the development, monitoring and further review of the EU Circular Economy Package in particular	Government (Defra) confirms it is still actively engaged in EU Circular Economy negotiations but no overall confirmation of UK policy positions is available for comment. ESA and CIWM engaged in occasional workshop events organized by Defra / BEIS.	
Develop and articulate a coherent and positive position on the future EU circular economy package which reflects the opinion of all four UK national Governments	Routine liaison maintained between all 4 UK governments.	
Require fair and consistent data standards, metrics and reporting under all appropriate EU-driven targets to allow realistic comparison between Member States' performance and to support the review and development of evidence-based policies and interventions.	Maintained as an early priority in Circular Economy development by both Dutch and Slovenian Presidencies.	
Argue for the introduction of longer term financial instruments to drive behaviour change on resource consumption across the whole supply chain from raw materials through to supply and use of recycled materials or recovery of value from wastes. This should include assessment of the potential for differential VAT rates for materials, raw materials levies and the development of new or tightened Extended Producer Responsibility mechanisms	No action	
Support the development and monitoring of Improvement Plans for Member States who cannot meet the various targets under the	No action	

<p>appropriate EU Directives, Regulations etc. Compliant states must be able to see that the needs of non-compliant countries are recognised but that over time all Member States will drive for the same standards and levels of achievement</p>		
<p>R&WUK and the industry will:</p>	<p>Action</p>	
<p>Fully support Government in all appropriate EU negotiations</p>	<p>ESA and CIWM engaged in occasional Defra / BEIS workshops. Government “not engaging in a running commentary” on the negotiations.</p> <p>ESA active via FEAD.</p>	
<p>Provide data and information as evidence for policy development and to allow full reporting to support monitoring and review of UK performance and the effectiveness of EU policy and interventions</p>	<p>ESA published strategy report in summer 2016 which included data and information to support policy development.</p> <p>ESA and CIWM both participate in BREF development and have helped EA closely on waste treatment and Incineration BREFs.</p> <p>CIWM report on calculation methods for municipal recycling reporting published October 2015.</p>	
<p>R&WUK will actively seek opportunities to promote the UK sector’s interests and views at a European level to influence the circular economy agenda</p>	<p>ESA active via FEAD.</p> <p>CIWM active via ISWA.</p>	

National Infrastructure Assessment, Call for Evidence

The Scottish Futures Trust was established in 2008, operating at arms' length from the Scottish Government to improve the efficiency and effectiveness of infrastructure investment in Scotland by working collaboratively with public bodies and industry, leading to better value-for-money and ultimately improved public services.

We have restricted our submission to digital communications which we consider to be a sector of economic infrastructure particularly important to Scotland. That is not to say that we don't consider any other areas of infrastructure to be important, but simply that this area is where SFT's perspective may be most relevant to the work of the Commission.

Many areas of infrastructure policy, prioritisation, funding and delivery are devolved and your cross-cutting themes cover a number of these areas. Should the Commission wish to discuss these areas with the Scottish Futures Trust we would be pleased to do so.

Response to Questions 17 & 18 - Delivering digital connectivity as a Utility

1. Introduction

SFT is supporting Scottish Government to establish a roadmap for delivering a world class digital vision for Scotland¹, for which it is imperative that both consumers and enterprises in Scotland have access to enhanced digital services and mobile connectivity. A report commissioned by SFT² in 2015 identified that the potential impact of achieving such a world leading position would be to increase GDP in Scotland by c£13bn (or 10% per) annum, and would require both infrastructure and devices to achieve:

- Seamless delivery across fixed and wireless platforms;
- A quality of service and user experience commensurate with other leading and modern digital economies; and
- Investment into Scotland's digital infrastructure that will guarantee the country's future competitiveness, as well as its ability to provide enhanced public services and opportunity to its citizens.

A key aspect to this work is to assess a wide range of potential interventions that could be considered to enhance the opportunity for public and industry investment in digital infrastructure across Scotland; these interventions include UK and Scottish Government policy and legislation and Ofcom regulatory measures. It is important to note, that whilst the emphasis of this submission is focused on the situation in Scotland, many of the issues and suggestions identified could equally apply to many other parts of the United Kingdom.

¹ A summary of the progress made to date can be found in the attached document, http://www.scottishfuturestrust.org.uk/files/publications/Taking_the_Connected_Highway.pdf

² The economic and social impacts of enhanced digitalisation in Scotland, July 2015. http://www.scottishfuturestrust.org.uk/files/publications/Impact_of_digitalisation_in_Scotland.pdf

2. Background

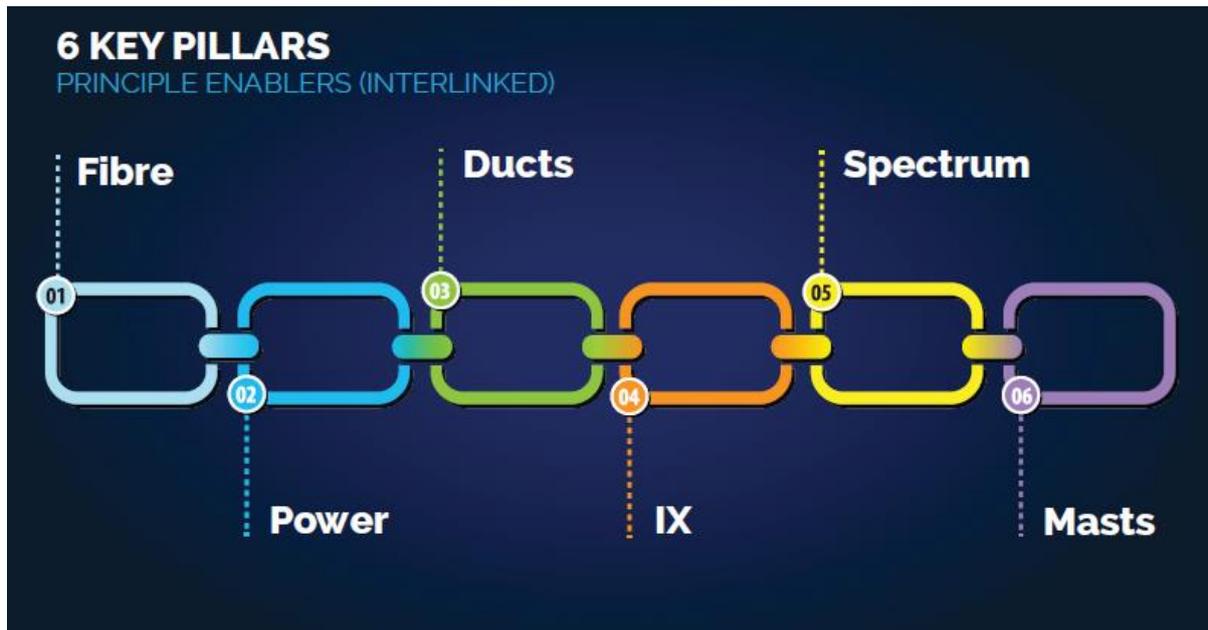
In recent years the demand for digital activity and data has increased significantly and with it the demand for seamless broadband and wireless connectivity. The telecoms industry has seen considerable recent developments with the emergence of ‘quadplay’ and structural consolidation across wireless and fixed platforms. Convergence has also changed how people access services, and indeed Over the Top (OTT) content has grown exponentially over the last few years³. It is the case that the promotion of effective and sustainable competition has delivered efficient investment and widespread availability of services for a considerable number of consumers across the UK over the last 10-15 years; for some there has been significant improvement in terms of superfast broadband and 4G coverage, alongside growth in the number and types of connected devices. However, a collection of studies⁴ by Ofcom and others, suggest that in “non-competitive” areas of Scotland and other parts of the UK, the regulatory strategy driven by competition, has not delivered the same positive consumer outcomes, nor the necessary investment to maintain and upgrade network infrastructure to support a digital economy. This has a detrimental impact upon the economic performance of such areas. In these areas, the evidence would suggest that the user quality of experience is one of unreliable broadband and mobile connectivity services in many parts of Scotland. This experience is replicated in both the consumer and business connectivity markets, therefore there is a strong case to ascertain whether adequate investment and innovation has been delivered into those, primarily regional markets. Whilst improvements to current provision are an important focus for Ofcom and government, actions taken now will have a clear impact upon the future telecoms investment and capability in Scotland; and so, any policy of regulatory measures need to account for future investment, not only for current customer needs.

3. Market and technology drivers

Although 5G technical standards have not yet been agreed, we know that the next generation of networks will rely heavily upon six key components, illustrated below:

³ Ofcom: Strategic Review of Digital Communications, July 2015

⁴ Example studies include: Ofcom: SRDC Discussion Documents, July 2015; Business Connectivity Market Review, May 2015; Ofcom Analysis of Operator Data, May 2015 (as detailed in the SRDC 16 July 2015; Communications Market Report: Scotland, August 2015; Jigsaw Research: SME experience of communications services – a research report, October 2014; Infrastructure Report 2014, December 2014; Saville Rossiter-Base: Quality of Customer Service Report, December 2014; Which?: Broadband Advertising speeds not up to speed; Broadband Services for SMEs: assessment and action plan, June 2015; Federation of Small Businesses: The fourth utility, July 2014; and Ofcom presentation: Ofcom’s Strategic Review of Digital Communications, October 2015.



The six pillars outlined above are the essential elements of the infrastructure needed to support 5G connectivity. Although many of the standards are still being developed, it is clear that 5G networks will represent a genuine step change in mobile connectivity. The International Telecommunications Union has defined that 5G ready networks will be capable of supporting speeds of up to 20Gbps. If this is to be delivered in Scotland, our digital infrastructure will need to be enhanced.

Existing copper infrastructure will be unable to support such high speeds. **Fibre** is the critical component, with a need for fibre to reach as far into the network as possible, whether to small cell locations on street furniture or buildings or to rural masts.

However, it is not all about fibre. The ability to access, and more efficiently install, underground **ducting** is critical to enabling the proliferation of fibre. It will require collaborative working between industry and the public sector to ensure that all opportunities to deploy ducting in the right place at the right time are exploited, especially when planning new developments and buildings.

There will be a need for a significantly higher concentration of **masts** and antennas, particularly in urban areas, to deliver the headline user experience described above. This will need the co-operation of government and local authorities to provide more readily available access to street furniture and other infrastructure to enable deployment. All of this will need to be underpinned by a densely-structured fibre network and the latest in ultrafast millimetre-wave (mmWave) technology.

Due to the higher data demand transferring between a significantly greater number of devices and antenna, a more effective and efficient use of **spectrum** will need to be identified; and there will need to be more spectrum capacity made available to cope with that demand. All of this new energy-hungry equipment will require innovation to ensure that there is sufficient **power** supply in both urban and rural areas. Support for sustainable energy supplies and battery **power** technology will be a key success factor.

The amount of data and content being used by consumers is growing rapidly and this trend will continue in future as new, smart technologies grow and the Internet of Things becomes a reality. This will require near instant access to data; and for that content to be closer to the user. Relying on

information being stored at **internet exchanges** in London or Manchester will not deliver the anticipated 5G user experience. That will require peering at Internet Exchanges located in Scotland, which is why we have already invested to support the growth of IXScotland – the first Scottish internet exchange. Likewise, delivering international connectivity for Scotland will be key to delivering resilience, speed and opportunity.

The internet of things sits across the pillars, drawing upon the various infrastructure elements. We are working with Scottish Enterprise and CENSIS – the Centre for Sensor and Imaging Systems – to look at options for developing a national network to support the Internet Of Things. These ‘things’ (whether sensors, switches or machines) can be integrated into just about anything – from cars to street lights; manufacturing equipment to livestock. The information generated can improve business efficiency, influence service delivery and genuinely improve people’s lives.

None of these 6 pillars are new; but the way in which they will need to mesh together as a unified digital network is. Government, regulators, businesses and the telecoms sector in particular need to work together to enable that integration to happen in Scotland. That will be key to delivering a world class user experience.

4. Potential areas to consider

In its Strategic Review of Digital Connectivity, Ofcom identified a clear vision for future telecoms provision that has much in common with the Scottish Government’s digital vision, and we are working with Ofcom to establish what more can be done from a regulatory perspective to enable this vision to become a reality. The Strategic Review identified a number of further enhanced remedies, however based upon consumer outcomes and projected future user requirements, we believe there is scope for Ofcom to be increasingly proactive as regards regulation of the market and how this will be applied over the next ten years. Ofcom is increasing its presence in Scotland and this is a welcome broadening of its resource base and recognition of the potentially differing market conditions across the UK. There are a number of additional areas where Ofcom could enhance regulation beyond the current competition focused approach, that include:

- a. Consideration of more locational remedies to address the digital infrastructure deficit in Scotland and stimulate innovative investment and service coverage.
- b. Completion of a fully comprehensive assessment, for both premise and mobile service provision, to determine whether the competition based regulatory approach to infrastructure is delivering the advertised user experience across the geographies of Scotland and the UK.
- c. The development of comprehensive consumer metrics at a granular localised level to include coverage, availability (both geographic and population based), as well as other aspects such as customer satisfaction, quality of experience, contention and resilience.
- d. Development of a more active requirement (or burden of proof) on operators to demonstrate delivery of actual user experience as opposed to planned or predicted experience.
- e. The establishment of a more comprehensive mapping of infrastructure ownership as well as monitoring of current and future industry investment plans, to enable the regulator to better inform the development of future interventions or enabling legislation.
- f. The development and publication of a future technology implementation roadmap to enhance regulatory strategy and policy thinking going forward.

- g. Ofcom has consulted on its preferred approach to the future structure of BT Openreach, and final consideration should reflect the following aspects:
- i. Separated from the rest of the BT Group as a functioning standalone operating entity. The potential for shared ownership with external parties could also be considered;
 - ii. Stand-alone governance arrangements with a separate board that contains external representation (possibly from wider industry or representing the wider public interest) set up to oversee the operations and performance of Openreach. Such an approach would see Openreach having its own constitution;
 - iii. Requirement to develop and publish an investment plan that reflects the needs and investment priorities of wider industry players and not just BT Group, and for this to be updated on a rolling 5-year infrastructure investment plan that includes investment in renewals and new infrastructure; the EAB and Ofcom would then monitor performance against this plan;
 - iv. Returns to be driven by and, if necessary, regulated on the basis of the long term infrastructure assets of the new standalone business. This basis of a future rate of return should also take into account the significant levels of public sector infrastructure investment made in the current fibre assets of Openreach;
 - v. Ability to raise finance separately from BT Group to meet investment requirements;
 - vi. Ability to enter into joint venture arrangements for services and investments;
 - vii. Requirement to re-invest surpluses into infrastructure enhancement, with possible link to regulatory relief in competitive markets, based upon a regulated return;
 - viii. Requirement to invest in fibre only products to ensure a future-proof investment plan is developed;
 - ix. Introduce an enhanced regulatory and monitoring regime in relation to consumers and service providers;
 - x. Requirement to ensure input/output equivalence access (in relation to services, data provision and investment plans) is available to all operators; and
 - xi. Requirement to provide not only PIA to ducts and poles but also to offer dark fibre as a product at both the access and backhaul level to ECC undertakers; and
 - xii. Requirement to work with all MNOs to understand the required infrastructure to support mobile connectivity and how this can be put in place.
- h. The following elements should be considered in developing and designing future release of spectrum:
- i. Benefit valuation – there is a trade-off between short term primary funding generated through an auction bidding process versus a focus on wider and longer term secondary order economic, social and fiscal benefits that could be delivered. This could be also be assessed by for example by encouraging and rewarding plans by providers to accelerate investment in the underlying infrastructure
 - ii. Geographical Use – sharing of spectrum if not in use by an operator
 - iii. Geographical Obligations – that can be used to require investment in targeted areas such as an “outside-in” approach, priority on transport routes, or differential obligations on a geographic basis
 - iv. Spectrum capping - It may be of value to cap future auctions dependant on what spectrum is being auctioned and the amount available to mobile operators, such as 700Mhz to allow fair competition across the network providers. The emphasis could be on how operators will use the spectrum actively and effectively. “Banking”

spectrum could be discouraged unless there is a clear worldwide recognition that a certain band will be used for future network innovation. .

- i. Building upon locational regulation, Ofcom should also consider what additional powers and approaches it needs to enhance and strengthen its regulation role, and indeed it may wish to look more widely at regulation of other sectors across the UK (e.g. water, electricity, gas, rail) for comparison and potential adoption of elements of these.
- j. With regards to the current considerations in relation to a Broadband Universal Service Obligation:
 - i. The underlying principle should be that it ensures a genuinely universal right of access and be funded from as broad a base as is deemed feasible;
 - ii. The user experience should be considered in relation to download and upload speeds, alongside other factors such as resilience, latency and current and future contention rates;
 - iii. The performance and requirements of a USO should be benchmarked and updated on a regular basis;
 - iv. It could be delivered through many different technologies, fixed or wireless, depending on the underlying nature of existing and future infrastructure as well as geographic and localised considerations;
 - v. Due consideration should be given as to how other regulated industries such as electricity and postal services apply universal service obligations and what approaches and / or lessons can be learnt from the application in these sectors.

We would encourage an overarching policy and regulatory strategy and framework that seeks to (i) understand local markets and economic conditions; (ii) uses both ex ante and ex post measurement to gauge service delivery; (iii) reduce the cost of finance to support investment; and (iv) endeavours to meet the digital aspirations of all communities. Within this framework, Government and Ofcom should consider local economic bottlenecks as well as a national assessment of bottlenecks. Such an approach will have different effects on competition, and likewise, delivery. Over reliance on competition will leave many parts of the UK lagging in digital investment and in levels of digital service.



SCOTTISHPOWER

[name redacted]
[job title redacted]

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

10 February 2017

Dear Team,

NATIONAL INFRASTRUCTURE ASSESSMENT: CALL FOR EVIDENCE

We welcome the opportunity to respond to the above Call for Evidence. This response is on behalf of the ScottishPower group and is particularly relevant to our thermal and hydro generation, renewables and networks businesses.

We support the high level objectives of the National Infrastructure Commission (NIC). In particular, we agree that an independent NIC can help to promote a better quality of discussion on future infrastructure projects, and, in turn, ensure that decisions are made in a timely fashion and on the basis of robust analysis and evidence. A key aspect of this will be helping to promote a political consensus around long-term infrastructure plans.

Clearly, the National Infrastructure Assessment (NIA), setting out the NIC's assessment of long-term infrastructure needs, will be at the heart of this important work. As the NIA has the challenging task of horizon-scanning for future infrastructure issues over an extensive time period, up to 2030 and beyond, we have focused our response on some of the key developments and areas that we currently see as being important as part of the transition to a low carbon economy, namely:

- Facilitating an effective switch from coal to gas generation in the power sector consistent with the Government's commitment to restricting coal generation in the early 2020s and taking it off the system by 2025;
- Continuing deployment of cost effective large scale renewable generation through the 2020s, including offshore and onshore wind in suitable locations;
- Promoting a greater role for storage to support a smarter power system, including greater deployment of large-scale storage such as pumped storage;
- Whilst recognising the potential role of interconnection, ensuring that overseas generation competes with domestic generation across interconnectors based on a level playing field and maintains an appropriate balance between our reliance on domestic generation and interconnection in terms of ensuring security of supply and resilience;

ScottishPower, London Office, 4th Floor, 1 Tudor Street, London EC4Y 0AH

[redacted]

www.scottishpower.com

[contact details redacted]

• Conducting further analysis and policy work on how best to address cost-effectively the huge challenge around the decarbonisation of heat, taking into account research on consumer views and demand;

• Undertaking further analysis and research on the potential large-scale uptake of electric vehicles in terms of wider system and infrastructure impacts and needs.

We have attached an Annex containing our views on the questions specific to the energy sector and on some energy-relates cross-cutting issues.

If you have any questions regarding any aspect of this response, please do not hesitate to contact me.

Yours sincerely,

[Redacted signature]

[signature redacted]

[Redacted name]

[Name redacted]

[job title redacted]

ScottishPower response to energy questions and energy-related cross-cutting issues**ENERGY****Question 19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?**

The decarbonisation of heat is a difficult problem and it is not yet clear whether the most cost-effective solution has been found. It would be premature to focus on one particular technology until there is a clearer idea of how technologies will develop and perform in the future. The timing of decisions on large scale roll out will inevitably be linked to when there is confidence in the availability of a cost effective way forward that consumers and industry will accept.

In particular, we are some way from having low carbon solutions on heat that are competitive on cost and performance with a modern condensing gas boiler. This suggests that the gas pipeline infrastructure will be with us for some time to come and that consumers who do not have the option of mains gas will tend to be more accepting of current low carbon heat technologies than those who do. We therefore believe that it is beneficial at present to focus the application and demonstration of innovative technologies (such as heat pumps) in off-gas grid areas.

Question 20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

We support the Government's continuing commitment to progressing with cost-effective decarbonisation, consistent with the provisions of the Climate Change Act 2008 (and as reflected in the Government legislating for the 5th Carbon Budget for 2028-32). This commits the UK to a 57% reduction in emissions on 1990 levels by 2030 which involves substantial decarbonisation of the power sector by the 2030s.

This means that there will need to be continuing progress towards the decarbonisation of the power sector in the 2020s, building on the delivery to date and planned for the rest of this decade. We see continuing to develop and deploy renewable technologies at scale as being a key part of this, including offshore and onshore wind. Given that onshore wind is the lowest cost large-scale low carbon technology, we strongly consider that its continuing deployment in the 2020s should be promoted provided it is taken forward in appropriate locations where there is public support.

Throughout this process, affordability will be critical. It is a statement of the obvious that if an option is unaffordably expensive, it will ultimately get scaled back until it is affordable. Successful decarbonisation can only be achieved within cost parameters that are feasible.

Accordingly, we would stress the need for caution and robust cost assessment when considering the potential role of novel high cost options in the transition to a low carbon economy, particularly given the difficulty of delivering such projects through some form of competitive allocation. For example, the Government is currently considering these important issues following the recent publication of the Hendry review into the strategic role of tidal lagoons in the UK.

In this context, we would highlight the importance of such competition taking place on a level playing field in the various markets (such as the Capacity Market and the ancillary service markets) that will procure the capacity that the system requires to cost effectively balance supply and demand. One aspect of delivering effective competition based on a level playing field involves having a clear overview and understanding of the interactions between the various markets, possible revenue streams and charging regimes. A good example of this relates to the important work currently being done by both BEIS and Ofgem on addressing

As we outlined in our response to your Call for Evidence on System Flexibility at the end of 2015, when considering the delivery of flexibility we think it is important not to be technology-specific, but rather develop functional specifications that can be met using various technologies. For example, 'flexibility' is about the speed of response and the magnitude and duration of response, rather than any given specific technology. Indeed, this kind of approach facilitates the promotion of competition between technologies thereby promoting cost-effective delivery.

Smart power and promoting effective competition

On the role of interconnection, we are fully supportive in principle of the potential benefits arising from trade with Continental Europe through greater cost-effective interconnection. However, as with all efficient linking of markets to facilitate international trade, it is essential that this takes place based on a level playing field if the benefits are to be realised in a cost-effective and economically efficient way.

In the case of the GB electricity market, we consider that there are number of dimensions of the charging and taxing regime, as well as the regulatory framework for interconnectors, which have the effect of distorting the market in a way that creates a fundamentally uneven playing field between domestic generation and overseas imported generation. Taken together, these various elements significantly disadvantage domestic generation in its competition with imported electricity from overseas generators. We consider that this issue will need be addressed over the medium term and would note that Brexit could provide additional scope to take this work forward.

We consider the most promising approach would be to develop a Cap and Floor mechanism (similar to that already available to investors in interconnectors) to support investment in new PSH (and other large scale storage technologies).

In this context, pumped storage hydro-electric (PSH) and battery storage have very different characteristics and will have complementary roles in this future mix of flexibility assets. Both can provide a range of benefits including improved system operability, reduced network congestion costs, reduced CO₂ emissions and improved security of supply. However pumped storage can be deployed at scale, has an exceptionally long operating life and is particularly well suited to applications requiring longer discharge times. It is therefore likely that the optimal future mix will involve significantly more pumped storage capacity than is installed at present and, if overall system costs are to be minimised, it will be important to remove barriers to the further development of PSH.

This drive towards further deployment of low carbon generation will need to be complemented by investment in new large scale gas generation, storage and potentially other innovative technologies so as to deliver security of supply and system flexibility in an energy system that is based on a higher volume of intermittent renewable generation. The requirements for storage are likely to apply on differing timescales: minute by minute to address short term fluctuations in supply or demand, and over a period of hours, to smooth out slower moving variations in supply or demand, typically within a day.

the 'hidden subsidies' to small-scale embedded generation (through the grid charging regime and current structure of the CM supplier obligation) which significantly distort outcomes in the Capacity Market.

Question 20. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Significant uptake of electric vehicles (EVs) could have significant implications for the electricity system, particularly local distribution networks, if there are high concentrations of EVs in any one area. Charging of these EVs will, therefore, need to be carefully managed and it will be important to strike the right balance between managing this charging through price signals and possibly an element of direct control by distribution network operators (DNOs).

Whilst the long term aim should be for consumers to be able to choose when to charge their EVs based on time-of-use price signals facilitated by smart meters, if EV usage grows strongly it may be necessary in some cases in the medium term to provide DNOs with the ability to have an element of direct control over these resources (possibly mediated by the supplier) so as to limit the need for (otherwise unnecessary) local network reinforcement.

However, this clearly raises important issues in terms of consumer control and this will need careful consideration including robust and widespread trialling evidence around what different types of consumers in different areas might or not might find acceptable. For example, consumers may be cautious about any arrangement that risks leaving their car with insufficient range at a time when they want to make a journey. It will be important to monitor the impact of EVs on the electricity system over time as uptake increases.

CROSS-CUTTING ISSUES

Question 10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The Planning System is critical to the successful delivery of national infrastructure priorities, in terms of an efficient and timely consenting mechanism and to ensure that projects can move smoothly from consent through to construction and operation. Whilst we consider that the Planning Act process is operating effectively, there are a number of areas where small improvements could be beneficial in terms of increased flexibility and efficiencies.

There is an opportunity to address matters of importance to the successful and efficient delivery of infrastructure priorities through the National Policy Statements (NPS). Many of the current NPSs are to be updated shortly and there could be a role for the NIC in providing evidence on particular sectoral requirements. In this context, we welcome the projected 30 year timescale of the NIA, and it is important that any review of the NPS's also consider the long term energy infrastructure requirements.

The NIA should also look to review thresholds for nationally significant infrastructure projects (NSIPs) and the introduction of a more proportionate approach to applying the requirements of the Planning Act 2008. For example, in terms of thresholds, consider the height of a 132kV overhead Trident wood pole line (on average 12m) and that of a 33kV overhead wood pole (standard height of 10m). If the Trident wood pole is installed over a distance of 2km or

more a Development Consent Order (DCO) consent is required. However, a 33kV overhead wood pole line only requires s37 consent under the Electricity Act 1989. We would argue there is less of a difference between the 33kV and 132kV wood poles when comparing a 132kV Trident wood pole with a 132kV tower (on average 26m). The likely environmental impacts for wood poles are significantly less and we would therefore suggest reviewing the appropriate consenting process to remove all 132kV wood towers from the DCO process.

We would also welcome a more proportionate approach applied to different schemes coming through the DCO process. For example, the precautionary approach advocated by the Planning Inspectorate can lead to some projects, which are at the lower end of the threshold, requiring DCO consent during the Examination stages. This can over-complicate the process and stretch resources for all those involved including Interested Parties.

A more proportionate approach in the NSIP process for material and non-material changes to DCOs would also be helpful. There is an eight month statutory timeframe for material changes to DCOs but no statutory timescale for non-material changes to DCOs. We acknowledge that efforts are made to ensure timely and robust decisions for both material and non-material changes to DCOs. However, current figures show that non-material decisions can take up to ten months with an average of seven months for determination. We would recommend a three month timescale for decision-making for non-material changes to DCOs. This would allow sufficient time for consultation and would be proportionate to the level of impact proposed by minor, non-material changes.

We also consider that it would be timely to review the planning system in respect of some of the primary and secondary legislation. With regard to key planning legislation, there could be some efficiencies in consolidating a number of new provisions introduced through legislation since the 1990 Town and Country Planning Act. This could include listed building consents.



[name redacted]
SGN
Station
Approach Horley
Surrey
RH6 9HJ

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

10 February 2017

SGN Response to National Infrastructure Assessment Call for Evidence

Dear Sir/Madam,

SGN welcomes the opportunity to respond to this National Infrastructure Assessment Call for Evidence. As you may be aware, SGN manages the network that distributes natural and green gas to homes and businesses across Scotland and the south of England. We deliver a safe, secure and reliable gas supply to 5.9 million customers through 74,000km of pipeline.

We welcome that the Commission has identified that decarbonising heat at an affordable cost is one of the UK's pressing infrastructure challenges. It is only recently the scale of this challenge has started to be fully appreciated. With peak heat demand around four times greater than peak electricity demand, there is a growing weight of evidence that low carbon solutions which utilise our existing gas network infrastructure will allow for the decarbonisation of heat in the most affordable way.

We now believe there is a significant opportunity for the Government to look beyond the widespread electrification of heat, and towards a low carbon transition aligned more closely to its priorities to deliver secure and affordable energy to customers. The injection of renewable gas, such as biomethane and hydrogen into the gas networks, will allow UK customers to continue to benefit from our existing gas network infrastructure, a uniquely flexible asset already built to meet peak heating needs.

Our response focuses on question 19 posed by the commission relating to the highest value solution for decarbonising heat, and question 21 on the energy implications for low carbon vehicles. If you have any questions on the points raised please don't hesitate to contact me by email at [email redacted].

Kind regards

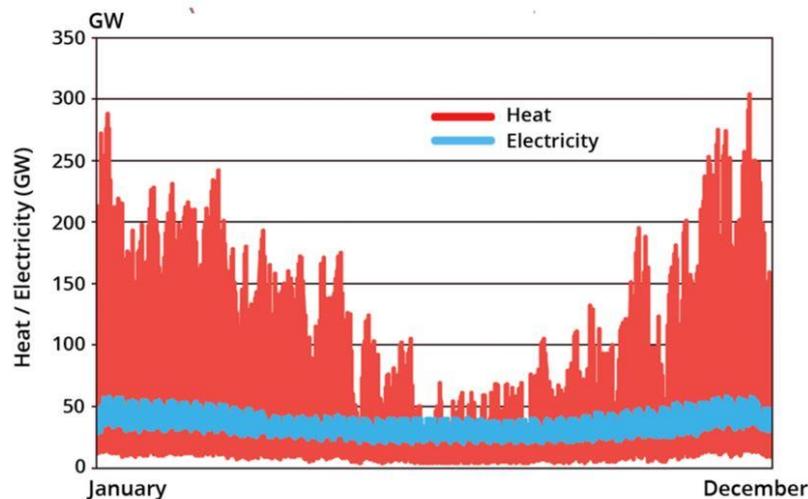
[name redacted]
[job title redacted]

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

As noted previously, we welcome that the Commission has recognised that the decarbonisation of heat is one of the UK’s most pressing infrastructure challenges. With peak heat demand around four times greater than peak electricity demand, ensuring this continues to be met in an affordable way will require detailed consideration of the energy infrastructure required.

We know we need a solution which is clean and meets the country’s 80% carbon reduction target from 1990 by 2050. We also want it to be affordable and able to continue to meet peak demand on the coldest of days too. But to understand what might be the highest value solution for decarbonising heat, we feel it is crucial to understand how heat demand is met today.

Heat demand today accounts for around 45% of total UK energy needs¹. While electricity demand remains fairly constant throughout the year, heat demand is around four times higher than peak electricity demand in winter. Currently the UK’s gas network infrastructure allows these extreme peaks in heat demand in winter to be met in an affordable way, with customers paying a third of the price per unit of gas, than for electricity.



Source: DECC’s “Future of Heating” strategic framework, 2012.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48574/4805-future-heating-strategic-framework.pdf.

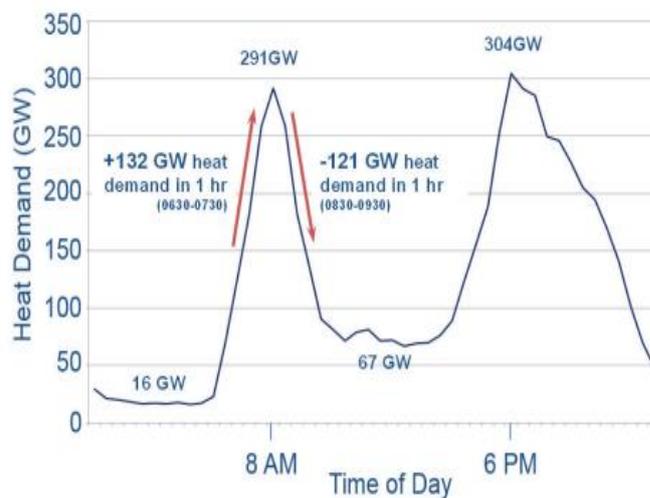
With almost 85% of homes and many businesses connected, the UK benefits from one of the most extensive gas networks in the world. As well as being extensive, the gas networks also provide a means to transport three times more energy over the course of the year than the electricity networks. Without the gas networks we simply wouldn’t have the means to transport the vast amounts of energy required during peak periods.

The gas networks are also a uniquely flexible part of our energy infrastructure. On a cold winters day the gas networks have the ability to ramp up to just over 130 GW in just an hour to allow peak heating needs to be

¹ DECC (2015) Energy Consumption in the UK, 2013 data

met. To put that into context, peak UK electricity demand is less than 60GW². These very large swings in heat demand can be met because of the capability of the gas system to store significant volumes of energy and then quickly convert this into heat as required.

Recent research by Imperial College suggests the gas network is capable of storing 50,000 GWhs of energy at any time, whereas, the electricity system is only capable of storing 27 GWhs of energy³. This independent study also suggests the cost of storing electricity is also at least 2,000 times more expensive than gas (on a £/MWh basis). Therefore, there is a growing weight of evidence that low carbon solutions which utilise our gas network assets will allow us to decarbonise heat in the most affordable way.



Source: Robert Sansom, Imperial College (2011)

We believe that there is now a significant opportunity for the Government to develop a strategy to decarbonise heat which is more closely aligned to its priorities to deliver secure and affordable energy to customers. The current strategy published by the former Department of Energy and Climate Change (DECC) in 2013 suggested a large proportion of future heat demand would be met by electric heat pumps. This would require significant investment in additional electricity generation and reinforcements to the electricity networks to allow it to transport the volumes required. This has been shown to be a pathway that would be very expensive⁴. These costs would ultimately be passed on to customers via their energy bills.

Heat is inherently a local issue and therefore the decarbonisation of heat is likely to require a portfolio of solutions depending on a range of location specific factors. The electrification of heat may be the most appropriate solution to decarbonise heat in certain areas. This could be for households off the gas grid who currently rely on high carbon fuels such as heating oil or coal and have sufficient space for an air or ground source heat pump. In off gas grid areas, the disruption caused by the work that would be required to upgrade the electricity network to meet the large increase in demand, may also be more acceptable to customers.

² Sansom, R. (2014) Decarbonising Low Grade Heat for a Low Carbon Future. Imperial College

³ <http://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Heat-infrastructure-paper.pdf>

⁴ https://policyexchange.org.uk/wp-content/uploads/2016/11/PEXJ4810_Too_hot_to_handle_09_16-V2-WEB.pdf



Electric heat pumps are capable of being more efficient than gas boilers, taking advantage of the latent heat that exists in the ground, water or air. However, research has shown that efficiencies tend to vary considerably in real life scenarios, and also fall in line with temperatures⁵. This means that heat pump efficiencies are likely to be at their lowest at times of peak heat demand which could add to the level of electricity network reinforcement needed.

At the moment electric heat pumps (£8,500–£13,000) are considerably more expensive than gas boilers (around £2,500)⁶. Although heat pump costs may fall slightly, research has shown that the majority of households would still need substantial financial help to install one⁷. The additional insulation and larger radiators that would be required within homes for heat pumps to operate efficiently would also be costs that would be passed on to customers. The difficulty to date in deploying heat pumps suggests that public acceptance could be a major barrier to future heat solutions which require large changes in behaviour.

Fuel Poverty and Affordability

Ensuring heat continues to be affordable will need to be one of the key considerations when determining the highest value solution for decarbonising heat. Currently, the cheap and reliable nature of the heat delivered by our gas network infrastructure has very important implications for fuel poverty. SGN and the other Gas Distribution Networks (GDNs) play a key role in combating fuel poverty by extending our networks to fuel poor communities. This Fuel Poor Network Extension Scheme (FPNES) administered by Ofgem continues to be recognised as one of the most effective tools to combat fuel poverty.

Extending the network for these kinds of connections can both reduce heating costs removing people from fuel poverty and reduce carbon emissions from homes which were previously heated using oil or electricity. Because heating your home by gas is around 3 times cheaper than using electricity, consumers can save over £400 per year. We have provided over 30,000 of these connections since the FPNES was introduced in 2008. Across GB 91,203 of these connections will be delivered over the course of the RIIO-GD1 price control period which runs from 2013-2021⁸.

As our gas network infrastructure is largely underground, it is also highly resilient. The gas network is over 99.9% reliable, with unplanned outages expected once every 40 years⁹. This level of reliability is important in meeting the heating needs of vulnerable customers, particularly during winters where the UK experiences severe storms and interruptions to power supplies can occur.

Green Gas

The injection of renewable gas, such as biomethane and hydrogen into the gas networks, will allow UK customers to continue to benefit from our existing gas network infrastructure already built to meet peak heating needs.

⁵ Roy, Robin; Caird, Sally and Potter, Stephen (2010) [Getting warmer: a field trial of heat pumps](#). The Energy Saving Trust, London, UK.

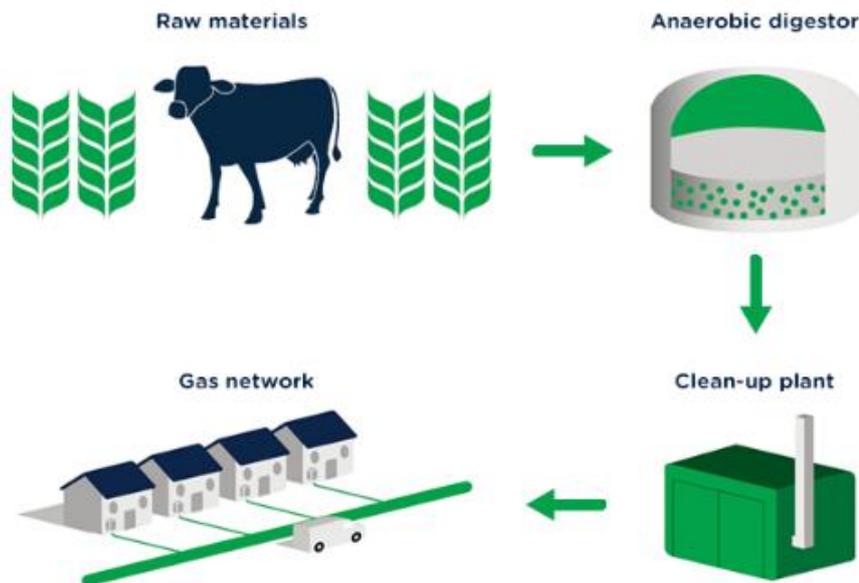
⁶ https://policyexchange.org.uk/wp-content/uploads/2016/11/PEXJ4810_Too_hot_to_handle_09_16-V2-WEB.pdf

⁷ Wales and West Utilities, "[Bridgend Future Modelling](#)" (2015)

⁸ https://www.ofgem.gov.uk/sites/default/files/docs/2015/09/fpnes_3009_published_2_0.pdf

⁹ https://www.ofgem.gov.uk/system/files/docs/2016/03/riio-gd1_annual_report_2014-15_final.pdf

Biomethane (also known as green gas) is produced by the breakdown of organic material such as food waste or crops by anaerobic digestion. Once cleaned up to remove contaminants it is injected into the gas network and used like natural gas for heating and cooking. It is already helping to decarbonise the gas flowing through the UK’s gas networks. It is also helping to diversify supply sources, in turn reducing the reliance on imports, increasing security of supply, as well as stimulating economic activity and employment.



By taking the carbon element out of the gas flowing through the networks, customers can be provided with a low carbon heating solution without the need for new heating systems in their homes. Unlike other low carbon heat options, the use of green gas requires no expansion of gas or electricity networks, saving money for consumers.

Having led the way in the development of green gas, we already have over 160,000 homes supplied, with a target to increase this to 250,000 homes by 2021. Out of the 60 fully registered UK projects, we have 30 biomethane sites connected to our network. The Renewable Heat Incentive (RHI) scheme has enabled the UK to become the fastest growing and most innovative biomethane market in Europe.

A recent decision to limit the support available under the RHI to projects that primarily use crops as feedstock could reduce the number of new biomethane projects coming online. As a lot of food waste is locked into long term contracts, we urge the government to align its waste policy to the changes in the RHI, to ensure sufficient feedstock remains available. While we welcome the news that the RHI tariff for biomethane will be raised back up in April 2017, in order to continue the impressive growth seen in recent years there is a need for more stable levels of support, and clarity on how biomethane will be supported beyond 2021.

Real-Time Networks

We recognise the gas networks will need to become more flexible as we move to a lower carbon future with a greater integration of renewables. We are therefore undertaking a project to develop a ‘real-time network’



that can support a greater volume of renewable gas like biomethane and hydrogen¹⁰. This will be achieved through the installation of sensing technologies in a section of our network in the Medway towns in North Kent.

As greater volumes of renewable gas are injected into the network, we will need to measure the energy content of the gas in the grid, rather than just the traditional flow and volume. The sensors will measure variables including flow, pressure, temperature, and gas quality. As well as enabling greater volumes of renewable gas into the network, the flexibility will increase the gas network's ability to adapt to the future energy needs of GB.

Hydrogen

Hydrogen is an emerging green energy source which we believe could offer a high value solution to the challenge of decarbonising heat. It would leave no carbon footprint as the combustion of hydrogen with oxygen results in water and heat. In the short term this could be blended with natural gas in the network, offering many of the same benefits as biomethane in terms of making use of our existing gas infrastructure to decarbonise heat.

There is a growing role of hydrogen within other gas distribution grids and we must aim to maximise its potential in the UK. Current legislation only allows for the blending of 0.1% hydrogen by volume with natural gas within the UK gas network¹¹. Studies have shown existing appliances can operate safely with up to 10% hydrogen by volume¹². In Germany, up to 10% hydrogen is already permitted within the gas distribution system utilising renewable electricity produced at times where supply exceeds demand to split water to produce hydrogen.

A research project we were involved in called Hyhouse, investigated the potential safety risks of using the gas as a heating fuel. The results of the project showed that hydrogen 'poses no significant increase in risk to methane' if released in a domestic environment¹³. The use of hydrogen within the UK gas networks is also not a new concept, as it made up around half of the old town gas mix.

In the longer term there is the potential to convert the low pressure gas distribution networks to 100% hydrogen networks. A key advantage is that the gas distribution system would need minimal modification, as old metal pipes are already being replaced by plastic ones which are potentially suitable for the transportation of hydrogen, at low pressure with very low losses¹⁴. It is envisaged the majority of the low pressure distribution network will be made up of plastic polyethylene pipe by 2032 as a result of the Iron Mains Risk Reduction Programme (IMRRP).

Hydrogen is a technology that would benefit from a holistic whole systems approach to decarbonisation as it could make a significant contribution to reducing emissions in both the heat and transport sectors. SGN is committed to a 100% hydrogen network demonstration in Scotland. We are currently undertaking feasibility

¹⁰ <https://www.sgn.co.uk/real-time-networks/>

¹¹ Health & Safety Executive. (1996) A guide to the Gas Safety (Management) Regulations 1996.

¹² <http://www.hse.gov.uk/research/rrhtm/rr1047.htm>

¹³ http://www.igem.org.uk/media/361886/final%20report_v13%20for%20publication.pdf

¹⁴ <http://discovery.ucl.ac.uk/1391051/3/1-s2.0-S0360319913006800-main.pdf>



studies for 3 sites, seeking to select the most economic and viable location to construct the world's first hydrogen network¹⁵. Each site will be scalable and will look to utilise the hydrogen infrastructure in place for other applications including hydrogen vehicles and Combined Heat and Power (CHP) applications.

KPMG Report - The UK Gas Networks role in a 2050 Whole Energy System

There is a growing weight of evidence that solutions which utilise our existing gas network assets will allow us to decarbonise heat in the most affordable way. In 2016, the Energy Networks Association (ENA) who represent the electricity and gas network operators in the UK and Ireland commissioned KPMG to produce a report on 'The Gas Networks role in a 2050 whole energy system'¹⁶.

The study looked at four possible pathways that the heat sector could be decarbonised; evolution of gas networks and green gas; prosumer (self-generating energy solutions); diversified energy sources with different technologies used across the country; and electric future with a switch to electric heating technologies like heat pumps.

The report found that injection of renewable gas into the grid, such as biomethane and hydrogen, offers significant cost savings against alternative low carbon heating sources. It was also shown to be the most practical option in terms of technical feasibility and importantly, the most acceptable to customers and society. Customers place great value on the convenience and reliability of the way heat is currently provided¹⁷. The report highlighted this as an important consideration in future policy decisions.

The analysis called for gas and heat innovation and funding to continue, especially in areas that help to firm up the understanding of options for 2050. It also recommended that transport decarbonisation policy be more closely integrated with power and heat decarbonisation policy.

Policy and Regulatory Decisions

The UK Government is developing work considering long term heat decarbonisation and the impacts on infrastructure requirements the different option, or mix of options would have. This will, over the coming years, gather evidence and analysis and try to fill key gaps relating to options such as future of the gas grid, electrification of heat and district heating. Policy decisions on heat from the UK Government are not expected to be made until the next Parliament i.e. 2020.

As suggested by the Committee on Climate Change (CCC) in their recent report on 'The Next Steps for UK Heat Policy', action is needed now in order for informed decisions to be made during the next Parliament (2020-2025)¹⁸. We believe it is crucial the UK Government takes forward the CCC's recommendation to commence a significant programme of work on options around converting the gas grid to hydrogen. This will allow for decisions to be made on rolling this out at scale in the next Parliament.

¹⁵ <http://www.smarternetworks.org/Project.aspx?ProjectID=2051>

¹⁶ <http://www.energynetworks.org/assets/files/gas/futures/KPMG%20Future%20of%20Gas%20Main%20report%20plus%20appendices%20FINAL.pdf>

¹⁷ [Hoggett, R., Ward, J. and Mitchell, C., 2011. Heat in homes: customer choice on fuel and technologies. Study for Scotia Gas Networks, Energy Policy Group, University of Exeter, Exeter.](http://www.scotiaenergygroup.com/heat-in-homes-customer-choice-on-fuel-and-technologies)

¹⁸ <https://www.theccc.org.uk/publication/next-steps-for-uk-heat-policy/>



We would like to see much closer working between the Scottish Government and the UK Government as they work to identify the highest value approach to long term heat decarbonisation. While we strongly welcome the Scottish Government's interest in SGN's practical demonstration of a 100% hydrogen network in Scotland, we feel the evidence being gathered by the UK Government can help inform the Scottish Energy Strategy currently being consulted on. This is particularly important as decisions on the future of the gas network itself are reserved to the UK Government (whatever gas is transported through those pipes)¹⁹.

The Gas Distribution Networks are currently half way through the current eight year RIIO-GD1 price control period set by Ofgem which began in 2013. The next price control period, RIIO-GD2 will commence in March 2021, providing a fast approaching deadline for regulatory decisions on the gas networks covering the eight-year period out to 2029. While we welcome the UK government's re-assessment of the best value option to decarbonise heat, there is a need for some clarity in terms of policy direction as soon as possible due to the long term nature of network investment.

While delivering a low maintenance fit for purpose gas network for the future will not require significant new investment, it is important that the IMRRP continues at current levels. Under this programme significant sums are already invested to replace metal gas mains with modern plastic pipes. We believe it is crucial this programme is continued at current levels during the RIIO-GD2 price control period to ensure potential least cost routes to UK heat decarbonisation utilising our gas network infrastructure are kept open.

If the decision is made to repurpose the gas network to transport hydrogen, the costs of this could be absorbed into the normal regulatory processes of the gas industry. This would involve the capital and operating costs of the hydrogen supply being accounted for in the appropriate regulatory settlements, on a similar basis to the current IMRRP.

For all of the main approaches to heat decarbonisation, Carbon capture and storage (CCS) is likely to be vital in order to remain compatible with our climate change targets. This is either because of the need to significantly increase electricity production at the required new power stations, if electrification were to be deemed the highest value solution, or to produce decarbonised hydrogen.

We therefore see it as essential the government support CCS development across not just the power sector but also heat and transport. As identified in a recent report to the Secretary of State on 'Lowest cost decarbonisation for the UK economy', having the option to begin converting the gas network to hydrogen in the 2030s requires CCS transport and storage to be in place during the 2020s²⁰.

21. What are the implications of low carbon vehicles for energy production, transmissions, distribution, storage and new infrastructure requirements?

In order to meet our climate change targets in the most efficient way we believe there is a need for greater integration between the transport, electricity and heat sectors. For example, there could be a huge

¹⁹ <http://www.gov.scot/Resource/0051/00513102.pdf>

²⁰ http://www.ccsassociation.org/index.php/download_file/view/1043/508/



opportunity to use our existing gas network infrastructure to provide a cleaner, quieter and cheaper alternative to diesel.

Currently, 25% of total greenhouse gas (GHG) emissions comes from transport, and of that, around a quarter is produced by heavy goods vehicles (HGVs) and buses. But because these vehicles actually account for only about 1.5% of all road traffic in the UK, their emissions are disproportionately high. Whilst electrification is one of the leading options to decarbonise transport in smaller vehicles, it is not a practical solution for HGVs and buses. Compressed Natural Gas (CNG) is currently the leading option in this area. As well as being cleaner and quieter than diesel, it is also 30% cheaper.

Utilising biomethane in HGVs can unlock additional benefits in terms of the carbon benefits achieved. The Renewable Transport Fuel Obligation (RTFO) has suffered because support has been restricted to biomethane transported straight from the source of production to the vehicle being fuelled. We welcome the Department for Transport's (DfT) intention to make biomethane injected and delivered by the gas distribution network eligible for support if it is then used as a transport fuel.

A host of British retailers including John Lewis have recognised the cost and carbon benefits of converting its fleet of long distance HGV fleets to run on CNG. The first high pressure CNG filling station which opened at Leyland in Lancashire last year is capable of filling over 500 HGVs a day. CNG is also a leading solution to green the UK's bus fleet and there are already 34 CNG buses and over 100 taxis benefitting from a gas refuelling station connected to our network in Reading.

There could also be an important role for hydrogen as a future transport fuel as it produces no harmful emissions, emitting only water vapour. As well as improving air quality, hydrogen vehicles are also quieter and smoother to run. Hydrogen can be produced by electrolysis, utilising green electricity to split water into its constituent parts, oxygen and hydrogen. We are a partner in the Aberdeen Hydrogen Bus Project, Europe's largest demonstration of hydrogen fuel cell buses. The fleet of 10 hydrogen buses is part of an initiative which aims to commercialise hydrogen fuel cell buses across Europe.

With less than half of the British rail network electrified and electrification proving expensive, there is increasing focus on the potential for CNG or hydrogen to decarbonise rail transport. This is in particular for the large number of diesel trains operating on routes that do not attract the volumes of traffic that would make electrification viable. CNG or hydrogen trains could therefore provide a lower carbon solution to reduce emissions from transport, taking advantage of our existing gas network infrastructure. The world's first zero-emission, hydrogen powered train is expected to enter service in Germany next year.

As mentioned in our answer to question 19, hydrogen is a technology that would benefit from a holistic whole systems approach to decarbonisation.

**Sheffield City Region
11 Broad Street West
Sheffield
S1 2BQ**

10 February 2017

Dear Sir/ Madam

NATIONAL INFRASTRUCTURE ASSESSMENT: CALL FOR EVIDENCE (FEBRUARY 2017)

The Sheffield City Region (SCR) is strongly supportive of the NIA Call for Evidence and recognises that infrastructure is key to unlocking and driving the SCR's economic growth. Our Strategic Economic Plan (SEP) sets an ambitious target to increase GVA to £3.1bn by 2025. To secure these outcomes we will deliver enhanced infrastructure, supporting an attractive environment for businesses and residents.

We have a strong track record in infrastructure delivery through our existing SCRIF Programme (Sheffield City Region Investment Fund), valued at £650m. This infrastructure investment is unlocking the following benefits for the City Region:

- GVA (£) 2,974m
- Private Sector Leverage (£) 956m
- Jobs Created Number 20,452 (net)

In November 2016, we launched an early commission call for new projects to the existing programme and the Combined Authority has just approved a further £46m of projects, delivering significant additional benefits to the SCR including:

- GVA (£) 561m
- Private sector leverage (£) 213.5m
- Jobs Created 4109 (net)
- New homes 1978

The SCR's future infrastructure requirements are contained within our recently launched Integrated Infrastructure Plan (IIP), this plan is the first of its kind in the country. The IIP recognises the full range of infrastructure requirements needed to unlock growth.

This plan clearly articulates and evidences the diverse range of opportunities that our infrastructure investment will unlock in the City Region and identifies £28bn of infrastructure investment opportunities surrounding the SCR's growth areas and these opportunities are presented as spatial packages. Our IIP recognises the need for a focus on multiple infrastructure types to enable a comprehensive understanding of SCR's challenges and opportunities, whilst aligning itself with national agendas such as HS2, Northern Powerhouse and Transport for the North as well as alignment with Local Plans and Strategies.

A programme led approach is proposed, utilising a single collaborative commissioning approach linked to integrated funding sources to drive the delivery of schemes. This is to ensure that the SCR has appropriate infrastructure governance arrangements in place to deliver a pipeline of infrastructure projects in the short, medium and long term as efficiently as possible and on time.

I attach a copy of the Sheffield City Region's Integrated Infrastructure Plan to inform your evidence base. The SCR would welcome the opportunity to work with the National Infrastructure Commission in the future and the IIP provides a real opportunity for the Government to work with the SCR to progress infrastructure investment.

Yours faithfully

National Infrastructure Commission
The National Infrastructure Assessment Call for Evidence
A Shropshire Response, 10th February 2017

Local contact details:

Report Editor:

[Name redacted]

[Job title redacted]

Shropshire Council

Shirehall, Abbey Foregate, Shrewsbury

Shropshire SY2 6ND

Telephone [Phone number redacted]

Email [email address redacted]

Foreword

This response sets out to be a collegiate response, submitted on behalf of Shropshire Council, and supported and informed by response also being made by Herefordshire Council. The Herefordshire and Shropshire responses have both been shared with the Marches LEP and strengthened by input from the LEP, making these very much partner and partnership documents from the Marches subregion.

As will be noted by the National Infrastructure Commission, there are commonalities of views, as befitting our shared approaches in the subregion, as well as additional local detail from a local authority perspective. The Shropshire response is further informed, for example, by evidence already given to the National Infrastructure Commission through the regional workshop held by the West Midlands Combined Authority (WMCA) on 19th January 2017.

The Council previously made submissions to the Infrastructure Commission in response to calls for evidence with regard to energy and electricity, and with regard to northern connectivity (8th January 2016). The following extracts from the latter submission provide the context for the submission that we now make.

“As a large, rural and sparsely populated county (310,000 population; 0.96 persons per hectare (Source: ONS mid- year estimates, 2014), Shropshire is dependent on a good, well connected and integrated road network, which links to rail networks and to airports. Travel to work patterns across our porous borders indicate large numbers travelling for work to the West Midlands, to the South and East, and North and North West, to Cheshire, Staffordshire and Manchester and beyond, as well as into Wales.

“This Council has previously made submission to the BIS Select Committee Inquiry into the Government’s Productivity Plan, and was one of just two rural unitary authorities to do so, the other being Cornwall. We have already commented to that Committee as follows: “In welcoming the forthcoming new long-term National Infrastructure Plan (NIP), Shropshire Council advocates that Government follows the

Natural Capital Committee recommendation for incorporation of natural capital into each of the economic infrastructure sectors including energy, flood defences and water, and for an investment programme for natural capital to explicitly feature in the NIP. (paragraph 4.1 of the Shropshire Council response)

“Shropshire sits within the Marches LEP, one of the largest geographical LEPs in the country covering the local authority areas of Herefordshire, Shropshire and Telford & Wrekin. It is an area of both urban and rural assets; Hereford, Shrewsbury and Telford are the principal urban settlements which provide employment and social opportunities, supplemented by market towns and villages, whilst the landscape supports a rural economy of farming and tourism and attracts people to live and work in the area.

“This natural landscape itself presents a tangible economic asset, given the actual and potential positive value of natural capital. For this reason, we advocate including the actual and potential positive value of natural capital as a specific measure to aid productivity growth, using measures such as site based natural capital assessments.

“The physical realities of a geography that includes the River Severn and upland and hill areas, with a dependency on key arterial routes through the region that are liable to flooding, causes practical challenges around transport connectivity exacerbated by ongoing challenges around digital connectivity.”

The Marches forms the southern boundary of the Northern Gateway, where the subregion directly adjoins Chester West and Chester and Cheshire East, whilst Shropshire and the Marches is equidistant to Manchester and Birmingham and is closer to Chester than Worcester. The Marches also forms the western boundary of the Midlands, and benefits from close proximity to a number of other urban centres: Stafford; Stoke-on-Trent; Worcester; and Cheltenham/Gloucester/Bristol.

Looking to the devolved administration, and to national and international borders, the Marches plays a key role linking England and Wales with towns located on the periphery of the Marches, including: Wrexham; Welshpool; Newtown; Abergavenny; and Monmouth, and through the A483 and A55 to Holyhead and Ireland.

These strategic links mean that the Marches has a role to play in the regional, national and international economy. The following responses have been made with regard to the twenty-eight questions posed by the NIA in its Call for Evidence for the UK’s first ever National Infrastructure Assessment (NIA). We would be pleased to provide any further information or clarification of the points that we make. Thank you.

Twenty Eight Questions

The questions that the Commission has identified to assist respondents in focusing their submissions to this call for evidence are set out below, with responses.

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support longterm sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

A contention from the Shropshire and Marches region would be that infrastructure investments are most likely to lead to long term sustainable growth in the region where there is collaboration and ongoing engagement between the private and public sector, taking a long term view rather than a piecemeal project by project approach, and reframing that view in the light of local evidence. Such an approach relies not only upon the collective acquisition and forensic analysis of local data, but also the recognition at national level of the importance of utilising this intelligence to better understand local geographical, demographical and political realities and shape national policy accordingly.

In Shropshire, by way of illustration, we work within the Marches LEP and with neighbouring authorities for mutual benefit, and continue to exploit opportunities to do so, including those that arise around transport, housing and digital infrastructure, and around land assets and natural capital, including water quality and supply.

The Marches LEP, with Herefordshire, Shropshire, and Telford and Wrekin, the local authorities working within the LEP, are Non-Constituent Members of the WMCA.

As will no doubt have already been advised to the NIA through its evidence-gathering workshop in Birmingham in January, it is the combined impact of metropolitan Constituent Members, Local Enterprise Partnerships and Non-Constituent members, working together to deliver step changes in productivity, growth and public sector reform across a broad geography, that makes the WMCA approach unique. The collective effect is to: *"provide the scale and capacity to respond to the opportunity of devolution and go further and faster in enabling economic growth."* The strength of the Combined Authority is very much in its geographical and economic diversity and a strong shared ambition expressed through the Strategic Economic Plan.

In terms of Shropshire's connectivity to the West Midlands, ongoing investment in both the road and rail network east/west will continue to be a priority.

Similarly, Shropshire also looks north through the Northern Gateway Partnership, with particular reference to links being made and continuing to be made between the Midlands Engine and the Northern Powerhouse, where HS2 rail transport may already be thankfully in the pipeline as a key regional and national project, but could also usefully be considered an anchor for associated infrastructure planning in the short and long term.

Turning to road transport, the anticipated Shrewsbury North West Relief Road (SNWRR) would provide a new single carriageway road in the north-west quadrant of Shrewsbury. Links between the north and west of Shrewsbury are very poor; this affects local commuters and longer distance business and freight traffic, moving between northern business areas and the North West, and Wales. Together with the A5 and A49 bypasses, the Oxon Link Road and the Battlefield Link Road, the SNWRR would provide the missing link to provide a complete and strategically significant (in SRN terms) outer bypass of Shrewsbury.

All long distance through traffic would be able to avoid the town completely. In addition it would complete Shrewsbury's distributor ring road, which would aid the high volumes of orbital Shrewsbury traffic, travelling to or from different locations in the suburbs. The SNWRR will support a number of local policies, including the three main objectives of the Shropshire Local Transport Plan (2011-2026), economic growth, carbon reduction, and promoting healthy, safe and confident communities.

Such is the interdependency between transport, housing and digital connectivity, particularly in a large rural county such as Shropshire, that the highest value investments may be said to be as much about the potential value to be gained from sustaining and supporting our communities, as they are about transport for people, goods and services to and through the region.

Investments which support the provision and location of housing that will encourage young people to make their homes here are part of the equation, along with appropriate land supply for businesses, assured water and energy supply for both, and the digital connectivity required to support day to day life for those who live here and work here, and the businesses wishing to attract people to visit here.

Our Connecting Shropshire Programme Manager, Mr Chris Taylor, comments that: *"There is a wide and diverse range of opportunities, particularly across economic growth, created by the investment in next generation access networks (NGA)¹. Some of these metrics remain unquantifiable locally but national statistical data supports evidence that investment in improved broadband and mobile network is a significant contributor to national GVA growth and inward investment."*

¹Next Generation Access - capable of delivering 30 Megabits per second

However, rural reality continues to present practical challenges. An example would be the planned extension of local full fibre broadband networks, where we have responded to the recent DCMS call for evidence, extract below:

"We have noted the recommendations made by the National Infrastructure Commission in its recent report about achieving 5G, "Connected Futures", particularly the commentary about the role of local planning policy, and calls for the effective integration of transport and digital infrastructure to hasten establishment of 5G across both rural and urban areas.

“5G remains, however, in our view a long-term technology that will predominately benefit urbanised environments rather than rural hinterlands. We would very much want to stress that, although 4G services have been available in some geographies since 2012, many rural parts of Shropshire and neighbour counties still have not spot or partial coverage areas. The Council does not accordingly see 5G at this moment as a solution to current data/voice coverage issues in the county.

“Whilst there are potential benefits for LEPs to seek collaborative delivery plans to address poor 4G coverage and new 5G coverage in urbanised landscapes, including major shared highway routes, the new technology development has limited opportunities in addressing infrastructure in rural areas.”

2. How should infrastructure most effectively contribute to the UK’s international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Rural counties such as Shropshire, who have distributed business communities, are now completely dependent on having access to ubiquitous digital infrastructure in order that they compete equally both locally, regionally, nationally and in the worldwide markets.

One such example of this is rural tourism, where the subregion recently responded to the ongoing inquiry into rural tourism by the EFRA Select Committee, commenting on behalf of local businesses that: *“visitors increasingly wish to access the internet throughout the day as well as make and receive mobile phone calls. Rural tourism businesses need easy access to the internet for business and marketing purposes. A Herefordshire business made the comment that the WiFi code is one of the first things a guest asks for as they walk in the door.”*

As far back as 2015, in the collegiate response to the BIS Select Committee about Government’s Productivity Plan, we also made the following commentary, which remains pertinent post-Brexit to the NIA call for evidence with regard to international competitiveness and overseas markets:

“5.6 Chapter 14: a trading nation open to international investment

5.6.1 *Further support would build confidence for companies to consider international markets, in addition to the commitment to support LEPs boost exporting. Access to finance and challenges facing SMEs keen to export, eg production costs here versus Far East costs, are key factors for the British Business Bank to tackle. (point 14.6)*

5.6.2 *On inward investment, a fast track or incentives for investors to move into non-city areas could be a positive mechanism for growth, allied to local planning policies that encourage commercial enterprise and put appropriate community and business infrastructure in place. Critical to all of this is support for transport infrastructure, to not only attract people to live and work outside*

urban areas but also open rural areas up to new investors and markets at a European and international level.”

In our own early analyses of a post-Brexit UK, reported to the LGA in December 2016, we commented as follows in relation to transport infrastructure:

“Locally, two key transport issues may be highlighted here that are of direct relevance to international trade prospects post-Brexit; the A5 dualling to which local businesses have referred in the survey, and a North West Relief Road for Shrewsbury.

“The consistent dualling of the A5 is a stated priority for Shropshire Council, not least given wider regional views of this as a key road freight route to European and international markets by sea. However, as the A5 is a Highways England (HE) owned and managed asset, options for local influence over works are extremely limited. In order to exert influence over HE’s future Route Investment Strategies (RIS), Shropshire, along with LEP colleagues is actively engaged with the Midlands Connect initiative. In doing so, the A5 has been taken successfully through the first MC round of scheme prioritisation, and is now into the next round whereby Strategic Outline Business Cases will be developed for all schemes. This is being done primarily around the economic benefits that will accrue, as opposed to more traditional route enhancement triggers such as accident rates and road safety matters.

“Turning to the prospects of a north-west relief road (NWRR) for Shrewsbury, Shropshire Council has been awarded funds this week under the 2017/18 round of the Local Majors Fund as part of the Chancellor’s Autumn Statement. £950k of the total £1m cost of a refresh of the evidence base and Outline Business Case for the North West Relief Road will now be available through this fund.

“The OBC refresh will be undertaken and completed within the 2017/18 year (a prerequisite of the funding award), and will give a current and vital present day view of the viability of further investment in the road, something which has been a conceptual scheme for over 20 years. Note that this funding does not guarantee future national prioritisation for investment, or guarantee any of the considerable further funding required for construction at this time.”

The North West corridor (an extension of the East – West M54 / A5 Corridor) is currently the highest priority for Shropshire, because of its important strategic role as a freight route – in particular the Trans European Transport (TEN-T) network to Holyhead and the Republic of Ireland. We would expect this to continue to be a priority and ongoing investment on road connections here will continue to bolster the Shropshire’s, and the West Midland regions, international competitiveness, as has been identified through Midlands Connect.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Improving the physical and digital infrastructure whilst maintaining the natural capital in the county is critical to growing a prosperous economy in the Marches region, providing the conditions that will foster new medium to large businesses as well as sustaining and encouraging the businesses that already contribute to the local economy. This will include ensuring that the right employment land is available in the right locations for existing businesses to grow and for new businesses to be attracted to the county.

From a practical digital connectivity perspective, Chris Taylor comments that it is: *“...critical that all new premises (residential and business), regardless of their challenging location are connected to NGA networks by default as part of developers’ obligations. Making the requirement a planning condition would add accountability. Access to ubiquitous wireless and mobile networks should be complementary to all fixed broadband infrastructure. Priority of access should be to all main highways and transport corridors.”*

From an environmental perspective, Dan Wrench, County Ecologist, comments that:

“There is a need to consider green infrastructure either on its own merits or as a fundamental element of other hard infrastructure projects. Resilience of communities and physical infrastructure is aided by proper consideration of green infrastructure. For example, green infrastructure features built into or near hard infrastructure projects have multi-use capacity which includes capturing or slowing storm waters that impact business and can damage hard infrastructure.

“Green infrastructure can also serve local businesses as a resource for exercise which improves staff productivity and reduces absenteeism. Other means of attracting inward investment via green infrastructure is provision of clean air and a comfortable and safe working environment for business. Green walls, roofs and other features such as street trees both clean air and water, and reduce environmental extremes such as high temperatures and winds”

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

From a digital connectivity perspective, the commentary we would wish to give here is that internet data usage has continued to increase exponentially, with over 90% of world's data generated over the last two years.

The Internet of Things and 5G technology is expected to increase data volumes tenfold by 2020. This lowered costs of data storage, the increased capability of backhaul networks, has lowered Internet Service Provider costs and increased demand from consumers. More content, new creative applications, and consumer behaviour will continue to drive demand for faster networks and bandwidth over the next 10 years. There will be an expectation, unless data is compressed further, that all consumers have access to at least 100 mbps within the next 10 years.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Continuing our thread on digital connectivity, our technical expert Chris Taylor advises that: *“Existing legacy copper network provision which has supported early generation NGA deployments remains archaic and has been underinvested in. Without full renewal or replacement, preferably with fibre, then the full benefits of the public investment in fibre to the cabinet technologies will never be fully realised. Installing new NGA networks versus upgrading old is still seen in many professional quarters as more a most effective long term strategy.”*

In our collegiate response to EFRA Select Committee inquiry with regard to rural tourism, we also commented that there is a practical policy challenge around use of environmental and planning policy to strengthen infrastructure whilst protecting and enhancing the rural environment itself.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Opportunities, in whatever form they may take, will need to be informed by local geography. For example, in its 2017 Autumn statement, the Government introduced a strategic policy and initiative that could encourage new investment and competition to the telecommunications network market (Digital Infrastructure Investment Fund). This new funding will be targeted at supporting the market to roll out full-fibre connections and future 5G communications.

It remains critical that suppliers focus this new funding on supporting those geographies that remain the most challenged rather than adding competition to already well served urbanised areas.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

The following comments of relevance here with regard to funding and to housing development were made by Shropshire Council (27th June 2016) to the CLG Select Committee Inquiry into the recommendations made by the Local Plans Expert Group to improve local planning policy.

“4.7 Recommendation 37: Infrastructure Planning

4.7.1 *Shropshire Council strongly supports closer integration of the Local Plan process, infrastructure planning and developer contributions using a shared evidence base. Focussing Community Infrastructure Levy (CIL) on Local Plan priorities is consistent with the existing Shropshire approach and the potential to agree bespoke arrangements to recognise the specific requirements of large urban extensions would help to reinforce this. As highlighted in Shropshire Council’s contribution to the Rural Planning Review in April 2016, it has long been understood that the cost of providing all infrastructure needs associated with new development far outweighs the funds available through CIL and there is therefore a significant funding shortfall for infrastructure provision.*

4.7.2 *In particular, the current exemptions for self build relief have had a significant impact on a rural area, such as Shropshire, whereby the projected CIL revenue has fallen by over 60%. This, coupled with pooling restrictions on the use S106 planning obligations, means that there are real concerns within local authorities about the ability to deliver sustainable development in a context in which the ability to deliver new infrastructure is so constrained.”*

Shropshire Council would also add the following points with regard to the development of a Universal Service Obligation (USO) for broadband:

- The importance of ubiquitous broadband is clearly recognised by the telecommunications industry, business consumers and government.
- The Universal Service Obligation (USO) remains at the heart of national policy with consultation on going on who will supply service and how the funding policy will be applied.
- Any USO will need to quickly flex in order to accommodate the increased consumer demands for data and applications.
- Shropshire has contributed to a previous DCMS consultation on the matter and believes a demand side service in the open market remains critical to a fair and competitive solution for USO.
- At the heart of good service and pricing is supplier competition within a wholesale industry that remains fair and open to all retailers.

We have, further, noted the recommendations about transparency and equity from the Cities and Local Growth Inquiry conducted by the Public Accounts Select Committee, principally the following with regard to funding:

“Recommendation: Government needs to be clearer with local areas what is and what is not on offer; and what is mandatory as part of devolution deals. Government should also listen to local areas about their particular needs to avoid a ‘one size fits all’ model being imposed.

“Recommendation: As the full financial implications of devolution deals emerge, government should ensure that they are presented transparently in a way that can be compared between areas, including on a per capita basis.”

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

In the Government’s Autumn Statement (2017) the Digital Infrastructure Investment Fund was highlighted as a mechanism for suppliers to leverage equity for broadband networks. Details are still unclear on how this funding can potentially improve the current NGA projected gaps in Shropshire. Ideally, funding should include the ability for community groups to bid and leverage investment for localised network initiatives.

Shropshire Council would also ask the NIA to please note the following contribution from Herefordshire Council on this topic:

“A package approach to funding (local, LEP and national sources) to fund infrastructure projects without distorting well-functioning markets may well work. Local sources may include local authorities borrowing, asset disposal, New Homes Bonus contribution, Community Infrastructure Levy and developer contributions. LEP sources may include Growth Deal Funding and its successor funding. National sources may include departmental funding e.g. Department of Transport, and High way Agency Funds.”

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

Shropshire Council would ask the NIA to please note the following contribution from Herefordshire Council on this topic:

“To ensure that our infrastructure system is resilient to risks we recommend the following:

- Enhancing cooperation between the public and private sectors in protecting vital infrastructure system e.g. information systems supporting critical infrastructures in key economic sectors.*
- Proposing and developing ways to encourage private industry and the public sector to perform periodic risk assessments of key infrastructure systems.*
- The government adopts a common definition for resilience and disseminates a high level, top-down strategy for the development and funding of resilience activities.*

- *Increase the coordination among all levels of government and stakeholders and ensure shared understanding of regulations and standards that promote efficient and timely responses to incidents.*
- *Establish new or enhance existing public-partnerships to provide a common, agreed upon, set of sector specific goals, with clear input on feasibility and objectives.*
- *Government to work with stakeholders and local authorities to establish resilience goals, facilitate contingency planning, foster relationships, ease information sharing and garner best practices. “*

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The varying status of local planning policy arrangements means that Government will need to factor in very practical on the ground infrastructure issues, such as how extension of fibre broadband networks can operate across devolved national administrations as well as across existing and developing locally devolved bodies.

For example, in Shropshire the Local Plan situation is that consultation has just opened to inform a partial review of the Local Plan, and was reported to Shropshire Council Cabinet in January 2017 in these terms:

- *The Shropshire Local Plan currently comprises the Core Strategy (adopted 2011) and the Site Allocations and Management of Development (SAMDev) Plan (adopted 2015). These documents set out proposals for the use of land and policies to guide future development to help to deliver sustainable growth in Shropshire for the period up to 2026. However, Local Planning Authorities are required to keep under review any matters that may affect the development of its area or the planning of its development.*
- *There is a requirement to objectively assess the development needs of the County and this also permits a longer term view to be taken for the period to 2036. In addition, there continue to be significant national policy and procedural changes along with opportunities and challenges at the national and regional level which will impact, to varying degrees, on Shropshire. These matters should be addressed through a partial review of the Local Plan to help to ensure the continuing conformity of the Local Plan with national policy.*
- *This partial review of the Local Plan will provide an up to date and deliverable Plan for Shropshire. It will help to maintain local control over planning decisions by ensuring that the adopted policies and proposals will be the primary consideration for decisions about development in Shropshire.*
- *Maintaining an up to date Local Plan will further support local growth by generating certainty for investment in local development and infrastructure through a policy framework that supports sustainable development in communities across the County, during the period to 2036.*
- *A current (opened 23/01/2017) Issues and Strategic Options consultation will focus on key areas of change, and set out options for the level and distribution of new housing and strategies.*

In neighbouring local authority areas of Telford and Wrekin and Herefordshire, who jointly with Shropshire form the area covered by the Marches LEP, the Local Plan situation is different, with Telford and Wrekin currently about to undergo Examination in Public of their Local Plan. The situation will be different again in the Welsh border authorities.

Any approach that seeks to maximise the potential of public sector infrastructure, as suggested by Government in the approach of “Making public sector assets available”, will therefore need to account for these variations and perhaps look favourably on those for whom plan-making is robust and well advanced, as in Shropshire, in testing out pilots.

In addition, Dan Wrench, County Ecologist, comments that provision of ecological data to enable infrastructure projects to comply with a wide range of environmental legislation can be a time constraint. This is partly because such data is currently not open data and data providers charge to cover their time.

A small and centralised environmental levy on major projects would easily cover the funding requirements of Local Ecological Data Centres (LERCs) resulting in open data from which all infrastructure projects would potentially benefit. This would also have several spin-off benefits including open data for other users such as housing developers.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

We have referred to CIL as a developer contribution, which may potentially mitigate against impacts on the natural environment. Planning policy that itself encompasses environmental impact assessments and rural proofing, as is the case in Shropshire, can also mitigate risks.

Deployment of new infrastructure needs to be managed empathetically at the same time as the key stakeholders in the sensitive areas appreciate the business and consumer demand for better connectivity. In order to accomplish the balance, all parties need to adopt a pragmatic approach.

This view may be said to hold as good for physical infrastructure as it does for digital infrastructure.

There is a role here for utilities companies working closely with local authorities and LEPs, to develop mutual understanding and share information. For example, Scottish Power Energy Networks hold a regular Strategic Stakeholder Panel, to which Frank Mitchell, CEO, talked last week about the consequences of Brexit with an anticipated increase of 30-35% on the cost base of equipment and copper given currency and commodity changes. Increases in infrastructure costs will have an impact on energy charges by the energy suppliers. Also raised concern on availability of technical skills in the future and energy resilience as an issue for LAs.

Energy resilience emerged as a key issue along with water quality and water supply, at a Local Environment and Economic Development (LEED) Stage One workshop held by The Marches LEP in July 2014 with stakeholders including Defra's Local Nature Partnership (LNP) lead and the two LNPs serving the area.

Natural capital accounting or ecosystems accounting is seen as a practical way to inform policy on infrastructure considerations and help to measure outcomes, and is recommended to the NIC accordingly. Organisations such as National Grid have already undertaken assessments of the value of the Ecosystem Services provided by their land holdings and assessed how these values, to both their shareholders and the wider public, can be enhanced. Further information has been produced and published through the LNPs in 2016 on this practical way to protect and enhance the natural environment and to bring tangible economic benefits.

Infrastructure that leads to creation or management of grassland areas (such as roadside verges) could significantly help pollinators and also help protect remaining high quality grassland sites. The greatest gains could be achieved with the use of 'green hay' from species-rich grasslands in the creation of new grassy areas. 'Green hay' is hay that is cut and moved on the same day so as to retain the seeds with the hay.

Creation of a market in such hay from nature reserves and other high quality sites would help protect existing sites (whose farmers could charge over the going rate of species-poor hay) and also ensure that grassland creation results in high quality, species-rich habitats that also benefit pollinators and other wildlife. In effect this is an example of Payment for Ecosystem Services which is an emerging field for the enhancement of natural capital. Mention of this technique as best-practice would go a long way to protecting this increasingly rare habitat and helping pollinators.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: "credible" improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. "Tractable" improvements are those that can generate usable quantitative outputs. "Transparent" improvements are those that do not rely on 'black box' modelling and assumptions.

Shropshire Council would ask the NIA to please note that the contribution on this topic, from the Marches LEP, is that with the UK economy entering a new era, we will shortly be working in a post-Brexit landscape to deliver the new national Government economic growth agenda. In the light of this, we do very much consider that there is a need to review current cost-benefit analysis techniques, which tend to favour 'quicker wins', to ensure that infrastructure schemes, capable of delivering tractable longer term economic growth outputs, can be appropriately evaluated."

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: "travel patterns" include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

The expert view from Matt Johnson, Strategic Transport and Contracts Manager, Highways and Transport, at Shropshire Council, is as follows:

Within Shrewsbury, the planned development of the two main Sustainable Urban Extensions is integrated with engineering within the footprint of the development, and to enhance inter town links, with accommodation of increased short distance travel by sustainable (walking and cycling) modes.

Within the County Town of Shrewsbury, and for inter Market Town travel, there is a reasonable expectation that hybrid and electric vehicles will grow in uptake and usage. Whilst current technology suggests that there would be a predominance of local and short "within County" trips by such means, an expansion of the current limited longer distance charging network with public pump priming is already underway. It is reasonable to expect that the market will provide the necessary infrastructure along key and strategic routes within the time period being considered.

Home and flexible working and home delivery of services and goods would be expected to increase further removing the need for some considerable amount of peak time travel.

Further developments in autonomous vehicles, particularly in terms of HGV freight movements, may concentrate movements further towards key strategic routes. In a rural county such as Shropshire, the potential for growth in this technology is uncertain, but the remaining need for the "last mile" delivery of goods and freight will remain.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

Assuming a continuing reliance on road based transport, it would be assumed that zoned developments by sector, with appropriate connectivity to the SRN network would favour such development. The continued increase in light rail and metro style transport systems for personal transport, alongside appropriate accommodation for sustainable travel methods could be expected to return a high BCR when considering the wider built and public environment.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

Within those sectors currently strongly represented within Shropshire (Agri tech, food, tourism etc.), such an approach may not be the most appropriate, although a

free flowing and reliable transport network based on the local and secondary rural highway network would accrue similar benefits over and above simple geographical colocation.

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Incentivised options for alternatives to solo private car travel could be actively managed to reduce road usage in collaboration with investment in light transit and mass transit systems. Technological advances in personal information sharing and journey detail sharing giving informal agglomeration of trips can be expected to continue to rise and road user charging, managed sensitively, can be a positive influencing factor upon this.

Digital communications:

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

The expert view from Chris Taylor, Connecting Shropshire Programme Manager, is that: *"DCMS appear to be setting a consumer expectation of fibre to the home technology and 5G wide area coverage. Whilst these would provide a blended and complementary solution in urbanised areas they will be a challenging deployment in rural counties such as Shropshire where there would be significant cost implications without State Aid."*

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing "regime" refers to the current market, competition and planning frameworks. "Digital communications" includes both fixed and mobile connectivity.

Shropshire is expected to fall into the lower quartile for national digital coverage by the end of 2017. Rural counties such as Shropshire will continue to be challenged by the ability of commercial and intervention programmes to deploy digital networks to all premises in a predominately rural county. Shropshire will continue to work diligently with the market to address broadband gaps. However, the Authority will ultimately be reliant on further government intervention to address the digital gaps that are expected still by the end of 2020.

Energy:

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Heat constitutes the biggest use of energy in the UK. Integral to the issue of heat is the improvement of energy efficiency. Greater building energy efficiency reduces the need for additional electricity generation and ensures heat demand is as manageable as possible.

Uncertainties in heat infrastructure development relate to technical, economic and market challenges. Considerable investment from the public and private sectors would be required but public finances are constrained and perceived risk and uncertainty are barriers to greater private investment. Clarity in Government decision making is crucial in maintaining the confidence of investors in the UK's low carbon infrastructure.

20. What does the most effective zero carbon power sector look like in 2050?

How would this be achieved?

Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.

The UK energy sector needs to move from its centralised high-carbon power system to one that provides heat and power securely, affordably and with minimal dioxide emissions. Additional power generation capacity and improved infrastructure is required to meet increasing need and demand.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Implications perceived in Shropshire of low carbon vehicles:

- Facilities that are not only suitable but also suitably located will need to be provided, to enable charge or re-fuelling, in addition being able to do this in a timely and cost effective manner;
- Networks may need significant upgrades to increase efficiencies;
- Key routes and locations will need to be identified;
- Signposting to these will also be critical.

Shropshire Council would also ask the NIA to please note the following contribution from Herefordshire Council on this topic:

- Space requirement may increase. Access to and from potentially centralised location potentially could increase vehicle movements.
- Funding for skills development need to be made available to respond to the skills requirements for these new technologies.
- Resources for feasibility studies for any low carbon vehicle (e.g. feed stock supply, wind speed and capacity and scale of requirements) should be made available.

Water and wastewater (drainage and sewerage):

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

Reference has been made to the benefits of using an ecosystems accounting approach. It is commended to the NIA as being an approach worth a closer examination.

The Marches LEP has published a natural environment investment prospectus which highlights some natural assets of the Marches LEP area. Through case-studies we demonstrate how some businesses are making good returns on investment in natural resources like water and green infrastructure.

The case-studies illustrate how intelligent use of natural resources can bring both economic and social benefit to investors which also benefit the area's work force and the diverse local communities that make their homes in the region. Please see website and the following case studies, extracted from the prospectus.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

The following case study, published in the Marches LEP natural environment investment prospectus, provides an exemplar approach:

Ricoh is a Japanese multinational imaging and electronics company with production and warehousing units in Telford. A series of pools and wetlands are being created on site which will act as a sustainable drainage scheme (SUDS) and a pollution prevention control measure to meet the forthcoming Water Framework Directive (WFD) requirements. This removes the risk of the site being shut down due to any potential pollution incidents into the local water course.

Key points:

- Site closure would cost in the region of £1m per day.
- Surface water discharge rates will be reduced by £30k per year.
- Future legislative compliance with WFD will be achieved
- The scheme will cost in the region of £500k to install
- This is a new initiative requiring initial investment to evidence the benefits.

Other benefits:

- A variety of biodiverse habitats
- Greater productivity and fewer sick days for staff who use the area for work breaks
- Demonstrable evidence of business excellence measures and Corporate Social Responsibility

- Creation of an exemplar in retro-fitted SUDS that can be used as a demonstrator by other organisations, including businesses involved in the 'Business Environment Support Scheme for Telford' (BESST)
- Much improved carbon storage

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

The following case study, also published in the Marches LEP natural environment investment prospectus, provides an exemplar approach of using Catchment Management Partnerships.

Catchment Management Partnerships deliver activity that ensures Rivers of the Marches recover to good ecological status and meet water quality standards under the EU Water Framework and EU Drinking Water Directives. These partnerships complement existing regulatory functions and also bring on board businesses and NGOs who have an interest in clean rivers and issues of flooding or drought.

Shropshire Wildlife Trust (SWT) facilitates delivery in the Middle Severn catchment (central and north Shropshire) with co-hosts Severn Rivers Trust (SRT) leading on the Teme catchment. Defra has confirmed its policy commitment to the Catchment Based Approach (CaBA) to delivering the UK's obligations under the Water Framework Directive (EU2000).

Current project activity includes a wide range of advisory, education and practical works across Shropshire and Telford & Wrekin. These deal with diffuse and point source pollution, river re-naturalising, flood management, protected species work and new ways of working, such as payment for ecosystem services. Over the past three financial years over £1.5m has been directly invested through Catchment Management Partnerships.

Overall return on investment is difficult to quantify but costs of flooding and disruption to water supply and flood impact in the agricultural sector are enormous. The financial costs of floods and pollution, referred to here for additional context, include:

- Significant economic development in the Clun and Wye catchments have been held back until water quality improvements are achieved.
- A pollution incident in 2012 in Coalbrookdale closed the River Severn water extraction point south of Telford for over 24 hours. Supplies to Telford and nearby towns were put at risk.
- Re-seeding and crop loss on a single farm due to flood water inundation can cost upwards of £10,000 annually. Estimated annual total costs across Shropshire of the impact of floods on food production is in the £100,000s.
- The UK cost of the 2007 floods to agricultural production was estimated at £50m. The vast majority of this cost is borne by the farming community.

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

No comment made at this time

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

Dan Wrench comments as follows:

"The Catchment Based Approach is working well locally. However this requires long term input to ensure our water resource is well managed. Payment for Ecosystem Services pilot projects, which compensate farmers for managing their land for water management, need rolling out more widely. Evidence is now very significant that soft engineering (tree planting, etc) is more cost effective than hard engineering in most instances and that other benefits are gained (e.g. improved assets for tourism).

"For some infrastructure Sustainable Drainage Schemes are poorly thought out and don't consider multiple benefits that such systems can achieve. All infrastructure projects should go over and above existing policy to ensure additional benefits, such as improved water supply, are optimised.

"Standardised tools should be made available that allow assessment of the impacts of a wide range of land use change on ecosystem services such as flood alleviation. The full impacts of these changes, and ideally the financial costs / benefits, can then be better evaluated. "

Solid waste:

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Shropshire Council would ask the NIA to please note the following contribution from Herefordshire Council on this topic:

"Previous and existing incentives, such as recycling targets, landfill diversion targets and landfill tax have encouraged investment in waste infrastructure by local authorities. Future targets are uncertain due to Brexit but even so the UK is unlikely to meet its existing obligation of 50% recycling of municipal waste by 2020 without further investment let alone more ambitious targets.

“Current regulatory incentives do not correctly assign responsibility; they still place the burden of cost on local authorities rather than on producers. Increased producer responsibility for packaging waste, for example, would be a big step forward to address this.”

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

Assessment of the environmental externalities of economic activity is complex and poorly communicated. At present, the public pick up the clean-up costs of private economic gain that has a multitude of externalities. The County Ecologist, also co-ordinator for the Local Nature Partnership for Shropshire and Telford and Wrekin, provides the following example by way of illustration: the public subsidise farming; farming pollutes water courses with fertiliser and pesticides; the public, through water bills, then pay to clean this up; only the farmer may be said to gain.

A recommendation to counter this would be that the “Polluter Pays Principle” should be incorporated somehow. The public would gain in lower costs all round and improved health. The costs would be greater regulation of businesses.

A further recommendation is that a natural capital market, which would be overarching to the Carbon Market, should be developed as a good way forward.

Shropshire Council would ask the NIA to please also note the following contribution from Herefordshire Council on this topic:

“As discussed above there are no current or planned incentives to allow local authorities, in particular, to achieve a more circular economy. In respect of proposed recycling targets we should also be careful not to proscribe unsustainable methods of waste management such as food and garden waste collection.”

[SHROPSHIRE COUNCIL RESPONSE ENDS]



A proposal to the National Infrastructure Commission for a 6-months scoping study for the development of Smart Water Hub Project

Digitising Water & Customer Experiences Using Distributed Ledger Technology & Smart Contracts.

Helping Cities & Companies to achieve inclusive, resilient and sustainable development via design of efficient and flexible systems, digital economic incentives & community engagement.

CALL FOR EVIDENCE

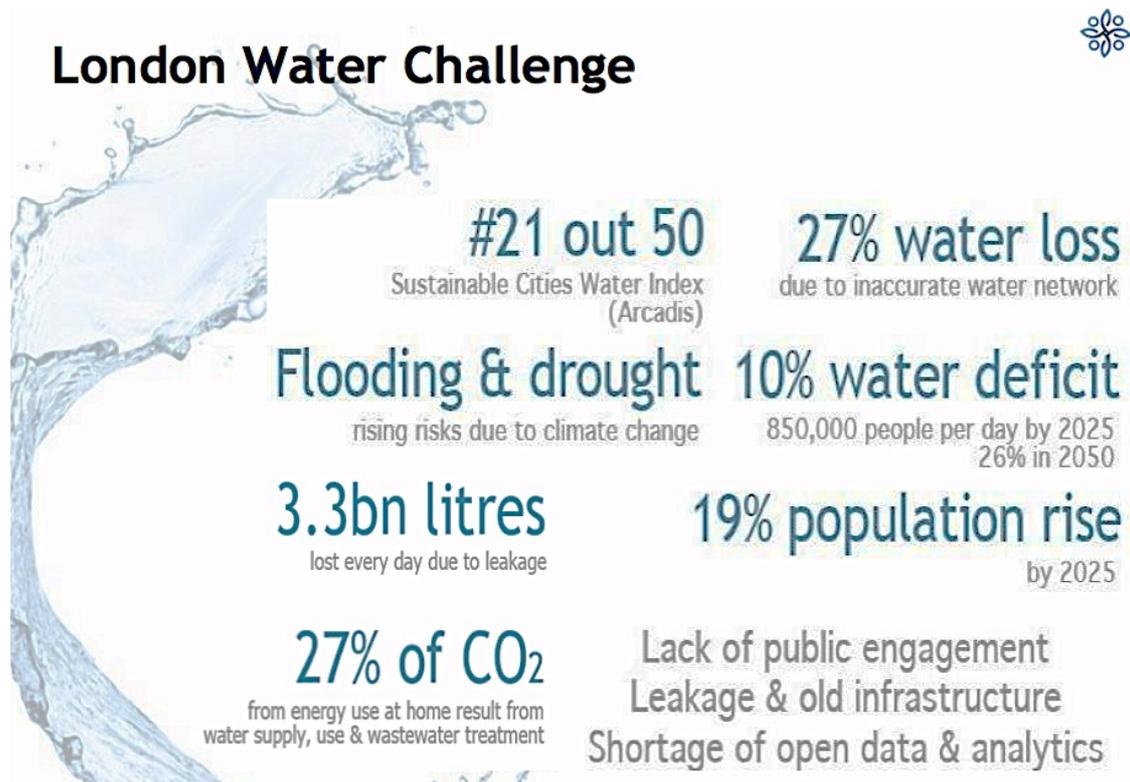
**[Name redacted]
[job title
redacted] Smart
4.0
(SCG London Ltd.)
www.smart4.tech
e: [\[email redacted\]](mailto:[email redacted])**

10 February 2017



Our Challenge

The water and sewerage sector in the UK is undergoing major changes as a result of the introduction of liberalised, regulated markets. Starting from April 2017, the non-household water retail market will be open. The sector will also benefit from further investment of £44bn into improving assets and services in 2015-2020.

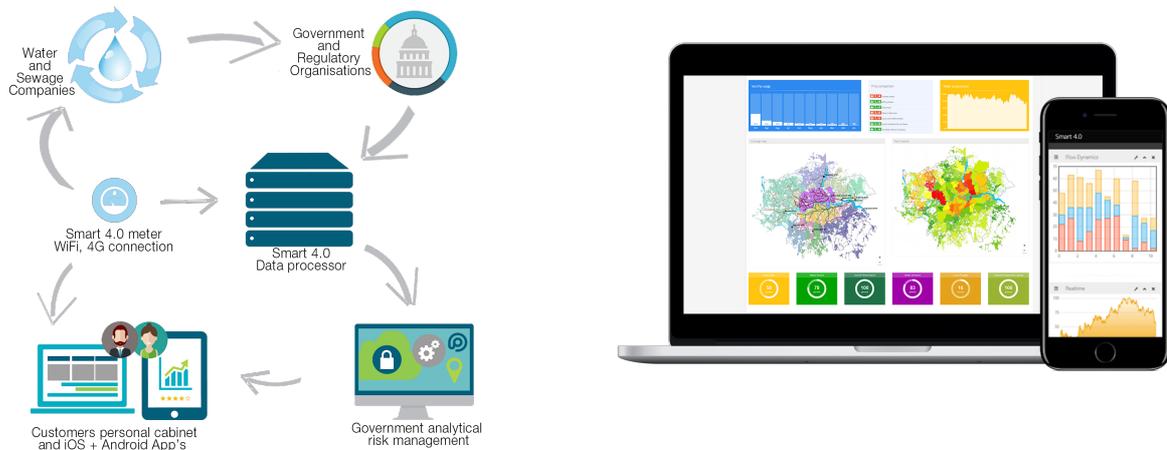


The project aims to address the existing and future challenges of the water and sewerage sector by providing digital products and services that bridge technology, market needs and sustainability. By creating a private-public ecosystem in the form of Secured Regulated Platform for water companies and their customers will build transparency, trust and mutually beneficial relations.

**Demo Prototypes Available on Request*



INTRODUCING SMART 4.0 PLATFORM



Creating Synergy of Innovation, People and Nature

The Digital Platform helps to engage with communities, by empowering individuals, private and public actors, and helps to build sustainable competitive advantage in the water sector.

It is aimed to improve interaction between stakeholders, increase operational efficiency and maximise revenues through a new functional ecosystem of technology and information, backed by IoT, cloud and distributed ledger technology (blockchain).

The platform will integrate and analyse existing and obtained data including open data, reports, real-time information, water suppliers and customers, including switching statistics and their margins. The gathered data will be allocated to individual accounts secured by private keys.

City Water Dashboard may include (by companies):

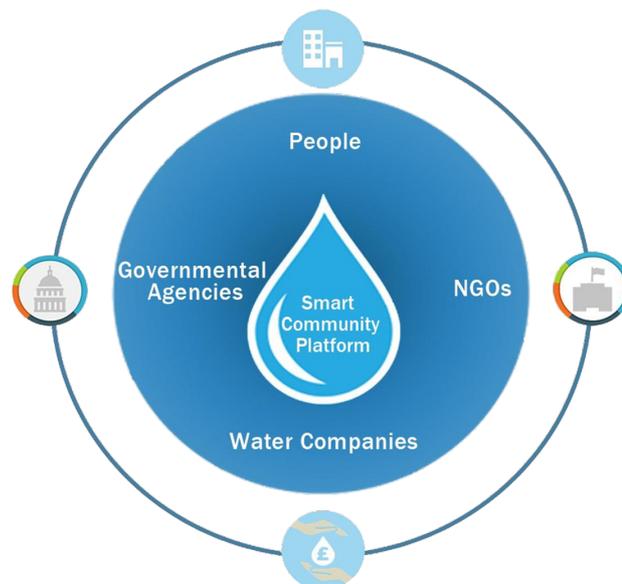
- Area coverage of water utilities (integration with energy, carbon)
- Problems
- Interactive data of water consumption in London
- Comparative analysis of monthly water consumption
- Market price comparison
- Saved amount of water

Platform Rating Dashboard

- The ratings of service suppliers may include: water quality, monthly leakage, coverage, number of clients, complaints, calls, maintenance, and level of trust.
- Ratings of customers can include: timeliness of payments, credit history, water consumption and water saving.

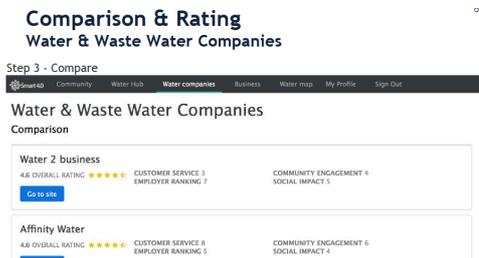


- **The Water Hub** (integration with energy and carbon), an engaging digital water community, an interactive water map and a marketplace platform for innovative solutions and services.
- **Water Credits** a monetary incentive program for customers (domestic and business) based on their water usage performance (smart meters data), community and project involvement. Potential integration with public-private incentives / local tax programmes, energy / carbon credits scheme and local trade exchange built on the custom blockchain platform. With further potential development of **green finance instruments, including water bonds (R&D stage)**.
- **Secured Personalised Accounts** for government, businesses, and customers with customised analytical reports and data on water consumption and relevant statistics.
- **Private blockchain platform** to optimise **recordkeeping, audit and compliance reporting** with a focus on disclosure of environmental impacts (sustainability indices, CSR, ESG, international ratings indices), providing multiple decision makers unified data they need to change market behaviour.





Customers and Companies Ranking: community engagement, customer service, employer ranking, social impact



Features How?



Real-time data analytics



Marketplace



Online customer service + AI (bot messenger)



Information & education



Mobile App



Online payments



Rewards



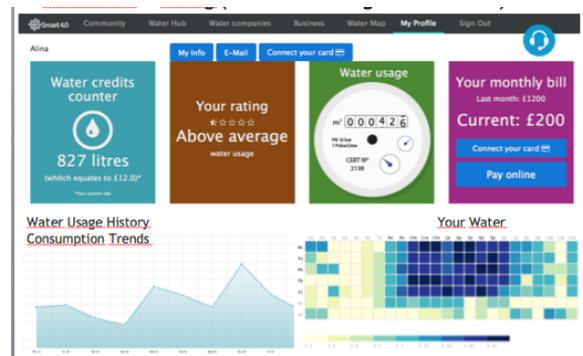
Rating systems of customers and companies



Reports & Analytics



Water Credits & Water wallet





Building Customer Centric Relationships Win-Win Model

The Smart 4.0 is designed to assist in matching suppliers and users more effectively, build long-term relationships and increase benefits for both

USERS	COMPANIES
Login to personal accounts	Public profile to manage reputation and credibility
Quick and easy integration	PR, news and company promo to enhance visibility
Follow companies to receive news and updates	Market feedback compared to peers via ratings
Real-time alerts (leaks, disruptions)	Connecting with sector specialists
Consumption trends	Communication tools, such as video and messaging
Customised savings recommendations	Targeted customer communications
Anonymous household water use comparisons	Data analytics tools
Data analytics tools	Online marketplace (services, devices)
Water Wallet (digital water credits)	Green Bonds (water flooding bonds)*

Education / Gamification

Educate individuals and corporates to address water challenges. Our comparison and service platform will show:

- Leaders in water sectors (utilities, service providers (B2B and B2C))
- Most innovative companies
- Top Individuals and companies who address the water challenges (water consumption/savings, innovation, initiatives etc.)



Value for All Stakeholders



Government Personal online account (City Boroughs):

- Full 'water balance': supply and demand
- Data analytics
- Tariffs analytics
- Easy connect to other water governmental organisations (Consumer Council for Water, Ofwat, The Water UK) and related NGOs



Companies Personal online account:

- Full 'water balance': supply and demand
- Real time data dashboards (London-specific & neighbourhood-specific)
- Data analytics
- Accurate billing information
- Optimised customer service
- Access to innovative startups



Customer Personal online account & App:

- Online control over water usage & bills
- Accurate data of water consumption & bills
- Reducing risk of leakages & problems
- Community involvement
- Easy online customer support
- Incentive tariffs (water credits) & loyalty schemes

UNIQUE BENEFITS		
<p style="text-align: center;">Governmental Organisations</p> <ul style="list-style-type: none"> ▪ Unified and processed information from all data sources: existing smart meters ▪ Customised reports and recommendations ▪ Real-time data ▪ Improved paper efficiency ▪ Increased transparency ▪ Increased data integrity ▪ Increased efficiency 	<p style="text-align: center;">Customers</p> <ul style="list-style-type: none"> ▪ Optimisation of water usage ▪ Automatisations of processes: billing, issues and complaints reporting, monthly service feedback, purchase of additional services 	<p style="text-align: center;">Utility Companies</p> <ul style="list-style-type: none"> ▪ Improved customer service ▪ Cost-optimisation (industrial level – energy consumption to supply water) ▪ Optimised timing ▪ Faster payments processing ▪ Water usage comparison



Blockchain Application for Industry (and Smart 4.0 Project)

We consider Interbit platform by BTL (www.btl.co) for use

I. Switching / Recordkeeping

Application of blockchain can help the water sector companies to manage balancing and settlement more efficiently in comparison to the existing applied methods. All information, including consumption and transactional records can be automatically stored on an immutable ledger.

Blockchain and smart contracts can potentially help the water sector companies and the government bodies to access real-time data regarding market shares, consumption patterns, management of utility bills of end consumers and other possibilities.

II. Reporting Repository / Compliance Reporting / Audit

Blockchain could be used to keep track of the steps required by regulation. Recording actions and their outputs immutably in a blockchain would create an audit trail for regulators to verify compliance.

Such a change could reduce dramatically the time and effort (and therefore cost) that financial institutions spend on regulatory reporting, as well as improving the quality, accuracy and confidence of and in the process.

Organisations could potentially being granted with a privileged digital key to obtain real-time market share intelligence / analytics of the various water providers (stored on a private blockchain) instead of having to survey providers to generate market data. Blockchain provides immutability, immediacy and transparency of information where stakeholders can be part of the real-time process instead of being recipients of post-hoc reports and analytics.

Distributed Ledger Technology (blockchain) provides immutability, immediacy and transparency of information where stakeholders can be part of the real-time process instead of being recipients of post-hoc reports and analytics. As an example, unique design of the developed Interbit (www.btl.com) blockchain platform provides powerful yet lightweight system with core **characteristics**:

- Effortless scalability across multiple networks
- True siloing of data for industry grade privacy
- Flexible redundancy across permissioned nodes
- HSM (Hardware Security Module) compatibility for transaction signing



Possible Use Cases

- * **Ofwat** and **Defra** could potentially be granted with a privileged digital key to obtain real-time market share intelligence / analytics of the various water providers (stored on a private blockchain) instead of having to survey providers to generate market data.
- * **Water retailers** need to report to **Ofwat** under the Wholesale Retail Code. By recording the data onto a blockchain Ofwat can guarantee the data hasn't been tampered with, thus enabling a greater level of transparency across the industry. This will also reduce the cost overheads associated with maintaining security around data records, as well as the overheads from the regulators to audit retailers and ensure they are not modifying data before submission.
- * For **MOSL** the blockchain can be deployed as an additional feature to their developed IT infrastructure that would simplify process of registration, customer switching and settlement between wholesalers and retailers, putting it on a single blockchain (automatic validation and confirmation of information: accounts, billing history etc.) with a different level of access to the information

Existing Applications of Interbit Blockchain Platform that we aim to use in Smart 4.0 (www.smart4.tech)

- Interbank payment networks
- Energy trading
- Public registries
- IoT



1. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Demand has to be created by all parties – mutual interests not vested or silo. Water accounts for 45% of the world GDP, 27% of Carbon emission and 33% of energy production costs. On the local level, a number of factors have to be considered.

To provide analytics and build economic models for energy and water efficiency, it is necessary to evaluate a number of factors:

1. Analyse historic and future water demands data stored and shared on blockchain to create a baseline (energy & water sector) and align it with present availability and development potential of all water resources in the country
2. Determine present availability and development potential of all water resources in the country, including alternative (desalination, water from air extraction).
3. State policy for installation of smart meters and sensors to build quantitative and qualitative data analytics and customised reports stored and shared via authorized access on blockchain (i.e. Interbit platform, www.btl.co)
4. Build interconnected smart energy and other utilities hub (i.e. by Smart 4.0, www.smart4.tech)
5. Create continuous awareness and public engagement (bottom – up approach triggered by top) where top will sustain regulatory control given importance of potable water security.
6. Reinforce public-private partnership and increase attractiveness for both institutional and private investors (both equity and fixed income)
7. Similar to transport, certain types of data has to be open source, instead of being exclusively owned by single market actors. This will create a better understanding between public and private sectors and impact the behavioural change.
8. Gamification and remuneration implemented across different levels (as part of CSR, city, district, NGOs levels) – both water and energy sectors will get an additional interest and reduce of behavioural constraints and rebound effects once the actual involvement will be rewarded via numerous possible schemes (water / energy credits, tax exemption, public leadership for both companies and individuals); intangible incentives - less time lost or better environmental outcomes



9. Use proved blockchain platform (i.e. Interbit platform, www.btl.co) to support existing initiatives and developments to implement IoT (smart technologies) and integrated ICT platforms with other sectors.
10. Consult and develop energy and water policies with international organisations, involved into the climate change risk (systemic risk) discussion (i.e. CDP, Financial Stability Board, NGOs, World Bank) along with the investors and insurers.
11. Develop social inclusion policy where infrastructure, particularly the green one, will be in heart along with the shift of the demand management

Based on the perceived information, metrics and predictions for maximum demand can be developed.

To reduce the losses of water or electricity, the following steps are indicated:

- *Use technology and analytics to detect leakages.*
- *Conscientiously and promptly repair leakages.*
- *Invest in new equipment*
- *Increase effective throughput by reducing commercial losses (smart meters, debt collection,*
- *Application of demand management*
- *Dynamic pricing based on real-time congestion*

5.How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Prioritise the resources (water -> food->energy) – the Nexus pyramid, which accounts to the National security of any state. Assess the impact of risks of infrastructure failure (i.e. drought might cost £1.2bn UK businesses/ day).

Water not only in heart of energy production and carbon emission, but also food production (70% of water accounts to agriculture, 20% for business, 10% for domestic use).

Analyse impact of digital transformation

The Boston Consulting Group: To narrow or close the infrastructure gap, governments can pull three levers:



1. Reduce infrastructure demand (if user needs for these essential public services can be satisfied in other ways, i.e. energy; however not applicable for water and transport much)

1. Build new assets
2. Optimize existing infrastructure assets via operation and maintenance (increase utility, decrease total cost by investing into technology and innovation, increase lifetime value, localise infrastructure assets).

One of the key priorities should be given to green / urban infrastructure projects that would contribute to decarbonisation, contribute to preservation of the natural resources (firstly, water) and increase resilience (micro grid projects similar to Brooklyn and Australian self-sustained villages where community can store and trade electricity internally).

Pareto 80:20 law remains constant across majority of sectors unless it is digital infrastructure where innovation takes place much more frequent in comparison to the traditional industries: 80% has to be invested into operations and maintenance whereas 20% should be new investment

Another approach to the ratio: **maintenance and repair vs construction of new assets can be developed on the asset management framework developed by BCG:**

- *Value perspective*
- *Triple bottom line objectives*
- *Whole life-cycle horizon*
- *Risk recognition*
- *Systemic scope*
- *Integrated activities*
- *Comprehensive measures*
- *Organizational integration*
- *Proactive attitude*



2. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

There is a difference between competition in the market and competition for the market. The traditional approach is based on the linear process: the disciplinary hierarchy and separation of design and construction, which leads to project failures and slow performance improvement. Instead circular process has to be built, a collaborative ecosystem where capital availability and capacity planning. There is an opportunity to improve if nearly 2/3 of construction problems can be eliminated with better communication and information. Along that it is rather important to create education opportunities for cross-sector leaders (i.e. a business-government-education facilities on the base of existing academic institutions and associations) and inclusive coalitions (i.e. transport, water, energy, food).

Cooperation between private and public sectors can be achieved via programme of market liberalisation, including a number of stages:

- Depoliticisation (decrease of bureaucracy);
- Commercialisation of operations (vendors and service providers);
- Creation of effective natural competition;
- Development of regulatory appropriate institutions to the market;
- Increasing transparency via and public involvement and compulsory reporting and ESG
- Integration traditional infrastructure (physical) with digital (ICT)
- Use private investment for public sector projects in supply of infrastructure services
- Accountability Requirements

Focusing on the technology aspect of service improvement, we would like to highlight how IoT and blockchain can address societal problems at the back-end, helping infrastructure services to be more efficient and transparent. These include provenance (producers/ manufacturers, registrars, certifiers, regulators, customers); quality control and tracking system over the system for businesses and customers. Along that energy infrastructure projects can use blockchain for energy and water procurement and sustainability, which should be an underlying goal for any infrastructure projects.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered? *Note: by “funding”, the*



Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

States have to pay attention funding policy changes that will increase productivity, support business growth, create jobs, create a healthier environment, and improve inclusiveness for all citizens. **Due to the fact of** public budgets facing continuous cuts nowadays today creating more uncertainty, additional diversified funding sources are needed.

One of the alternatives is to set up not only specific budgets for sectoral projects or place burden on the operating companies, but to create a range of dedicated maintenance funds, which receive the user taxes and disburses the money to the agencies responsible for operations and maintenance. This will allow creating a circular cycle, instead of one-time large investments. Second option is to create and appraise diversified revenue sources (i.e. road tax, MOT), and provide cross-sector support funding. Implement incentive-proof mechanisms such as indexation, and fiscal easing in combination with private investment stimulus.

Another option is Issuance of green infrastructure and other sovereign bonds to stay aligned with Global Goals for Sustainable Development and to minimise effects of Climate Change risks.

Grants remain a traditional funding instrument for mainly for the road and public transport / transit projects, utilities, and some other capital expenditures.

Project bonds or mini-bonds, issued by local municipality, construction, utility and other infrastructure service companies can increase community involvement and short-term liquidity to contribute to the operations and maintenance aspect.

Funding policy mix should include assessed portfolio above-mentioned instruments, with priority on green infrastructure renovation and “delayed” operation and maintenance projects (water sector, transport), which provide national security and improve international competitiveness of the country.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?



There number factors that can result in failure of finance of infrastructure projects, including failure of effective functioning of PPP due to existing policies, unsound investment climate, heavy tax and fiscal burdens. Another reason is the lack of investable projects where projects are not properly planned and designed. To address this problem, a risk-management approach and finance planning have to be in place in order to create right incentives among various stakeholders. Three key risks include: high initial risks illiquidity, the time profile of cash flows (ROI), and liquidity. The efficient distribution of risks and returns along with careful design of economically rational financing structures would increase private investor interest and mitigate failure of investors' involvement. A pipeline of investable projects would help large institutional investors to plan and participate in the upcoming projects accordingly. Additionally, an effective re/utilisation of capital markets resources can also increase infrastructure finance and providing interest among a broader group of investors.

Many Infrastructure projects are often complex and involve a large number of counterparties (i.e. water sector) where a high level of bureaucracy and private interests exist. To address this challenge, a level of competition and necessary legal base should be provided in order t attract no only local but international investors. Privatisation of existing infrastructure assets, pure public procurement, economy and policy transformation in order to attract additional sources of private investment and finance. Focus on green infrastructure, decarbonisation and sustainability projects or upgrade existing ones may attract additional investment; however sound judicial, legal base should provide a framework of accountability, reporting, transparency and cost-benefit analysis of such initiatives. Also focus on development on cross-sectoral infrastructure projects with high share of digitalisation (ICT) with service/customer oriented strategy may attract additional interest and commitment from both local and international finance and investment organisations.

Depending upon the stage of the project, there are a number of alternative sources should be endorsed by policy initiatives:

1. initial stage: mezzanine investors, banks (syndicated loans), development banks, export credit agencies
2. operational phase: bond financing and other FX debt instruments



9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? *Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.*

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

In the era fourth industrial revolution connectivity and information accessibility in the form of shared digital information is among fundamental principles that would ensure resilience of cross-merged infrastructure system. McKinsey and Imperial College studies suggested that any new project should include a high level of connectivity and integrity with other data collections points, and should openly available without additional expenditure. To provide immutability, security distributed ledger technology (Interbit platform, www.btl.co) and real time portals that connect all stakeholders in a gamified way (comparison, rating, community and social impact, UNGC principles, accountability rating) may add value and traction (i.e. Water Hub by Smart 4.0 www.smart4.tech).

To prevent external risks and problems, caused by and natural disasters as an increasing climate change, state should must identify and assess those risks and to develop cross-sectoral master plans (open data) available for cross-parties (insurance and reinsurance companies, investment finance institutions, and academic institutions along with others). A different set of measures can be applied:

- structural measures that include construction of protective barriers and maintenance /renovation of existing facilities. Cost-effective or non-structural measures comprise of effective nature use (forests as natural prevention), creation of natural buffer zones and development of resilient design codes for future projects, reconstructions and upgrades (brownfield and greenfield).

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Natural capital is the most fundamental of the core forms of capital (fertile soil, , mixed forests, productive land and water resource, good quality freshwater and clean air). With increased risk of climate change, which became a systemic risk, protection, conservation and enhancement of natural capital should be among core requirements for any infrastructure projects.



Green infrastructure is a smart solution for today's needs and demands to achieving environmental, public health, social, and economic benefits. Sustainable projects can be developed both on brownfield and greenfield projects. Level of scope should be defined at the design and planning stage.

‘Building local, thinking global’ - to achieve these tagline, a structural plan should be designed. Focusing on placemaking where people are in heart of the process development and implementation.

A basic checklist can be incorporated into some infrastructure projects on the city level:

- preservation of open space and green areas;
- development of green areas and recreation zones;
- building mixed-use developments with a strong sense of place (place branding);
- carless streets, conversion into walking and biking streets;
- promotion and state regulation for green building practices (BREEAM, ISO certification, UNGC, CDP, Carbon Credits)

There is no “one fits all” approach, however a starting point for such projects should include not only top-bottom approach only, but promoted across communities and local residents where the prime goal achieving resilience of natural systems and the built environment. Additionally digital infrastructure (ICT) has to play a vital role in the process and, adding practical value and efficiency to existing systems.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent? Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

To increase existing models and techniques, tech innovation can be applied. One of such technologies is distributed ledger technology / blockchain (Interbit, www.btl.co). It does not replace existing audit or financial practices, however it adds a number of advantages. Interbit enables institutions to issue and transfer assets over a network, which uses smart contracts and blockchain technology to automate processes and reduce cost.

Why Mutual ledger means there is no way for the parties to fall out of sync



with each other.

Audit costs are reduced and regulatory reports are automated as the blockchain provides a provable trail of all recorded events in your platform. Blockchain is a digital “assurance” instrument that provides necessary transparency being independent and ‘unhackable’. Interbit is designed from the ground up with a key focus around privacy and scalability, meeting the needs of the most demanding enterprise business use cases. Built on proven technology, Interbit implements unique design patterns to develop a powerful, yet lightweight, DTL platform, which enables:

- Effortless scalability across multiple networks
- True siloing of data for industry grade privacy
- Flexible redundancy across permissioned nodes
- HSM (Hardware Security Module) compatibility for transaction signing

Interbit empowers businesses to accelerate their digital strategy, and find increased efficiency, reduced cost and a high level of automation, by leveraging DLT.

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

To effectively provide the water management solutions, firstly it is important to continuously measure and analyse the water demand. Alternatively, it would be useful to measure wastewater, which accounts for higher costs and greater environmental impact. In addition, use of smart technologies such as sensors that would transmit real-time information into country Water Hub (Smart 4.0 www.smart4.tech), (potential integration with energy and carbon), an engaging digital water community, an interactive water map and a marketplace platform for innovative solutions and services. It may also act as a unified platform for billing and transactions for service payments (B2B and B2C level) secured by smart contracts. Water Hub will also provide Secured Personalised Accounts for government, businesses, and customers with customised analytical reports and data on water consumption and relevant statistics.

Secondly, it would potentially useful to introduce compulsory reporting – Water Disclosure where set rules, limits and norms would be outlined (i.e.



CDP, <http://www.cdp.net>) with integrated set norms for Energy and Carbon.

Thirdly, it would be helpful to introduce water credits system (i.e. Smart 4.0, www.smart4.tech) that would be tradable and exchangeable with other. Hence, creating 360 resilience and smart communities. Alternatively to Brooklyn microgrid, water provision along with a

Development of green finance instruments: water mini-bonds, where individuals can invest into local “water project” and innovation of the sector.

Decentralised Water Supply Systems to complement centralised water services. Innovation and interconnectivity: using alternative water sources, water saving devices for corporate and domestic levels, water re-utilisation opportunities.

National promo communications campaign integrated with all measures above, creating 360 strategy and tactics aimed to change behavioural patterns with proactive call to action and facilitation means to provide active response (i.e. combining efforts of numerous actors, Government, NGOs, Enterprises, Start-Ups, R&D sector, Smart 4.0 and local communities).

Collaboration via market liberalisation with the final goal of creating Water Trade Exchange, that would be interconnected with 5 other ones (Chile, Australia, US and others).

Similarly to water supply management, application of decentralised water supply (drainage and sewerage can be applied) in order to localise the processes and downsize the water supply chain cycle where possible.

Additionally, wastewater credits can be introduced (Smart 4.0).

Submission to National Infrastructure Assessment Call for Evidence 2017/18

Context: Transport Q15: “What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?”

Contact: [Name redacted], [email address redacted], [telephone number redacted]

Date: 10 February 2017

Overview

We would like to propose three junctions on the Strategic Road Network for consideration as high value transport investments (see map on following page):

- A14-M11-A428 (Girton Interchange)
- M11-A11 (Junction 9)
- A14-A11 (Junction 36)

We make the case that building additional connections at these junctions would improve regional connectivity and increase resilience of the key strategic freight route between Felixstowe and the Midlands.

The A428 does not connect directly to the M11. This is where the Oxford–Cambridge and London–Stansted–Cambridge corridors should connect. The A428 also does not connect with A1307. If it did, it would provide strong support for a business case to build a Park & Ride site at the Girton Interchange.

The M11, A14 and A11 form a triangle around Cambridge. This has the potential to be a continuously-dualled outer orbital route if connections were added between the A11 and the M11 north, and between the A11 and the A14 west. It would then be possible for traffic to bypass a closure of any one side of the triangle without using local roads.

Road delays owing to road works, collisions and other incidents reduce the productivity of businesses that use the strategic road network, most obviously those involved in moving freight. Diverting this traffic onto local roads causes severe congestion and reduces the productivity of local businesses.

As we shift to considering transport needs in terms of *mobility*, we must recognise that *resilience* and *capacity* are both critical components of an efficient network.

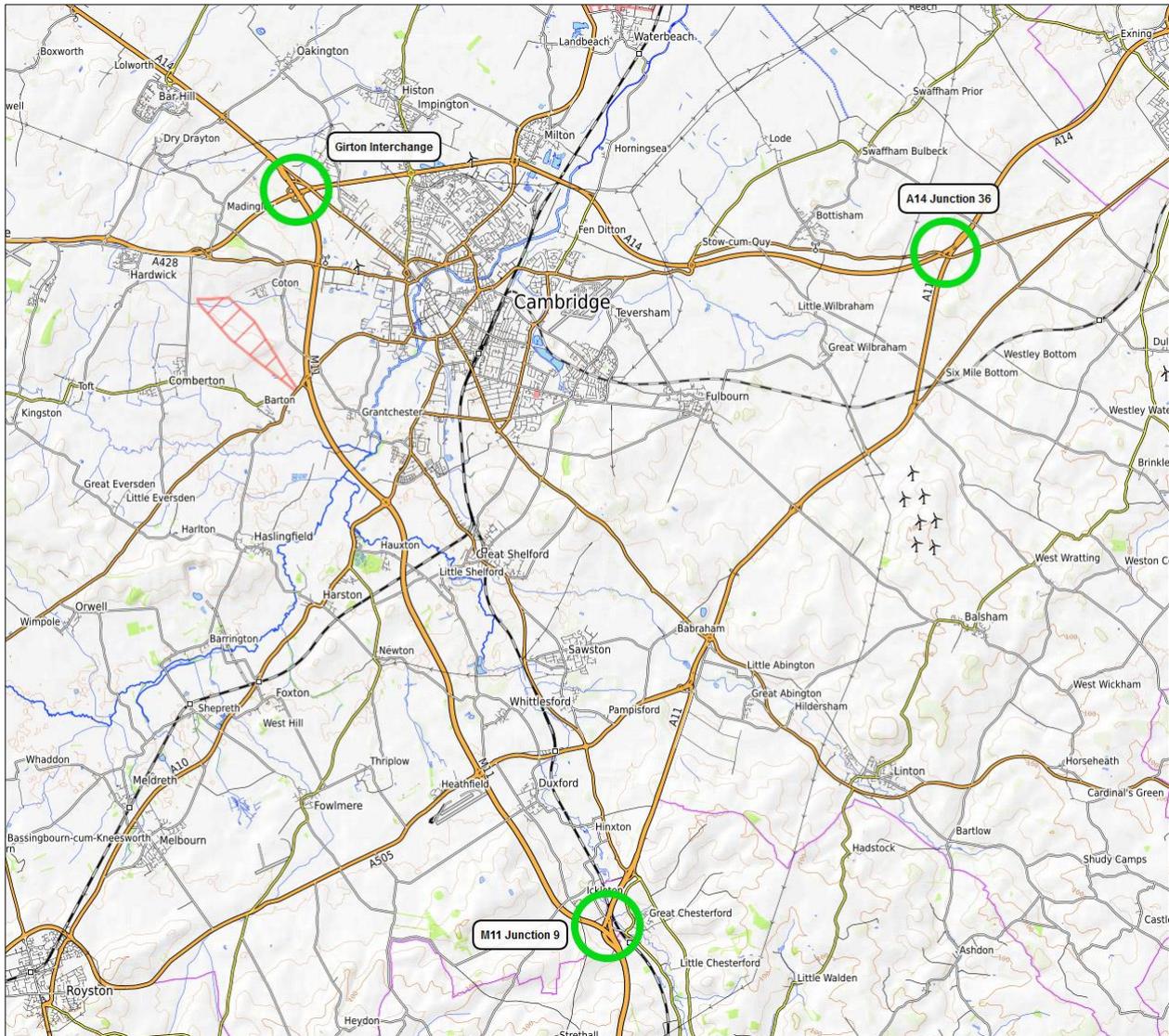


Figure 1: Junctions proposed for investment

Girton Interchange

The Girton Interchange already features in the National Infrastructure Commission's study for the Oxford-Cambridge Expressway. We want to make sure that its potential strategic role, regionally and locally, is fully appreciated.

Even after the [A14 Improvement Scheme](#) is completed, connections at the Girton Interchange will be limited. Traffic moving between the A428 and M11 will still have to use a congested single-carriage local road (A1303). Cambridge city centre is not the only destination: traffic arriving on the A428 from Cambourne, St Neots, Bedford, Milton Keynes, Oxford, etc is also aiming for the Cambridge Biomedical Campus, the science parks south of Cambridge (Genome Campus, Babraham Research Campus, Granta Park, Chesterford Research Park), and Stansted Airport.

In other words the Oxford-Cambridge corridor needs to connect seamlessly with the London-Stansted-Cambridge corridor. This requires the Girton Interchange to be reconfigured as the critical road connector.

But there is a local need for this too: a Park & Ride at this interchange (off the A1307) could intercept traffic from the north and west of Cambridge. At the moment the choice is between driving into the city and parking (possibly for free on a residential street) or detouring 6km (to Milton) to reach the nearest Park & Ride.

A Park & Ride here also has strong potential to be a hub for a rapid transit (e.g. light rail) line connecting the Girton Interchange, Cambridge city centre, Cambridge rail station, the Biomedical Campus, and Trumpington Park & Ride. It is likely that such a line would quickly attract a ridership in excess of 10 million passenger-journeys a year. This is based on some headline figures: each year the city already welcomes 5 million tourists, 5 million arrivals at the railway station (including tourists), and over 1.5 million Park & Ride users. The Biomedical Campus is expected to see 10 million arrivals per year within fifteen years.

Design ideas for the Girton Interchange are appended.

M11 Junction 9

In theory, the A505 provides the missing link between the M11 north and A11, but this is almost entirely single-carriageway (4.3km), already heavily congested, and an important local road. It serves a number of villages (Duxford, Whittlesford, Sawston, and Pampisford) with a combined population in excess of 10,000; employment centres around the A505 and in Sawston are growing; and it is the main access route to Whittlesford Parkway rail station, with an annual footfall of 493,004 passengers (2015/16), and services to London, Stansted and Cambridge.

There is a great need for a high capacity alternative route for A14 traffic when there is an incident or road works. In the two years 2015–16, there were 24 [collision incidents](#) recorded on

the section of the A14 between the M11 and A11. There were also delays owing to road works. If there were an alternative, fast route via the A11 and M11, the impact of such disruption would be greatly reduced, increasing productivity and hence GDP.

The next junction south on the M11 (Junction 8) is 22.5km away at Stansted Airport, so not a practical diversion.

The choice therefore is between bringing the A505 into the Strategic Road Network, dualling it and adding grade-separated junctions; or adding connections at the M11-A11 junction. The latter would create more extra capacity (in effect three lanes in each direction: A505 plus M11–A11) and greater resilience (two routes instead of one). The investment cost would also be lower.

A14 Junction 36

The lack of a connection between the A11 and A14 west does mean that traffic must use local roads, but the main benefit of adding a connection here would be to add resilience to the strategic road network. Closure of the northern part of the M11 (perhaps as part of future road widening) would have a greatly reduced impact if traffic could travel via the A14 and A11.

Design ideas for the Girton Interchange

Extract of paper as published on 30 Jan 2017 at smartertransport.uk/a14-girton-interchange

Since the new design for the Girton Interchange is now fixed, we have updated our proposal to fit around what will be built over the next few years. The two key objectives for us are:

1. Connect the A428 directly to the M11 in both directions, taking traffic off the heavily congested A1303 (Madingley Hill).
2. Provide a new Park & Ride site at the Girton Interchange, serving traffic arriving from the west on the A428 and from the north-west on the A14.

This [rough sketch](#) (which should not be taken to be geographically or technically precise) shows how these objectives could be met with the minimum of land take, and preserving or enhancing cycle/bridleways ([view map interactively](#)):

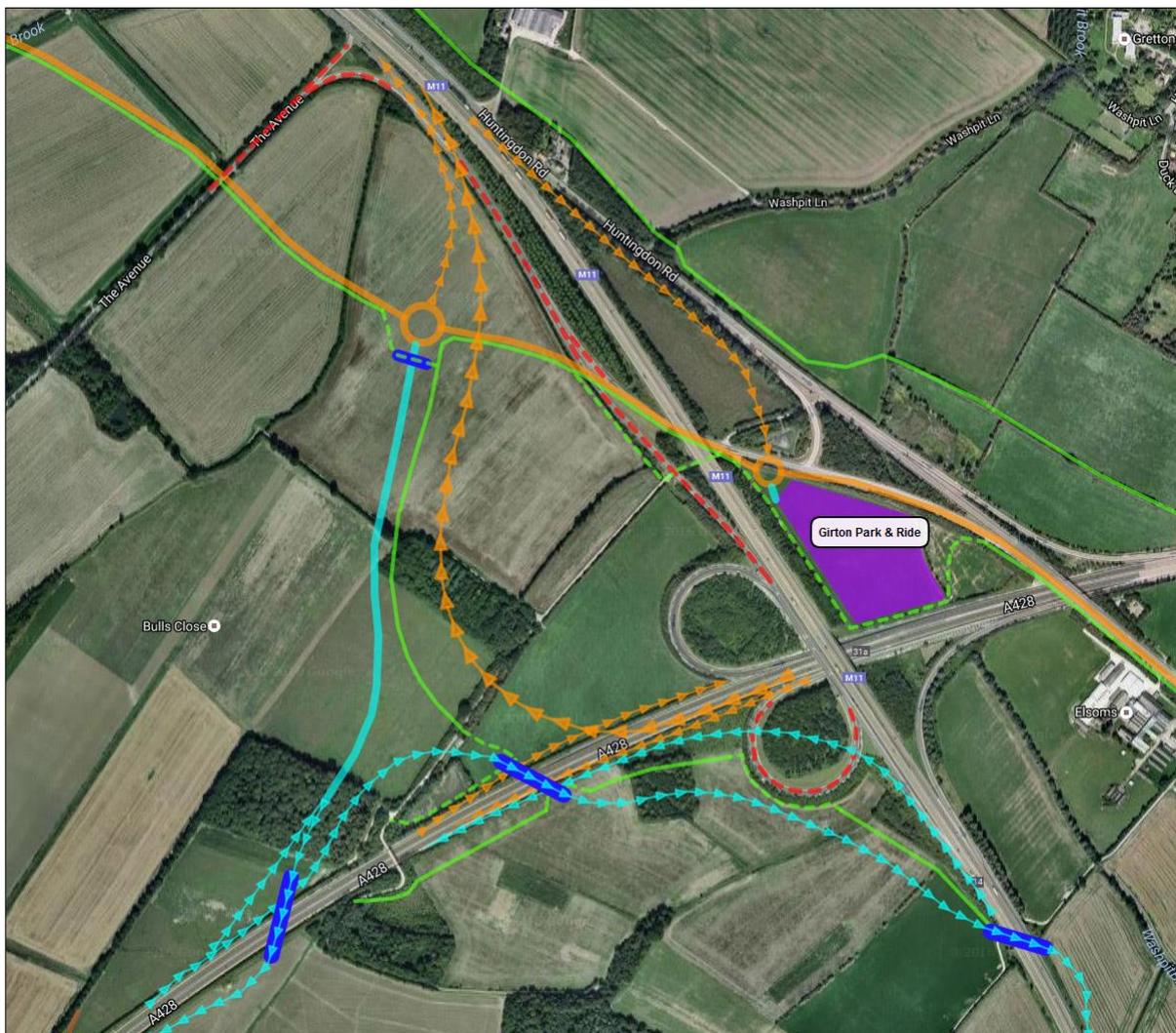


Figure 2: Smarter Cambridge Transport's sketch showing connections that could be added to the remodelled interchange.

Orange indicates roads to be built and red dashes mark roads to be closed as part of the [A14 Improvement Scheme](#), now underway. Cyan indicates additional roads proposed by Smarter Cambridge Transport. Green indicates cycle/bridleways (existing or to be created as part of the A14 Improvement Scheme), with dashed sections being amendments that we're proposing. Dark blue indicates a new bridge. The brown line indicates where a new farm access road and bridge might be needed.

Design notes

1. The roundabouts on the A1307 (Huntingdon Rd) either side of the M11 should employ elements of '[turbo](#)' design to maximise throughput and safety.
2. The eastern roundabout, connecting to the Park & Ride site, should integrate the bus stops so as to minimise bus journey times.
3. The bus station for the Girton P&R should be designed into the roundabout to minimise bus turnaround time.
4. We have shown the cycleway using the existing M11 underpass, officially a bridleway (rather than following the A1307 under the M11, as planned by Highways England).
5. The proposed P&R site is 3 hectares, which compares with 4 hectares for the existing Madingley Rd site. The site should be designed to be multi-level, enabling future expansion as demand grows. A compact, multi-level design minimises the land take and environmental impact (including rainwater run-off), and reduces the distance people must walk from their car to the bus station.

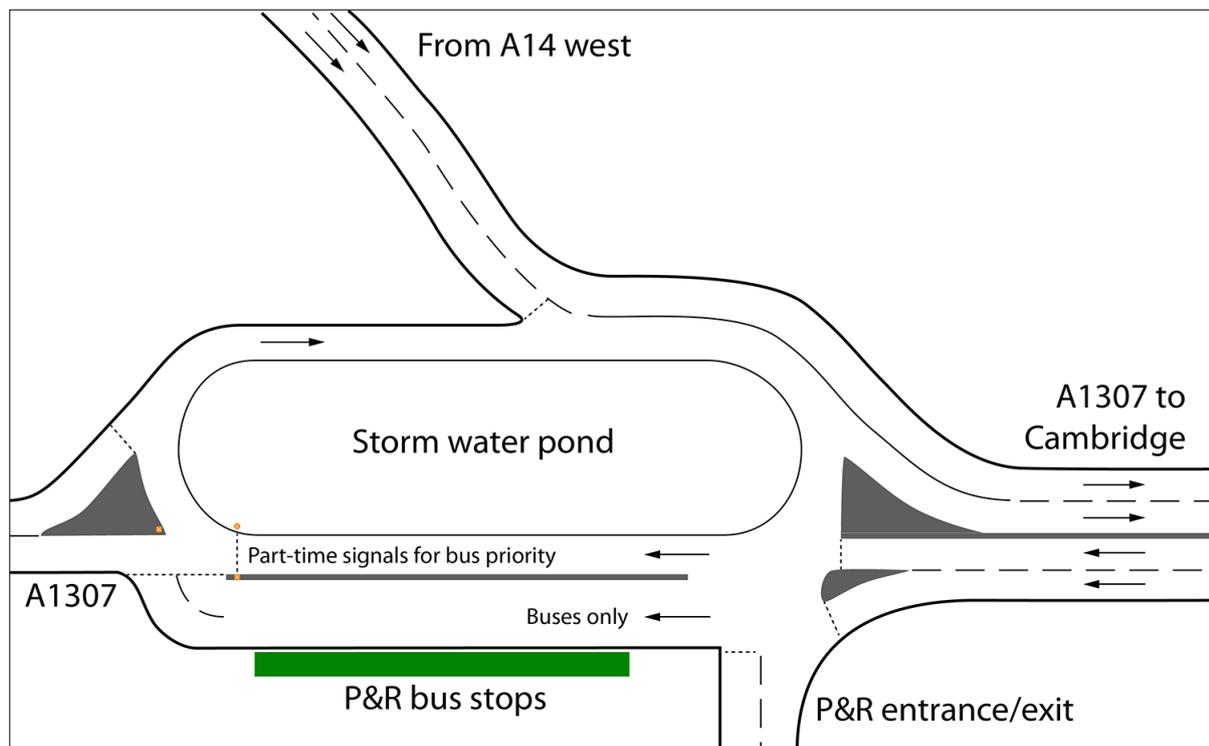


Figure 3: Detail of Girton Park & Ride junction

All-ways junction

There is a strong case for making this an all-ways junction. The lack of a connection between the A14 east and the A1307 (Huntingdon Rd) means that traffic heading for north-west Cambridge must leave the A14 at the Histon interchange and travel along Histon Rd and via the congested Victoria Rd junction, or rat-run via Windsor Rd and Oxford Rd. There are a few ways in which an all-ways junction might be achieved, one of which we have sketched here:

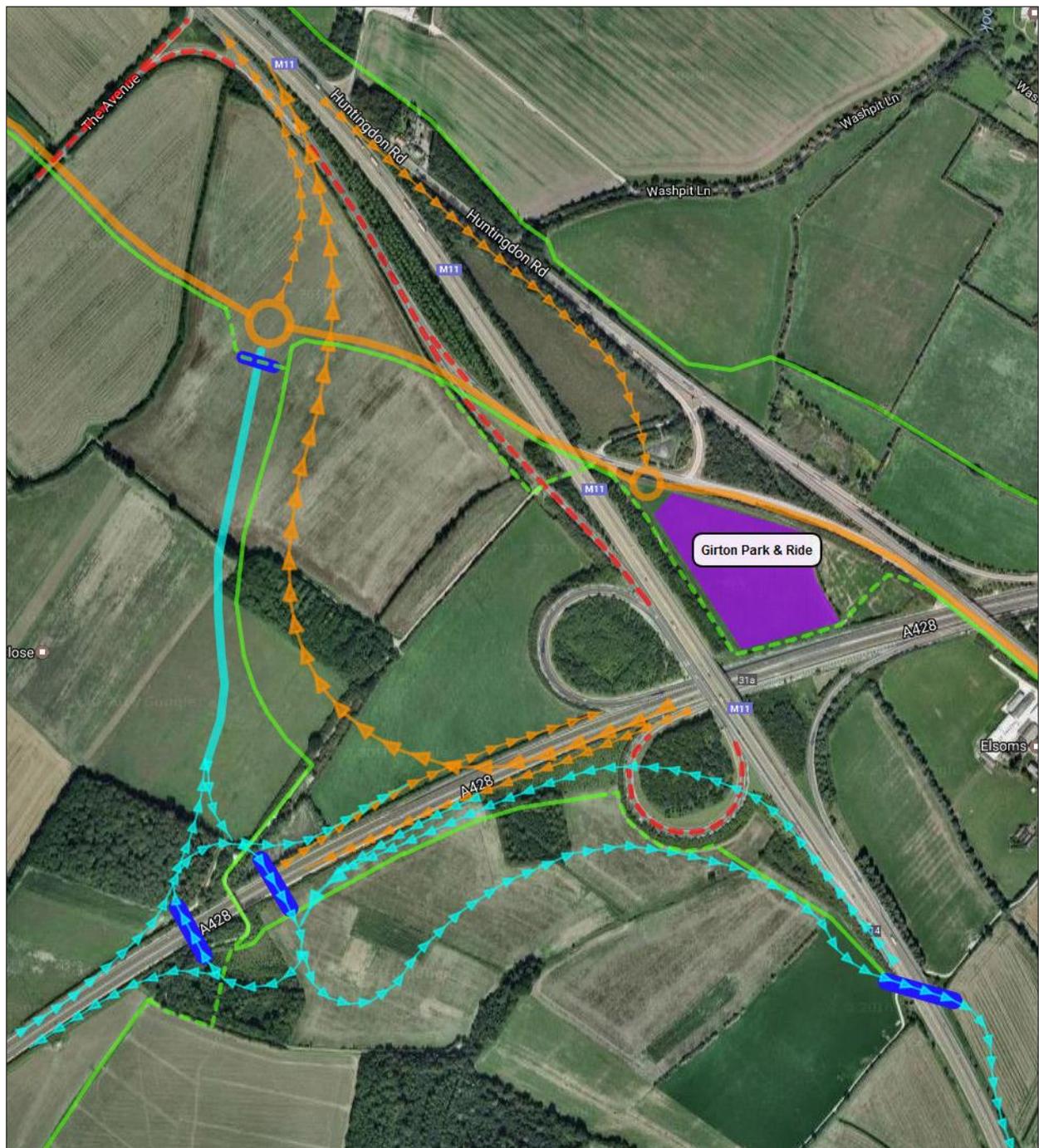


Figure 4: A possible design for an all-ways junction at the Girton Interchange ([view map interactively](#))

A14 Improvement Scheme

Highways England is going ahead with a major [upgrade](#) to the A14 between Cambridge and Huntingdon. It concluded a [public consultation](#) in 2014. The plans have been examined by the [Planning Inspectorate](#) and the Secretary of State gave his consent to the Development Consent Order. Construction is expected to finish in 2020.

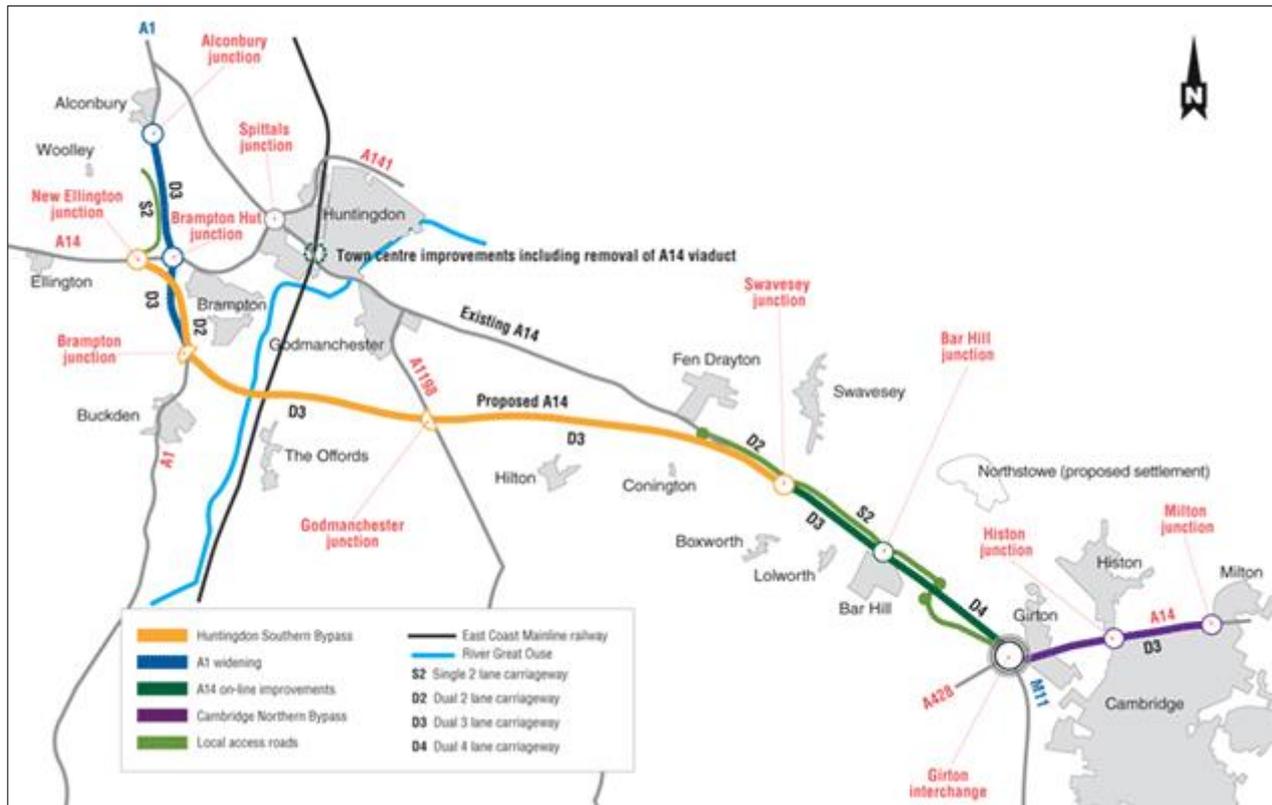


Figure 5: Highways England's proposed A14 Cambridge to Huntingdon Improvement Scheme

The principal improvements Highways England will make to the Girton Interchange are:

1. The tight loop in the A14 westbound is replaced by a gentle curve.
2. A new local access road connects Huntingdon Rd to Fen Drayton (and provides a new access to the crematorium).
3. Access to Huntingdon Road from the A14 west is via a new roundabout on what will become the local access road.



Figure 6: Draft plan of Highways England's remodelling of the Girton Interchange ([download as a PDF](#))

Principal concerns

1. It adds no new connections (in fact it removes a connection from the M11), even though it is acknowledged by the County Council and City Deal Board that a high capacity connection between the A428 and the M11 is essential for the viability of planned developments at [Cambourne West](#), [Bourn Airfield](#) and [St Neots](#); and also for the realisation of the planned [Oxford–Cambridge Expressway](#).
2. Access to the M11 from the A428 will continue to be via the A1303 (Madingley Road), which is already severely congested.
3. Access to the A14 east from Huntingdon Road or from the [North West Cambridge](#) development will be via a 5.5 mile detour to Junction 29 (Bar Hill) and back (as the Oakington Road junction is to be closed) or, as now, via congested city roads (either Histon Road to Junction 32, or Victoria Avenue and Milton Road to Junction 33).
4. The effectiveness of a park-and-ride site at this location will depend on good connections, for cars and buses.

-
5. Whilst addressing the safety concern over the tight loop that currently carries A14 westbound traffic, the safety of the similarly tight loop joining the M11 to the A14 eastbound is not addressed.
 6. Building a massive embankment and flyover to carry the A14 westbound lanes is unnecessarily expensive.
 7. Construction will have a huge environmental impact, including obliterating 2 hectares (5 acres) of woodland.
 8. Elevating the carriageway will amplify traffic noise for residents of Girton, Madingley, Dry Drayton and north-west Cambridge.



National Infrastructure Assessment Call For Evidence 2016-17

Response on behalf of the Solar Trade Association

About us

We are a not-for-profit trade association representing both the solar heat and solar power sectors in the UK. We are funded entirely by our membership, which includes installers, manufacturers, distributors, large-scale developers, investors and law firms.

Respondent details

Respondent Name:	[redacted]
Email Address:	[redacted]
Contact Address:	Greencoat House, Francis Street, London SW1P 1DH
Contact Telephone:	[redacted]
Organisation Name:	Solar Trade Association
Would you like this response to remain confidential?	No

Answers to Consultation questions

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

Solar is now the lowest cost, lowest carbon energy source which if effectively invested in now, along with the accompanying smart power infrastructure, would allow an accelerated growth through 2030 to 2050.

This would meet the Governments stated objective on energy policy which is:

“To ensure that the country has secure energy supplies that are reliable, affordable and clean”

Solar power combined with a smart energy policy can meet all of those elements. Solar is:

- **Secure:** solar energy uses an unlimited, free source of energy with a lifespan 25-40 years. There is no reliance on overseas feedstocks with volatile pricing from politically unstable regions. In 2014, over 60% of the fuel used to generate electricity in the UK was purchased from overseas. The Committee on Climate Change’s ‘High Renewables’ scenario proposed 40GW of solar and 45GW of wind by 2030, which would meet 55% of UK electricity demand. Investing in UK solar generation would reduce imports, which would greatly reduce the balance of payments deficit while significantly enhancing our security of supply.
- **Reliable:** Variable generation from solar and wind packaged together with battery storage and flexible capacity from CCGT, peaking power and demand-side response converts variable generation into predictable and reliable generation throughout the year, which far better matches consumer and industrial demand.
- **Affordable:** Even allowing for the cost of intermittency, the cost of solar is plummeting. But factor in smart power, in particular the potential to deploy 8GW of battery storage by 2030, and that apparent cost becomes a net financial benefit to the system as presented by the [Aurora Energy Research report](#). This also complements the evidence from the NIC’s £8bn savings by 2030.
- **Clean:** like wind, solar is a free source of clean energy.

2. How should infrastructure most effectively contribute to the UK’s international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Energy is a key part of economic infrastructure, as identified in this consultation and by Government in the recent Green Paper on *Building our Industrial Strategy* ([HM Government, 2017](#)). Solar can provide sustainable growth in the form of cheap, low-carbon and zero air pollution energy generation, high-quality jobs and export possibilities.

Lower energy costs

Government analysis forecasts large-scale solar photovoltaics (PV) could be the cheapest form of new electricity generation, alongside onshore wind, within the next five years ([BEIS, 2016](#)). By 2030 the cost advantage of solar compared to all other technologies bar onshore wind is forecast to be significant – potentially £45/MWh cheaper than combined-cycle gas. As ageing generation capacity is decommissioned and power demand rises with electric vehicles and the electrification of heat, it is in the interest of consumers we meet this gap with the cheapest generation available. It is important the UK is positioned to deploy solar as these cost reductions are realised, and that there is sufficient strength in the UK solar industry that the value is not entirely captured by overseas installers and investors.

As well as low-cost, low-carbon power, localised ‘behind the meter’ generation (e.g. a PV installation on a factory roof) reduces pressure on the electricity grid, reducing overall demand and the need for costly transmission network reinforcements (which ultimately must be paid for by the consumer). For example, Bentley’s rooftop solar installation provides up to [40% of energy](#) requirements at peak times, while also providing certainty on a proportion of the business’s future energy costs, enhancing competitiveness.



Considered in this light, solar power becomes cheaper still than other energy sources, which require costly grid re-enforcement.

Employment

Solar is the most job-rich energy technology in terms of jobs provided per generation output. At its peak in 2014 the UK solar industry employed 35,000 people. The sector has developed a workforce built on highly valued, transferable skills while providing opportunities across the UK ([Solar Trade Association, 2015](#)), though research has shown that one third of these jobs were lost following changes to the subsidy regime ([PwC and Solar Trade Association, 2016](#)). A strong solar industry will boost employment and help to retain and develop a skilled labour economy ([Centre for Economics and Business Research, 2014](#)).

Exports

Globally, 2016 will see solar attract more investment and employ more people than any other renewable power source ([IRENA, 2016](#)). The IEA expects renewables to absorb two-thirds of all power investment to 2020 ([IEA, 2015](#)), with solar set to attract \$3.7 trillion or a third of *all* power technology investments to 2040 ([BNEF, 2015](#)). The question is how can the UK benefit from this trend?

It is a widely-held misconception that because the majority of solar cells and modules are manufactured in Asia, that there is no value in solar for the UK economy. In fact the UK has developed significant installation expertise across a number of companies. Similarly, the UK investment and legal sectors have both flourished. Over 60% of the capital cost of installing solar remains in the UK as part of the balance of systems, labour and overheads.

The UK benefits from being an early mover, currently the sixth largest solar market globally by capacity deployed ([Bloomberg, 2016](#)). Already our members are investigating the possibility of bidding into tenders for solar power provision in Saudi Arabia, while also looking at investment opportunities in India. But tapping these external markets requires a strong UK solar base, something which current policies do not support.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Incorporating solar power into new-build homes is an easy way to meet many of the Government's stated goals such as reducing carbon emissions and making the electricity network 'smarter'. London and Scotland have both adopted new-build energy efficiency requirements (which can be met in part with rooftop solar panels) above that of the national average, without any impact on the number of new homes under construction.

Similarly, minimum efficiency standards for new commercial buildings would increase the number of rooftop solar installations. Certainty over new building regulations in both the residential and commercial sectors would encourage the uptake of solar in the UK and also preserve and create jobs in the UK solar industry.

With Government targets of building 250,000 homes per year, if even half were appropriate homes with roofs to install solar that would allow nearly 400MW of generating capacity. As storage continues to drop in price, most of these installations will add storage, smart meters and electric vehicle charging points and will be close to self-sufficient with their electrical energy needs.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

Solar power offers the greatest scope for demand management when combined with storage systems such as battery storage. At the domestic level, a house-scale battery can hold 15kWh (see [example](#)) of electricity, which represents roughly the daily electricity consumption of an average UK household. Solar panels can charge the battery during the day, which households can then consume in the evening, reducing stress on the grid at what is typically the peak time for demand.

Rebound effects are inherently hard to quantify, but there is no evidence that the installation of rooftop solar leads to increased electricity consumption. At the domestic level, the combination of smart meters and time-of-use tariffs means solar and battery combinations are more likely to time-shift consumption than increase it. Once storage becomes widely and economically available, the incentives will be in place to ensure most new build homes can be self-sufficient on electricity as ‘prosumers’.

On the utility scale, the majority of (non-hydro) storage at this stage is focused on frequency-response rather than demand management. However as storage becomes cheaper we can expect a similar time-shifting of demand as batteries are charged during peak solar output during the day, with electricity consumed later during the demand peak.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

At current wholesale power price levels, it does not make financial sense to construct new utility-scale power generation of [any type](#). Solar cannot access capacity market auctions, the Renewables Obligation scheme has closed and feed-in-tariffs have been cut to near-negligible levels for larger plants (once capping provisions are considered). Barring a total redesign of the electricity market, the logical way to fund utility-scale solar in the short term is to hold a Pot 1 contract for difference (CfD) auction. The government is averse to CfD rounds because of the limitations to the Levy Control Framework budget as well as their manifesto pledge on stopping further subsidies for onshore wind. However, the upshot of this policy is to shut off new large-scale solar power from the market altogether. This therefore needs to be addressed.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system

Localised solar power (whether at the residential or commercial level) generation improves system resilience – consumers are less dependent on single large generation plants for supply, particularly as

batteries are introduced. On-site solar supply also reduces pressure on the grid, freeing up capacity for more distant generation (e.g. offshore wind).

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

There are two aspects to this question: the impact on the wider environment (in terms of air pollution and climate change) and also the local environment. Solar installations can be placed on the rooftops of [industrial sites](#) and [railway bridges](#) with minimal visual impact, while sheep grazing can be maintained in and around utility-scale solar farms. Indeed, one of the conditions of planning for ground-mounted solar sites is dual-purpose usage which ensures that if sheep grazing isn't appropriate, other measures such as enhancing biodiversity are required, contributing to the natural environment.

On the climate change front, the UK is committed to reducing carbon emissions by 80% from 1990 levels by 2050. The Committee on Climate Change says electrifying our heat and transport network is necessary to meet this challenge, with consequent increases expected in electricity demand ([Committee on Climate Change, 2015](#)).

Solar is among the lowest carbon-output forms of electricity generation, with utility-scale solar accounting for around [48g of CO₂ /kWh](#) (based on the CO₂ associated with construction – after construction emissions are essentially zero), compared with [820g of CO₂ /kWh](#) for coal-fired plants and [490 CO₂ /kWh](#) for efficient gas plants. Replacing existing coal and gas-fired infrastructure with solar power is therefore an obvious way to reduce carbon emissions cheaply.

Energy:

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

There are two strands to our response: solar thermal in domestic, commercial and industrial heating; and electrifying heat.

Electrifying heat

We do not have specific comments on the method by which heating should be electrified, other than to echo our earlier comments that electrification of heat will naturally lead to increased power demand in coming years, and the best way to meet much of this new electricity demand will be a combination of domestic and utility-scale solar power. We support the roll out of both air and ground-source heat pumps and comment that additional flexible generation such as wind and solar is available to meet that demand.

It should also be noted that a Kingspan study stated the technical potential of south-facing commercial rooftops was 2,500km², or the equivalent of 380GW. To date we have only installed solar on 0.1% of that. We anticipate that from around 2018-2020 a subsidy will not be required and the majority of this potential can be installed without a generation tariff. But a strong UK market is needed now to ensure we can achieve that potential.

Solar Thermal

By both European and international standards the UK has a historically low deployment of renewable heat technologies, including solar thermal. In 2015 renewable sources provided only 5.6% of the UK's heat, which puts the UK well behind its own target of 12% renewable heat by 2020 ([DECC, 2016](#)). It is widely understood that a step change is needed in renewable heat deployment across Europe given the dominance of heating in energy use and the consequent implications for energy security (particularly in relation to gas security) and carbon emissions.

The scope for solar thermal to displace fossil heating is significant in both the domestic and non-domestic market. At the household level its potential contribution to energy savings through hot water heating increases as regulations increasingly tighten the thermal performance of buildings. Solar thermal also ensures the widest possible number of homes, including smaller, urban and less-able-to-pay homes, will be able to benefit from the Renewable Heat Incentive, helping improve fairness and inclusivity in public funding. Solar thermal is also unique in not presenting ongoing fuel cost risk, which is particularly important for the future, especially for more vulnerable households.

Technologically solar thermal continues to develop internationally and it offers tremendous potential in industrial process heating, as well as growing complementarity with other heat technologies, both through the development of combi-systems and increasing the overall performance of other renewable heat technologies such as heat pumps. Analysis by [IRENA](#) shows that:

- In developed countries solar thermal technologies could technically provide nearly half of heat demand in the industrial sector. Process heating accounts for two-thirds of total energy consumption in industry and half of this is for medium to low temperature processes, much of which can be met by existing solar thermal technologies.
- IRENA estimates that thermal technologies have the potential to supply 10% of industrial energy demand by 2030.
- However, while the technical potential is extremely high, deployment remains low, with low levels of awareness recognised as a particular problem.
- IRENA recommend that governments work to grow awareness of solar thermal potential in the industrial sector and the STA is keen to work with the NIC and other departments to do this.

Despite all this, rates of solar thermal deployment in the UK have fallen in both the domestic and non-domestic sectors since 2010, as a result of several factors:

- Space heating and solar thermal combined with PV technology are both excluded from the Renewable Heat Incentive (RHI), discouraging deployment.
- There is an absence of regulatory support for including solar thermal on new-build domestic properties.
- The non-domestic RHI has an upper installation size limit of 200kW, which limits economies of scale and discourages those with large roofs from deploying solar thermal technology.

Remedying each of these factors is likely to see a significant increase in the number of solar thermal installations.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

What the 2050 power sector will look like

According to the [IEA](#), solar power costs will fall another 40%-70% on today's numbers by 2040. Wind costs are also projected to fall significantly. With these falling costs, in the future solar power is likely to represent a significant share of total electricity generation, possibly even the majority. The efficiency of solar panels is also likely to increase as developments in inverter and panel technology take hold. Total power generation requirements will be far higher as the majority of heat generation has been electrified and road transport is increasingly the domain of electric vehicles.

This means integrating solar power's variable output into the electricity system. New research shows that the system cost of integrating variable renewables is modest at the levels of penetration needed to meet our 2030 carbon commitments; costs are still lower than those of traditional generation, even accounting for the costs associated with variability ([Aurora Energy Research, 2016](#)). Research by Imperial College for the National Infrastructure Commission shows combining renewables with greater system flexibility can bring [huge net economic gains](#) while also retaining security of supply.

As we move through the first half of the 21st century battery costs will continue to fall, while the proliferation of electric vehicles will also provide additional storage which can potentially be integrated with the grid. The greater the incidence of batteries in the system, the easier it will be to match the supply from solar power to demand.

How could this be achieved?

Much of solar's march to grid dominance will be driven by ever-falling costs, which will happen as a natural function of global markets and technological advances. However there are a number of policies which must be altered to ensure solar has market access, which we have set out earlier in this document.

In addition, the grid needs to be 'smartened'. The National Infrastructure Commission, Ofgem and Government have identified the direction of travel in the UK energy system towards a smarter, more flexible energy system ([National Infrastructure Commission, 2016](#)) ([BEIS and Ofgem, 2016](#)). A smarter system in future will require greater demand and supply flexibility to maintain the system balance, using synergies across a portfolio of different technologies and appliances. It will empower consumers, as well as new market entrants and distributed generation and provide more localised price signals. The technical and financial characteristics of solar have stimulated much of the recent innovation in the power sector so it sits naturally at the heart of this transition. 'Baseload' has already become an outdated term in energy supply ([National Grid, 2015](#)), as solar and other renewables with zero marginal costs dispatch first and are complemented by flexible generation and demand.

Companies offering solutions adjusting demand to meet supply need to be given greater access to markets, and District Network Operators (DNOs) need to be incentivised to procure their services. Currently DNOs are resistant to flexible generation and lack the incentives to improve grid flexibility.

On a general level, the UK cannot wake up in 2049 and decide that solar should be an integral part of the power-generation system. There needs to be a clear policy roadmap over the next thirty years, based on the areas set out in this response.



**SOLENT
LOCAL
ENTERPRISE
PARTNERSHIP**

Solent LEP Office
Second Floor
1000 Lakeside
Western Road
Portsmouth
PO6 3EN

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Sent by email only to NIAEvidence@nic.gsi.gov.uk

10th February 2017

Dear Sir / Madam,

Re: Solent LEP Response to the National Infrastructure Assessment Call for Evidence

The Solent LEP is the key interface and lead for economic development in the Solent. It is a partnership organisation between the business community, the Further Education and Higher Education sector, three unitary authorities, eight district councils and one county council, all of whom are actively working together to secure a more prosperous and sustainable future for the Solent area. Meeting our growth aspirations requires the area to attract investment and create jobs that support growth in the business sector and create jobs, while also ensuring that we have the infrastructure through facilitating the growth of innovation and research and development in the Solent area that will support our economic growth.

Call for Evidence
by panel, this
in, the
on an
S. att

A. Executive Summary

The Solent is an interconnected city region with two major economic centres in Portsmouth and Southampton, connected by the M27 corridor. The area as a whole has a complex socio-economic geography that is influenced by its 290 miles of coastline, high levels of urbanisation and population density, and skills and sectoral profiles that are contributing to a significant underperformance in productivity.

The Solent economy is positioned as the "Southern Gateway," shaped by the three ports which are high performing economic assets of national significance (Port of Southampton, Portsmouth Naval Base, and Southampton International Airport). Clearly they are not only hugely important to the Solent area, but they also need to be positioned in terms of the wider contribution they make to the growth and prosperity of the UK economy as a whole. The Southern Gateway performs a vital role in delivering access to global markets supporting the UK industry and specifically the automotive sector, whilst having a key defence cluster of international significance as well as being the home for the Royal Navy. Alongside this, the Solent has three universities which are also major economic assets, providing the region with a world class research, innovation and science base as well as a strengthening skills base.

The economy of the M27 corridor, incorporating the two cities, is growing rapidly, driven by an emerging tech sector, further expansion of marine and maritime sectors, higher levels of consumer spending and population increases. This growth is now stalling and is constrained. There are already clear signs that it is underperforming as evidenced by the growing productivity gap. This sees the Solent lagging behind the south east average GVA by 9% and the UK average by just under half a per cent. This disparity is widening and is typically characterised by a lack of resilience in existing transport infrastructure on both road and rail, longer journey times and excessive congestion, poor air quality, significant unmet housing need, a lack of commercial space to support the expanding tech sector, breaches in flood defence, and challenges in energy supply.

Yet the intense growth of the area, in population terms, and of the two cities, its research, innovation and science base and its international gateways has not been matched by the provision of the modern infrastructure required to accommodate and fuel this growth, and this is holding back the economic potential of the Solent and its contribution to the wider UK economy.

On this basis it is vitally important that the National Infrastructure Assessment prioritises the following:

- **Support for the key Solent gateways** that underpin UK trading on both an import and export basis. This is vitally important as the UK establishes a new trading relationship with the world and it is critical that new infrastructure investment is targeted at road and rail in the Solent to upgrade and improve logistics connectivity and freight capacity to support our successful exporting sectors such as automotive.

- **Improving connectivity across the Solent and from the Solent to London** will lead to a greater pool of skills and talent being available, greater connections between businesses and supply chains and higher productivity in the area. Improving connections between our two cities and from the cities to London will drive growth, by improving economic proximity. Lowering travel times by rail to 30 minutes between Portsmouth and Southampton, and improving links between the Isle of Wight and the

mainland will lift productivity in the Solent by 10%. Significant gains can also be achieved by improving local transport links and reducing congestion.

- **Addressing unmet housing demand in the Solent** as the growing population and an acute shortage of housing impacts on affordability and consequently the recruitment of talent to support a shift to a more productive, high growth economy. There are increasing pressures on existing infrastructure (energy, wastewater, transport), which, when coupled with a legacy of underinvestment, challenges the viability of many developments and this has resulted in an infrastructure deficit.
- **Affordable Energy and clean growth including** energy security to support growth, and optimising the renewable energy potential of the Solent including the offshore wind manufacturing base on the Isle of Wight.
- **Ensuring that the Solent's digital infrastructure is prepared for the challenges of tomorrow** is pivotal to productivity. The Solent is home to an expanding tech sector which has grown by 33% in the past five years, outpacing the UK average of 29%. Southampton had digital turnover growth of 180% between 2010 and 2014, faster than any other UK city. The University of Southampton plays a key role in this with the Web Science Institute, and there is also a strong marine intelligence systems presence in Portsmouth. However significant investment in digital infrastructure to secure total superfast broadband coverage and 4G and, in the future, 5G networks, is necessary if we are to retain this capability.
- **Support for our key cities of Portsmouth and Southampton**, which require over £140 million investment in Flood defence to safeguard existing development as well as unlock new employment and residential land.

This consultation response has been shaped by engagement with the private and public sectors and is underpinned by a detailed published evidence base as set out in the following documents:

- [Solent Strategic Economic Plan](#)
- [Solent Productivity and Growth Strategy Update 2017](#)
- [Solent Strategic Transport Investment Plan](#)
- [Transforming Solent: Marine and Maritime Supplement](#)

In addition, the LEP is currently developing an Island Infrastructure Investment Plan, which will set out the key infrastructure priorities to support the specific economic challenges of the Isle of Wight - themselves influenced by its island geography. This is expected to be published in the summer of 2018 and will be forwarded to the DfID to support their work

...applied to the economy... economic... this... and incl... key... profit... the... Part... connected...

The Port of Southampton is strategically positioned in relation to the UK automotive industry based in the Midlands Engine and Northern Powerhouse, and is just 20 nautical miles from the key Shanghai to Rotterdam shipping superhighway. It is the UK's prime export port, and is strategically placed to support the changing flows of international trade. It alone handles exports worth more than £40 billion, with 90% of exports going to destinations outside of the EU. The Port of Portsmouth (including the Commercial Port and Naval Base) provide the anchor points for our globally leading marine and maritime sector, contributing 20.5% of our GVA, 5% of our private sector jobs and 7% of all manufacturing in the area. The Naval Base will see the first of two new QE Class Aircraft Carriers this year, which will be the largest and most complex warships in the history of the Navy. These are significant strategic national assets, and will require reliable and upgraded infrastructure, and notably transport and energy). Their arrival will result in associated peaks and troughs in infrastructure demand

Gateways of the area.

Whilst this complex economic geography gives the area its unique character, it also provides both opportunities and challenges with regard to local economic growth. Overlaid on this complex economic geography are the three major economic assets; the International

the current and forecast demands of a highly urbanized and growing economy. left the Solent in a position where the historic supply of infrastructure is unable to cater for cities but also the emergence of an increasingly polycentric settlement structure, which has 8,000 people each year. The long term growth trajectory has seen the not only growth of our residents, a total increase of 20%, or 0.6% annually, which is equivalent to adding around the population across all 12 local authority areas of the Solent has grown by 264,000 connectivity, transport, flood defences and provision of utilities. Between 1981 and 2014 islands and two peninsulas, present unique infrastructure challenges around digital London. This, coupled with 290 miles of coastline, habits of international significance three and the mainland part of the Solent is the most urbanised area in southern England outside The Solent has two large, growing, densely populated cities (Portsmouth and Southampton),

The Solent economy has a population of over 1.3 million, 50,000 businesses, local GVA of £27 billion. It has a range of assets that are globally renowned, a strong SME and skills base, and a thriving research community through its universities and research institutions. The coastal location and marine business base provide us with immense strengths on which we can build, taking advantage of global growth in maritime trade, the rapid expansion of the cruise sector and automotive exports, rising demand for leisure marine and specialist vessels, expansion in marine renewables and in technology-led industries.

B. Solent LEP Economic Profile

- Improved rail journey time to London from Portsmouth.
- Improved highway and rail access to / from the Port of Southampton;
- Improved Highway access to support major housing developments adjacent to the M27 Corridor and also on the M275 to improve access to the centre of the City of Portsmouth
- Flood defence to safeguard residential and business properties and unlock development opportunities in Portsmouth and Southampton;
- Future-proofing digital connectivity; and
- Providing energy security to support growth, and optimising the renewable energy potential of the Solent.

and draw on a pool of skilled labour that will be nationwide - requiring strong connectivity to the Solent.

Southampton International Airport plays an important complementary role in the south east's aviation offer, and has significant capacity for growth, which would free up capacity at other airports in the south east. In 2017, the airport is expected to surpass 2 million passengers, and plans for Southampton becoming an aerotropolis. Southampton Airport's Masterplan highlights plans to increase capacity at the airport on a phased basis to meet increasing passenger demand initially up to 3 million passengers per annum, and ultimately up to 6 million passengers. All three international gateways play an important role in the national infrastructure provision and, therefore, are national infrastructure assets.

As a result, the Solent is widely regarded as the Southern Gateway economy, with strengths across a range of industries in the private sector. As a consequence of these economic assets, the three Solent "ports" and their respective cities contain important clustered sectors and concentrations of economic activity and smart specialisation, most notably in the marine and maritime sector, and also in defence, logistics, and advanced manufacturing (including advanced materials and photonics), aerospace, digital (creative and cyber security) and tourism. These are some of the principal industries which benefit from the unique and beneficial economic environment in the Solent.

Despite our existing strengths and opportunities, the Solent economy is yet to reach its potential and productivity remains a major challenge. Measured by GVA, the area is lagging behind the south east average by 9% and the UK average by just under half a percent. Strong polycentric population growth combined with clustered economic development means that infrastructure will play a critical function in:

- providing satisfactory links between homes and jobs and key economic centres; and
- maintaining the critical artery for the automotive industry in the Midlands and the North and the Port of Southampton in the South.

A growing population and an acute shortage of housing, which impacts on affordability and consequently the recruitment of talent to support a shift to a more productive, high growth economy, mean that there are increasing pressures on existing infrastructure, which, when coupled with a legacy of underinvestment result in an infrastructure deficit. Ease or difficulty of commuting, and thus quality of the transport and digital network, is frequently highlighted as a key factor in our economic competitiveness whilst also being important to the locational decisions of high skilled and highly mobile labour in the Solent.

In an era of global competition, economic assets are only ever relative and require continued investment in order to maintain their international attractiveness. Efficient and effective infrastructure is an essential component in the success and survival of economic clusters and the Solent must continue to act to strengthen its comparative advantages across its key sectors to realise economic value.

As a result, the Solent's infrastructure (defined by government as transport, energy, water, waste, digital services and digital) are areas that are of significant importance to the Solent economy.

The Solent's infrastructure challenges to connect / changes, which are in part, influenced by the growth of the area, population growth and the presence of major economic hubs within the Solent, which contribute to the growth of the Solent.

rail connectivity is slow (45 - 60 minutes for a 20 mile journey) and infrequent, as is rail connectivity to Southampton airport from the east, when compared to other dual city areas such as Nottingham - Derby and Newcastle - Sunderland (both 15 miles apart with rail journey times of circa 20 minutes). This results in the parallel M27 being the default option, resulting in chronic peak period congestion. Rail access between Portsmouth and London is also unacceptably slow (between 96 minutes and 129 minutes). This erodes the geographic proximity of Portsmouth to Southampton Airport and on a wider basis to London, which is becoming even more pronounced as rail access to London from other towns and cities is enhanced.

Our response has been drafted within the context of the Building Our Industrial Strategy Green Paper and its focus on the role of infrastructure in unlocking place-based growth through increases in productivity and competitiveness, and within the changing landscape of international trade as a consequence of the decision of the UK to leave the European Union.

It is clear that the provision and performance of economic infrastructure in the Solent area does impose challenges to business growth and productivity and that future investment in economic infrastructure provides significant opportunities to support sustainable economic growth; improve competitiveness; and improve quality of life. It will therefore be important that the outputs from the NIA support the Solent to:

- Build on our strengths and extend excellence into the future;
- Close the gap in productive between the Solent and the wider south east and the UK; and
- Ensures that the Solent plays its full role in making the UK one of the most competitive places in the world to start or grow a business.

Our response considers the following thematic areas:

- Cross-Cutting Issues
- Transport
- Digital Communications
- Energy
- Flood Risk Management

We provide links to evidence documents, as requested, which support our position.

C. Cross-Cutting Issues

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

The highest value public infrastructure investments that would support long term sustainable growth in the Solent and contribute to broader growth in the UK are:

- Improved rail connectivity within and to/from the Solent, focussed on:
 - Delivery of an integrated high frequency Solent Metro service transforming journey time between Portsmouth and Southampton (including Southampton Airport) and better connecting our polycentric settlement structure and improved rail journey time to London from Portsmouth.
- Improved highway and rail access to / from the Port of Southampton; Improved Highway access to support major housing developments adjacent to the M27 Corridor and also on the M275 to improve access to the centre of the City of Portsmouth

- Flood defence to safeguard residential and business properties and unlock development opportunities in Portsmouth and Southampton;
- Future-proofing digital connectivity; and
- Providing energy security to support growth, and optimising the renewable energy potential of the Solent.

Solent Metro

Solent LEP very strongly contend that government should increase investment in the commuter rail network and other public transport in the Solent to ensure the economic development of our cities and urban centres is not constrained by overcrowding and congestion. Currently road congestion in our area severely delays commuting and other economic activity, and the city of Southampton is currently in breach of air pollution limits. This is exacerbated by an under-provision of public transport in our area and as a result the Solent area now needs to take the bold decision to focus on the development of an integrated and expanded public transport network - Solent Metro.

A Solent Metro network spanning the Solent would support the delivery of new housing and employment development opportunities along the M27 Corridor and in our two cities. Solent Metro will transform the Solent economy through: improving labour mobility; broadening the labour pool available to employers; supporting growth at our nationally important international gateways; improving productivity and competitiveness; improving agglomeration and economic interaction between Portsmouth and Southampton; improving connectivity of the Solent with London, the wider UK and international markets to enable the Solent to maximise its proximity advantage; and improving the attractiveness of the area to new investment, including foreign direct investment.

This is in line with the Solent Strategic Transport Investment Plan (STIP) published in 2016.

The STIP focuses on the more economically transformative and longer term investments necessary to support and unlock the Solent's growth potential over the next 30 to 40 years and ensure that the Solent's economic assets continue to play a key role in the wider UK supply chain. Over this timescale an additional 300,000 to 400,000 residents could make the Solent an area of 2 million people – equivalent to dual cities such as Nottingham/Derby and Newcastle/Sunderland. In order to accommodate this growth and to strengthen the role of our economic assets such as the Port of Southampton, there will be a requirement to address the transport deficit and invest in a modern metro-style transport network, to relive pressure on our highway network.

The STIP concludes that in the long term the Solent LEP's business-led transport strategy should aim to “increase economic proximity” through the following elements:

- Increase dual city (Portsmouth to Southampton) linkages around public transport and business critical movements to integrate labour and consumer markets.
- Support clustering and agglomeration around key local strengths and competitive advantages that other areas do not replicate (e.g. port functions).
- Develop a corridor of development nodes based around an improved public transport offering between the cities and across the urban network to 2040
- Optimise and integrate the transport network (ticketing, information and operation) using demand load that can be spread to improve resilience and especially in more constrained cities with pinch points.

The M3/A34/M40 spine is a critical artery in the UK supply chain, providing access to the UKs growing automotive industry to global markets. Investment is planned at the M3 Junction 9 / A34 interchange, which is key bottleneck along this route - but the scheme is not expected to commence until the end of the decade. Whilst funding was identified for the project in 2015, the pace of progress, is frustratingly slow, and is failing to build on the back of over £150m private sector investment to enable the UK to accommodate the world's

of Southampton. reflects the scale and pace of growth in these sectors and the market preference for the Port set out that within the period to 2035 it will need to expand to accommodate growth. This Master Plan forecasts for 2020 for Cruise Passengers and for 2030 for automobiles and has a context of increasing mode share for rail. The Port has already surpassed its 2009 Port forecast growth is such that additional highway and rail capacity will be required, even within going to non-EU destinations. Whilst 40% of freight traffic is transported by rail, the scale of passengers per annum and is the UKs second busiest container port, with 90% of exports the UK automotive supply chain. It is also the UKs premier cruise port, handling 1.77m Southampton in the UKs international automotive hub and therefore performs a key role in automotive supply chain. Handling 1m vehicles per annum (the vast majority for export), Southampton. The Port of Southampton plays an increasingly important role in the UK Our response to question 2, below, sets out the national strategic importance of the Port

and construction of new infrastructure. efficient maintenance and upgrade of existing infrastructure and the cost-effective design the effects of climate change and the increasing demands on the network, through the major focuses will be on rail transport, to meet challenges such as improving resilience to Southampton, which is presently building the National Infrastructure Laboratory. One of the In relation to this, there is an opportunity for the NIC to draw on the work of the University of

primary road and rail networks. The NIA should identify priority routes for capacity improvement on the strategic road,

Improved Highway and Rail Access to the Port of Southampton

Feasibility work on the initial phase of Solent Metro is being taken forward by the LEP and is focused on a route connecting Southampton Central Railway Station with Eastleigh Town Centre, via Town Quay, development sites along the River Itchen, and Southampton Airport. This will help optimise private sector investment in the area and will support the delivery of new housing and employment developments such as Itchen Riverside, Southampton Waterfront, Southampton Airport Economic Gateway, the former Ford site (now Mountpark), and respond to increasing congestion and air quality issues in the Southampton / Eastleigh area. This will provide a catalyst for the delivery of the future phases of the wider Solent Metro network.

- Secure improved strategic connections to London, the south east (airport passenger market), the UK (especially for port freight) and internationally for airport leisure and business market and "European" inward investment
- A greater focus on Transport Orientated Developments (TODs). Increase residential densities around new and underutilised transport nodes to accommodate additional housing development while protecting natural assets and addressing affordability with the same land take.

largest cargo and cruise ships through the DP World operation, which has a capacity for 35,500 containers.

Conversion from DC to AC of the freight route between Southampton and Basingstoke, as part of the route to the Midlands was planned as part of the Network Rail Control Period (CP) 5 Enhancements Programme, but will now be considered within CP6 (2019-24). This would have enabled faster and more efficient rolling stock to operate the route. Opportunities for decking container trains should be considered, to make best use of finite rail pathways.

Whilst investment in the Strategic Road Network (SRN) is critical to support access to the Port of Southampton, it is the final leg of the highway journey that can take a disproportionate amount of total journey time. This is the case in Southampton; congestion on the M27 and M271, as well as the A33 Redbridge Road / Millbrook Road (which is a local road) form the local access to the Port of Southampton, but are also used by commuters, businesses and visitors, which add significant delays to journey time and contribute to significant air quality issues experienced on the western approach to Southampton. Consideration of highway access to international gateways should reflect the whole route, not just the SRN.

Flood defence

There is an ongoing need to analyse flood risk at the scale of catchment and coastal cells such as the Solent. Resources should be allocated so as to minimise the economic risk of flooding and there is a very strong case to invest in flood defence in the Solent as it is clearly cost beneficial to do so.

Two schemes are of particular significance in the Solent: along the western bank of the River Itchen in Southampton, adjacent to the city centre, and at Southsea in Portsmouth. The former reduces flood risk to 1,157 properties and 679 businesses, whilst the later reduces flood risk to £649m of assets, 8,013 existing homes, and 1,035 businesses. In addition, the Itchen scheme enables over 2,000 new homes, and the Southsea scheme enables 1,000 new homes.

Energy

Ensuring secure, affordable and low carbon energy supplies requires a range of actions to manage energy demand and provide new energy generation capacity. Uncertainty over energy policy has dis-incentivised investment. In the Solent area, population increases, the growth of the economy, and increasing demand from the defence sector provide upward pressure on energy demand. As part of the NIA, there should be a commitment to set out alternative strategies for energy security post 2030 and this should include the use of technologies such as carbon capture and storage, electricity storage and low carbon generation.

In relation to the Solent, powerful ships such as the new QE Class Aircraft Carriers that will be base-ported in Portsmouth need strong power supplies and work is underway to create a new high voltage substation at Portsmouth Naval Base to support the energy requirements of the ships whilst in port. Each ship will host an independent distribution network capable of managing up to 200MW of power for 100 family homes. It is unknown if this upgrade will be sufficient to support the power demands when both Aircraft Carriers will be in Port at the

The Port of Southampton is a major private sector contributor to the Solent economy, and plays a critical role in UK trade - which is expected to become more pronounced following the decision of the UK to leave the EU, with Southampton in close proximity to the major shipping lanes linking Europe to the rest of the world, and in particular the key Shanghai to Rotterdam route. The Solent benefits from the natural advantage of a double high tide and sheltered berthing and is a sought after location for shipping.

The Port of Southampton is a major private sector contributor to the Solent economy, and plays a critical role in UK trade - which is expected to become more pronounced following the decision of the UK to leave the EU, with Southampton in close proximity to the major shipping lanes linking Europe to the rest of the world, and in particular the key Shanghai to Rotterdam route. The Solent benefits from the natural advantage of a double high tide and sheltered berthing and is a sought after location for shipping.

It is clear that the nature of the UK's trading relationship with Europe and the wider world will change. However, this is within a context of changing trade patterns brought about by globalisation.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

There is an opportunity to provide the private sector with incentives to roll-out ultra-fast broadband and the NIA should fully explore the digital communication requirement of new and emerging infrastructure systems and ensure that enabling digital technologies are put in place at the same time.

There is a need for significantly enhanced digital connectivity (both fibre and 4G/5G) to ensure that all areas of economy can access opportunities for growth. Yet, like many areas, and in particular rural areas, we have so called internet "hot spots" and areas where the market size make delivery unviable. This disadvantages some businesses and holds back growth. Furthermore, digital connectivity along key rail routes - including to London - is unacceptably poor, with large sections offering no connectivity. This reduces productivity.

Technological innovation provides an opportunity to use new and existing infrastructure capability more productively and efficiently and the Solent area would strongly support an infrastructure policy which combines and increase in capacity with optimisation of existing infrastructure through technological innovation. Some of the greatest opportunities for innovation are in people's homes and work places and ultra-fast digital connectivity would reduce and/or remove the need to travel as well as encourage smarter use of energy and storage as well as utilise sensor technology to deliver significant cost-savings in new construction and the ongoing management and maintenance of infrastructure.

Digital Connectivity and Technological Innovation

The Solent has immense potential with regards to marine renewables, and in particular tidal stream technology. The UK currently has a competitive advantage in the development of this emerging technology, as significant research and development capacity has taken place. However, the increased costs of developing such new technology result in more mature renewables being more cost effective, and there is a danger that the expertise the UK has in relation to marine renewables could be lost to international competitors. As such, there is a need to nurture this competitive advantage to scale-up and realise its potential.

outside of the EU. The Port performs a critical role within the UK supply chain, handling 900,000 vehicles in 2015, including around 520,000 for export, making Southampton the leading UK Port for car exports.

The significant role of the Port of Southampton in relation UK trade is clear and the combination of geographic location and the markets the Port is engaged in it is strategically positioned to perform an increasingly important role for the UK economy within a new international trade landscape.

The container trade is a key facilitator of UK exports and the Container Terminal in Southampton has been a leader in the UK in terms of productivity and customer service, which in turn has led to significant volume growth over the recent years. Substantial investment in the rail infrastructure has allowed close to 40% of containers to be transported to and from the port by rail, however the remaining 60% still depends on transport by road and is suffering from a road infrastructure which is heavily used and often congested.

ABP has invested significantly in Port infrastructure and this has both underpinned its rapid growth as well as the growth experienced by its customers. Investment has enabled the Port (and the UK) to accommodate the largest container vessels and cruise liners in the world, within the context of increasing length and tonnage of vessels operating in both markets. More generally, the Port plans to invest a further £200m of private sector investment over the next five years, including £50m in vehicle handling facilities to support the continued growth of UK automotive exports through Southampton.

Outline planned growth forecasts for the port show that further growth is forecast across all markets, further placing demand on the SRN, Local Highway, and rail infrastructure. The Port is of the view that significant port expansion will be required, opposite the existing port estate, in this timeframe, which may well require upgrades to the existing highways and rail network to optimise this potential.

The National Policy Statement for Ports states that Government policy is to encourage sustainable port development to cater for long-term forecast growth in volumes of imports and exports by sea with a competitive and efficient port industry capable of meeting the needs of importers and exporters cost effectively and in a timely manner. It is also noted that there is a compelling need for substantial additional port capacity over the next 20 to 30 years. Within this context it will be imperative that transport infrastructure continues to be invested in to support the important role of the Ports of Portsmouth and Southampton.

Portsmouth International Port is the second largest cross channel ferry port providing a gateway for over 2 million passengers and up to 1 million cars and freight vehicles to France, Spain and the Channel Islands. In addition Portsmouth Naval Base is a strategic national asset, and is at the heart of the sub-regional defence cluster providing, directly and indirectly, 20,000 jobs across the sub-region and contributing over £1.6bn GVA of output. The Naval Base is the base port for half the Royal Navy surface fleet and there is a strong maritime services function offering: integrated ship support; complex software engineering and advanced manufacturing solutions; equipment management; training; and estates and logistics service. It encompasses: the Naval Base; associated Naval establishments; the defence industrial base and other dependent firms.

The first of two new Queen Elizabeth Class Aircraft Carriers will arrive in Portsmouth in 2017. The carriers have a 50 year life span and at 260m long, 30m wide, 56,000 tonnes and 100,000 sq m of deck area are the largest surface warships in the Royal Navy. With

crews of 733 each, 500 support staff and others, the ships will require around 2,000 personnel providing links into the local economy and wider supply chains. There are good multiplier effects with every £1 million spent by the base triggering £0.75 million of additional spend locally, and every 100 jobs support up to 66 jobs elsewhere.

Southampton International Airport serves up to 49 short-haul UK and European destinations for business and leisure travellers (e.g. Glasgow, Manchester, Amsterdam, Jersey and Mallorca). About 1.4 million people live within 30 minutes of the airport and 3.5 million within an hour. The airport has one of the closest rail stations to a terminal in the UK and is adjacent to the M27, yet a number of transport constraints affect the economic performance of this asset:

- The airport runway length is shorter than many other regional airports limiting the range of aircraft that the airport can handle.
- Despite quick and direct rail connections to Southampton Central (7 min) and Winchester (10 min), there is no direct rail connection between the airport and Portsmouth (the journey time is 55-67 minutes for a journey of 20 miles) and eastwards along the South Coast.
- Locally the road network around the airport and surrounding development sites (including a major development opportunity at the former Ford manufacturing site) is comparatively constrained with a number of narrow and/or old bridges.

Despite this the airport is set to surpass 2m annual passengers in 2017. With plans for a high-tech development cluster centred on the airport, excellent transport connections (just 63 minutes to London Waterloo) and good links to local Universities, there is potential for Southampton becoming a future aerropolis - a combination of airport, city, shipping and business hub.

The airport was built for 1.5m annual passengers, and currently handles 1.77m (30% of which are business travellers) and aspires to grow to 3m annual passengers through increasing connections through Southampton for onward destinations.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

The availability and affordability of housing poses a major challenge to the Solent area. Demand for housing is projected to grow and the planned increase in housing supply is unsurprisingly increasing demand across all sectors in the Solent including transport, energy, digital, flood defence and energy. Much of the Solent's infrastructure such as sewage systems, rail networks, highway links water based connections and housing stock have been serving the area much longer than originally designed for. Many of these assets need replacement or investment to extend their lives and given current fiscal constraints a strategic asset management approach is required to provide clear prioritisation and better performance. On this basis the Solent would encourage the development of an infrastructure pipeline to support economic assets of national significance. This should be managed by the Infrastructure Projects Authority and should provide the private sector and investors in general with a forward view of upcoming infrastructure programmes and projects. A long term programme approach to infrastructure development is needed to address stop start investor concerns and it will be particularly important to the Solent given that our international gateways including the Port of Southampton and Southampton Airport are developing new Master Plans for the next 50 years. Part of the approach to national

infrastructure investment should be inclusion of a whole life assessment to infrastructure investment.

It is recognised that there is a national imperative to build new homes. This imperative is particularly pronounced in the Solent with an assessed housing need for the Solent, published in June 2016, identifying a need to deliver 121,500 homes over the period 2011-2036. Given the limited geographic scale of the Solent, the existing densely populated geography, the large amount of MoD land, areas of flood risk, and our coastal location, this is a considerable challenge, yet critical to ensure the pipeline of employment to fuel economic growth and attract the talent to this area.

Infrastructure is often required to unlock and/or mitigate the impact of new housing development. This can significantly increase costs and reduce viability, or make projects uncommercial. However, the Solent does suffer an acute housing shortage, and the new funds announced as part of the Autumn Statement 2016 to accelerate housing delivery are welcomed and new opportunities to accelerate house building through up-front infrastructure funding are encouraged.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Solent LEP has identified that the nature and scale of demand will be driven by long term changes in population, economic growth, technological change and the environment. In the Solent area demand will be influenced by population growth as already acknowledged, forecast increased in economic activity in our key centres and economic assets, and technology and digital communication.

The Solent is becoming increasingly polycentric and therefore there is already a demand to improve the proximity of our two cities as well as the urban centres along the M27 corridor and linkages from the Island to the mainland.

A key priority for the area is smart motorways, which offers potential to better manage current and forecast demand on our motorway network. Highways England have committed to delivery Smart Motorways along the M27, and parts of the M3 this will contribute to mitigating existing levels of chronic congestion.

There is also potential for demand management in the energy sector to ensure that best use is being made of a finite supply and that people and businesses are incentivised to draw energy in a way that does not compromise supply.

Technology advances have the potential to dramatically improve connections from isolated communities to urbanised areas and markets. This is particularly relevant for the Isle of Wight, where it is recognised that digital communication could play an important role in shaping work habits and supporting high quality connection through fixed and mobile digital networks.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Capital investment in new infrastructure as well as revenue for the maintenance of existing infrastructure is equally important. Capital investments in new infrastructure can only deliver value if they are supported by the maintenance of existing infrastructure.

There can be a need for forward funding, to accelerate or unlock private sector investment, where cash-flow may be a blockage. This can be particularly relevant in relation to new employment and housing developments, which may require new or upgraded transport infrastructure. Locally, in the Solent, flood defence infrastructure can also be an essential

8. Are there circumstances where projects that can be funded will not be financed?

In addition, in funding policy terms currently it is recognised that a mix of private and public investment pays for infrastructure programmes and projects. Regulated sectors enjoy a high level of private investment as they benefit from a high level of certainty. As previously advised, providing a forward view of upcoming infrastructure programmes and projects across all sectors would improve investor confidence, particularly for locally based infrastructure investment. This would complement the current approach to programme planning that we see in certain areas of government such as DfT / Highways England through the Roads Investment Strategy.

Please see response to question 6, above.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Opportunities for collaboration should also be encouraged, in particular where this will deliver efficiencies and better value for money. An example would be the way in which rail and strategic road infrastructure are delivered in the UK, as highlighted above. In many instances, investment in one will influence demand on the other - yet the investment plans of Network Rail and Highways England are created separately and on differing timescales. Within the Solent context, rail and SRN infrastructure between Portsmouth and Southampton run, broadly, parallel. The supply of one influences the demand for the other, and locally the inadequacy of rail infrastructure and services is a contributory factor to chronic peak congestion on the M27. There is a broader need for the integration of investment and planning in rail and SRN infrastructure, which is something the LEP would encourage Highways England and Network Rail to pursue.

Competition should be encouraged to support innovation and value for money. Regulation should be light touch to encourage private sector investment and new entrants, but ensure fairness and customer responsiveness.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

The adoption of advanced materials and intelligent infrastructure provides an opportunity for reduced through-life costs, which will enable maintenance to be more targeted, and informed by real-time information.

We would encourage a fresh approach to capital investment in new infrastructure and maintenance that considers infrastructure in the round. For example, investment in rail that encourages mode shift from the car / HGV can reduce highways maintenance costs, which could be offset against the rail capital investment. However, presently, strategic rail and strategic road investment plans are developed in isolation and on differing timescales, and are not able to factor in reduced costs on other infrastructure within their value for money assessments.

up-front capital requirement to unlock a site for development in advance of a cash-flow being realised. In addition, many brownfield sites can require decontamination and up front funding to de-risk such sites can ensure that sites become more commercially attractive for new development.

Locally, the Solent has a range of MoD sites which no longer form part of strategic defence requirements, and are expected to become available for commercial development. Typically, such sites can require significant investment to de-risk them to make them commercially viable. As public estates, there is a key role for public funding to unlock these opportunities to regenerate areas.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Infrastructure in the Solent lacks resilience. This is most acutely felt in relation to highways infrastructure. The M27 suffers chronic peak hour congestion, but there have also been a number of instances when whole sections of the M27 have been closed recently, which, given the geography of the Solent, has brought the area to a standstill and impacted on Port Access.. This lack of resilience has the potential to present significant problems for the automotive sector, as the lead time for vehicle manufacture to export is just one week.

The current approach to infrastructure investment does not always recognise the interdependence between different types of infrastructure and it is widely felt that there should be a stronger commitment to integrated infrastructure investment planning across modes of transport, such as road and rail. In the Solent, poor rail connectivity between Portsmouth and Southampton has resulted in severe congestion on the M27 and investments on both networks are considered independently. The establishment of a single funding pot to improve connectivity across city-regions would undoubtedly improve the overall infrastructure system in the Solent, reduce the over-reliance on one mode of transport (i.e. the Motorway), and improve overall resilience.

We would also suggest that the NIC should consider the opportunities for using new technology to improve information and network management, giving users the information they need, when they need it.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

As noted above, the pace of infrastructure delivery both by the private and public sectors can be frustrated by the planning process. This can result in delays to benefits being realised, and a failure to optimise and build on investment. Feedback from business, in particular, is that the current spatial planning framework can work against market demand, and so stifle growth opportunities.

In relation to the growth of strategic national assets we would encourage the introduction of a long-term approach to infrastructure provision for such assets and the NIA should identify priority routes for capacity improvements on the strategic road, primary road and rail networks. At a national level, the government should increase investment in the commuter network, as well as public transport, to ensure that the economic development of our key growth areas and cities is not constrained by overcrowding and congestion. Alongside this,

substantive funding for transport and housing should be devolved to local areas to allow them to invest in the growth of their economies.

The Local Growth Deal has been an important and welcome introduction in this regard. We would also strongly support closer working and the development of new delivery models between key agencies such as Network Rail, Highways England and the HCA, working with Local Authorities to deliver new housing on sites around stations or adjacent to the SRN. This would facilitate the development of housing in areas supported by appropriate economic infrastructure. This is particularly important in the Solent, where we have seen extensive residential development along the M27 corridor encounter delays due to the need to introduce significant new junction improvements to ensure that infrastructure is in place to support housing growth.

On the assumption that economic assets such as ports and airports are considered nationally important infrastructure, we would recommend that the planning systems provides greater certainty and more responsive consideration of planning applications, recognising that the growth of such assets needs to be supported by the delivery of up-front enabling infrastructure to accommodate forecast growth and that arrangements for the financing of this investment will need to be put in place. This means that the lead in time for delivery of infrastructure ahead of forecast growth can be considerable, and that delays or indecision, does create a hiatus and planning blight. This can result in uncertainty in both UK markets and on a broader basis, global markets.

Greater autonomy for local areas in terms of funding and decision-making for smaller scale (or local infrastructure) projects is encouraged, to support planning decision-making and land allocations on a basis that reflects the economic geography of areas. The LEP also supports, consideration of sub-national architecture to enable local economic areas come together to plan for infrastructure that is of mutual benefits - for example the role out of 5G, or the planning or key sub-national transport infrastructure.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

A balanced approach should be taken to protection and enhancement of the natural environment. Economic growth should be allowed to come forward in a way that is not overly stifled or slowed by environmental considerations.

In the Solent, through the Solent Growth Deal, we have supported a green infrastructure project, which has enabled the purchase and upgrade of green assets to enable and mitigate the impact of new housing. Collectively the five projects have enabled Natural England to agree to these as mitigation for 10,000 new houses.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

We agree that infrastructure analysis techniques should be credible, tractable and transparent. Whilst value for money is important, it is clear that the government is seeking to rebalance the economy spatially, but it is not clear how this is captured in cost-benefit analysis. This needs to be more transparent and apply to all areas of the country that underperform relative to more successful areas. We have described, above, how the Solent, despite being part of the south east economy, does underperform in productivity terms.

Current cost benefit analysis techniques are focussed on evidencing unmet demand and do not seem to be able to return favourable assessments for projects that seek to transform or generate demand. Within the Solent, our two cities do not interact economically as other dual city regions, despite being just 20 miles apart, and as a consequence city to city movements are limited. This is, in part, a function of the infrastructure deficit that exists in the Solent - particularly in relation to rail. The delivery of Solent Metro - a high quality, high frequency, reliable public transport - would transform agglomeration and deepen labour markets and enable our two cities to collectively contribute more to UK growth.

Any cost benefit analysis should focus on value for money, but this is not always the case. For example DfT WebTAG prioritises transport benefits, but, in our view, should capture and account for the wider economic growth benefits that the transport project will unlock. Equally, cost benefit assessment of flood defence projects focusses on safeguarding properties, but should also factor in the benefits of flood defence projects in unlocking new development opportunities. We have also seen that the provision of superfast broadband can also provide the catalyst for tech-led development. Presently, it is the view of the LEP that current methods of cost benefit appraisal are too narrow, and that approaches should be broadened to prioritise the impact of an infrastructure project on productivity and competitiveness.

D. Transport

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Autonomy, artificial intelligence (AI) and robotics, along with increased use of the internet will change travel patterns over the next 30 years. Autonomous vehicles are already being trialled, and can be expected to be omnipresent over this timescale, for both personal and freight journeys. This in turn should result in optimum use of networks and increase system resilience.

Increase penetration of the internet and technologies can also be expected to influence the demand for travel, with increased use of artificial intelligence to undertake roles currently performed by humans. In addition, the internet of things, for example, within intelligent infrastructure will reduce the need for surveys and site visits.

In planning infrastructure for the future, it is clear that technological change is enabling, and will continue to enable new ways of working, which will impact on demand for infrastructure. People will increasingly be able to live and work in the same place, thus negating the need for travel, and resulting in the unlocking of capacity and reduced journey times - but this should not be an excuse for not upgrading infrastructure in the short to medium term.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

We have identified the role that a Solent Metro service and Smart Motorways can play within the Solent and the economic benefits that this can bring in our responses to questions 1 and 4 respectively. Both interventions will free up highway capacity for the increasing volumes of port traffic that are forecast.

It will be important that the UK stays at the forefront of digital connectivity and only attract inward investment, but to enable the talent and assets that reside in the UK is already leading on the development of 5G technology, and within Southampton's world leading Optoelectronics Research Centre, a Photonics Highway Programme is developing the next generation of optical fibres that will be 100 times faster and 1000 times more advanced than the fibres that are currently in use.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Whilst it is recognised that laying fibre is a costly process, and, as a consequence, there are some locations where it is not commercial, as noted above, digital connectivity is essential for connecting people and businesses and enabling all parts of the UK to be actively engaged in the 4th Industrial Revolution and its pace of technological change. As such, there is a role for government to ensure blanket roll out of fibre.

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

E. Digital

A shift away from personally owned modes of transportation and towards mobility solutions that are consumed as a service could be supported through the delivery of high quality, affordable, high frequency public transport infrastructure and services. This may negate any requirements for road-user charging as it would be expected to free-up highway capacity.

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

In addition, within our answer to question 1 we set out the need for digital connectivity to better connect people and businesses and to allow flows of knowledge.

We have identified the role that a Solent Metro service and Smart Motorways can play within the Solent and the economic benefits that this can bring in our responses to questions 1 and 4 respectively. Both interventions will free up highway capacity for the increasing volumes of port traffic that are forecast.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

The increased use of e-commerce is resulting in increased customer expectations on deliveries. This is resulting in a number of smaller van deliveries, with limited coordination across urban areas and associated diesel emissions. Break-bulk distribution centres on the periphery of urban areas supported by electric-powered vans could provide greater coordination across distributors, with resulting benefits in terms of reduced vehicle miles and improved air quality.

F. Energy

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

No response.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

The UK has significant potential for renewables. Locally, in the Solent, there are opportunities for tidal stream power as an important (and predictable) part of the UK's future energy mix. Whilst the government has nominated a strike price of £300/MWh for tidal stream energy, which reflects the true current cost of energy, in order to ensure that the short to medium term consumer prices are kept to a minimum they have also announced that they would not ring-fence (minima) any of the £290m budget for tidal stream energy in the Contract for Difference (CfD) auction (Round 2) in April 2017.

The price for energy at the auction will therefore reduce to the market value of the mature renewable industries (around £70-100/MWh for offshore wind). This is an unexpected change of policy from the initial elevated prices offered to develop wind and solar energy, which successfully reduced the cost of energy. The consequence is that the UK may not be able to commercialise their geographic (15% global/50% Europe capacity) and technical advantages and shovel ready projects until other countries have deployed sufficient capacity elsewhere, to bring down the cost of tidal stream energy. This may delay the introduction of continuous, totally predictable tidal stream energy in the UK and effectively reduce the UK to a customer only status surrendering our global lead in this technology.

A regime that enables new technologies to come forward and compete commercially to move the UK towards a zero carbon power sector.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

The electrification of transport (vehicles and rail) as well as other modes of transport such as ships is placing a strain on the energy distribution network. Significant upgrades are required to support the arrival of the new QE Class Aircraft Carriers. It is unknown if this upgrade will be sufficient to provide for the rare occasions when both Aircraft Carriers will be in Port at the same time.

Increasing electricity requirements from transport should be considered alongside increased energy demands that will result from the internet of things, which combined will place significant strains on energy distribution networks in the UK, and therefore have the potential to frustrate the uptake of, participation in and creation of new technologies.

The increased use of e-commerce is resulting in increased customer expectations for deliveries. This is resulting in a proliferation of smaller van deliveries, with limited coordination across urban areas and associated emissions. Break-bulk distribution centres on the periphery of urban areas supported by electric-powered vans could provide greater coordination and efficiency, resulting in benefits in terms of reduced vehicle miles and emissions.

G. Flood Risk Management

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

Investment in flood defence should prioritise those areas that pose the greatest economic risk and that have the greatest opportunity to generate GVA. The Environment Agency's approach is focussed on safeguarding existing properties. Whilst we agree that this is critical, the opportunities for flood defence to unlock economic growth should also unlock flood defence funding.

With 290 miles of coastline and a highly urbanised geography, the role of flood defence in safeguarding existing properties and unlocking new development potential is significant in the Solent. Two schemes are of particular significance: along the western bank of the River Itchen in Southampton, adjacent to the city centre, and at Southsea in Portsmouth. The former reduces flood risk to 1,157 properties and 679 businesses, whilst the later reduces flood risk to £649m of assets, 8,013 existing homes, and 1,035 businesses. In addition, the Itchen scheme enables over 2,000 new homes, and the Southsea scheme enables 1,000 new homes.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

No response.

I hope that this response is helpful as the NIC finalises its Vision and Priorities document for publication in summer 2017. Should you have any questions in relation to this response, please contact [redacted]

[redacted] [email address redacted] [phone number redacted]

Yours sincerely,

[Signature redacted]

[Name redacted]
[Job title redacted]

Solent Local Enterprise Partnership



**SOLENT
LOCAL
ENTERPRISE
PARTNERSHIP**

Meeting: Business Roundtable on the National Infrastructure Assessment Call for Evidence

Date: 24th January 2017

Time: 0830 - 1030

Venue: Spitfire Meeting Room, Southampton Airport

Attendees: Dave Lees (Solent LEP / Southampton Airport) Chair
Gary Jeffries (Solent LEP / Hughes Ellard)
Brian Johnson (Solent LEP / BAE Systems)
Stuart Baker (Solent LEP)
Robin Dickens (Lambert Smith Hampton)
Richard Peckham (Airbus Defence)
Jan Edrich (Eastleigh College)
Alex Howison (Scottish and Southern Electricity Networks)
Kevin George (Red Funnel)
Elwyn Dop (Wightlink)
Peter Goodship (Portsmouth Naval Base Property Trust)
Stewart Dunn (Hampshire Chamber of Commerce)
Veronika Krcalova (South West Trains)
Clare Little (Land Securities)
Sue Simmonite (Associated British Ports)
Commodore Jeremy Rigby (Portsmouth Naval Base)
Don Spalinger (University of Southampton)
Sean Sweeney (Land Securities)
Adrian Went (Griffon Hoverwork)
Jonathan Williams (Williams Shipping)

NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE

RESPONSE FROM SOMERSET COUNTY COUNCIL

Cross-Cutting Issues

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

High value investment programmes supporting growth in Somerset (and in some cases the wider South West Peninsula) include:

- **Hinkley Point C development.** EDF Energy's planned development of two new nuclear reactors at Hinkley Point in Somerset will meet 7% of the UK's energy needs and directly create 5,600 jobs at peak construction. Longer term the renaissance of the nuclear sector in the UK through the proposed programme of new build provides an opportunity to re-establish the sector as an important part of the UK economy as recognised in the consultation draft of the Government's industrial strategy. Hinkley Point C (and other nuclear investment in the South West, estimated at a value of £50 million over the next 20 years in a 2015 study commissioned by Heart of the South West and West of England LEPs), provides an opportunity to establish Somerset and the South West as a leader in this sector in the UK. Sustained investment is required to ensure that the right infrastructure is in place to enable connectivity, facilitate skills development and support research, development and innovation to enable business growth, investment and the development of supply chains
- **Tidal Power generation in the Bristol Channel.** A range of options have been promoted by different organisations to meet future energy use through the tidal power generation in the Bristol Channel and Severn Estuary. These include barrage options and the development of tidal lagoons and are estimated as being capable of generating up to 5% of UK future energy needs, with significant regional economic impact through their construction. Government has previously considered aspects of this through the Severn Tidal Power Feasibility Study –see link for further information. http://webarchive.nationalarchives.gov.uk/20121217150421/http://decc.gov.uk/en/content/cms/meeting_energy/wave_tidal/severn_tidal_power/severn_tidal_power.aspx. Detailed assessment of the environmental, economic and community impacts of any proposed developments would be necessary.
- **A303/A358/A30 corridor improvement programme.** An economic assessment (<http://www.somerset.gov.uk/policies-and-plans/schemes-and-initiatives/a30-a303-a358-improvement-project/>) demonstrates that an end-to-end improvement of the A303/A358 to dual carriageway and smaller scale improvements on the A30 to Exeter would deliver 21,000 jobs and £41.6bn GVA increase through improved productivity of existing businesses; £21.2bn of taxation, welfare savings, disposable income and tourism benefits; and £1.9bn transport benefits. It is essential that Government allocates sufficient funds in the next road investment strategy to honour a commitment

(<https://www.gov.uk/government/publications/a303-a358-and-a30-corridor-feasibility-study-technical-report>) to complete the end-to-end improvements despite recent cost increases. The full economic potential of the corridor improvements will only be realised if the whole corridor is improved.

- **The South West Peninsula 20 year rail strategy.** This proposes a long-term programme of investment in rail links between London and the South West which would unlock a host of benefits, generating an additional £7.2bn of GVA and £1.8bn of transport benefits. The strategy also suggests productivity benefits from simple improvements such as high quality/uninterrupted wifi connectivity enabling productive use of the travel time. Both improvement programmes also tackle an inherent lack of resilience in the south west transport networks which are increasingly vulnerable to extreme weather events. Further background available at <https://peninsularailtaskforce.co.uk/closing-the-gap-the-south-west-peninsula-strategic-rail-blueprint/>
- **Digital - The Connecting Devon and Somerset Programme** has made good progress in driving the delivery of digital connectivity and Next Generation Access broadband infrastructure will require high levels of investment which are secured by very long term returns of around 20 years. CDS' recent experience suggested a good appetite in the market for investment in NGA networks with significant private investment being made. However further commitment to gap funding is needed in areas which are not commercially viable.
- **Flood and Water Management** – Following the severe flooding in 2013/14 a multi-partner Flood Action Plan was produced in Somerset and this includes significant infrastructure works which increases resilience against flooding but also supports longer term economic growth and development. The largest proposal is a tidal barrier for the River Parrett, which will make use of funding from a range of sources including Section 106 and Community infrastructure Levy funding. There is also a flood alleviation scheme in the Upper Tone area above Taunton, providing protection to the county town. A post-flood economic study undertaken has demonstrated that up to £147.5m worth of damage was created by the flood event, strengthening the need to make investment decisions to improve resilience and infrastructure against future floods. The Flood Action Plan has also resulted in the creation of the Somerset Rivers Authority (SRA), a body whose role is to provide an enhanced level of flood protection in the county. The SRA is the vehicle to administer funding for a range of flood-related works, including the funding of major infrastructure works.
- **Somerset University** – Somerset is the only shire county in England without a dedicated University and, while growing amounts of NVQ level 4 and above provision is delivered through our Further Education Colleges under franchised arrangements with external Universities, the absence of a Higher Education institution in the county is a barrier to economic growth. The extent of Higher Education “coldspots” in the county is reflected in HEFCE’s published evidence base, with significant parts of the county experiencing

deprivation of access to Higher Education. This results in the relatively low levels of NVQ 4 and above qualifications in the workforce and the low levels of innovation and research and development engagement with Universities by Somerset businesses. The absence of a University also has implications for the ageing demographic balance of Somerset's working age and overall populations. Given these factors the ambition to establish a University of Somerset forms a key ambition in Somerset County Council's County Plan Vision for Somerset (2016).

- **Infrastructure for raising economic productivity.** Productivity in Somerset (measured on a GVA per capita basis) is circa 80% of the national average and this performance gap has remained consistent over a long period of time. This gap is a reflection of a number of factors including Somerset's geography (the county's dispersed economic geography limits the agglomeration effects which promote critical mass, competition and higher value business activity) and our economic structure (which includes a high representation of lower value business sectors including agriculture, tourism and care). A key economic priority for Somerset County Council, the Heart of the South West LEP and our partners is to address and improve this productivity performance. As part of our approach to this we aim to facilitate innovation and growth in our key opportunity business sectors of aerospace and advanced engineering, nuclear and low carbon energy and agri-food. Infrastructure investment priorities include the development of the Somerset energy innovation centre in Bridgwater (to act as hub for a nuclear cluster centred in Somerset) an iAero centre in Yeovil (to promote innovation linked to high value design, with a particular focus on rotorblade technology) and an agri-food centre.

In addition the main growth hubs in Somerset also require infrastructure investment to accommodate planned growth and development, given a significant funding gap between what development can afford (viability challenges) and the infrastructure needed to ensure transport networks continue to function effectively in the future. Infrastructure improvements are needed on the M5 corridor particularly at junctions 22, 23 and 25 in Somerset which are the gateways to planned growth areas, and on the local highway, bus, walking and cycling networks in our main towns.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

No response provided.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Whilst the need to provide appropriate infrastructure to facilitate other development, and the need to provide better places to live and work, is obvious, care should be taken when it comes providing infrastructure that could help to alleviate flood risk.

Sustainable urban drainage systems should be seen as both a way to mitigate flood risk and of enhancing developments, thus providing critical infrastructure but also as a means of natural enhancement. It goes without saying that housing estate layouts should where possible incorporate green spaces; however, using these spaces for drainage/flood mitigation should also be an important part of their design and use.

The planning process should also be wary about using the introduction of new infrastructure as a way of freeing up land for development without proper and sound flood risk assessment.

Developments should also ensure waste management is incorporated within them and this should be done in innovative and attractive ways wherever possible.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

There is considerable potential for demand management on the highway network. With one or two exceptions outside London there is currently unrestrained access to the network resulting in significant congestion at peak time.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The use of cost-benefit analysis and ensuring there is a strong business case in place are critical when making investment decisions and local expertise should be used to assess whether it is more efficient use of funding to repair and maintain infrastructure or to replace it with modern infrastructure. Regular repair and maintenance will avoid capital outlay for replacement structures and local government should ensure risk management authorities have sufficient funds to conduct their responsibilities effectively and to ensure flood risk is well managed.

Sufficient resource should be provided to all Local Authorities as a basic need annually to keep local networks in a steady-state prior to considering allocation of any improvement funds nationally. Current allocations of maintenance funding for basic need are insufficient and there is an over-reliance on ad-hoc 'top-up' grants and challenge funds to secure sufficient funds locally. Assets created over the last 30-40 years (traffic signals and lighting columns etc) are now becoming life-expired and a national replacement strategy should be considered to complement carriageway maintenance programmes and enable implementation of new smarter technologies which will deliver operational efficiencies.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Somerset is a good example of where risk management authorities (in the case of flood management) and waste disposal and collection authorities (waste) have come together in partnership to provide an improved and coordinated service. Both are good examples of collaboration; the Somerset Rivers Authority includes local government, Environment Agency, internal Drainage Boards and is progressing to

becoming a precepting organisation; this process should be as quick and efficient as possible to help similar processes in other areas of the country.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The current policy of 'funding competition' to allocate large tranches of resources to local highways and transport projects is extremely time consuming and costly to local authorities. Significant sums and scarce officer time are often invested in preparing bids which may be unsuccessful, and assessing the bids must also be resource-hungry. The reasoning behind the choice of which bids to fund is often not transparent, often simply noting 'oversubscribed funds'. Successful authorities can build a resource pool to win more bids resulting in funding opportunities often going to the same pool of authorities, leaving some authorities with little resource to create future successes. Authorities are developing schemes 'at risk' until capital funding is secured and risk the sunk costs reverting to (scarce) revenue pressures if bids are unsuccessful. Efficiency could be improved through agreeing a long-term investment plan for each area covering a defined funding period with funding allocations made at the outset.

Funding for flood risk management is a complex area and the current cost benefit ratio applied by the Environment Agency is not fit for purpose for delivering smaller schemes. These currently have to be funded locally and funds are reducing for this work. Simplifying and clarifying the whole landscape when it comes to funding for flood and water management would be an improvement.

Funding reductions to local government have meant finding more innovative ways of waste collection/disposal. Whilst this in itself is a positive development it is important that sufficient funding is made available, based on a formula that meets the needs of all areas of the country (specifically, both rural and urban areas).

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

No response provided.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? *Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.*

One crucial factor relates to the skills shortages and distortions in the market created by the demand for specialised skills in competing areas. Particular examples in the Heart of the South West relate to the requirement for construction skills which are already in high demand and short supply across the area, and with the imminent

significant potential for Hinkley C to draw on the labour pool. The risks around skills shortages need to be better understood and planned for.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The planning system in two-tier authorities can result in conflicting priorities and lack of clarity about the delivery plan for the infrastructure (including for highways and transport and flood and water management) required to support development. The two-tier system can also introduce a political element into the choice of where to invest scarce resources, rather than having one agreed list of priorities for an area. There can be a tendency to attempt to share resources thinly across a wide area rather than focusing on a smaller number of essential infrastructure investments. Similarly the introduction of the LEP as a further upper-tier of decision making and choice about infrastructure investment has led to a complex patchwork of routes for investment in critical infrastructure (Planning authorities have infrastructure delivery plans, highway authorities have LTP implementation plans and the LEP has an investment programme). Simplification to enable one infrastructure plan and delivery body per-area would be helpful in prioritising investments and managing spend in a more coherent way.

Phasing of development with essential infrastructure still needs to be improved. In addition there has to be an appropriate balance on what is asked of developers, and making sure the development process within a two tier system reflects the true priorities (rather than political decisions made by one tier possibly favouring the requirements of that tier instead of taking the most balanced view possible.)

The whole viability assessment process is also not currently fit for purpose. Local authorities are ill-equipped to challenge developers' claims that delivery of infrastructure is not viable. In addition, CIL rates and developer contributions are based on excessive assumptions on land values, minimising the adopted CIL rates and section 106 contributions. These issues cause significant difficulty in securing sufficient funding to deliver the infrastructure required, meaning development impact is often not appropriately mitigated. To avoid this, the planning system needs to be better equipped to either control or capture land value uplift.

Another issue associated with the operation of CIL is the lack of control over phasing, at present development can get ahead of the delivery of critical infrastructure. One option to address this could be some form of Grampian type control to ensure infrastructure is in place to support sustainable development. As we have already pointed out, the reason why new communities such as Cranbrook have been a success is because infrastructure funding is front loaded.

Regulation 60 of the Community Infrastructure Levy (CIL) Regulations makes provision for a percentage of CIL receipts to be used to pay borrowing costs. Currently however the percentage of CIL that can be used to pay back loans, as

prescribed within the Regulations is set to zero. There is also provision for the Secretary of State to change this and allow repayments, specifying the percentage that could be applied.

Generally, infrastructure needs to be provided up front to enable growth. Not being able to apply the CIL funds in this way is an impediment to growth. Therefore, there should be a change to the Regulations to allow repayments on loans.

In our Devolution Prospectus, we advised Government of our strong track record of delivery in partnership with residents and businesses. We believe that scaling up our governance arrangements will deliver greater efficiency and accelerated delivery. This would come through the sharing of resources and collective leadership on commonly agreed goals. The effective delivery of new infrastructure investments would be a beneficiary of these new arrangements.

In order to facilitate this Government would need to allow local areas to control investment, for example by lifting pooling restrictions for those areas that wish to enter into new arrangements for the use of CIL, Section 106 and other capital investments.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The current legislative framework is very effective at protecting and enhancing the natural environment and (Brexit issues aside) is fit for purpose.

Sustainable transport schemes are increasingly important in managing urban growth yet there is no routine allocation of infrastructure for bus networks or walking and cycling networks; or 'behaviour change' revenue funds. Local Authorities have the flexibility to use existing capital grants for these networks, but in reality there is little left once maintenance need is covered. Occasional competitive funding opportunities result in some ad-hoc investment for some authorities. Specific funding need for these networks should become part of routine national funding allocations.

Having the correct flood and water management infrastructure is essential for building the resilience of communities, and whilst environmental protection regulations can slow down delivery it is accepted that it is important that all factors are properly taken into account in the development process.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

It would be helpful to have a greater ability to base decisions on the wider economic growth and productivity benefits of schemes rather than a narrow reliance on the Benefit/ Cost ratio. In transport schemes (e.g. A303 above) the wider economic benefits far outweigh the transport benefits but decisions are often based on the narrower transport benefits. Some standardisation of approach in this respect would

also be useful as business cases are currently being prepared using a variety of approaches making it difficult to compare competing investments.

The funding of an enhanced level of flood management through the initial delivery of the 20 year plan for the Somerset Levels and Moors and establishment of the Somerset Rivers Authority demonstrates how an area can adapt to locally important issues. The cost benefit ratio typically employed by the Treasury would stifle a lot of the improvements in this case; employing our own method of raising funding and scheme prioritisation in the county has shown that alternatives are possible. Either sufficient resourcing from government or guidance on ways to address locally important issues would be useful.

Transport

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

The CIHT has produced a useful 'futures' report (<http://www.ciht.org.uk/en/knowledge/futures/index.cfm>) which starts to consider these issues and manage the difficulty in predicting future travel behaviour and adoption of technologies. Government should enable the market to come up with technology solutions and then form appropriate frameworks for managing new technologies as they mature. A flexible and agile approach is needed to enable rapid response to change as it will be impossible to predict what the technologies and impacts will be. It makes sense to plan ahead in relatively short periods (say 15-20 years) so that sensible investments can be made for the medium term allowing change to happen in the longer term. It is clear that autonomous vehicles and smart cities technologies will have a radical impact over a relatively short time period and a useful report by WSPPB/ Farrells explores the implications (<http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=0ahUKEwjVj5nd4d3RAhXEWhoKHbHcBlSQFggaMAA&url=http%3A%2F%2Fwww.wsp-pb.com%2FGlobaln%2FUK%2FWSPPB-Farrells-AV-whitepaper.pdf&usq=AFQjCNGNV3ITUVZt7PCHn8ETIPsYls418w>)

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

This is likely to be very specific to the place, and most major urban areas should have well developed plans to identify appropriate investments. In the medium term, the required investments are likely to continue to include a mix of road and rail, bus, walking, cycling and parking projects. Smart technologies will become an increasingly important area of investment to facilitate efficient movement into and around urban areas. As new technologies mature and vehicles become increasingly autonomous it should be possible to re-allocate more of the road-space and parking space and dedicate it to other modes.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Strategic road and rail investments are likely to continue to be required. (See answer to question 1).

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Most people are currently used to buying a car and paying road tax, with the associated expectation of a subsequent right to use the road as much as they like without further charge. Mobility as a service (Uber etc) is already starting to get people used to the concept of paying for a car journey as a service and if their travel needs are being met effectively in this way then this is likely to get more popular. Once people are used to paying for mobility as a service then the introduction of a charge to use the road (which would simply become an additional element of the bill for the journey) should be more acceptable particularly if that funding provides improved infrastructure which keeps the journey cost down through managing congestion levels and ensuring good levels of service. Managing demand for travel then becomes easier by increasing charges at peak times.

Mobility as a service (in conjunction with increased automation) would appear to create significant further opportunities to reduce car ownership, reduce road space, reduce land dedicated to car parking in urban areas and reduce investment needs for highway assets (currently required to support and manage human driving) and make more efficient use of the available road space.

Digital Communications

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends? When would decisions need to be made?

A Full Fibre infrastructure network providing symmetrical and ultrafast connectivity across the country is currently acknowledged as the way forward for fixed Broadband infrastructure.

Existing programmes achieved significant uplift in the numbers of premises receiving SF broadband (24 mbps) in a relatively short time, largely by utilising and upgrading existing infrastructure. However a number of these premises will have to be revisited to achieve Next Generation Access (NGA) (30 mbps) speeds. Dated copper networks are being superseded by fibre technology and are unlikely to merit significant or long term maintenance investment.

Investment needs to be made as soon as possible as demand increases rapidly and feeds economic growth.

Government should encourage commercial providers to provide this infrastructure. However gap funded or public/ private collaborations should be considered for areas which are not yet commercially viable.

Continual technical developments should mean that most areas will become commercially viable. This is illustrated by the recent Connecting Devon and Somerset (CDS) experience. In December 2016 CDS awarded 4 contracts for the delivery of NGA Full Fibre services on a gap funded basis. These contracts will deliver symmetrical Full Fibre networks providing speeds of up to 1 GB. The value of the network is £62.25 M including a £43.75 M private sector investment. In addition the contractor is also undertaking commercial build. A number of providers participated in the procurement providing a competitive environment. This resulted in a good proposal for a joint public/ private collaboration and with a significant private sector funding contribution which greatly exceeded the public sector subsidy.

NGA broadband infrastructure requires high levels of investment which are secured by very long term returns of around 20 years. This may point to a different investment model using equity investment. CDS recent experience suggested a good appetite in the market for investment in NGA networks with significant private investment being made. The CDS procurement tested the market on a gap funded basis. The continued market dominance of a single commercial provider causes imbalance in the telecommunications market and appears to frustrate competition. A competitive environment accelerates delivery of Full Fibre networks and provides additional resilience for important infrastructure.

The CDS procurement also highlighted that some deeply rural areas will remain outside the current long term economic limit for Full Fibre networks. This means that other technologies and existing technologies will need to be supported for the next 5-10 years on a “stop gap” basis so that more remote areas are not left behind.

Full Fibre Broadband infrastructure should be included in all new build or a suitable alternative for single premises/ remote sites.

18. Is the existing digital communications regime going to deliver what is needed when it is needed in the areas that require it if digital connectivity is becoming a utility? If not how can we facilitate this?

At present no. Whilst there is increasing investment in fixed connectivity which can be supplemented by mobile connectivity in more remote/ difficult to reach areas, the timescales for roll out of comprehensive full fibre networks are not within the next 3-5 years. That timescale may be changing as the dominant provider appears to be contemplating further investment in fibre to maintain its position.

Mobile connectivity whilst better than nothing is not available universally and provides comparatively low speeds and at comparatively higher cost.

Interim solutions such as fixed wireless access do appear able to provide a useful speed increase, whilst not having the full flexibility of a Full Fibre network.

Fixed connectivity

In addition to testing markets and taking a gap funding/ public/private collaboration approach the following should be considered;

- Supporting commercial providers to innovate new techniques resulting in a reduction in costs.
- Promoting effective competition and seeking to achieve a more balanced market rather than continued market dominance by a single provider.
- Pump-priming more remote communities or co-investment models using public funds
- Availability of long term low cost finance whether by loan or equity investment.
- Use of “interim” solutions pending a Full Fibre solution. E.g. CDS has awarded a fixed wireless contract to cover parts of Dartmoor and Exmoor; a particularly challenging location to deliver broadband infrastructure.
- Local Body/ Local community solutions – no “one size fits all” approach. Previous experience of a nationally driven solution has not worked particularly well for more rural areas. Greater flexibility could be achieved by devolving funds in sympathy with the devolution proposals.

Mobile Connectivity

O2 has a licence obligation through the 2013 4G spectrum auction to provide 98% indoor coverage by the end of 2017 however this is only at 2Mbps and is a national target. EE is investing around £1Billion to achieve 98% of the UK population as soon as possible and 95 % of the UK landmass by 2020. However national targets mask under delivery in rural areas. It is anticipated that there will be a shortfall of between 6-10 % indoor 4G mobile coverage in Devon and Somerset and a shortfall of around 1 % outdoor coverage for the area. These are significant shortfalls when compared to the national targets.

On an interim basis it may be possible to improve indoor mobile signals using Femtocell and VoWiFi. These solutions are reliable and comparatively cost effective ways to improve mobile signals but less well known. Mobile solutions still tend to be comparatively more expensive.

The Mobile Infrastructure Project (MIP) was intended to improve 4G “not-spots” by provision of additional mobile sites. The project was not as successful as hoped with around 8-10 sites becoming operational out of a projected 43 sites which were expected to be needed across Devon and Somerset. Locations had to be set aside due to location, planning or other problems. It may be appropriate to re-launch the MIP whilst incorporating the lessons learned from the last phase including;

- more consultation (not imposing large lattice masts on communities where smaller less obtrusive masts would be appropriate),
- being flexible - inconsistencies in mapping between operators needs to be considered,

- reflecting the costs that the market can sustain when compared to annual revenues. As remote masts have a limited market these will not sustain high annual rental fees in addition to power costs.
- Mobile operators should be encouraged to use the experience gained from 3G small cell deployments in rural areas and apply that to 4G rural not-spots. Costs may require community engagement.

Other ways in which mobile infrastructure might be facilitated include;

- Amendments to planning and permitted development rights for small cell sites
- Business rate relief for small masts

It would be worthwhile having a reliable source for information about “stop-gap” technologies which could be used pending a universal Full Fibre solution. This could be promoted in areas which are unlikely to have early Full Fibre networks.

It may also be appropriate to offer some form of subsidy for more costly connectivity pending a universal Full Fibre network.

Energy

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

No response.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Somerset already has a thriving low carbon power sector in the form of nuclear. The construction and operation of Hinkley Point C will bring jobs, skills, training, and investment, and give huge opportunities for a supply chain that stretches across Somerset and the South West and the wider UK. There are £50billion worth of opportunities in the nuclear industry within 75 miles of the South West. We are leading a global renaissance in nuclear power. Getting it right in the South West will demonstrate the UK’s pre-eminence in the global nuclear marketplace. But this needs to be supported through appropriate and ongoing investment in the region’s infrastructure system, including transport (including roads, rail and air), communications and the electricity distribution system.

A zero carbon power sector in 2050 undoubtedly needs to harness the opportunity that renewable energy production presents. Given that the Severn Estuary has the second largest tidal range in the world, the South West is well placed to support renewable energy production through the development of water based technologies.

Through the Bristol Channel & Severn Estuary Energy Group (Energy Group), support has been expressed for exploring a balanced technology approach to the

regions energy assets, advocating that water based projects and technologies are deployed in a way which contribute significant energy and economic benefits in balance with the environment, other marine users and all relevant stakeholders in the region. In summary this would involve

- Treating the Bristol Channel as a holistic, energy system including tidal stream, wind, floating wind, wave as well as tidal range.
- Considering the various energy technologies in combination to understand their impacts and interdependencies, as each converts energy from the system.
- At all times considering the balance of economic and energy benefit of project development in the estuary against the environmental, ecological and other impacts.
- A time based strategy to develop and deploy a portfolio of technologies allowing new technology to be developed and brought on stream when proven, their risks and costs understood and managed.
- Supporting technologies which can be built out incrementally, with continuous monitoring and evaluation so that individual and cumulative impacts and risks can be understood and mitigated.

In conjunction with the tremendous opportunity presented for energy generation, tidal lagoons and other marine based technologies present a huge opportunity for UK companies to deliver significant supply chain content. The marine based elements and civil engineering elements of schemes, particularly lagoons, are largely compatible with other large scale infrastructure projects. These opportunities are very important and weigh significantly in favour of tidal lagoons forming part of the UK energy mix.

Recent publication of the Government review, led by Charles Hendry, into the feasibility and practicality of tidal lagoon energy in the UK is therefore a positive step forward confirming “that tidal lagoons would help deliver security of supply; they would assist in delivering our decarbonisation commitments; and they would bring real and substantial opportunities for the UK supply chain”.

The success of large scale energy schemes in the Bristol Channel must however be based on a strong consensus and secure support from communities on both Welsh and English sides of the channel. To date, prospective development of the regions' energy resources has been left in large part to individual project developers and consortia to evolve piecemeal. Whilst private sector engagement is essential, without participation and agreement between relevant authorities it would not deliver the necessary balance with the environmental and economic interests required and further requires project developers to take on burden of planning risks.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

No response

Water and wastewater (drainage and sewerage)

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

No response

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Close working between local planning authorities, statutory drainage consultees (utilities and the lead local flood authority) is important. Adopted development plan policies will ensure embedding the issue in the planning process; these have to be informed by water companies and housing/development projections.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Partnership working and appropriate funding is critical to the success of a whole catchment approach. Catchment Partnerships may be a mechanism for enhancing the approach taken however their success at present is patchy and requires a) more time and b) more funding (currently funding is only guaranteed until March 2017).

Flood risk management

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

Put simply, the UK has to take a pragmatic and realistic approach to flood management and aim to provide as high a level of resilience as possible with the funding available. Evidence has to be used to inform the level of resilience provided, and this is likely to mean difficult decisions will have to be made in the future about the allocation of funding and the level of protection afforded to certain areas. Primarily in this areas changes to our climate has to be a key issue to inform policy and spend in the future.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Natural flood management schemes tend to be less expensive, less intrusive and have a range of potential benefits including environmental ones (biodiversity benefits, water quality, carbon storage, recreational access to nature). They can be more aesthetically more pleasing too. These schemes can mean engagement with landowners who can feel they are helping their communities through implementing

natural flood risk management schemes. “Innovative technologies” can actually mean relatively simple activities, which can improve the potential for them to be delivered. Accessing funding for these worthwhile schemes is not sufficiently straightforward; there is still also a lack of evidence from existing work that gives a rigorous scientific base and as such it is sometimes difficult to justify the investment. Collecting evidence can be expensive, with proper monitoring sometimes difficult to finance.

Solid Waste

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

There is still some way to go to provide sufficient incentives to ensure that waste is treated in the correct way and that there is sufficient treatment capacity. The discord between reducing funding and the ability of waste collection/disposal authorities to manage waste effectively needs to be reviewed. The planning process is a key facilitator of this capacity and waste planning authorities need to work closely with operators, and cooperate with other waste planning authorities, to ensure sufficient and coordinated capacity.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

No response provided.



South East England Councils
& South East Strategic Leaders
Room 215 County Hall
Penrhyn Road
Kingston
Surrey
KT1 2DN

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

t: 020 8541 7555
e: admin@secouncils.gov.uk

Sent to: NIAEvidence@nic.gsi.gov.uk

10 February 2017

Submission to the National Infrastructure Assessment – call for evidence

Together SEEC and SESL promote the views and interests of all tiers of local government across the South East, representing over 60 local authorities and over 9.1 million residents – the largest population in the UK.

We are pleased to have the opportunity to respond to your call for evidence, developing further some of the issues raised at the National Infrastructure Commission's stakeholder event in Winchester on 20 January. The South East plays a key national economic role and needs transport and infrastructure investment to continue delivering this success. The South East is the engine room of the UK economy, generating £249bn GVA in 2015. The South East is also a global transport gateway for businesses and travellers UK-wide, by air, sea and rail. Both roles are at risk from major infrastructure deficits which, if not urgently addressed, will undermine future long-term national economic success and the South East's ability to facilitate further housing and economic growth.

We have grouped our response to your call for evidence by question themes, and provide more detailed answers to questions in Appendices 1, 2 and 3.

Cross-cutting issues: Questions 1, 2, 3, 7, 10, 12– see appendix 1 for further detail

The South East offers the highest return on public investment in England, contributing a net profit of £80bn to the Treasury between 2002-12, some £6bn more than 2nd place London, profit the Government reinvests across the country. However the South East's economic success and role as a major funder of public spending nationwide are at risk from under-investment in transport and infrastructure that is essential for local and national economic growth. National criteria for investment should be updated to take better account of GVA uplift that infrastructure schemes will deliver. A transparent, accountable approach to investing an agreed proportion of national funds in schemes that deliver this uplift – in the South East and elsewhere – will ensure that both the economy grows and that the Government achieves the best returns on public funding.

We draw your attention to the LG Futures (LGF) table (in Appendix 1) which shows the £15.4bn infrastructure investment funding gap in the SEEC area over the next 15 years. This will restrict economic growth, impact on the viability of new home-building and risks harming public services if not addressed.

Whilst local authority Leaders recognise that there is no new money on offer from Government, we believe that reallocating existing funding and providing councils with financial freedoms and flexibilities could help address this growing infrastructure gap. Clearly schemes with a national impact need an allocation of national funding, but there are also changes that could release more investment from councils for local priorities – for example creating more infrastructure funds, reviewing proposed changes to the New Homes Bonus, retaining first time sale Stamp Duty for infrastructure funding and greater local decision-making over income streams such as business rates. These would all give councils greater certainty to support borrowing for infrastructure investment. This would pay tremendous dividends in helping to enable local authorities to provide some of the infrastructure needed to support housing and business growth.

Not only is the South East's economic success/return on investment critical to spending nationwide, but the South East is a key global transport gateway vital for businesses UK-wide. This access to international markets underpins the UK's global competitiveness and inward investment now and post-Brexit. Without significant infrastructure investment, businesses face increased congestion and operational costs, not only in the South East but across the UK. This includes addressing South East impacts of Heathrow Airport

expansion in light of the Government's recommendation. This will have significant impacts on the South East, placing extra demand and needs on transport, housing, infrastructure and risks to the environment and air quality, which all require significant investment to address.

Infrastructure is also critical to unlock development sites for housing and economic growth, but existing deficits in investment hinder this across the South East. Councils know where major infrastructure is needed to support and unlock development but currently lack the funding to take forward projects on the scale required to meet national needs. Utility companies also need to play their part in planning infrastructure to better match housing delivery. We have provided more detail on this in Appendix 1.

Transport: Questions 13, 14, 15, – see Appendix 2 for further detail

As we highlight above, the impact of South East infrastructure is national, not just local. Companies UK-wide rely on our transport gateways to reach international markets, now and post-Brexit. However these links are increasingly congested, harming businesses, commuters, residents and the environment – reducing UK attractiveness for global investment. Without action now, these problems will continue to get worse - and Heathrow Airport expansion risks further exacerbating them without significant new infrastructure investment.

Also as set out above, the South East is an economic powerhouse in its own right. Over 1.2 million residents commute within the South East's boundaries, roughly 750,000 more than commute into London. Improvements to orbital routes will support and strengthen the South East economy and national network – not simply those commuting into London - and complement radial links to and from London.

There are a number of critical strategic transport routes in the South East, as highlighted in SESL and SEEC's recent Missing Links [report](#), which, if delivered, would unlock significant economic and housing potential. We ask for the NIC's support in moving these schemes forward and to consider undertaking a study on the economic benefits of improving surface access to international gateways. The schemes identified in the report – listed in Appendix 2 - represent strategic cross-boundary transport needs and opportunities across the South East. Investing in these strategic transport corridors, international gateways and wider transport networks would benefit job creation, the reliability of imports and exports, and the delivery of homes.

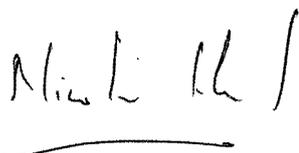
Digital: Questions 17, 18 – see Appendix 3 for further detail

Across the South East many rural homes and businesses do not have access to the broadband they need, which is detrimental to the area's economic potential and the profits of UK plc. Improving broadband speeds, access and delivery will boost productivity across many industries, opening up more markets without the need to travel. This will allow all businesses, regardless of location, to access customers and suppliers creating a bigger and more competitive marketplace.

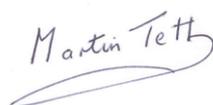
All utility companies, including broadband companies, should be required to engage in the planning process at the earliest stages.

We would be pleased to discuss these points further with you.

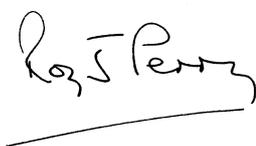
Yours sincerely,



Cllr Nicolas Heslop
Chairman, South East England Councils
Leader, Tonbridge & Malling Borough Council



Cllr Martin Tett
Chairman, South East Strategic Leaders
Leader, Buckinghamshire County Council



Cllr Roy Perry
Deputy Chairman, South East England Councils
Leader, Hampshire County Council



Cllr David Renard
Vice Chairman, South East Strategic Leaders
Leader, Swindon Borough Council

Appendix 1: Cross-cutting issues

Questions 1 and 2: What are the highest value infrastructure investments that would support long term sustainable growth in your city or region? How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

The South East is the engine room of the UK economy, and offers the best return on investment in England. The South East made a net contribution of £80bn to the Treasury in 2002-12 - supporting public spending across the whole country. Its GVA (£249bn in 2015) is greater than all 8 English core cities combined (£169bn). Investing in infrastructure to support this high performing economy, maintaining growth in jobs and productivity, and unlocking housing, is vital for the whole UK now and post-Brexit.

Research for SEEC and SESL by local government finance experts LG Futures (LGF) estimates the South East has an infrastructure funding gap of £15.4bn by 2030 in the SEEC area. Additional data from Essex, Central Beds and Swindon further increases this gap. The scale of the infrastructure funding gap across the South East, broken down by type, can be seen in the table below. Taking account of expected population growth, providing transport, education, health, community and green space infrastructure for South East residents, plus flood protection, utilities and emergency services, the total infrastructure cost is calculated at £38.3bn for the SEEC area. Current funding streams are expected to cover around £22.9bn of this, leaving a gap of £15.4bn for the SEEC area.

Table 1 - South East (SEEC) region estimated infrastructure cost (over 15 years)

	Estimated Cost	Expected Funding	Gap	Estimated cost per head
	£m	£m	£m	£
Transport	17,822	8,154	9,668	1,796
Education	4,634	2,699	1,935	467
Health and social care	6,145	5,375	770	619
Community	1,675	928	747	169
Green infrastructure	399	106	293	40
Utilities	5,088	4,606	481	513
Flood protection	2,387	912	1,475	241
Emergency services	127	93	34	13
TOTAL	38,275	22,873	15,402	3,858
Current population	8,919,600			
Growth in population to 2030	1,002,100			
Population estimate in 2030	9,921,700			

SEEC and SESL's recent Missing Links [report](#) highlights some of the most important vital strategic transport investments that would help alleviate pressures across the South East, creating better productivity and fewer delays to freight transport. Without South East infrastructure investment, companies across the UK who rely on our transport gateways to reach international markets now and post-Brexit may choose to move to alternative EU locations where infrastructure is better equipped to handle demand. As road and rail routes to and through the South East become increasingly congested, overcrowded and inefficient they damage business profitability and inward investment to the UK.

Heathrow Airport is one of the UK's most important international gateways, and proposals for expansion would have a significant impact on South East. Accommodating the additional runway and achieving its full economic potential are dependent upon maintaining and improving access to the expanded Airport. Although not in the South East, Heathrow's position close to the London/ South East border means much of the airport traffic needs to travel via the South East. It is also inevitable that many of the approximately 48,000 new homes needed to support Heathrow expansion would be in the South East, further adding to congestion. Without investment in infrastructure, the expansion of Heathrow Airport will have significant impacts on transport links across the South East and to the rest of the UK. While access to Heathrow Airport is important, there is also a need to invest in improving transport links to other major air and sea ports, and commercial centres across the country. This is an opportunity to invest in the South East's existing and new road and rail infrastructure to maintain and improve access to all gateways so that it is able to reach its full economic potential and support UK plc's success.

As highlighted in our covering letter, there needs to be clear, accountable criteria to underpin allocation of national funding for infrastructure projects with significant national/ global economic significance.

Questions 3 and 10: How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this? What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The South East has England's largest population and largest growth in homes, with an increase of 34,900 across the South East in 2015-16 (SEEC area). This was 4,500 more homes than London delivered in the same period. SESL members in Essex, Central Bedfordshire and Swindon saw completion of 8,060 homes in the same period. SEEC's Unlock the Housing Blockers [report](#) highlights that many areas suffer from an existing infrastructure deficit which can hinder development, and which new developments will add to. Congestion and pollution degrade the environment and impact on residents' quality of life, while poor road and rail links have a negative impact on commuting times and reliability of freight transport. These factors not only create local concerns about further new development – which can delay the delivery of planned housing - but also undermine our vital economic profitability to UK plc. Without the necessary investment in infrastructure, it cannot be assumed that the South East's economic powerhouse role and track record in supporting new homes will continue now and post-Brexit.

We fully support raising the economic performance of other parts of the country through infrastructure investment, but believe this must happen alongside continued national investment in the South East success – in terms of its vital contributions to housing delivery and economic growth. Alongside this, allowing councils to access a greater share of locally-generated business rates, retain Stamp Duty from first time property sales to reinvest in infrastructure, and to have greater freedoms to set tax rates locally would help release funds that councils could contribute to the provision of essential local infrastructure thereby opening up housing sites and reducing the costs of congestion for businesses.

In addition, South East Councils would welcome better co-ordination to ensure infrastructure investment is well aligned with councils' housing and other economic/growth plans. This would allow for timely delivery, ahead of new housing and workplace developments, supporting sustainable growth and ensuring infrastructure is designed and delivered effectively and in the right places for new developments. There is a need to better balance national, regional and local investment priorities.

Encouraging utility companies, including energy, water and waste management companies, to better align their infrastructure investment in advance of planned housing growth would speed up the delivery of new housing developments. Requiring utility companies to fully engage in the earliest stage of the planning process would help support the delivery of more timely utilities for new developments. Allowing councils to negotiate high level development agreements with utilities, other infrastructure providers and developers on the timing of development would help agree approaches to infrastructure investment and avoid blocking sites.

Questions 7 & 12: What changes in funding policy could improve the efficiency with which infrastructure services are delivered? What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

SEEC and SESL members want to explore solutions to infrastructure funding to ensure that continued housing and economic growth does not become unsustainable by simply adding to existing congestion, overcrowding and existing pressures on services. Changes to how infrastructure is funded are needed because of the growing funding gap across the South East, made worse by a lack of council freedoms and flexibilities to raise their own funds for more local infrastructure needs. For example, giving the South East access to one or more infrastructure funds, similar to those operating in areas with devolution deals, would release significant capacity for investment at more local level. Other options to explore include reviewing the proposed changes to the New Homes Bonus, greater accountability over local income streams (such as business rates) for councils, giving councils greater confidence to borrow for infrastructure investment, and allocating first-time sale Stamp Duty on new South East homes for infrastructure investment. While these measures are not appropriate ways to fund national, strategic priorities, these measures would allow councils to make a much greater contribution to more local infrastructure needs.

Exploring the Stamp Duty example further, in 2014-15, 209,000 properties were sold in the South East, generating a total of £2.1bn in Stamp Duty. New homes were some 13.5% of the total sales. Allocating councils 13.5% of the total Stamp Duty receipts to spend on infrastructure would have generated £278m for South East authorities in 2014-15. Stamp Duty receipts can vary significantly each year but, if receipts were to continue at 2014-15 levels, the South East authorities could raise £4.1bn over 15 years (SEEC area).

Another example is allowing councils to maintain access to the New Homes Bonus (NHB) which could deliver £2.1bn funding for South East authorities over 15 years. The NHB initiative has been very popular with local authorities and residents alike. A review of the Government's planned changes to the NHB, which propose to reduce the pot and introduce a threshold before councils can qualify for payments, should be undertaken. We recognise the pressing need for care funding but know there is also a strong need for wider infrastructure. It is not a choice of either social care or infrastructure, the South East needs investment in both.

At national level, we urge the NIC to review the criteria currently used to allocate Government departments' infrastructure investments. For example:

- Our member councils have previously found that flood prevention funding failed to take adequate account of the economic impact of flooding.
- There are also concerns about outdated methodologies used in assessments such as the DfT green book appraisals, which should be refreshed to ensure assessments give more weighting to the GVA uplift to be delivered by transport investments.

SEEC and SESL believe that the NIC can play an important role in updating investment criteria to deliver an investment programme that is fit for the 21st century. Within such an updated system we believe there could then be transparent and accountable decisions made about the proportions of funding to be allocated to projects that offer strong GVA growth alongside those that offer lower growth but regeneration opportunities.

Appendix 2: Transport

Questions 13-15: How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas? What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

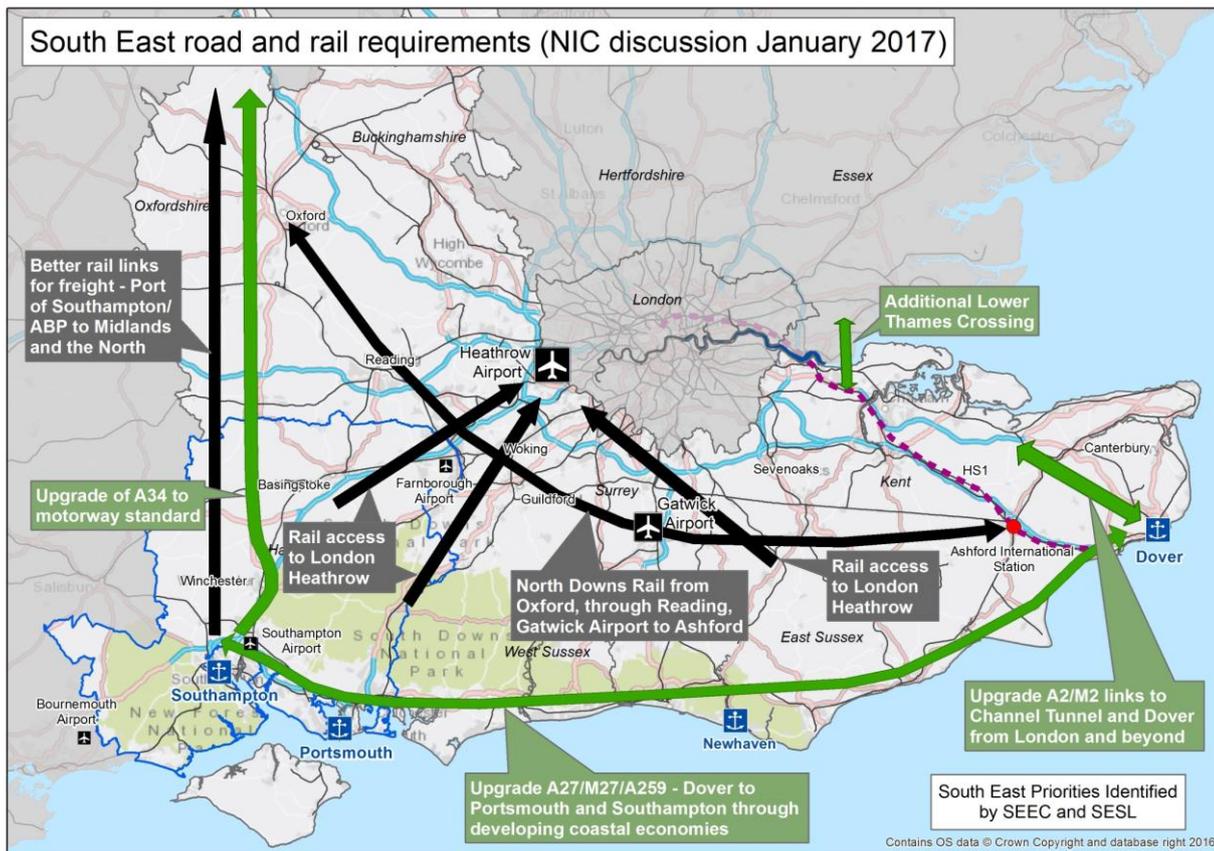
The South East has a dual role as the UK's most profitable economy (in terms of net profit to the Exchequer) and as a major international gateway used by businesses nationwide. Investment in improving the South East's strategic road and rail routes will provide significant dividends for the Treasury and for the country as a whole. SEEC and SESL's Missing Links [report](#) highlights some of the nationally important South East projects which are vital for future economic success and which cross multiple council and LEP boundaries. These strategic transport routes (Map 1) include major schemes which would also facilitate growth at Heathrow Airport, open up significant economic and housing potential across a much wider area and support housing and economic growth in other areas of the country. For example:

- Improving the A34/M3 and rail links to Southampton-Portsmouth from Oxford, the West Midlands and beyond;
- A2/M2 – links to the Channel Tunnel and Dover from London, East, the Midlands and beyond;
- A27/M27/A259 – from Dover to Southampton and Portsmouth, through developing coastal economies and university towns;
- North Downs Rail – from Oxford, through Reading and Gatwick Airport to Ashford in Kent will have major benefits for the local and national economy.

These projects include both radial and orbital routes. The value of radial routes is widely recognised, but the South East also sees significant benefits to improving orbital routes as a way of supporting the South East's own economy by linking key economic centres across the South East and beyond without the need to travel via central London. These orbital routes would relieve pressure on already heavily-congested routes, such as the M25 and rail routes into central London, by providing viable alternative travel options. Combining physical road and rail improvements with new transport technology and innovation would improve travel capacity, reduce congestion and support inward investment and business growth.

Without infrastructure investment businesses face increased congestion and increased operational costs, not only in the South East but across the UK. Figures from the Freight Transport Association, for example, put the cost of traffic congestion at £1 per minute for their members. Without South East infrastructure investment, companies across the UK may choose to move to alternative global locations where infrastructure is better equipped to handle demand.

Map 1 – South East road and rail requirements



Appendix 3: Digital

Questions 17 and 18: What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made? Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Access to superfast broadband is critical for continuing the economic success of the South East and UK in the future. It supports economic growth and productivity across all sectors and provides access to international markets without the need to travel. Almost 5% of homes and businesses across the UK are still without access to superfast broadband. It is important to recognise that economic activity takes place across a range of locations, generating income for UK plc.

Delivering coverage for all homes and businesses should be a priority to boost the economic success of the South East. Superfast broadband gives homes and businesses access to services, customers, markets and suppliers regardless of location, allowing all areas to compete on equal terms locally, nationally and globally. For example, in rural Hampshire where the council have paid for the installation of infrastructure, over 75% of households have taken up superfast services. Without it, rural areas are not able to participate on the digital community or economy.

In future to avoid creating a digital deficit for newly built homes or employment sites, broadband companies, should be required to engage in the planning process at the earliest stages.



Peninsula House, Rydon Lane, Exeter, EX2 7HR
www.southwestwater.co.uk

10 February 2017

Commission Secretariat
NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

By email: NIAEvidence@nic.gsi.gov.uk

Dear Sir,

THE NATIONAL INFRASTRUCTURE ASSESSMENT: CALL FOR EVIDENCE

We welcome the opportunity to respond to the National Infrastructure Commissions Call for Evidence, and have provided detailed answers to the questions in the Appendix to this letter.

South West Water Limited (SWW) provides water and sewerage services to a population of approximately 1.7 million in Devon and Cornwall and parts of Dorset and Somerset. Pennon Group Plc (our parent company) acquired Bournemouth Water in April 2015 and has now integrated the company into South West Water. Bournemouth Water provides water services to a population of approximately 0.4 million people in the Bournemouth and Christchurch region.

Pennon has strong links with both the National Infrastructure Commission and the Institution of Civil Engineers. Pennon is also currently working with the Treasury on the National Infrastructure Plan for Skills and UK Infrastructure Delivery. Pennon is investing, innovating and working to deliver the infrastructure networks and services the UK needs.

We have sought to outline our responses using experience from our business. You are welcome to acknowledge South West Water in the final report and to use and publish evidence submitted with our consent. We would also be very willing to participate in any further consultations and to offer any members of our Executive Management Team to speak to you in further detail on any of the topics in this report.

If you should require any further information please do not hesitate to contact me.

Yours faithfully,



(signature redacted)



(name redacted)
(job title redacted)
(phone number redacted)
(email address redacted)

APPENDIX

Cross-cutting issues:

1. *What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?*

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline

The economic structure of the South West reflects its geographical location at some distance from major markets and centres of commerce. It continues to have a high reliance on traditional land based and extractive industries, together with tourism all of which are a function of its natural environment.

The overwhelming majority of businesses in the South West are small, with 75% having no employees. There has been an increase of 118,000 businesses in the past 5 years, and this is almost entirely down to the start-up of micro businesses with fewer than 5 employees.

The South West Peninsula has a smaller share of exports than almost every other part of the UK and low levels of foreign direct investment. These are key indicators of the fact that the South West Peninsula is one of the most cut off areas of the UK.

The view that emerges of the South West Peninsula is an area with skilled workers, innovative businesses and resilient productivity, but one in which not all business opportunities are captured and which is poorly related to other communities in the area and to national and international markets.

The South West is considered by some to be an unattractive place to do business because of poor access, prolonged journeys, increased cost of transport leading to uncompetitive pricing or reduced margins, disruption due to lack of resilience in communications networks and difficulties in recruiting key personnel because of extended travel. If these communications deficiencies can be addressed then the productive energy of the South West Peninsula can be released. As a result of the above we consider that infrastructure investment in road, rail, air and broadband are essential to the productivity of the region.

2. *How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?*

Businesses in the South West have the best prospects of trading internationally if they are well connected to key gateways, particularly major airports such as Heathrow, Gatwick and Manchester. Direct services by rail and good highway connectivity to international gateways will be increasingly important in maintaining the UK's competitiveness.

SWW is therefore supportive of the Western Rail Access to Heathrow as well as the role of regional airports which should be supported, not just for outbound travel to international

destinations, but also for inbound travel – particularly to areas such as the South West which attract significant tourist numbers. Enhanced surface access to regional airports such as Exeter Airport is therefore a priority for attracting inbound visitors.

SWW is currently discussing with Defra the delivery of water and sewerage services for the Isles of Scilly. The continued maintenance and enhancement of transport link to the Isle of Scilly is therefore essential to maintain the efficient delivery of these services. It is therefore important that plane and sea transfers to the islands are maintained and improve in terms of both frequency and reductions in cost. We are supportive of the currently proposed helicopter services to the islands.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Significant growth is being experienced in the South West, with new housing coming on stream as employment rises. The South West also faces housing pressures because it is a popular area for retirement and tourism, and in some parts of the region the ratio of house price to income is among the highest outside London.

Sustainable new communities, at Cranbrook (Exeter) and Sherford (Plymouth) are being delivered in the South West as a result of strategic land use planning decisions taken 20 years ago and they highlight the need for housing to be planned in conjunction with key supporting infrastructure such as transport, education and training, energy and water. Similar commitment to support early infrastructure delivery will be needed to successfully deliver the new garden town at Taunton, and the garden village at Culm in Mid Devon.

We continue to support an integrated approach which we consider will deliver the broadest range of gains with active attention to opportunities to enhance natural capital as an integral part of infrastructure planning. We continue to consider that water companies should be engaged in the planning process and should be a statutory consultee on all planning applications.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

Within the water industry the biggest contribution towards more effective demand management is increased levels of metering. Both SWW and Bourne mouth Water have reached relatively high levels of customer metering. This is not yet compulsory, so may yet reach a maximum. The potential for further savings resulting from new meter optants is therefore limited. This high level of metering could however result in greater customer engagement and incentives through gamification with demand management initiatives, as reductions in consumption can be promoted as a way of cutting bills.

Recent decades have seen an increase in the frequency of personal washing, with a daily shower now normal, particularly among younger generations. This behaviour may lead to increased average demand in the future. Future population growth for the Devon, Cornwall and Bournemouth regions show a increase in population within the >60 age band as these regions continue to be a retirement destination. Over time this will result in more single person households within the regions with an increased per capita consumption. This increase in per capita consumption has been countered somewhat by improved efficiency in water using fixtures and fittings, for example lower flush volume toilets and more efficient washing machines. Potential for future reductions in consumption from improved efficiency fixtures and fittings is limited, but savings through influencing customer behaviour could be delivered in the medium to long-term.

SWMW has run successful behavioural change campaigns such as Love your Loo and Think Sink, which aim to reduce sewer blockages. Lessons learnt from these campaigns are being used to design campaigns aimed at reducing water consumption, for example through encouraging more efficient garden watering strategies.

SWMW also targets customer behaviour by offering free water saving devices and advice to customers on conserving water. SWMW offers home visits to its most vulnerable customers with a focus on reducing bill costs through water conservation. More could be done to engage customers, e.g. through offering home visits out to more all customers.

Consultancy packages are offered to business customers, offering leak detection, water efficiency advice, devices and rainwater harvesting.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Infrastructure investment should be planned from cradle to grave with clear accountabilities in place for the maintenance of the system of assets which deliver the services to customers and the environment. Within the regulatory period from 2015-20, water companies are incentivised to move to a tolex based approach through the application of whole life costing and efficient asset management. These incentives should be sustained to ensure that incremental improvements in asset management continue to deliver economic and efficient delivery resulting in greater value for customers and the environment.

Some aspects of asset management are hampered by customer behaviour; we have a throwaway culture across the developed world, with products no longer designed for re-use with quick, simple solutions which fit easily into our daily routines. Changes around personal hygiene are also driving a continuing increase in the use of wet wipes which are being inappropriately disposed in the toilet causing a massive problem for water companies, with wipes and non-sewer products being responsible for around 75% of all sewer blockages.

Campaigns such as our Love your Loo and Think Sink are very efficient methods to target customer behaviours, informing the optimum opex vs capex balance to attain the best system reliability without resorting to constructing expensive new assets.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Competition and collaboration are key roles within the delivery of economic and efficient infrastructure services, particularly as most of the infrastructure services are delivered by discreet service providers with separate regulation or governance arrangements. At times these operational and regulatory boundaries can lead to inefficient delivery or perceived lack of co-ordination.

Competition is already occurring within the water sector with Open Water, the non-household water retail market opens in April 2017; shadow operation is now well underway across the sector. One of the key requirements in the market will be that the wholesaler maintains a level playing field, in that it treats all retailers exactly the same.

Collaboration across utilities and with local authorities is also key to delivering services across our operational areas. Through our Upstream Thinking (UST) and Downstream Thinking (DST) programmes of work we have been working collaboratively with external organisations to deliver long term sustainable solutions to issues. These collaboration initiatives could be more comprehensive and better supported by the UK Government through incentivisation and stronger regulation for catchment polluters. Legislation and support for ecosystem service payments and natural capital accounting can play a significant role alongside more accessible regional or national co-funding for catchment management.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

Many would consider that the privatisation of infrastructure services such as water, sewerage, electricity, gas and telecoms has been successful at raising private finance and investing to improve our asset infrastructure over the last 25-30 years. We consider that these mechanisms have been very successful and should continue but greater emphasis should be placed on co-ordination across these regulatory regimes to ensure that common outcomes are delivered at least cost.

These could include:

- improving the delivery of infrastructure projects and how access to infrastructure corridors can be improved and co-ordinated
- incentivisation for developers – the requisition process is changing to a roof tax (yet to be confirmed but is likely to be Spring 2018) which should balance who pays for infrastructure services
- FDGIA funding is driven by risk to life and properties at risk i.e. residential dwellings. This does not give much weight to commercial property and does not consider the impact on the economy/tourism by not providing flood defence
- The Countryside Stewardship funding for water quality on farms could be better distributed by water and sewerage companies (WasCS) through for example UST so this should be changed

- public funded bodies could also be incentivised through totex regimes to align with the funding processes within the regulated utilities.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

There are a number of these projects within the South West region where infrastructure projects can deliver benefits for the region, however the funding streams are across multiple parties each of whom have different objectives, constraints and timing of funding. Infrastructure projects require medium to long term commitments to funding. Many local government bodies are dependent upon support from either central government or European structural funds for infrastructure investment. The future of these investment funds is uncertain post Brexit, creating project uncertainty.

Commitments to long term funding over five to six years for Government bodies alongside an alignment to risk based outcomes and totex incentives should encourage greater collaboration across infrastructure providers.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

Holistic total system resilience assessments will be the key to the effective delivery of these resilience outcomes. These should be common risk assessments across power, water, telecoms and transport based upon shared hazards. This approach should build on the foundation of the good work that has gone into flooding to wider infrastructure and should encourage the establishment of better links between service industries with more collaboration.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Schedule 3 of the FWMMA should be enacted and WaSCS should be made statutory consultees in the planning process. The right to connect should also be removed. Enacting Schedule 3 would also resolve the outstanding issues of ownership and maintenance of SUDs.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The local environment in the South West region is a distinctive and unique natural asset. For example according to the Great Britain Tourism Survey 2010 – 2012¹ the area attracts approximately 26.7 million visitors per annum. Therefore, infrastructure developments that promote access but that are sensitive to preserving, protecting and enhancing it are very important.

An integrated approach to catchment management and the natural environment will deliver the broadest range of gains with active attention to opportunities to enhance biodiversity and other natural capital as an integral part of infrastructure planning. Ideally, local regions would be charged with providing and maintaining information on the location of the most valuable natural and cultural capital and opportunities to enhance these alongside future development. For example, establish natural flood management approaches to protect infrastructure at risk from flooding.

Regulatory regimes should be aligned and should promote this long term thinking with robust Natural Capital Assessments included within evaluations and regulatory decisions.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

Cost benefit techniques should be focussed on real world outcomes that are measurable and deliverable. The techniques should reflect the needs of the end user and of the wider environment as well as the costs of asset ownership and management.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

With increasing prosperity demand for travel is likely to grow. However, there is also likely to be a greater tendency for flexibility in terms of journey time and destination such that demand for travel may reach more of a continuum across the hours of the day with less pronounced peak periods.

¹ https://www.visitbritain.org/sites/default/files/vb-corporate/Documents-Library/documents/England-documents/gjb_tourist_-_30-08-2013_-_lv_lcm30-38527.pdf

The widespread deployment of autonomous vehicles could lead to an increase in the demand for highway capacity, as personal travel may be available to those who are not able currently to drive cars.

It is reasonable to assume that there will be a further erosion of public transport in rural areas, but that this decline may be offset by the availability of autonomous vehicles and widespread use of information systems to match drivers with potential passengers.

The continued adoption of new and alternative technologies may lead to a reduction in the number of business trips taken, as road congestion continues to worsen and broadband and communications channels such as video conferencing become more attractive.

The spread of Ultra Low Emissions Zones (ULEZs) across the country and road charging may mean that only absolutely critical meetings occur face to face. Freight may see a shift in delivery patterns as more delivery activity occurs over night when the roads are quieter.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

Highway space in our urban areas is going to remain at a premium, with effective capacity potentially declining as the size of the vehicles increases while the available width of the highway network is constrained by adjoining development. Therefore the highest value transport investments are likely to be those which overcome such constraints, for example greater use of the urban rail networks, together with off road cycle and pedestrian routes.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

The increasing size of heavy goods vehicles and more access restrictions make this an interesting issue. Coupled to ever decreasing levels of public transport is 'forcing' a modal shift from public transport to private. Rural transport infrastructure should be enhanced utilising public funding and incentivising developers away from developing industrial activity in sparsely served areas.

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Road charging will inevitably spread further, particularly from a commercial perspective, although this will place additional pressure on the cost of goods and services and would ultimately impact on the cost base of companies. Obviously this would be an undesirable position.

Digital Communications:

17. What are the highest value infrastructure investment to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

The water industry relies on reliable low bandwidth communication and high bandwidth communication to operate its assets. While the rise of superfast digital communications has enabled us to deploy advanced technologies in the field, we continue to see the withdrawal of low bandwidth services with no equivalent services being made available. The CSDN network was retired in 2008, in three years time analogue private circuits and TDM digital private services will be withdrawn from service. In the longer term the future of ISDN and even analogue PSTN is uncertain.

If superfast is the only future solution, it must have the coverage and reliability that low bandwidth services have provided and the costs to install business grade services significantly reduced. To date, affordable products have relied on consumer orientated broadband and mobile products which, compared to low bandwidth services, are complex, have poor coverage, are unreliable and have poor service levels. Fibre to the premises provides the reliability and service level required but infrastructure needs to be put in place, in rural areas, so that installation costs are not an insurmountable hurdle. Rental costs of fibre services are far too high compared to the low bandwidth services currently in use. If charging is to continue to be based on distance from ethernet points of presence then more ethernet POPs need to be established closer to customer sites.

We need a new universal service offering with fibre as a core component.

Low bandwidth services

The water industry's machine to machine communication requirement has changed little over the past several decades, requiring reliable low bandwidth services.

We believe there is a place for low bandwidth services alongside superfast services. A reliable low bandwidth copper delivered service with the reach of analogue exchange lines sitting along side a pervasive low bandwidth radio service would provide for most of our critical communications needs.

It is rather too late to make decisions to build infrastructure to cope with the withdrawal of analogue private circuits; even if radio technologies such as Lower Power Wide Area Network and TV Whitespace were immediately made available it will take some time before manufactures develop products to work with the technology. There is time left to pre-empt the retirement of analogue exchange lines and plans to retire traditional, modem friendly services, should be accompanied by products that will provide at least as reliable service with the same reach.

Mobile communications

Water utilities also require good mobile communications to operate their large field teams. To date, the rollout of 3G and 4G has largely passed by the rural areas where we operate our assets. Decisions should be made now to attach conditions to new licenses to get coverage to places where people go as well as where they live. Conditions based on national coverage rates continue to exclude rural areas.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Note: the existing “regime” refers to the current market, competition and planning frameworks. “Digital communications” includes both fixed and mobile connectivity.

The regulatory regime for telecoms appears focussed on making the market work and does not drive investment in infrastructure. Regimes in the water and rail promote large investment driven by central policy rather than market forces; sometimes with public money. Communications providers, both fixed and mobile, appear to meet regulatory targets by picking off low hanging fruit – like superfast broadband to cities, or rural areas that are easy to reach with fibre. As the number of customers using older services dwindle (typically to those in rural areas), we see these essential services withdrawn because they are no longer popular or are uneconomic to sustain. Regulation needs to be more focussed on ensuring infrastructure is built and services delivered in all areas to ensure essential services remain available.

Energy:

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

The highest value option would be to extract heat benefit from power generating equipment as in combined heat and power (CHP) to achieve a much higher overall operational efficiency. New communities and housing estates should have distributed heating systems installed as part of their initial construction. Decisions need to be made at the design and planning stages.

The water sector uses many CHP engines to generate electricity from biogas produced within anaerobic digestion processes.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

Zero carbon should specifically relate to the generation of energy and there should be clear product differentiation and carbon labelling, thus supporting consumer choice.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Low carbon vehicles include electric hybrids, plug-in hybrids or pure electric vehicles. Plug-in vehicles will create extra demand on the supplying infrastructure introducing additional peak demand periods. There is a rising need for rapid charging facilities which will require new, specific infrastructure to service. The need for and technological capability to create large battery storage systems could smooth these demands but these systems bring further additional costs

Water and wastewater (drainage and sewerage):

22. What are the most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

Water companies have statutory duties to manage and maintain water and sewerage systems to deliver water and sewerage services to their customers. The costs of maintaining and enhancing these services are regulated by Ofwat with the companies presenting five year plans to the regulator through the price review process.

There are a number of projects testing approaches to catchment management, including: Defra Pioneer projects developed under the Government's 25 Year Environment Plan. Recently, the Environment Agency has been working with local communities to set out how to manage flood risk across their catchments.

Defra's 'Catchment Based Approach' (2013)² advocates community participation in decision making, and improving the water environment. Alongside this, the Environment Agency can now better consider ecosystem services³ across catchments and make more joined up decisions about development and infrastructure in a way that can take better account of environmental hazards, including floods and drought. Whilst many of the catchment partners are willing to work together on this catchment based approach, one key challenge to note is around the leadership of a catchment based approach, as current legislation and policy does not determine the lead (who's catchment is it anyway?).

Water supply and water quality concerns often cross local authority boundaries and are best considered on a catchment basis. Liaison between local planning authorities, the Environment Agency, catchment partnerships⁴ and water and sewerage companies from the outset (at the plan scoping and evidence gathering stages of plan-making) will help to identify water supply and quality issues, the need for new water and wastewater infrastructure to fully account for proposed growth and other relevant issues such as flood risk.

One of the challenges of a holistic approach to flood drainage is that the duties of drainage are split across many parties whether water and sewerage companies, highways authorities, lead local flood authorities, the Environment Agency or riparian land owners. Simplification of these duties should be considered to enable clarity to be given to customers affected by flooding and to ensure that an appropriate lead can be determined for action. Water companies could well be an appropriate vehicle to manage and maintain all drainage matters within a catchment, with the Environment Agency managing rivers and maintaining flood and coastal defences.

² <https://www.gov.uk/government/publications/catchment-based-approach-improving-the-quality-of-our-water-environment>

³ <https://www.gov.uk/guidance/ecosystems-services>

⁴ <https://www.gov.uk/guidance/water-supply-wastewater-and-water-quality#catchment-based-approach>

The river basin management plan⁵ prepared by the Environment Agency is the key over-arching source of information on the water environment including the condition of water bodies and measures to help meet Water Framework Directive⁶ objectives.

Resilience of water and sewerage services is important to ensure that these key public services are maintained and continuous during extreme events. Continuous water supply is essential to maintain public health and should be protected to resilience hazards. Maintaining resilient wastewater services is essential to the environment and should be considered to reduce pollutions and ensure that recovery following major events is swift in order to protect any permanent damage to the environment.

Water and sewerage services should be considered as part of the development of the circular economy through the use and promotion of grey water reuse, the generation of energy from sewerage sludge and the recycling of biosolids to land as a natural fertiliser. The South West is a key region for the circular economy as it has such a rich and diverse natural capital landscape which can take advantage of the benefits of the circular economy to improve efficiency and economy of our region.

2.3. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

In the water and sewerage industry, Water UK has led a sector wide initiative in this area, 21st Century Drainage. A key workshop underway within the programme is that of drainage capacity management. This aims to better understand the linkage between current and future pressures on available hydraulic capacity and in turn on outcomes, to facilitate the development of optimal long term interventions.

Our sewer network is in most places a 'combined system', taking both surface water and foul flows. This network is increasingly being inundated by storm water from the catchment. SWW believe that long-term planning and collaboration are key to meeting future demand. As an example, SWW's Downstream Thinking Programme is an ambitious long-term approach, to achieve both the best outcomes for customers in the short term and support our longer term goals by applying the principles of holistic catchment management with the removal of surface water from the combined sewer network.

Sewer flooding is a blight on society, an extremely distressing experience for householders, a health hazard and can be harmful to river ecology. Some traditional solutions, such as massive storm storage tanks or upsizing pipes, might resolve the sewer flooding for a time but unless the whole issue of surface water in the area is tackled, homeowners and businesses will continue to suffer from flooding. This requires partnership collaboration to provide long-term resilience to the network.

⁵ <https://www.gov.uk/guidance/water-supply-wastewater-and-water-quality/#river-basin-management-plan>
⁶ <http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32000L0060>

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Integrated catchment management solutions can be applied to whole catchments to protect and enhance raw water supplies (resilience and quality). The techniques and evidence for successful catchment management are now well documented from multiple practitioners and projects in the UK. The future approach should be whole catchment management and the application of natural capital solutions to risks and challenges that affect all parts of the raw water supply (rivers, reservoirs and aquifers), the treated water networks and waste water/drainage systems. Issues such as raw water quality, low base flows, peak flow excesses and whole catchment nutrient budgets can be addressed successfully through whole catchment management.

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing cost, development pressure and the long-term risks posed by climate change?

The National Flood Resilience Review has looked at how we:

- understand the risks of river and coastal flooding from extreme weather over the next 10 years
- assess the resilience of key local infrastructure (such as energy, water, transport and communications), and identify ways to protect it better
- improve how we respond to flood incidents, including through new temporary flood defences

Even though, the Environment Agency are now designing for exceedance i.e. understanding where water will go when defences are beaten etc. and ensuring it doesn't go towards properties, there will always be a residual risk and this also needs to be explained and understood so members of the public can be prepared and take effective action during a flood event.

As identified in CIRIA Report C688, flood resilience measures should be adopted as an integral part of individual organisation's business continuity management processes, whole life management plans, and climate change adaptation strategies. Critical infrastructure owners need to develop long term strategic investment approaches that allow for optimised investment optimised investment decision making. The economic regulators should aim to provide a framework to achieve this objective.

Through the development of the Water 2020 framework, water companies are working with Defra, Ofwat and the Environment Agency around the development of resilience metrics for water and sewerage services, to measure and incentivise effective decision making for resilient services.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

Following the National Flood Resilience Review, the Government is launching four new trailblazing projects to develop, test and accelerate new ways of managing the environment; this will include a

project in Cumbria, which focuses on natural flood management strategies and up-to-date modelling and data tools. While these tools will undoubtedly deliver benefits in the long term, many of these will take many years to deliver and as a result there remains a need to invest in the short to medium term in order to reduce flood risk.

Solid waste:

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Although we have landfill tax that has discouraged the use of landfill, greater incentives are required to support the installation of new treatment capacity such as anaerobic digestion. Further incentive mechanisms for embedded generation would also be beneficial.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

SWW consider that we already operate in a circular economy in the fact that we currently recycle the vast majority of our treated biosolids to agricultural land in line with the ADAS Safe Sludge Matrix and the recently introduced Biosolids Assurance Scheme.

Incentives to recycle more waste materials in both operational and construction activities would

GROWTH

Southampton City Council
Civic Centre
Southampton
SO14 7LY



Direct dial: 023 8083 2882

Our ref: [officer reference
redacted]

Please ask for: [name
redacted]

National Infrastructure Commission - Call for Evidence Southampton City Council response

Southampton City Council welcomes the opportunity to respond to this call for evidence. Southampton has maintained strong economic growth in recent years having weathered the recession relatively successfully – PWC's Good Growth for Cities Index places Southampton in the top 4 fastest growing cities for the 4th year in a row. No single factor can account for this success, but a major feature has been the development of the City Centre Master Plan that provides the basis for £3bn of investment in housing, business space, retail and leisure attractions. More than £1.6bn of development has been completed or has entered the development pipeline since 2010. The City Council through its Master Plan has provided the property industry with a clear vision of what the City Council is seeking to achieve and this has created the confidence for their substantial investment. Confidence is critical in driving investment, and this relates equally well to certainty about the infrastructure that will support all stakeholders making development decisions. The NIC should seek to ensure all parts of the infrastructure jigsaw plan effectively, communicate well, and remain open to adjusting schemes so that they can deliver shared benefit for all investors.

Cross-Cutting Issues

The public transport network in the City, and beyond, is in need of significant additional investment, having suffered from a long period of poor levels of resourcing. In particular, the connection between Southampton and Portsmouth is very poor, limiting the opportunities for people and goods to move effectively. The development of a Solent Metro integrated public transport system is widely supported across sectors and administrative boundaries. The implementation of this scheme, in particular the first phase linking Southampton Airport and Port of Southampton, would assist in improving labour mobility, reducing road congestion, and make a major contribution to productivity.

The Port of Southampton contributes in a significant manner to the local and national economy. It is a key component in the automotive sector's export success and is acknowledged as the largest home port for cruise liners in Northern Europe, joining up the varied infrastructure requirements that support key gateways such as the port is vital – different parts of the system (rail, road, public transport, air, utilities) need to consider improvements in a cohesive manner and developed shared work programmes to deliver improvements that will underpin further growth. Investment in existing infrastructure assets, often designed to deal with far lower densities of housing, movements and business operations, should be considered carefully. Improvements to these assets can assist in engaging with local communities, as opposed to new schemes which often take more valuable land. Ensuring the digital capacity of existing infrastructure to link different elements and ensuring that this enables capacity improvements is vital to taking advantage of demand management opportunities. Public transport usage can be significantly enhanced by quick, accurate and easily received communication about availability, delays and arrival times.

As a coastal City, flood resilience remains a major consideration. Securing flood defences along the River Itchen to protect over 1,000 homes and 650 businesses, but also secure large tracts of development opportunity (up to 2,000 homes) is vital.

The planning cycles of the infrastructure providers need to be better synchronised, be able to respond to regional priorities and be flexible and commercial enough to participate in development opportunities. As land values rise following infrastructure implementation, a commercial concordat of public sector and infrastructure agencies should be in a position to drive development and benefit from rising land values.

Transport

Perhaps the most fundamental change in the next 30 years will be electric and autonomous vehicles. This may allow for much greater utilisation of the road network and modelling should take account of this. It seems quite possible that autonomous vehicles could lead to a wider ability to share vehicles and potentially reduce use at peak times, with a positive impact on congestion. A potential disadvantage of this may be that parking income for local authorities may fall – a key source of funding for highway and transport projects. Charging points for electric vehicles via charging could present commercial opportunities to replace this revenue challenge.

As previously mentioned, the development of the Solent Metro is a key transport initiative required to address the productivity challenge in the City and region. In addition, the development of rail and road infrastructure on the west side of Southampton Water will be critical to enabling the use of the strategic land reserve held by the Port of Southampton, enabling its ongoing expansion, a vital part of the regional economy, and reducing congestion.

Digital Communications

Extending and increasing the speed of the fibre-optic network is critical to enabling the potential of digital technology to be realised and increasing productivity. Ensuring that major infrastructure projects, such a rail and road, make provision for this in implementation seems an important element for developing the grid. Government will need to find a way to ensure the market agrees how to support this approach.

Energy

Energy generation is clearly important – waste to energy plants should be considered an important part of the UK's energy infrastructure, given the other considerable environmental benefits they provide.

At the same time, reducing energy consumption needs appropriate attention – not least the ability to drive up standards of housing and commercial properties. Modern methods of construction are important and need to be supported in this regard.

Flood Risk Management

As already mentioned, flood risk management is vital to the continued growth of the City. A key issue to address is the current stance of the Environment Agency which provides support for schemes that protect existing property (largely housing) with no consideration as to how that funding may unlock development sites, such as the significant potential in Southampton.

[name redacted]

[Job title redacted]



National Infrastructure Assessment Call for Evidence Southern Water's Response

February 2017

Introduction

We are grateful for the opportunity to contribute to the National Infrastructure Commission's work to develop a body of evidence for the National Infrastructure Assessment.

The recognition of interdependencies between sectors is critical in meeting infrastructure challenges. The challenges posed by climate change, population and housing growth, and their impact on vital infrastructure, cannot be addressed in isolation. The Institution of Civil Engineers' National Needs Assessment¹ found almost 30% of all licenced abstractions are used for cooling water used in power generation – constituting 5% of all freshwater resources in the UK. The Committee on Climate Change Adaptation Sub-Committee warned the amount of water needed for energy generation could “markedly increase” if there is greater reliance on biofuel production, fracking or carbon capture and storage². This is just one example of where future infrastructure policy must take into account the impact sectors have on each other and the critical role the water sector plays in supporting others.

Likewise, the water sector is reliant on constant, uninterrupted sources of power to provide vital services for households, businesses and integral public services such as schools, prisons and hospitals. We are taking steps to generate more of our own power, and in 2015/16 17.3 per cent of our energy was self-generated – largely through Combined Heat and Power plants on our sites. In total, we generated 77 gigawatt hours and exported 13 gigawatt hours back to the national grid. We have investment plans in place to grow the amount of energy we self-generate, but we will still rely on external sources of power for most of our sites.

Much of the water sector's infrastructure investment has been driven by EU legislation, and Britain's exit from the union provides an opportunity to re-design legislation in a smarter, more effective way. It could also allow greater alignment of planning cycles – such as water companies' price reviews, Water Resource Management Plans (WRMP) and River Basin Management Plans (RBMP). There is also an opportunity to examine potential wider benefits from agricultural subsidies, delivered through the replacement to the Common Agricultural Policy – particularly a closer alignment of land management practices and water quality.

We remain heartened by the NIC's proactive approach to engaging with stakeholders. We attended the South East event, hosted by Hampshire County Council, and found it to be thought-provoking. When developing its assessments and recommendations, we would welcome clarity on where the burden of funding is likely to fall – whether on government, the private sector or a combination of both.

This is a wide-ranging response, so we would like to outline our six key points. They are:

- Infrastructure should be planned using techniques which consider what could happen, rather than basing analysis on the historical record. This is especially important in water resources planning
- Greater integration and collaboration within and across sectors is critical in meeting the challenges of the future and ensuring the resilience of our service is enhanced
- Demand reduction can play a vital role in securing supplies and in ensuring there is sufficiency capacity for growth in existing networks – for both water supply and wastewater services
- Water infrastructure should be recognised as key to supporting economic growth and the “value added” to the region taken into account, rather than just considering impact of failure

¹ [National Needs Assessment](#) – Institute of Civil Engineers

² [Is the UK preparing for flooding and water scarcity?](#) – Committee on Climate Change Adaptation Sub Committee

- Investing in innovation and new technology will be critical in ensuring infrastructure is provided in a cost effective way in the future
- Effectively valuing the natural capital associated with our infrastructure and operations will be critical in developing sustainable and resilient solutions for the future.

We will be responding separately to the Department for Business, Energy and Industrial Strategies' consultation on future industrial strategy but hope that the work of the NIC is closely aligned with any new strategy. As both documents recognise, it is critical that government agencies and delivery bodies are aligned when planning new infrastructure.

We have responded to the areas which are most relevant / topics in which we have direct experience. We would be happy to further discuss any of the points made below.

Cross-cutting issues

What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

The highest value infrastructure investments – both in terms of their capital cost and the growth they are supporting – would be any potential new wastewater treatment works and associated networks to support large developments such as the proposed garden cities in Ebbsfleet and Otterpool, Kent. Due to the size of the developments, it may not be possible to connect to existing assets if there is insufficient existing capacity. We are working closely with the Ebbsfleet Development Corporation (EDC) and local authorities to determine the scale and pace of growth and will develop appropriate solutions as part of the master planning process.

In terms of water resources, the highest value planned investments are two planned water reuse schemes – one each in Kent and West Sussex planned for 2022 and 2026 respectively. These combined will have a benefit of around 40 ml/d across the catchments – at a (currently estimated) combined cost of £107.7 million. Future high-value investments are anticipated to include a desalination plant – the size and timing of which is not yet determined.

We are in the early stages of our next water resources management plan (WRMP) and business plan processes, so will have a clearer idea of costs the further we progress through our plans. While indirect water reuse is currently an expensive option, we predict, due to future tightening of wastewater treatment processes combined with improved technology, the marginal costs of reuse will fall. It also offers greater resilience, particularly at times of drought and potential three dry winter scenarios, where a prolonged lack of winter rainfall will mean groundwater sources, which make up 70% of our water resources will see limited recharge and low river flows will limit our ability to fill our reservoirs.

While there are some specific, high-value investments which will support long-term economic growth, there are many more, smaller projects across our region which will support economic growth by providing essential water and wastewater services. We are glad government continues to recognise the important role of the services we provide by including upgrading water infrastructure in the ten pillars supporting its industrial strategy³.

We make the point below about the importance of improving water resilience to protect against economic damage, but we believe water infrastructure should also be considered as a driver for economic growth, rather than purely a guard against economic damage. Water infrastructure can deliver wider benefits through maintaining or increasing amenity value of the natural environment and plays an important role in protecting species and habitats.

³ [Building Our Industrial Strategy](#) – The Department for Business, Energy and Industrial Strategy

Water infrastructure also plays a vital role in driving growth in certain industrial sectors. We are working with farmers, growers and other abstractors in the Medway catchment on a trading pilot linked to our water reuse scheme to support sustainable growth in their sector. Tourism is another large sector in the south east and our infrastructure – both water and wastewater – plays a vital role in supporting it.

How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

New infrastructure and significant new developments need to be designed holistically, recognising the interdependencies between, and impacts on, housing, water and wastewater services, energy and flood defences. The designs for new infrastructure are likely to be influenced by the needs and location of the development, and new developments should take the needs of infrastructure into account when being designed. For example, new homes in a water stressed area should be water efficient and new developments in areas liable to flooding should have mitigation measures. Water efficiency standards in new affordable and social homes would also have a positive impact on the overall cost of the home for customers by minimising running costs.

By planning new infrastructure alongside new developments, authorities and infrastructure providers can work together to ensure issues such as surface water management can be properly addressed. This could include sustainable drainage systems (SuDS) or including plans for meadows or attenuation ponds to assist drainage and provide valuable green spaces, increasing the natural capital of an area.

It is important to consider existing assets when planning new infrastructure – including housing. We are working with developers, local authorities and our regulators to trial a variable infrastructure charge for a development of around 1200 homes in Hampshire. This will see us waive all or part of our connection fees if a developer proves they have installed water efficiency devices. We hope this will incentivise water efficient development and if this pilot is successful, we will look to extend this approach across our region.

Beyond the design stage, the delivery of new housing and supporting infrastructure needs to be aligned. We are working closely with the EDC to develop a strategic solution for the area, including understanding the certainty and pace of growth, capacity in our networks and considering the need for a new wastewater treatment works. This approach will mean that new homes are built alongside their supporting infrastructure – meaning the 15,000 houses are delivered as timely and cost-effectively as possible.

What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

We are the first water company in the UK to undertake a universal metering programme (UMP). The programme saw us install more than 450,000 meters over five years and means more than 90 per cent of our customers are now metered.

A study by the University of Southampton⁴ found metering reduced household consumption by 16.5 per cent. The study found customers reduced their consumption as a result of the meter being installed – rather than waiting until they would see a financial benefit from using less water.

Customers were not placed onto a measured tariff as soon as meter was installed. There was a three month period where customers' charges were still based on the rateable value of their property.

⁴ [The Effect of Metering on Water Consumption](#), University of Southampton

Three months after this switch, we wrote to customers with an estimated bill based on their consumption since the meter was installed.

The study found customers started to reduce their consumption in the first three months after a meter was installed – before they would receive any financial benefit from doing so. The study also found there was very little rebound from metering, with the average 16.5 per cent reduction in consumption continuing after customers moved to fully metered bills.

Metering customers gave us access to a vast amount of data on customers' consumption habits – meaning we can continue to target water efficiency support in areas with higher consumption. Our programme of water efficiency visits – including retrofitting water efficient devices and encouraging behaviour change – has shown an additional sustained reduction of 10 per cent. It is worth mentioning the Isle of Wight was metered in 1989 and now has a per capita consumption of less than 120 litres per person per day – demonstrating metering drives long-term behavioural change.

On average, Southern Water customers are now using 130 litres per person per day, meaning we have achieved the government's aspirational target for per capita consumption (PCC) of 130 litres by 2030, 13 years early. We believe this demonstrates water efficiency is achievable, effective and there is potential for it to go further and be more widespread. However, the platform of metering is integral to this.

A Green Alliance report⁵ estimated that ambitious water efficiency programmes could save customers almost £80 per year through reduced water and energy bill –, with up to £20 of this coming from reduced energy consumption. The concept of linking lower water consumption with reduced energy bills helped inform our water efficiency messaging – save water, energy and money and it again demonstrates important links between the sectors.

Demand reduction could also help reduce bills by reducing the need for, or deferring, capital investment. The same Green Alliance report uses the example of Barrie, Ontario when faced with a \$68 million bill to meet new demands on its water and wastewater networks, city planners chose to implement a demand management incentive scheme, costing \$4.7 million. This reduced consumption by 1.78 megalitres per day (ml/d) and wastewater entering sewers by 55 litres per household. This resulted in a net saving to the city of \$17.1 million by deferring capital investment of \$21.8 million.

The national long-term water resources framework (see below) advocates enhanced demand reduction measures, including behaviour change and leakage reduction, to reduce per capita consumption (PCC). The report predicts under “business as usual” demand management, PCC could fall to an average 130 litres per day. Enhanced demand management – including large scale mains replacement to address leakage, all new homes being water efficient to 105 litres per head and extensive retrofitting – could see savings of 5,000 ml/d⁶.

As part of our future planning, and building on our metering programme, we are starting to think about possible different tariff options. These could be reflective of the cost of supplying water in each area, the level of investment required to maintain services or to achieve certain environmental objectives. Tariffs could also be reflective of the amount of water a customer uses – either “reward” tariffs for those who use less, or higher tariffs for those who use more. Using data from our meters, they could also be dependent on the time of day water is used to reflect the increased costs during peak times.

At this stage, this is just indicative of our thinking and is not company policy. If we were to follow this thinking, we would undertake detailed studies and engage with customers, stakeholders and our

⁵ [Cutting the cost of water](#), Green Alliance

⁶ [Long-term water resource framework](#) – page 102 – 106 – Water UK

regulators. With any potential tariff options, we would consider the impact on affordability and customers in vulnerable circumstances.

What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Greater collaboration between local authorities, developers and infrastructure providers is integral to ensuring large developments are built as timely and cost-efficiently as possible. We are working closely with EDC to ensure the garden city development is a success and that, where possible, infrastructure construction can be done in a co-ordinated and efficient way through the use of utility corridors.

As mentioned above, there is a strong link between water and energy efficiency – with benefits both to consumers and infrastructure providers. Greater coordination and shared messaging between different utility sectors could have a significant impact on demand for relatively low cost. The Green Alliance report calls for water and energy efficiency programmes to be integrated, lowering their cost and reaching a wider audience. This was originally recommended in the Walker Review in 2009⁷, saying “hot water efficient fittings should be included in any energy efficiency retrofitting scheme”.

Catchment management will only be successful through collaboration with key stakeholders – ranging from small landowners and farmers, to local authorities and organisations such as the National Farmers’ Union. Whether this is through joint funding of Catchment Sensitive Farming Officers – which we are doing with Natural England – or new ways of working such as water trading and funding models which would need support from government and stakeholders⁸.

The variable infrastructure charge pilot, mentioned above, is an example of multiple sectors working together to minimise the impact on existing infrastructure, provide a financial benefit for consumers and lay the groundwork for an approach which could be mirrored elsewhere.

Water Resources in the South East (WRSE)⁹ is a group comprising of the six South East water companies along with our regulatory bodies – Defra, the EA, Ofwat, CCWater and Natural England – with the purpose of developing long-term plans for securing water supplies and identifying strategic solutions. The aim is to develop a regional water resources strategy with the most appropriate long-term solutions for customers and the environment. This collaboration is particularly valuable in the south east, given the crossover between companies and potential for shared benefits from catchment management and inter-company transfers. We do, however, recognise greater integration between companies will be required so at a regional level the plans offer the highest level of resilience and the best value for customers.

There is also opportunity for it to be extended to capture the needs of industry and agriculture to ensure the water needs of other key users are planned in a more holistic way. Further work will be needed to consider how multi-sector funding arrangements could be put in place. A study commissioned by Anglian Water considered a number of possible funding arrangements, each with strengths and weaknesses, which could be supported by multiple parties to bring wider benefits such as alignment of water resource planning¹⁰.

Competition can play an important role in driving innovation and efficiency in the delivery of services and infrastructure. For example, we anticipate the non-household retail market will drive innovation in demand management by incentivising retailers to help their customers save water and money.

⁷ [The Independent Review of Charging for Household Water and Sewerage Services](#) – Anna Walker

⁸ [New markets for land and nature](#) – Green Alliance

⁹ [Water Resources in the South East](#)

¹⁰ [Financing Multi-Sector Water Supply Assets](#) – FTI Consulting

However, the role of markets in delivering services can be overstated and markets alone should not be relied on to deliver an optimal level of resilience. As in our response to the NIC's consultation on the methodology for its National Infrastructure Assessment, we feel it is important there is a clear policy framework with decisions taken about what is delivered reached collaboratively, while harnessing competition to drive innovation in how it is delivered.

What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Much of our investment in infrastructure is in response to demand – either environmental protection or to meet the needs of growth. Environmental protections can be factored into our long-term planning, but growth needs can arise outside of our usual five-year funding periods – despite the work we do to understand local planning expectations. If we are unable to raise or recover funds needed to provide necessary infrastructure, this could delay a development. A mechanism could be put in place for infrastructure providers to raise or recover funds partway through a regulatory period if necessary to fund significant infrastructure projects.

The switch to a total expenditure (totex) approach in the water industry has encouraged water companies to consider demand reduction measures alongside new sources by removing the “implicit financial incentive to favour” capital assets over water efficiency programmes¹¹. It is also supporting the industry to try more catchment-based solutions to address issues such as water quality, rather than relying on more expensive end of pipe solutions. However, there are still limits on the certainty of success of such schemes and the timeframe required to see benefits, which poses a challenge under our current regulatory and financing structure.

Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Investment in infrastructure is by its nature long term and investors will require some surety over being able to make a return on their investment. Within regulated sectors the Regulatory Asset Value was created to provide this degree of surety and ensure investment can be financed at reasonable cost. As regulators seek to open up markets in infrastructure services they naturally will wish to consider the extent to which such long-term guarantees are compatible with a market.

This creates a risk that necessary, long term investment is unable to be financed and will not be provided at the right level. It will be important that, if RAV-protection is not provided for new investment, then an alternative mechanism exists to ensure that investors are able to earn a reasonable return on their investments. This could be through a government guarantee, but will more likely be better effected through the creation of long-term contracts (either real or deemed) which ensure that over the life of an asset, the investment can be recouped.

How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

In the National Flood Resilience Review, government said it was proactively working with utility companies to establish “a national infrastructure resilience council or forum”. This, when it is established, should provide a way of enhancing collaboration and coordination between infrastructure providers. In addition to addressing short-term resilience to flooding, the council/forum should be asked to consider longer-term resilience challenges such as reducing the risks of future flooding and water resources challenges.

¹¹ Cutting the cost of Water – Green Alliance

The National Infrastructure Commission must ensure it uses its position and remit to share best practice and highlight areas of concern between sectors to ensure they can be addressed. It must push, as much as possible, for holistic solutions to infrastructure challenges and encourage collaboration, cooperation and communication across sectors. It could consider creating a database of planned infrastructure projects and their likely demands on infrastructure, such as water and power. This would give greater sight of the demands future infrastructure will have on other key infrastructure and allow for informed planning, possible identification of interdependencies and opportunities for collaboration between infrastructure providers.

This could also highlight how reliable sources are, and the expected recovery times to bring them back online after a shock. This would assist with planning against high-impact, low-likelihood events and what level of resilience providers should consider to be as cost-effective as possible. This would be particularly critical for the interdependency between water and power companies. For example, a wastewater pumping station could be reliant on a particular electricity sub-station. We would benefit from understanding the probability it could be taken offline by flooding and how long it would take to become operational again. This way we could plan for appropriate levels of back-up power supplies or arrange for additional fuel for on-site generators.

Local groups will play an incredibly important role in improving the resilience of our infrastructure systems. Local authorities are responsible for surface water management, and local groups – such as local resilience forums – have a wealth of knowledge that can help identify potential resilience gaps. These groups are important in bringing groups of stakeholders together to address short and long-term challenges in specific areas and their significance should not be overlooked.

Moving towards a circular economy approach will also help reduce some interdependencies. In 2015-16 Southern Water generated 17.3% of our energy from renewable sources – largely from the 16 combined heat and power plants (CHPs) on our sites, powered using biogas from sludge – a by-product of the treatment process. These generated 77 gigawatt hours over the year. This reduces our reliance and demand on local power infrastructure and, in some cases, can support it. Of the 77 gigawatt hours we generated, 13 were exported to the national grid.

We are increasing the amount of generating capacity we have to 14.1 megawatt hours by improving CHP engines at a number of sites. Our largest wastewater treatment works will become around 95% self-sufficient, with another, smaller site becoming totally self-sufficient.

What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

As mentioned above, for the most part we build new infrastructure in response to a demand – either meeting environmental or housing growth requirements. When planning and designing the required infrastructure, we work to ensure as little disruption to the local environment and customers as possible.

When infrastructure is considered as necessary for economic growth, some of the planning hurdles could be lowered – or removed – and greater priority could be given to it to ensure planning permission is granted in sufficient time for the infrastructure to be built. We would welcome a review of planning guidance regarding economically significant infrastructure to see if it can be simplified or streamlined.

How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Infrastructure providers would benefit from a fuller understanding of the natural capital of an area as this would give us a better appreciation of the impact of our assets.

For water companies, natural infrastructure such as groundwater sources and rivers are a critical part of our wider networks. Being able to better value these assets, and incorporate this into our decision making, will enable us to choose solutions which provide greater environmental benefit and enhance the resilience of the natural infrastructure we rely on. We previously developed a shadow pricing approach which took water scarcity into account when considering the cost of water abstraction. This approach promoted alternative solutions to those in our previous WRMP¹² and have encouraged Ofwat, the EA and Defra to consider how this method could be used to complement the Abstraction Incentive Mechanism approach. We welcome the work of the natural capital committee, and look forward to understanding how the NIC will incorporate natural capital accounting into its plans.

A better understanding of natural capital could, for example, mean we find it would be beneficial to divert an outlet from a wastewater treatment works upstream of a wetlands, rather than releasing treated effluent into a river. It would also give all water users in a catchment a better understanding of the impact of abstractions, support licence trading and could lead to innovation in areas of water storage and reuse, as alternative, less detrimental sources are required.¹³

It is important to consider soft infrastructure solutions as well as “hard” capital investment. Moving towards greater integration in catchments, and more applications of natural flood management and SuDS, will also enhance the natural environment in an area. Catchment management methods such as, for example, planting trees can have benefits to flood prevention and providing a habitat for wildlife. SuDS such as drainage ponds can provide valuable green spaces to otherwise urban areas.

What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

There is a strong argument to consider alternative cost-benefit measures when planning infrastructure and moving away from basing decisions on customer’ willingness to pay towards factors such as the cost to the economy. The impact on vital public services – schools, hospitals and the emergency services – should also be considered.

Within the water sector cost benefit analysis is typically based on customers’ willingness to pay for investment through their bills, as a benefit value. In general, this works well and helps to maintain the legitimacy of the water sector. However, there may be circumstances where these techniques will deliver a service that does not capture the wider benefits to society. For example, we know the cost to the wider economy of water restrictions is significantly in excess of customers’ willingness to pay to avoid such events. The National Water Resources Framework project estimated a cost of £1.3 billion per day to the wider economy if level 4 water restrictions were introduced. In areas such as London and the south east which make a significant contribution to GDP, this would be felt most acutely. We would welcome guidance on how these wider costs should be reflected in cost benefit analysis, while being mindful of the issues around legitimacy and affordability.

How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Where appropriate we will seek to repair, refurbish or maintain existing assets rather than build new ones. This is primarily due to the costs and disruption associated with putting new assets in place. In the future we will increasingly rely on new technologies to ensure we can still make the best use of our existing asset base.

¹² [Interconnection and Bulk Water Trade – Part 1: Modelling Scarcity](#) – Southern Water

¹³ [Water 2020: Water resources: proposed changes to enhance the scope for innovation and competition](#) – Southern Water

In our 2015-2020 business plan¹⁴ we outlined our plans to replace or refurbish around 310 kilometres of our water mains by 2020 – representing two per cent of our total network. This includes replacing around 30km of water main in Chatham, Kent to improve the supply of water to almost 13,000 customers. This is in addition to the nearly 50km previously replaced.

Also in our business plan, we will be replacing or refurbishing over 220km of sewers. Again, due to the high cost of replacing and renewing our sewers we are targeting this investment in the areas we know we can bring about the most benefit. This is part of a longer term approach to replacing and refurbishing sewers where their condition deteriorates, have insufficient capacity or become prone to flooding.

Making the economic case for large-scale replacement of pipes is difficult, and may not be necessary. Technological advances means it is easier, cheaper and more effective than before to repair and refurbish pipework against a variety of different challenges and in a number of environments. These advances, combined with consistently improving performance means large-scale replacement does not make economic sense. Our programme to find and fix leaks – including identifying leaks on customers' supply pipes – has been successful without the need for large scale renewal and replacement.

We have a large programme of repair and maintenance underway during this AMP. This will help improve site performance and efficiency, as well as extending the life of existing asset in a cost-effective way. It is important to strike a balance between ensuring our services are resilient while keeping customers' bills affordable.

Taking a modular approach to design is another way of reducing the need for new infrastructure, by ensuring our assets can be modified at a later date with additional capacity or treatment facilities as needed. This can improve the resilience of a site as well as reduce, delay or negate the need for otherwise expensive capital investment.

Water and wastewater

What are the most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Universal metering

Water companies' Water Resources Management Plans (WRMPs) are a valuable source of evidence. They are produced every five years, and outline how companies will meet their water resource needs to a 25-year horizon. They take local factors into account, such as predicted growth and the geology and geography of a region.

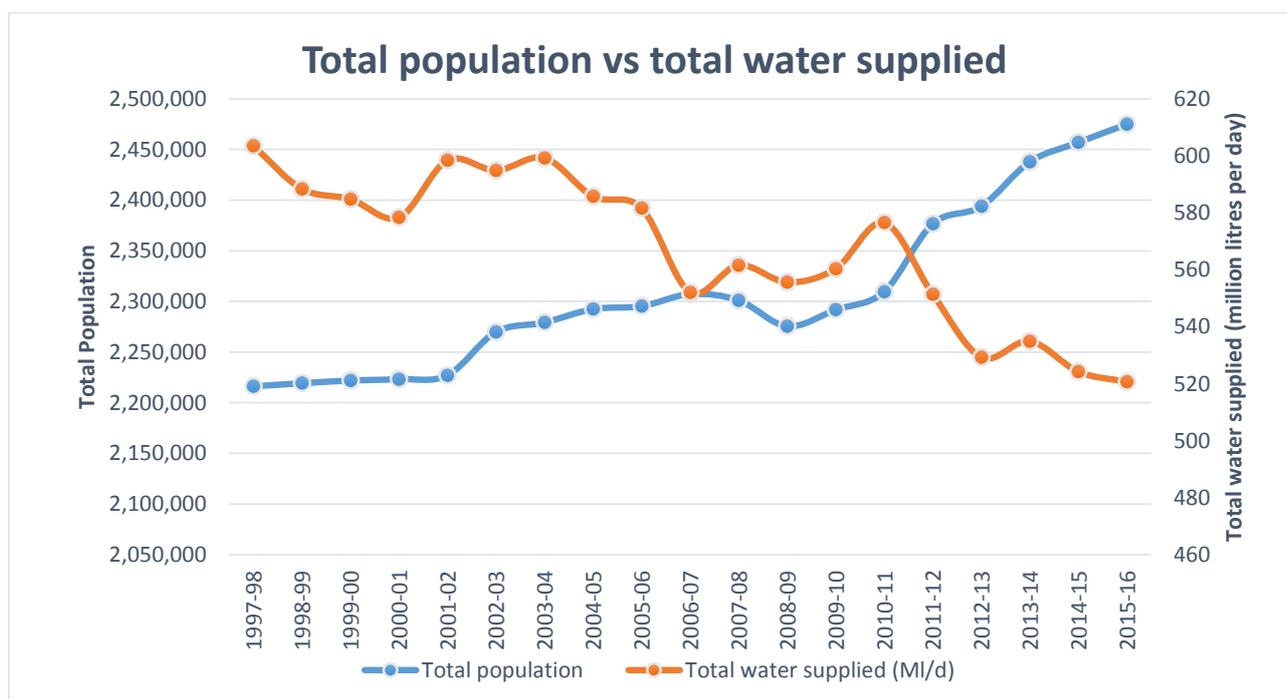
¹⁴ [Five-year Business Plan 2015 to 2020](#) – Southern Water

As mentioned above, our UMP reduced household consumption by an average of 16.5% with little evidence of a rebound effect. This, combined with demand reduction measures such as large-scale leakage reduction and water efficiency programmes has seen our per capita consumption (PCC) fall



to 129.72 litres per person per day and means we are putting less water into supply now (521 ml/d) than during drought restrictions in 1976 (550 ml/d). The graph above shows how the amount of water we put into supply has fallen over time.

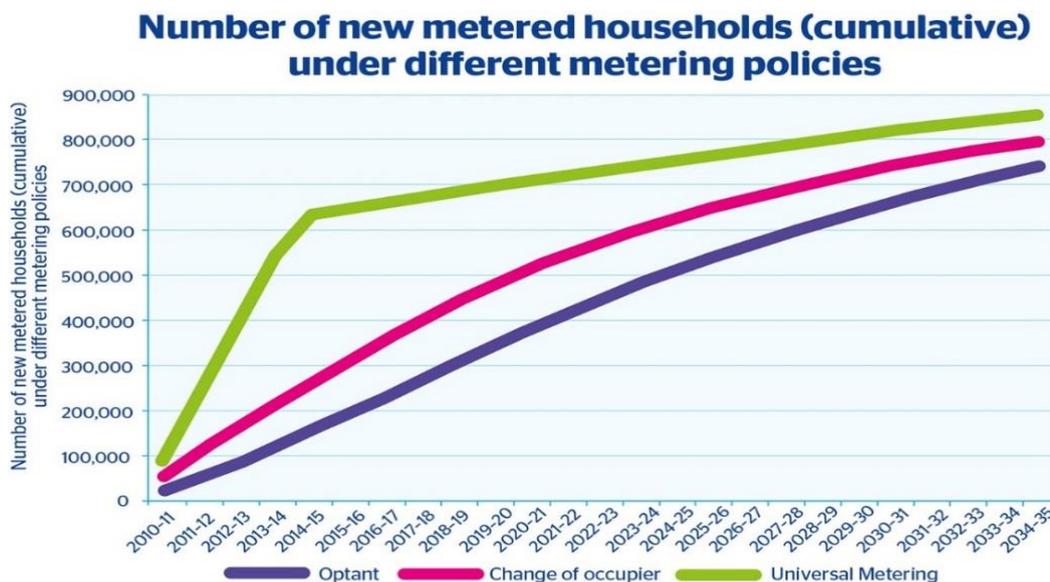
The next graph shows the contrast in population growth in our water supply areas with the amount of water put into supply. For reference, UMP started in 2010. It clearly shows the downwards trend in water put into supply against a continued increase in population – with notable differences from 2009-10 onwards.



In our WRMP 2010 – 2035¹⁵, we examined three different metering policies – optant, change of occupier and universal metering. Based on using “intelligent” meters read using a drive-by facility, and factoring in reduced operating costs from a 10 per cent drop in demand, universal metering was

¹⁵ [Water Resources Management Plan – 2010 – 2035](#) – Southern Water

found to be the most cost-effective – more than £7 million cheaper than optant metering and almost £22 million cheaper than change of occupier metering. The graph below shows how effective universal metering was projected to be in contract to optant and change of occupier policies.



There is a case to consider allowing water companies to consider universal metering, whether or not they are in a water stressed area. Our experience demonstrates it is the most cost effective and efficient way of metering a customer base and can significantly reduce household consumption. We would be happy to share our experience of metering and have already worked with the Consumer Council for Water on research into how to improve the experience for customers¹⁶.

National long-term water resources planning framework

The national water resources long term planning framework¹⁷, developed by water companies in England and Wales and published by Water UK, provides the first detailed, long-term look at national water resources needs and is a valuable source of evidence. It found droughts of the future will be more severe and geographically widespread than previously thought and the potential economic impact of inaction could be as high as £1.3 billion per day during severe droughts. It advocates a number of interventions, both policy changes and capital investment. One of which is looking to a 50 year time horizon to fully understand the impacts of climate change and population growth on water resources. We encourage the NIC to extend its ability to examine future needs from a 30 year horizon to a 50 year horizon.

The most important intervention to take from the long-term framework is the use of new techniques to understand and plan against uncertainty. The framework uses stochastic modelling – a technique pioneered in the water industry by Southern Water – to examine a wide range of different possible weather scenarios. By changing the fundamentals of our approach to planning to what could happen, rather than what has happened, our infrastructure will be in a much better position to deal with the uncertainties of tomorrow.

This modelling approach will feed into new design standards based on a number of different factors and should be supported by decision making techniques which allow for uncertainty, such as Real Options. This approach allows plans to be developed which meet current demands and pressures, whilst still being resilient and adaptable to future scenarios – based on outputs from stochastic

¹⁶ [Beneath the Surface: Customers' Experiences of Universal Metering](#) – Southern Water and Consumer Council for Water

¹⁷ [National water resources long term planning framework](#) – Water UK

modelling. This modelling and decision making will determine which options are most appropriate for the “twin-track” approach, explained below.

The report makes a strong case for a national minimum standard of resilience, to ensure all customers receive the same level of resilient service, providing it is set at an appropriate level. This could be achieved for a relatively low cost of £4 per household. The most appropriate approach to achieve greater resilience is a “twin-track” of enhanced demand management and new resources – including inter-regional transfers between companies. More extensive demand reduction measures includes further work to reduce leakage, significant changes to consumers’ behaviour and increased efficiency of new homes.

Large scale transfers of water between companies potentially “offer some of the best value options” to address the supply and demand balance after demand reduction measures have been implemented. Despite possibly offering the best value solutions, transfers face a number of environmental, technical and commercial challenges which require detailed investigation before the benefits could be realised – including identifying which body would be the lead planning authority for nationally significant infrastructure which crosses multiple local authority boundaries.

The report makes the case for a national level adaptive plan which would support ongoing WRMPs and balances risks against opportunities to defer costs. This adaptive plan would identify key “trigger points”, which would determine which “investments and policy decisions would be needed for the 2040 and 2065 horizons” – dependant on how risks materialise. Southern Water has taken a step towards this by using a Real Options approach to determining which investments would be suitable for current needs – while still being suitable for a number of future scenarios.

It is increasingly important to support capital investment with catchment based programmes such as more effective land management or nitrates reductions. For example, we are investing in four nitrates removals plants in Sussex with supporting catchment management work to negate the need for the plants in the future. Across our region, we are spending around £700k to investigate 25 sites across to inform future catchment management work and around £2.5 million to mitigate the impact of pesticides.

We release around 860 ml/d of highly treated wastewater into rivers, estuaries and out to sea. We recognise the potential for this to become a resilient supply of water and are planning two indirect water reuse schemes – one in Aylesford, Kent and one near Ford, West Sussex. We will redirect highly treated final effluent upstream of abstraction points to augment flows and provide a combined 40 ml/d across the two catchments.

These are both being supported by trading pilots to ensure that the additional water is used effectively by abstractors that need it most, and the environment is protected from over-abstraction. Due to possible misconceptions about water reuse, these projects will be supported by customer and stakeholder engagement to allay concerns and ensure we get the greatest benefit from our investments. In the Medway catchment we are working closely with the agricultural sector

Other interventions

As with wastewater provision, we need certainty to effectively plan our water infrastructure. The work of the NIC is welcome in helping to determine future infrastructure needs and identifying interdependencies.

The 25-year plan for the environment should be published, consulted on, and finalised as soon as possible – while still undertaking a thorough development process. It needs to accept a range of possible future scenarios and have capacity to adapt to changing challenges from climate change and population growth. We welcome the suggestion by the Natural Capital Committee that the 25-

year plan is put on a statutory footing and encourage a regular review process to be adopted. This will allow the plan to be adaptive and reflect the most current research.

It would be beneficial to understand through the 25-year plan what future ecosystems will look like. This will help providers plan infrastructure more effectively as the levels of protections required for certain species may change. It will also help water companies better understand the possible impacts on raw water quality and if alternative sources need to be identified.

Continued innovation and investment in new technologies will be extremely beneficial – as will a focus on circular economy approaches. Demand management – leakage, metering and water efficiency – have all been effective. Likewise, storage reservoirs have been successful, but the space for new reservoirs is limited.

Continued investment in research and development will lead to new technology and techniques which will address these problems. We agree with government when it says “we must become a more innovative economy” and agree that investing in science, research and innovation is a key pillar to support its industrial strategy.

As part of our investment in research and development, we are looking into alternative methods of finding and fixing leaks. Our current echo correlation techniques for finding leaks are less effective with plastic pipes than metal ones. As a result, we are looking at methods such as ground-penetrating radar to find leaks. We will also be collecting more data, and making better use of it. We are looking into increasing the amount of data points on our networks and feeding this data into smart algorithms. These algorithms will help us to balance the pressure in our networks, reducing the likelihood of bursts and leaks.

More efficient technology for water reuse and desalination will be extremely beneficial. As mentioned above, more efficient technology combined with increased wastewater treatment standards will drive down the marginal costs of water reuse. Treating highly-treated final effluent as a resource rather than a waste product will make more water available in a catchment for public supply, businesses and the environment.

What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

One of the most effective interventions to ensure drainage and sewerage capacity is sufficient to meet future demand is removing surface water from the wastewater networks. To help achieve this, we would like to see the automatic right for developers to connect surface water systems to our networks end unless alternative methods have been given proper consideration.

We – alongside most of the water industry – asked our regional MPs to support the Lords amendment 110 to the Housing and Planning Bill which would have removed the automatic right to connect. Before connecting surface water systems to our networks, developers would have had to ensure they had properly considered SuDS as an alternative. We welcome the upcoming review of SuDS legislation and hope it is full, thorough and takes serious consideration of stakeholders’ views.

To give an example of the costs of removing surface water from wastewater networks, we invested around £20 million on a surface water separation scheme in Portsmouth. This scheme removes up to 6,400 litres per second of surface water from the wastewater network during rainfall, reducing the burden on the network and our pumping station by up to a third, thereby dramatically reducing the risk of flooding to Portsmouth, its critical infrastructure and nationally important naval base. Crucially, this also makes additional capacity available for new growth – without the necessity for additional infrastructure.

While investment may be needed to separate existing combined surface water and wastewater networks, there is no reason new developments should automatically have the right to connect surface water drainage to wastewater networks – unless other options such as separate surface water networks or SuDS have been properly considered.

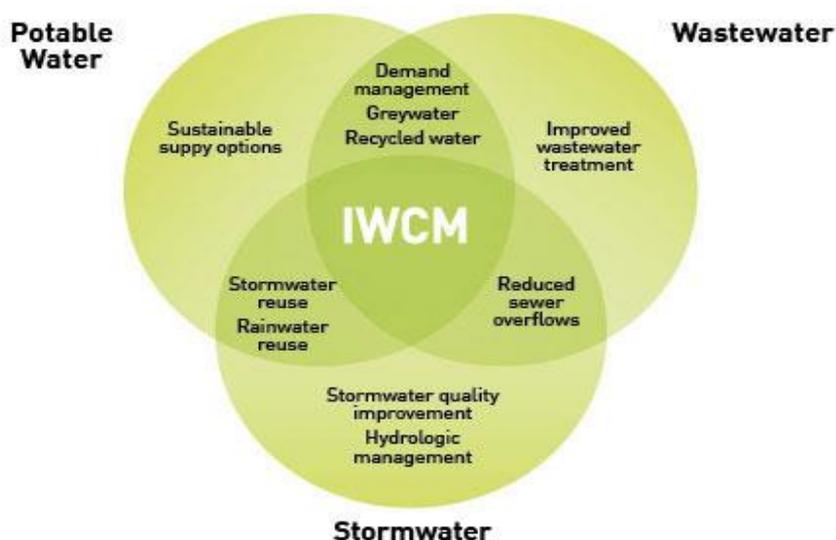
Encouraging a modular approach to asset design will help ensure assets have sufficiency capacity to meet future demand. By ensuring new sites have suitable technology and space to expand if necessary, it will make it easier for water companies to quickly adapt to changing growth patterns. This may need to be included in planning applications for new sites, so would benefit from supportive planning guidance.

An example of where we are taking a modular approach is our Tangmere wastewater treatment works near Chichester, West Sussex. We recognise the need to expand capacity to meet immediate growth, but also that Chichester is likely to experience growth in the future. This approach means we can be flexible and add additional treatment capacity, without the need for a new treatment works.

How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

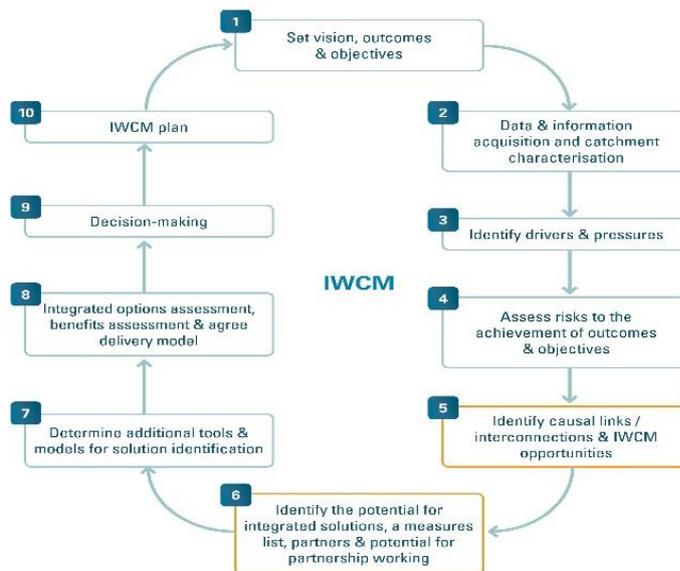
We believe greater integration and coordination is the most effective way of using a whole catchment approach. A single plan for water would be the best way to manage water, wastewater and flood management systems and we are very keen to see best practice and learning emerging from Defra's current Pioneer projects.

We are developing an Integrated Water Cycle Management¹⁸ (IWCM) approach to help us address multiple, complex issues at a catchment scale. We will work in collaboration with stakeholders to drive innovation and deliver the most effective solutions for our customers and the environment. This is an innovative approach and our ambition is to be operating a fully integrated water environment, across catchments, in a phased way, by 2040.



We recognise the issues and opportunities related to water management are complex and inter-related, but that there are significant benefits to be derived from an integrated approach. To start to understand what IWCM means in practice we have developed a 10 step approach (see below).

¹⁸ [Integrated Water Cycle Management](#) – Southern Water



To further develop our understanding we are focussing on two catchments, the River Medway catchment in Kent, and the Arun and Western Streams catchment, which takes in large areas of West Sussex and parts of east Hampshire. These catchments have been chosen due to their contrasting features. The Arun and Western Streams is relatively small and rural in nature while the Medway is the largest catchment in south east England and Wales and has considerable urban pressures.

We are developing an evidence base and a number of tools to help us understand where integrated catchment solutions could deliver the greatest benefits, and how we embed this way of working. As well as potential cost savings, IWCM offers an opportunity to deliver wider benefits for our customers and stakeholders and we are exploring how we might use natural capital accounting to capture this. We plan to develop a number of pilot catchment schemes for inclusion in our PR19 Business Plan in order to test and further refine our approach, although we will implement sooner if opportunities arise.

Collaboration with key partners across catchments is essential to ensure that we focus on the most cost beneficial opportunities and deliver multiple benefits for customers and for the environment, now and for future generations. We recognise that there are existing mechanisms such as catchment partnerships and strategic flood risk management groups who can help us develop and deliver our IWCM approach through collaborative working. Collaborative working includes the potential for securing partnership funding from stakeholders with associated risks.

Considering water in a catchment holistically is important to understand the opportunities and the risks associated with certain interventions. It is also critical to recognise that not all catchments are the same and so interventions need to be take regional characteristics into account. Research has been focussed on upland catchment management but lowland catchments, especially those with groundwater connections, are complex and less well understood in terms of effective interventions. We are planning to host a workshop with key stakeholders to share best practice on lowland catchment interventions and help inform our approach.

The benefits of some catchment interventions may not be seen for many years (e.g. reversing trends in nitrate levels in groundwater) and we welcome the Natural Capital Committee's recommendation that Ofwat gives water companies "sufficient scope" to develop catchment approaches. We hope this includes the ability to plan to deliver benefits outside of the usual five year regulatory timeframe.

We understand measuring natural capital can be challenging – particularly with regard to water. The Office of National Statistics found "data and methodology limitations" prevented it from fully valuing the natural capital of water in the environment and so only included domestic and non-domestic water supply in its 2014 calculations¹⁹. The Natural Capital Committee has called for Ofwat to "encourage" natural capital catchment based approaches for the next price review process and recognised water companies as "key player in influencing natural capital" in catchments²⁰. We are using natural capital as part of our IWCM benefits assessment work to start to understand how we might practically incorporate this into our business planning. To support this, case studies and best-practice guidance would be welcome – particularly if this was agreed and adopted by government and regulators.

As this field is still developing, we believe it is incredibly important all parties look to take best practice from across the UK and beyond. When developing IWCM, we have looked to Australia and North America for their experience of operating in more integrated catchments. We have found working with universities to be incredibly valuable. Working with academia has brought fresh, independent thinking to projects and switched our approach from focusing on what we can currently do, to what we could do. This is leading to the development of transferrable skills and knowledge giving us much more dynamic understandings of the catchments we work in.

Flood Risk Management

What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

Setting a national minimum level of resilience to flooding, particularly when needing to balance cost-effectiveness, is difficult. Companies could invest to achieve a certain level of protection at specified sites, but this investment may not be cost effective. It may be more effective to have regional levels of resilience, depending on risk and wider economic impact.

The level of resilience should not only reflect likelihood of disruption, but also the economic or societal significance of the area. For example, London is protected against 1 in 1000 year flooding events due to its economic importance. Our surface water separation scheme in Portsmouth increase the city's resilience to 1 in 76 year events – due to its specific topography and the nationally strategic importance of the naval base. Water companies usual plan against 1 in 30 year events.

It is important to consider recovery as well as protection as part of resilience. When considering flood protection schemes, a key part of the cost-benefit analysis, alongside the impact of disruption to service, is the relative cost of recovering from an event. Taken as a hypothetical example, it could cost £1 million to make a site resilient to a 1 in 100 year event, while the cost of recovering from that shock could be £300,000. In this instance, it may make better economic sense to have plans in place to recover from an event that may not happen than protect against it.

What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

We support the development of natural flood management schemes and practices such as enhanced land management in reducing flood risk. As above, we are undertaking significant research into the

¹⁹ [UK Natural Capital – Initial and Partial Monetary Estimates](#) – ONS

²⁰ [Improving Natural Capital – An assessment of progress](#) – Natural Capital Committee

efficacy of catchment management and will be hosting a workshop to enhance our understanding of how upland catchment management practices can be successfully adapted to the lower-lying terrain of our region.

One of the drivers behind the research and workshops is to determine a level of certainty about how successful natural flood management schemes are. We are heartened that schemes such as slowing the flow in Pickering have been successful, but need to understand how effective they will be in our area.

Another concern, is the issue of continued ownership and maintenance. For example, if a water company pays for a farmer to plant trees on their land to reduce the risk of flooding downstream, and the farmer then sells the land, would the ownership of the trees be with the water company or the new owners, and would they be under an obligation to keep and maintain the trees?

We believe there should be a balance of traditional “hard” infrastructure supported by natural flood management schemes. This would allow for surety on levels on protection and developing innovative, greener ways of managing flood waters.



NATIONAL INFRASTRUCTURE ASSESSMENT: SSE RESPONSE

About SSE

SSE is a UK-listed utility and the broadest based energy company operating in Great Britain and Ireland.

SSE's core purpose is to provide the energy people need in a reliable and sustainable way. We operate across the energy value chain in GB from generation and production, through to transmission and distribution, and finally supplying electricity and gas to households and businesses. SSE has operations across the UK and independent research by PWC found SSE made a £8.78bn contribution to UK GDP in 2015, indirectly supporting around 106,000 jobs.

SSE welcomes the opportunity to respond to the National Infrastructure Commission's (NIC) National Infrastructure Assessment (NIA) call for evidence. The NIA represents an ambitious and important undertaking and could help ensure risk is managed and opportunities are grasped.



Executive Summary

The UK requires significant infrastructure investment to 2050 to support and maximise the benefits of the changes occurring in key sectors including energy, transport and communications.

SSE looks forward to supporting the National Infrastructure Commission (NIC) with regards to their three objectives to (i) support sustainable economic growth across all regions of the UK, (ii) improve competitiveness and (iii) improve quality of life.

It is important that the regulatory and policy framework(s) are fit for purpose to enable efficient markets to develop whereby all providers, including customers, are able to compete. Energy related technology and infrastructure has significant long-term impacts on meeting the three objectives the NIC have set. Therefore the NIC can play a key role in balancing the short and long term requirements of the energy system and its users.

SSE strongly supports the UK Government's decarbonisation aims and targets. The National Infrastructure Assessment (NIA) presents an opportune moment to consider how the heat and transport sectors can play a greater role in transitioning the UK to a cost-effective, low-carbon economy. These sectors will be underpinned by the energy assets that are built over the next decade. Therefore clear policy direction is necessary for the UK's heat and transport sectors to be underpinned by a low carbon electricity system from 2030-2050.

The emergence and uptake of low carbon technologies, electrification of transport and decarbonisation of heat will provide significant challenges to the GB electricity networks. Innovative solutions will allow networks to provide better services at lower cost, whilst opening up new marketplaces for other industry participants. The NIA's recommendations should facilitate the objectives of ultimately providing lower cost and sustainable electricity supplies for consumers as well as the chance to contribute to the efficient functioning of the country's energy infrastructure.

Energy Networks

The NIA should explore how the Government can ensure the UK's electricity network is both resilient and able to maximise opportunities from innovation

- The UK has led the way in stable, robust and efficient price control mechanisms (RIIO) which have delivered significant investment due to 8-year regulatory stability, maximising value for customers' money.
- Evolution towards a smart, flexible energy system must prioritise the interests of the end consumer. SSE supports a consumer-centric approach that will thoroughly examine the risks to consumers as a priority.
- SSE believes that consumers' and the UK's interests are best protected by a transition of the Distribution Network Operator (DNO) to a more active Distribution System Operator (DSO).
- DNOs will need to transition to new roles and are best positioned to support the efficient connection and utilisation of new flexible and dispatchable resource below the Grid Supply Point (GSP).

Energy efficiency

SSE believes improving the energy efficiency of the UK's housing stock should be a national infrastructure priority

- SSE believes the NIA should consider how future funding of energy efficiency programmes, and strongly supports eschewing regressive models of funding.



- Two thirds of existing properties in the UK will still be in use in 2050. Ensuring these properties are as energy efficient as possible can help not only reduce carbon emissions, but also lower consumer energy bills.

Heat

The NIA should explore a ‘whole-systems’ approach to the decarbonisation of heat

- SSE envisages a whole systems approach can be delivered through a mix of district heating, repurposing of gas distribution networks, and reinforcement of electrical distribution networks.
- Long-term sustainable growth in the district heating sector will be dependent on the development of effective legal and commercial structures that encourage investment and attract private sector expertise.
- Technologies that use electricity to generate heat are well placed to become major low carbon heating technologies in the coming decades as a greater proportion of our electricity is generated from low carbon sources.
- SSE urges that national infrastructure decisions are driven by the best information available and in the case of decarbonising heat more should be done to acknowledge the reducing electricity emission factor.

Decarbonised Transport

Removing barriers toward the decarbonisation of transport whilst ensuring the infrastructure critical to delivery is supported and protected

- Electric Vehicles (EVs) have demonstrated significant demand side response potential, which is particularly important to utilise low carbon generation at traditionally low demand times.
- Without managed EV charging, customer education, and time of use tariffs there is a risk that the high cost (networks/supply) associated with their peak demand will prohibit their uptake.
- The NIA should explore the benefits of standardising EV charging through dialogue between industry stakeholders and government. This can help avoid a system hampered by multifarious systems and technology, incapable of communicating and facilitating managed EV charging.
- The NIA should consider the role of hydrogen in delivering the UK’s decarbonisation in the transport sector, and how to develop and support hydrogen refuelling stations that maximises fuel cell electric vehicles (FCEVs) uptake in the coming decade.

Digital Communications

The digital communications regime needs to develop comprehensive, independent and transparent market governance arrangements

- SSE strongly believes that retail market governance arrangements for the digital communications sector should be developed in order to support the consumer switching experience
- An effective digital communications regime will coordinate processes ‘behind the scenes’ in order to ensure that consumers experience a seamless switch of services between different retail providers.
- SSE therefore supports the NIA exploring how elements of a traditional utility regulatory and statutory framework could be developed in the digital communications regime.

Section 1: Cross-cutting issues

What are the highest value infrastructure investments that would support long term sustainable growth in your region?

Energy efficiency

The decarbonisation of heat in the UK is a pressing challenge that requires greater levels of focus if we are to meet our future climate change targets. Heat represents almost half of final energy consumption in the UK and is an essential element in meeting the UK's decarbonisation targets. Improving the energy efficiency of the UK's housing stock should be made a national infrastructure priority. Two thirds of existing properties will still be in use in 2050 and 65% of the housing stock in England could benefit from energy efficiency improvement. Therefore the NIA should consider what actions need to be taken now to reduce the UK's carbon emissions from heating.

SSE advocates the Government takes a 'fabric-first' approach that ensures that improvements to heating networks will be maximised for households today and into the future. The policy work already being undertaken to improve the efficiency of buildings should be built upon as well as implementing incentives for retrofit district heating networks which are relatively rare in the current market.

Certain energy efficiency measures have been delivered at scale, such as cavity wall insulation. Similar levels of solid wall insulation have not been achieved – only 8% of solid wall properties have been insulated compared to 69% of cavity wall properties. SSE recognises that solid wall insulation is one of the more expensive energy efficiency measures that can be installed, and that remaining cavity wall properties may be harder-to-treat, meaning that the costs of any policy or government mechanism to address this need to be properly assessed at the outset.

As well as certain property types, certain property tenures are also less likely to be well insulated and energy efficient. Under ECO, the private rented sector has traditionally been hard to reach due to the split incentive and an earlier lack of regulation. In addition, the Green Deal model did not prove an appealing proposition for the able-to-pay market to improve the energy efficiency of their property. As a result, there is now a policy vacuum in this area which SSE believes needs to be addressed to ensure that the existing housing infrastructure is able to realise the maximum benefits of the decarbonisation of heat.

SSE advocates the NIA considering how future energy efficiency programmes should be funded. Funding policies through gas and electricity bills can be regressive and mean that the most vulnerable consumers pay disproportionately more than others; ultimately this could undermine the policy as it risks pushing more people into fuel poverty by adding to energy prices. Long-term recommendations should aim to shift costs to means-tested taxation so that those least able to pay for such schemes are sheltered from the burden, including those living in rural off-gas grid areas.

Heat networks

For new build developments, a series of interconnected heat networks will allow the best opportunity to take advantage of lower and zero carbon technologies as they become financially viable. These would include large scale EfW (Energy from Waste) and Biomass based systems as well as heat pump and fuel cell technologies. This can then enable a significant number of energy users to be provided with even lower, or zero, carbon energy as it becomes available.



SSE has specific experience in this sector through our project at the Wyndford Estate in Glasgow, where over 1700 previously electrically heated properties have been connected to a new district heating network. SSE carried out a social, environmental and economic impact study three years after the scheme's completion and found significant energy, carbon and wider social benefits had been achieved by this ground breaking scheme.¹

Long-term sustainable growth in both the district heating and energy efficiency sectors will be dependent on the development of effective legal and commercial structures that encourage investment and attract private sector expertise, whilst giving public sector bodies, (which will be imperative to the increased deployment of heat networks) the control and investment returns that they require. Avoiding the stop-start nature of energy efficiency schemes with a relatively short life (and changes to rules midway through) is welcomed, as the current arrangements makes it difficult for them to be efficient.

The role of hydrogen in heat

SSE is supportive of the actions to upgrade the majority of the UK's distribution pipes to polyethylene which is suitable for transporting 100% hydrogen. This should continue and extend to transmission networks as well so that existing networks are ready to transport hydrogen.

What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

The Government's *2050 Pathways Analysis Report* set out an expectation that electricity demand in the UK will double by 2050.² Demand management and demand side response will have an important role in ensuring that the UK efficiently and effectively meets this increase. It is important therefore that the NIA considers how to maximise the benefits of demand management and demand side response within energy, particularly in regards to heat and transport.

Maximising the benefit from demand management for heat

SSE is collaborating with Community Energy Scotland, V-Charge (an aggregator) and the Mull and Iona Community Trust on a project called 'Assisting Communities to Connect to Electric Sustainable Sources' (ACCESS). This project aims to develop a smart, active local network that balances local renewable energy sources with new electric storage heaters. Managing electric heating in this way provides a virtual district heating network without as much disruption and cost as commissioning new underground heat networks.

Technologies that use electricity to generate heat are well placed to become major low carbon heating technologies in the coming decades as a greater proportion of our electricity is generated from low carbon sources. Electric storage heaters are often seen as an ineffective and costly method for heating a home, and have not been deployed significantly under the Energy Company Obligation (ECO). Whilst other technologies, such as heat pumps, are more appropriate in certain locations, storage heaters have coverage across all British properties, and have low installation/maintenance costs. Yet modern high heat retention storage heaters bring many benefits as they are able to provide efficient heating and produce cost savings of 20% on an annual household heating bill. There is the potential for new generation storage heaters to contribute to the management of peak

¹ The Wyndford Estate case study is available online: www.sseenterprise.co.uk/information-centre/case-studies/wyndford-estate-case-study

² HM Government, 2050 Pathways Report (2010), available online: www.gov.uk/government/uploads/system/uploads/attachment_data/file/42562/216-2050-pathways-analysis-report.pdf



demand, through demand side response capabilities; this has already been demonstrated in the Northern Isles New Energy Solutions (NINES) project, which has used flexible smart electric thermal storage load to balance over 100 MWh of local inflexible generation.

Maximising the benefit from demand management for transport

The potential benefits of using ULEVs for demand management in GB are substantial. A key advantage of ULEVs is that there is a blank canvas from which systems can be built that help meet the challenges we are currently facing in the move to a smarter, more flexible low carbon system. EVs have demonstrated their significant DSR potential, which is particularly important to utilise low carbon generation at traditionally low demand times. Without managed EV charging, customer engagement, and the utilisation of 'time-of-use' tariffs there is a risk that the high cost (networks/supply) associated with their peak demand will prohibit their uptake. Furthermore, the customer journey in terms of meeting their requirements i.e. EV range, cost and convenience is fundamental to managed EV charging.

Educating customers about the potential benefits of ULEV and EV ownership will have an important role to play in addressing the behavioural constraints of switching from ownership of traditional cars. Without customer education innovative solutions presented by ULEVs and demand management may have limited uptake.

Findings from innovation projects such as Scottish and Southern Electricity Network's (SSEN's) 'My Electric Avenue' project show clustering of EVs will cause issues long before market saturation (32% of all GB circuits will experience issues when EV uptake on a street exceeds 40% of households).³ This work investigated how technology can be used to manage EV charging, to not only protect networks, but also to facilitate the connection of more load such as EVs. It is therefore recommended that there is need for localised managed (either through control or shifting) EV charging during periods of peak demand on a network.

Taking into account views expressed by the Society of Motor Manufacturers and Traders (SMMT) SSE is keen that the energy system is not deemed to be unfairly targeting EVs as a means of managing network protection. Ideally in the future it will be possible to allow customers to determine via a smart hub/smart meter how they wish to manage the load at their property in response to a signal from a supplier or aggregator, as they may wish to prioritise their EV charging and instead shift their cooking/washing activities outside the peak demand period.

A potential barrier for any party seeking to implement managed EV charging could stem from the fact there is no standard agreed in the UK for managing communicating with, and managing the charging of, EV chargers. It is crucial, therefore, that standards are agreed between the energy, automotive and electric vehicle supply equipment (EVSE) industries to avoid there being a large number of different types of system and technology in the market and connected to the networks that are incapable of communicating and facilitating managed EV charging. Our Smart EV project is seeking to address this by informing an engineering recommendation (or similar standard) for the control of EV charging.

Whilst cost reflectivity and cost efficiency with regards to charging arrangements and affecting investment/and or behaviour decisions is welcome, this needs to be balanced with the benefits that the socialisation of costs brings. We believe this trade-off is for policymakers to determine, SSE would welcome guidance on what the Government's policy objective is as it will affect decisions taken by DNOs and investors in smart technology (suppliers, aggregators, tech companies).

³ Further information is available online: www.myelectricavenue.info/



SSE envisages that if DSR happens in clusters without DNO involvement this could lead to network related issues. Ideally DNOs should be a key facilitator and not a barrier, and this could be helped by greater visibility and engagement with aggregators e.g. obligations on aggregators and suppliers to provide visibility of their anticipated volumes, profiles and recruitment for defined areas. In order to engage with end users, simplicity will be crucial as experience shows that complexity is a barrier – ideally domestic customers will have one point of contact that will be licensed as the balancing responsible party for those customers’ site(s).

How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Unlike direct fuel use such as gas for heating and oil for transport, electricity networks require more sophisticated tools to maintain resilience. As heat and transport become electrified, and more devices become connected, in terms of being remotely controlled, the system operation of electricity networks will become more complex and potentially more vulnerable.

Risks associated with the removal of diversity

SSE is particularly concerned with the risk that ‘connected’ devices will have on the potential of removing electric load diversity from current end use. Load diversity is essential in terms of reducing the need for network reinforcement and additional capacity. The diversity of 10,000 households effectively means that less than 20% of the network is required than if each individual household had its own network. Diversity is caused by individual end users operating devices in a largely randomised way – albeit with general trends towards using more appliances at certain times of the day.

The rollout of smart and connected devices risks removing existing diversity as more appliances are controlled by agents or aggregators responding to price signals for set 30 minute (settlement) periods. This issue has already been dealt with when the transition to Radio-Teleswitching of electric heating occurred in the 1970s. A key learning from that process was that individual devices were required to have a random offset of +/- 3minutes to prevent large peaks and network capacity issues.

Guiding Principles

Insufficient regulation or coordination risks electricity imbalances and thermal or voltage issues being experienced on low voltage feeders. To prevent these issues DSOs will need greater authority to manage, from a physical perspective, aggregated load to ensure network resilience, whilst recognising that, in principle, where consumers are constrained as a result that they may expect to be appropriately compensated by the DSO. The NIA should consider the need for this greater authority to ensure these issues are avoided.

SSE believes network operators should work together with all stakeholders to ensure standardisation in this space, whilst recognising that developments in terms of the EU Network Codes may already address some aspects of this. One of the key issues is how data gets from a third party to network operators (and vice versa) and whether this is secure. It is likely that regulations will need to focus on ensuring all parties meet requirements on this as it will be these entities that are coming to market with innovative solutions and technologies.

Whilst there is an ongoing debate on how batteries are treated in regulations, the DSO will be principally concerned with how batteries behave in terms of importing electricity from, or exporting electricity to, the network and reactive power. This should be considered when any regulatory changes are being made, or recommended, especially as different batteries will behave in very



diverse ways in terms of power, efficiency and ramping up or down. Whilst a battery can help ease network constraints or help with network congestion, they also risk exasperating both of these issues when they operate in reverse; i.e. discharge to charge mode. Therefore careful consideration will be required in how to physically monitor and control batteries in order to secure the system, whilst recognising that, in principle, if a user is constrained by the network operator that appropriate compensation will be provided to them by that network operator.

Unintended Consequences

The regulation and specification of smart appliances is important. At low volumes the combined effect of smart appliances are relatively benign; however, when aggregated they can quickly create unintended effects on the system. This requires careful design and consideration of the “at scale” impact. A good example of this scenario can be seen in SSEN’s Northern Isles New Energy Solutions(NINES) project which illustrated that frequency responsive appliances can, if not properly regulated, add to system instability.⁴

⁴ SSEN’s NINES Project information available online: www.ssepd.co.uk/NINES

Section 2: Transport

How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

SSE welcomes the Government's bold ambitions for Ultra Low Emission Vehicles (ULEVs) and its desire for nearly all new cars and vans to be zero emission by 2040.

The application of financial support measures to support the increased uptake of ULEVs and a change in travel patterns will contribute to a significant shift away from internal combustion engines (ICE) vehicles to ULEVs.

SSE expects the use of plug-in hybrid vehicles (PHEVs) and battery electric vehicles (BEVs) to continue to increase steadily from 2017, with major leaps in uptake taking place from 2020-30 as more infrastructure is put in place. Manufacturers will release greater numbers of ULEVs, and legislation impacting both the sale and use of ICE vehicles, particularly diesel, will come into effect.

ULEVs could become competitive with ICE vehicles both in terms of costs and range, due to continued improvements in the capacity of batteries, the reduction of cost and increasing speeds of charging. These developments should increase both the frequency and distance of journeys undertaken by ULEVs.

SSE anticipates that the proposed support from the UK Government for the use of hydrogen in transport will ensure that hydrogen fuel cell electric vehicles (FCEVs) play a significant role in the personal and commercial travel markets, most likely during the late 2020s. The infrastructure required and range capabilities is likely to appeal to the commercial (notably freight) market initially, however it is envisaged that they will form a key part of the ULEV market as we move towards 2050.

The role of hydrogen in transport

Hydrogen produced from renewable sources such as wind through the process of water electrolysis is 100% renewable and produces zero greenhouse gases along the whole process from production to end consumption. Water is the only by-product emitted at the end of the process.

Hydrogen could dramatically reduce GB's reliance on diesel to propel its vehicles and tail pipe pollution. It has also the potential to replace carbon intensive fossil fuels in heating and cooling. It is an important and viable route for a country working towards decarbonisation of transport and heat, and could help achieve ambitious emissions reduction targets.

There is a need to develop a nationwide network of hydrogen refuelling stations that maximises fuel cell electric vehicles (FCEVs) uptake in the coming decade. SSE has been a partner in the Aberdeen hydrogen bus project, which has significant potential to scale up in the future.⁵

Managing the increased demand on networks

The increased adoption of ULEVs (including PHEVs, BEVs and FCEVs) will increase the demand placed on the electricity network. This will affect all levels, from generation to transmission and distribution, and will require significant generation and reinforcement or upgrade investment.

SSE recommends that the NIC liaises with the Office for Low Emission Vehicles (OLEV) to discuss the confidential analysis carried out by the Distribution Network Operator (DNO) community for the UK

⁵ Further information on the Aberdeen hydrogen bus project is available online: www.ukh2mobility.co.uk/the-project/refuelling-infrastructure/



Government ahead of their Autumn Statement, which contains forecasts of the anticipated increases in generation and reinforcement required to meet the demands placed by PHEVs and BEVs.

SSE has experience from its innovation projects (plus others undertaken by DNOs and research organisations) which have trialled ULEVs to determine the impacts to electricity networks and it is clear that in the early stages of uptake the clustering effect seen with early adoption of low carbon technologies (LCTs) will place significant demand on the networks due to periods of peak demand for ULEV charging coinciding with traditional domestic household peak demand periods.

SSE's research revealed that 32% of all GB distribution network circuits will experience issues when 40-70% customers charge an ULEV at home, which could equate to over £2.2bn in reinforcement required by 2050.

Supporting the changing nature of transport

Shared mobility is expected to increase substantially in the next 15 years (McKinsey predicts that one out of ten cars sold in 2030 could potentially be a shared vehicle⁶), which means government may have to consider the future role of public transport within the context of increased shared mobility. This might manifest in the Government's planning for the charging networks considering: shared and autonomous vehicles; coordinating of shared mobility and urban planning in order to avoid congestion around drop off points; and low public transport utilisation.

What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

SSE welcomed the Government's £80m commitment in the 2016 Autumn Statement to support ULEV charging infrastructure. Government support will be crucial for the commercial case for building ULEV infrastructure as the uptake of ULEVs increases concurrently. SSE would support the Government, and the NIA, considering further means to increase take-up of ULEVs through instruments such as Plug-in Car Grants as well as continued support for the infrastructure as announced in the aforementioned Autumn Statement.

A rapid-charging network for ULEVs, with appropriate numbers of PHEV/BEV charge points and FCEV well placed fuelling stations, will be crucial to facilitate movements between and via urban and rural areas as it will de-risk travelling using ULEVs and support the Government's ambitions.

⁶ McKinsey report available online: www.mckinsey.com/industries/high-tech/our-insights/disruptive-trends-that-will-transform-the-auto-industry

Section 3: Digital communications

Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

SSE believes that retail market governance arrangements for the digital communications sector should be developed to support the consumer experience in switching between the many different technologies and services available. A digital communications regime that effectively co-ordinates the 'behind the scenes' processes to deliver positive switching experiences will improve competition and deliver subsequent benefits to the customer.

In other utility industries, there is a clear and formal separation between the infrastructure providers and the suppliers of services using the infrastructure. There is generally long term regulated funding for dominant or 'legacy' infrastructure (not precluding competition for investment in 'new' network extensions) with incentives and standards on the required network performance characteristics such as repair time and high availability. Suppliers of services, on the other hand, are able to use the available infrastructures on a non-discriminatory basis and are exposed to market pressures to provide competitive, innovative product offerings and excellent, responsive customer service. This separation of roles facilitates the organisation of retail switching arrangements so that consumers can readily move between service offerings – whether they are connected to legacy networks or newly provided competing infrastructure.

Since the independent organisation of retail switching arrangements is such a key part of the regulatory framework for other utilities, SSE proposes the NIA consider how this could be developed in an appropriate manner for the parts of the electronic communications industry serving the 'mass market' of consumers.

In the energy industry, comprehensive, independent and transparent market governance arrangements exist to protect the consumer switching experience. In contrast, the retail communications markets have developed with no overall industry governance or coordination of this activity. Appropriate governance arrangements to define, maintain and develop industry processes that affect consumers do not emerge naturally in a market and need to be 'designed in' to market arrangements under the auspices of government and/or regulatory oversight, as is currently being seen in the preparations for the 2017 opening of the non-household water market in England and Wales.

Drawing on SSE's experience of the governed retail market switching in other industries, we believe that the following items need to be developed:

- An authoritative market body, owned and funded by relevant industry participants, whose remit is to ensure that retail switching is efficiently coordinated across market participants for the benefit of consumers; and
- Documentation of switching rules, processes and agreed procedures: these to be held centrally by the market body and subject to transparent change control to incorporate market developments and suggested improvements.

At present in the communications markets, there is no single body that represents all relevant parties involved in services to the 'mass market' of consumers. A market body that is set up to coordinate retail switching could provide such a focus and enable government or regulatory bodies



to instigate consideration of topics that need to be addressed by the consumer facing part of 'the industry'. SSE notes that the existence of this type of inclusive body in the energy industry has helped government and regulators to further the "faster switching" area of work in energy supply.

Currently, with the rate of technological change in the communications markets, new products and technologies develop relatively quickly and have led to fragmented, *ad-hoc* switching arrangements due to the lack of market oversight. SSE would support the NIA reviewing the regulatory and industry governance framework in the retail digital communications market.

Section 4: Energy

What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

District heating

The NIA should consider the existing barriers to increasing the uptake of affordable, secure and low carbon heat infrastructure. District heating can secure significant reduction in CO2 emissions using 'waste' energy from the industrial process. This removes the need for additional energy to be generated, allows for economies of scale and the integration of energy sources (meaning customers are not dependent on one supply source). District heating networks ensure greater reliability of service with the ability to balance the supply and generation of heat. CHPs used to power district heating networks are highly efficient, reaching efficiency ratings of about 80% compared to approximately 50% for gas power and 40% for coal-fired power.

SSE welcomed the Government's recent £320m commitment to the development of heat networks in the UK. If well targeted this money could provide the momentum for significant deployment of heat networks across urban areas in England and Wales.

The NIA provides a good opportunity to consider the role of district heating alongside others means of decarbonising heat. SSE advocates the NIA taking a 'whole energy system' approach, and believes that mass decarbonisation of heat is viable. SSE envisages this aim will be achieved through a mix of district heating, repurposing of gas distribution networks, and reinforcement of electrical distribution networks. Uncoordinated activity in the decarbonisation of heat risks stranded assets in future.

SSE is an investor and operator of district heating and cooling networks across the UK, and has experienced the issues associated with the successful development, implementation and operation of district heating sites. District heating schemes have had a far greater chance of successful implementation in situations where there is a strongly supportive planning policy in place that, in effect, obligates major developments and other relevant stakeholders to, where feasible, incorporate a connection to an existing scheme or develop a site wide CHP network of their own. This environment also provides investors such as SSE with additional confidence in achieving connected loads.

SSE believes preferential business rates and supportive building regulations can have an integral role in achieving a high value solution for decarbonising heat. The development of effective legal and commercial structures that encourage investment and attract private sector expertise, whilst giving public sector bodies (which will be imperative to the increased deployment of heat networks) the control and investment returns that they require. Capital guarantees are potentially critical as a long-term method for de-risking heat networks projects for investors. A low carbon heat incentive (including incentives to use waste as well as renewable heat as a low carbon) would be a positive step towards an achievable solution.

Early decision making is essential to provide planning for the long term decarbonisation of the heat sector given the long lead times in making infrastructure decisions.



Electric heating

Traditional electric storage heaters are often viewed as an ineffective and costly method for heating a home, and have not been deployed significantly under the Energy Company Obligation (ECO). Yet modern high heat retention storage heaters bring many benefits as they are able to provide efficient heating and generate cost savings of 20% or more on an annual household heating bill.

The NIA should consider how Ofgem and BEIS can drive the expansion of electric heating. SSE believes that the removal of policy costs on electricity bills and more reflective carbon emission factors on electricity use are sensible routes.

For the past decade supplier energy efficiency obligations relied on a market based approach to encourage measures that reduce carbon emissions at the lowest cost. The savings in carbon are estimated over the lifetime of the measure which can be a forty year period. The calculation of carbon savings requires a large number of inputs and assumptions, such as physical characteristics of a building, assumptions about the measure lifetime and assumptions about how a building be used. Although a significant amount of effort is made to try and ensure these calculations provide an accurate forecast of carbon savings, there is currently no recognition that electricity emission factors are reducing quite rapidly and are forecast to continue reducing until 2050. This means that any energy efficiency measures that involve the use of electricity are being assessed using historic (2012) carbon emission factors. Measures are being assessed on the basis of coal fired electricity generation continuing to play a significant role for the next 40 years, however we expect that by 2025 coal plant will have been phased out and replaced by low carbon generation sources.

SSE urges that national infrastructure decisions are driven by the best information available and in the case of decarbonising heat more should be done to acknowledge the reducing electricity emission factor.

From: [name and email redacted]
Sent: 10 February 2017 17:19
To: NIA Evidence <NIAEvidence@nic.gsi.gov.uk>
Subject: CALL FOR EVIDENCE - NIA

The Staffordshire Chambers of Commerce works with 4,500 businesses across Stoke-on-Trent and Staffordshire. It's central location in the country's transport network makes the area an ideal base for successful manufacturing, exporting and the transport and logistics sector.

Our infrastructure investment priorities which we believe are of national significance are as follows:

- **HS2 connectivity:** To unlock housing and economic growth in the city of Stoke on Trent and the wider Northern Gateway Development Zone, there needs to be a minimum of two HS2 services per hour serving Stoke-on-Trent and Stafford, and existing road and public transport infrastructure must be fully integrated
- **M6 Capacity and Safety:** To improve journey times, increase capacity and reduce congestion on the M6 through Staffordshire, there must be investment in Smart Motorway technology between junctions 15 and 16. In addition, urgent safety improvements are needed at J15.
- **East-West Connectivity:** To boost trade and access to skills, there is a need for upgraded rolling stock and electronic signalling which would improve capacity and frequency of rail services between Crewe, Stoke and Derby.

For more information on any of these priorities, please contact me.

Kind regards

[name redacted]
Deputy Chief Executive
Staffordshire Chambers of Commerce
[number redacted]
[individual twitter redacted]

We are backing the bid
STOKE-ON-TRENT-FOR
CITY-OF-CULTURE-2021

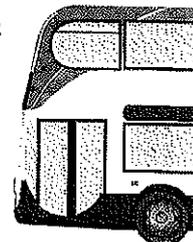
Commerce House, Festival Park
Stoke on Trent, ST1 5BE
Registered in England no. 465975

Mr Philip Graham
Chief Executive
National Infrastructure Commission

The Robbins Building
25 Albert Street
Rugby
CV21 2SD

T 01788 557000
F 01788 557040

stagecoachbus.com



9th February 2017

Dear Philip

NATIONAL INFRASTRUCTURE ASSESSMENT CALL FOR EVIDENCE

Thank you for giving Stagecoach Plc the opportunity to submit our thoughts on future infrastructure investment priorities. Our summarised response below addresses primarily the transport-related questions but also covers some of the cross-cutting questions posed.

I must stress that our submission is very much an executive summary of our thoughts on Infrastructure and as one of the largest providers of public transport in the UK we would welcome further dialogue on the matters we raised and can provide further data and substantiation behind any of our views if required.

How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? Note: "travel patterns" include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

The key ingredient here will be population growth and how the development landscape accommodates it. Whilst we have seen an increasing shift to urbanisation in recent years, there is no doubt that there will continue to be dispersed development in greenbelt locations. A growing population will naturally lead to a greater demand for travel across all of the modes. Planning and funding policy will, to a degree influence the split of demand between the modes together with the transportation marketplace.

The other key variable is technological change and how this impacts on lifestyle. Whilst trends such as increased internet shopping and greater home working would be expected to burn off some degree of a demand for transportation, we do not consider this to be significant in the short to medium term although by 2050, we would have expected an evolution of town and city centres, perhaps with more leisure options. Urban centres are traditionally quite resilient and have battled with competition from out of town developments for years.

Employment will be a key determinant of travel. Our current demand is generally although not exclusively determined by the level of economic activity and this is supported by the passenger growth we have in areas which are economically healthy and have growing

populations such as Hampshire, Surrey and West Sussex whilst in other areas such as North East England and East Scotland, the picture is the reverse. One trend that we do believe will continue is that people will be willing to travel longer distances to work and this will result in greater inter-urban and inter-regional traffic over time.

We believe that with greater population densities likely over time, there will always be a natural agglomeration of more popular journeys and therefore the demand for mass transit will remain or more likely increase. There will of course remain an increasing demand for road space from private forms of transport leading to increased pressures on the road network.

The need for better management of available road-space is already crucial will become more acute as the population increases. The use of smart technology will become more prevalent and some of the smart technology may impact on choice of mode if real time demand data is made available to help inform travel choices.

What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas? Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

The highest value transport will be that which can move people to where they want to be as quickly, cost-effectively, conveniently and comfortably as possible. Often this amounts to private transport as the natural choice for many people but choices are also influenced by levels of congestion, pricing of mass transit options, the cost of motoring, particularly fuel costs and parking charges, and general comfort of all modes.

Rail-based mass transit is an attractive, fast and relatively unimpeded alternative to the car. However, the cost of providing heavy rail is relatively expensive both in terms of the infrastructure and the ongoing running costs. There are significant constraints to increasing rail capacity and this is unlikely to change. Light rail, similarly offers an attractive alternative to other modes with lower running costs compared to that of heavy rail but with high infrastructure costs and the same project delivery constraints and lengthy lead times as with heavy rail. However many key links will never justify the investment required for rail services.

Currently by far the most popular form of public transport in the UK, with nearly 5bn journeys per annum is the bus, which offers cost effective road-based mass transit. Such is the flexibility of routeing and ability to penetrate more population and employment due to a greater infrastructure available (the road network) and more frequent stops, the bus simply caters for the journey needs of many people and this is unlikely to change materially. The capital cost of vehicles is generally far less than other forms of public transport while staff costs are lower than that of rail. Pricing is generally good value, reflecting lower running costs, which are unlikely to change markedly in relative terms over the coming decades. A shift has already started from diesel towards more sustainable propulsion such as electric power but this too is not impacting on pricing to any significant degree.

Whilst the bus is often the most cost effective mode, its comparative attractiveness is constrained by traffic congestion. Current policy and funding does not really address this despite the significant numbers of people affected and the resultant 'lost time' and impact on the economy. Allocation of road space to buses is often seen as politically unpopular and some cities, such as London have actually allocated road space away from the bus in recent years with a resultant reduction in journey speeds and reduced demand for bus services. Such policies can result in increased journey times and congestion for all. Conversely, a well thought out bus priority scheme which may allocate some road space to the bus but also

looks at the overall design of the highway including the efficiency of junctions will improve journey times overall as evidenced by the 'Quality Bus Corridor' Programme in Greater Manchester, which successfully navigated the consultation process and was delivered on the back of reduced journey times and improved street environment for all.

As noted previously, the smarter use of road space will become more important but, given the constraints provided by rail, it is also clear that provision of bus-related highway infrastructure should become more attractive over time. This will make the bus more attractive a mode and, in turn assist with the efficient use of road space.

Current trends in terms of equipping public transport with technological features designed to improve the customer experience will likely continue. USB chargers and wifi are already widespread but further projection of multi-media entertainment to passengers at their seat will become more popular thus further enhancing the unique selling point of public transport.

Technology will play an even greater part in the retailing of public transport. The last decade has seen a growth in smart ticketing and it won't be long before contactless payment and mobile ticketing largely takes over from cash transactions. Internet retailing and information provision together with ticketing and payment mechanisms will nevertheless become far more intuitive, driven by the market and this will serve to unlock latent demand from those who currently see information and ticketing as a key barrier to using public transport, particularly the bus. Increasing retailing of mobility covering all the travel options, assisted by data from transport providers will become more prevalent and potentially, with real time demand data, facilitate smarter use of road space.

It is expected that driverless technology will play a role in public transport and the agglomeration of journeys but the extent of that role is not yet clear and will be dependent on the level and cost of development in the coming decades. Driverless technology does, however present the opportunity to redefine private transport and, at least for urban journeys, assist in the smart use of the highways network. Arguably, the highways network will need to be much smarter and smooth flowing in advance of the driverless technology being a credible option.

What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area? *Note: this includes travel in and between rural areas, as well as between urban areas and international travel.*

Provision of connectivity depends on the flexibility of transport available to the public. The car can take you anywhere at any time subject to congestion but provision of rail services is restricted to a limited and costly infrastructure.

Outside the urban area, agglomeration of journeys becomes more difficult and public transport less viable. Equally, congestion is often less prevalent although this is challenged by the increase of dispersed inter urban and interregional journeys.

Often the most credible form of mass transit for such journeys is, once again, the bus as it can be provided at minimal capital cost and relatively low unit cost. The ability of the bus to penetrate dispersed settlements and places of employment is way ahead of other public transport modes.

As the demand for interurban road space increases, we will see the opportunity for more agglomeration of journeys but this will be dependent on facilitating attractive journey times by public transport compared to the car.

A good example of catering for inter urban and inter-regional journey needs is the Oxford – Milton Keynes – Bedford – Cambridge 30 minute frequency X5 service provided with 17 high quality coaches by Stagecoach. Such is the success of the service in agglomerating interurban and inter-regional journeys, it is now considered feasible to build a railway line along much of the route and support a rail service. There are plans for significant residential and business development along the entire corridor, which the X5 is well placed to support and service also passes a number of bus and rail based P&R sites at Cambridge, Bicester and Oxford. The rail line meanwhile will be able to support development to a degree but it is limited in its ability to reach and penetrate those developments and this could restrict the positive impact of the investment. The X5 could assist the railway in providing the penetration needed. We would be very keen to provide a better frequency of 3 departures per hour with faster journey times, aided by good bus priority measures including the East-West Expressway. This would require an additional eight vehicles with a capital cost of only £1.6m per annum and we would anticipate revenue generation to be about £800k extra per annum after year one of the enhanced service. These figures are, of course a small fraction of what the rail solution would cost.

What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Pricing of mobility according to demand levels will serve to more smartly manage the road network by reducing demand at peak times and spreading traffic over a far greater time period. This will provide restraint via the marketplace in the same way that rail pricing does to a degree. Road pricing of this nature could then be used to fund initiatives that encourage further agglomeration of journeys onto public transport thus taking more pressure off the road network. Pricing in this way will also provide a more level playing field with public transport whose cost of supply at the peak time can be far more expensive due to congestion on both road and rail networks.

There are further health benefits to this approach through tackling AQMA's and also improving safety. Reduced congestion at peak times will not only improve air quality but will also allow transport providers to either provide more frequency with the resource available or remove resource and reduce price.

What are the highest value infrastructure investments that would support long term sustainable growth in your city or region? *Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.*

The St Ives to Cambridge and Leigh Salford busways are great examples of where car users have been attracted to local and inter-urban bus services for relatively low capital cost. The services are not restricted to the infrastructure but serve a variety of other areas at each ends of the infrastructure. Journey times have been reduced and patronage has consequently grown. In case of the Cambridge busway annual patronage on our services benefitting from the busway increased from 1.1m in 2010/11 to 3.5m in 2015/16, a 200% increase.

We passionately believe that provision of segregated alignments for buses generally yields far greater passenger benefits than the same investment in other public transport alignments such as rail due to the increased penetration and lower costs previously mentioned.

How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Over the next 20 years, more new homes are anticipated to be built than in the last 40. In parts of the UK where growth will be focused, many towns will see the most growth they have ever experienced, and several will more than double in size. It is especially important that this growth makes fullest possible use of the opportunities offered by public transport, by "designing in" those features that support the efficient delivery of the highest-quality bus services.

Where buses are properly considered at the outset, in development location, master planning and detailed design, high levels of service take-up are achievable. Indeed, across a very wide variety of scenarios, appropriate development can help catalyse improved bus services that achieve mode shift across a wider area. This can help to offset the residual car-borne traffic from a proposal. Where buses are properly harnessed in support of the best development proposals, they can provide wider public betterment.

We feel that urban design must respond to a number of important drivers, so Stagecoach has produced a document, which is intended to highlight the features that are needed to ensure that buses can best serve developments, and the possible role in delivering high-quality, attractive and sustainable places. In this document, we tackle infrastructure design including highway configuration, bus stops, and parking. Meanwhile we also discuss how Stagecoach can work with stakeholders within the planning process. The document will be complete within the next month. We will forward a copy to you and we would welcome the opportunity to discuss it with you in detail.

What is the maximum potential for demand management, recognising behavioural constraints and rebound effects? *Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.*

The maximum potential for demand management obviously depends on the type and extent of measure(s) put in place. The London congestion charge has created a revenue stream and assisted in improving journey times within the central area for many years although demand has returned partly due to the growth of London. This has happened with little or no adverse economic impact. The charging mechanism could be far more sophisticated, however taking into account peak demand in greater detail although this may not be deliverable on the scale of London. There also needs to be some predictability to pricing and so pricing down to real time demand might have its constraints.

Congestion charging has been politically difficult to apply elsewhere in the country. Notably, Manchester's attempt saw millions spent on the proposal and little support gained from the general public. This should not deter authorities from pursuing it but the economic case will

probably become more marked in time as our cities become more choked. We definitely support congestion charging but it is best delivered alongside wholesale improvements to the public transport network.

Parking charging and control is another key restraint tool. Parking can occupy large areas of city centres and use of valuable land for parking could arguably be viewed as a lost opportunity when an alternative land use may have provided more contribution to the economy. People will be more likely to choose public transport to visit a place where parking charges are high.

Other ways of burning off peak demand could be delivered through influencing or controlling the active times of employers, schools or colleges. This form of demand management would also assist with the peak cost of road-based public transport provision.

Thank you once again for allowing us the opportunity to comment on future infrastructure priorities. We would be delighted to provide any further evidence in the form of reasoning, information or data should you require it. We see lots of opportunities ahead and would welcome the opportunity to discuss our vision with you in greater detail. If you are willing to meet with us then please let me know and I will make the necessary arrangements.

Yours sincerely



[signature redacted]
[name redacted]
[job title redacted]

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Statoil response to the National Infrastructure Assessment Call for Evidence

Statoil (U.K.) Ltd. welcomes the opportunity to respond to the Commission's call for evidence on the first National Infrastructure Assessment (NIA).

Statoil is building and investing in a secure and sustainable energy future for the UK, where our business encompasses a broad range of activities including upstream operations on the UK continental shelf (UKCS), the development of offshore wind projects, natural gas trading and crude oil sales.

On the UKCS we are the operator of the Mariner oil development, the largest investment on the shelf in a decade and which is due to start commercial operations in 2018. We are also partners in the Jupiter and Alba fields. Our belief in the potential of the UKCS has led us to take a significant position in the 28th UK licencing round, adding 12 new licences (nine as an operator) in the Central North Sea.

Natural gas is a key part of our partnership with the UK, where 4.1 million homes are fuelled by Statoil gas. We are committed to increasing that figure, and through the Langeled, Vesterled and Tampen links from the Norwegian continental shelf, we have the capacity to supply up to 25% of peak UK demand.

The UK has also been the springboard for our offshore wind projects which are part of Statoil's global strategy to gradually complement the oil and gas portfolio with profitable renewable energy and other low-carbon solutions. We hold a 40% share in the Sheringham Shoal wind farm, in production since 2012, a 35% operated share in Dudgeon and a 75% operated share in Hywind Scotland, the world's first floating wind farm. Both Dudgeon and Hywind Scotland will be completed later this year. Together with our partners we are developing an offshore wind portfolio with the capacity of providing over 1 million homes in Europe with renewable energy.

We would be pleased to continue to provide input to the Commission in developing the NIA. If any further information is required, or if we could be of further assistance, please do not hesitate to contact me.

Kind regards,

[name redacted]
[job title redacted]
[email redacted]

Responses to selected consultation questions

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

- The UK currently has one of the most efficient and liquid wholesale gas markets in the world. It adjusts volumes of gas to and from the UK via price signals, and this delivers the right volumes at the most efficient pricing to the end user. From a security of supply perspective and also an affordability one, it is very important that this market remains supervised as it is currently and allowed to continue to work efficiently.
- On offshore wind, there is currently a disconnect between the timing and regularity of Contract for Difference auctions (the first in 2015, the next in 2017 with the timing of subsequent rounds unclear) and the requirement in an offshore wind project's consent to commence construction within a certain time limit. There is a need for better alignment and adjustments.

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

- The challenge to decarbonise heat is recognised as one of the largest the UK must tackle so as to meet its targets under the Climate Change Act. It is also widely accepted that there is no single solution that can be deployed to effect change in a complex system where heating needs and provision currently vary greatly according to type of user (residential, commercial, industrial), location and time of year.
- Decisions taken on heating have a long-term impact since they necessitate changes which at the individual user level only happen once in a generation. And, as with other infrastructure challenges, energy investments require long-term planning and there is a risk of closing off options prematurely through policy decisions being delayed or taken without fully taking into account the full system costs.
- We believe the first step must be to improve building energy efficiency. Doing so can reduce carbon emissions, reduce energy bills and fuel poverty and therefore improve health, while also driving economic growth. The Committee on Climate Change (CCC) notes that reducing the level of energy demand through improve efficiency can greatly reduce the cost of meeting the 2050 emissions reduction target.
- 83% of homes in the UK are heated by natural gas, using an efficient transmission and distribution network. Even as new technologies emerge this level is unlikely to change significantly in the medium term. Natural gas will therefore continue to play a significant role at least in the short to medium term. The emissions impact can be lessened by installing high efficiency boilers in new homes and retrofits, and by "greening" gas through the use of biogas and to mix in hydrogen.
- Security of long-term natural gas supplies for the UK can be secured if there are sufficiently strong long-term signals on future levels of natural gas demand, when decisions on new upstream fields on the UK and Norwegian continental shelves need to be taken.
- A promising longer term route to cut significantly emissions from heat is to use natural gas to produce hydrogen for use in heating. Hydrogen is a zero carbon gas, and it holds the features of natural gas – i.e. the flexibility to

turn temperature up and down, to distribute the energy need intra-day, intra-week and even intra-season. The feasibility of converting the natural gas network to hydrogen is being tested by the H21 Leeds City Gate project and first results are promising. A recent assessment by Imperial College found that using hydrogen would result in the smallest disruption to the end-user compared with other options (electrification, heat networks) as very few changes would need to be made to households to convert from natural gas to hydrogen.

- The conversion of natural gas into hydrogen through steam methane reforming (SMR) is the most well-known short/medium term process to produce hydrogen in large enough quantities. Other methods of hydrogen production that are more efficient than SMR are currently under test and development. Common to all these industrial production processes is the requirement for the large scale Carbon Capture and Storage technology (CCS), where the CO₂ is injected into sub-surface reservoirs. Such CCS developments would not only benefit hydrogen value chains but also allow decarbonisation of industrial emissions and fossil fuel power generation. The UK has done extensive research on the storage potential on the UK continental shelf and ample storage capacity has been identified¹, especially on the eastern part. Hence storage capacity is not seen as a barrier. A transport and storage infrastructure development plan is required to access these assets in the most optimal way. In several cases existing infrastructure could be reused.
- The experience we have with CCS in industrial production indicates that the price of capturing, transporting and storing one tonne of CO₂ captured post production is currently well below USD 50 per tonne (2016). We would most likely see a significant drop in costs if this was done on a larger scale across a basin, but it is difficult to say how fast and by how much.
- Hydrogen can also be produced by electrolysis, but the cost is still very high. The technology is developing and, with increased use or and interest for hydrogen, the costs are likely come down.
- We support the assessment by Imperial College that heat networks are beneficial on efficiency and cost terms in certain locations around large sources of waste heat, and that electrification can be used for more remote locations and tied to other building upgrades and in high rise buildings. We note that a wider deployment of heat pumps or wider electric heating would require significant changes in each home and investments in national and local power networks to manage the seasonal swings in heating demand.
- The current gas system offers this flexibility to cope with uneven demand both intra-day but, more crucially, between seasons. While intra-day can increasingly be solved by smarter electricity systems and battery storage, the inter-seasonal difference cannot be handled in a cost-efficient manner.
- If the gas network is not used for green gas, the falling utilisation of the gas distribution network will increase the distribution cost per unit of gas and the maintenance of the system will become costly. It is likely the network will be forced to close long before it is totally empty, making the need for an alternative network more urgent. Alternatively, gas transmission and distribution system could - under the existing maintenance programmes - transport and distribute hydrogen by the early 2020s. The current system transports on average three times the energy of the current electricity system. Using the gas grid to develop a zero carbon energy system would mean that the cost of new supply infrastructure would be limited and this is key to keeping costs down.
- Hydrogen networks can also be leveraged for other uses. One is transport, and another is in power, with the possibility to retrofit Combined Cycle Gas Turbines (CCGTs) at low cost to run on hydrogen. If this happens, the

¹ CO₂ STORage Evaluation Database (CO₂ Stored). <http://www.sciencedirect.com/science/article/pii/S1876610214023558>

electricity system can retain flexibility and obtain another source of back-up to renewable generation, and new-build CCGTs that can be converted to hydrogen may even be incentivised now to strengthen the current system. A whole systems approach is therefore needed and projects to test the economics and practicalities of developing hydrogen networks must therefore be supported.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes

- The sector will need to be significantly larger than it is today as electricity will be used to contribute to the reduction in emissions from transport, heating and industry. We believe that CCS should play a significant role, with the former offering flexible low-carbon generation and being part of an emissions-free hydrogen production process. The Committee on Climate Change has estimated that the cost of meeting the UK’s 2050 emissions target would be up to twice as high without CCS deployment.
- In addition, we believe that offshore wind should play a large role. The total resource potential for offshore wind is, as the CCC notes, greater than the total UK’s total electricity demand in 2014. Offshore wind has shown substantial cost reductions in recent years and it is expected that costs will continue to decrease. This indicates that the potential for offshore wind after 2020 could be higher than the communicated 10 GW ambition level.
- To support growing generation from renewables, the electricity system will need to be more flexible with greater levels of back up generation. there will be a need for a responsive network with flexible demand and flexible generation. This system will need a much larger role being played by demand side response, plus large scale hydrogen storage and large scale batteries and other forms of electricity storage.
- We will be trialling a battery storage solution, Batwind, as part of our Hywind pilot park project. The ambition for Batwind is to investigate how the various value drivers (e.g. congestion management, time arbitrage, balancing, system services such as enhanced frequency response) may work in tandem to generate robust streams of revenues for investors. Furthermore, by placing the battery next to the wind farm, we will be able to evaluate the value from integrating generation with storage and test out value drivers that cannot be tested if the battery is connected directly to the grid: reduced balancing costs by smoothening the variability of intermittent generation (“self-balancing”) and management of grid constrictions on the wind farm.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

- Please see above answer to Q19. Converting the gas distribution to hydrogen would provide the infrastructure for the building of filling stations, at relatively low cost and complexity, to serve hydrogen-fuelled vehicles. Hydrogen could thus offer some relief from the need to expand the electricity system massively to cater for increasing levels of electric vehicles by providing an alternative zero CO2 emissions energy option.

National Infrastructure Assessment Call for Evidence

Response from SUEZ

Preamble

SUEZ R&R UK (SUEZ – formerly SITA UK) are pleased to respond to this call for evidence to provide input into the NIC’s National Infrastructure Assessment (NIA). SUEZ are one of the UK’s largest waste and resource management companies, providing services to the public and private sectors. A long-term vision and plan for this sector is critical to support and ensure the viability of the new business model our sector is developing, based on the principles of the circular economy. In moving from a disposal (predominantly landfill)-led business model to one that relies on end-markets for recyclates and recovered energy, capital investment in the order of £10-15 billion over the next 10-15 years will be needed across the sector, in order to construct the facilities necessary to recover value from waste in the form of secondary resources. This scale of investment will only materialise if a robust resources policy framework is in place, backed up with an assessment of national infrastructure requirements.

In our response to the NIC’s previous consultation and process and methodology, we noted with approval that the NIA will take account of the “long term objectives and strategy” of “moving towards a more circular economy”. We stated that while on a site-by-site basis our sector frequently falls below national infrastructure thresholds, when viewed as a source of supply of (secondary) raw materials and recovered energy supporting the UK’s industrial and domestic sectors, our sector in the aggregate assumes national strategic importance, and the sectoral NIA should be conducted with this in mind – as a provider of secondary materials and recirculated products to replace virgin raw material and energy supplies. We also noted that infrastructure development for the management of commercial/industrial (C&I) waste lagged behind that for municipal solid waste.

With these comments in mind, we present our response to the call for evidence.

Q1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

SUEZ prefers not to view waste and resource management infrastructure in this way. The sector as a whole requires a balanced portfolio of assets, in which landfills for residual non-recyclable and non-combustible waste are as important as processing plants for secondary resources (plastics, paper, metals, etc), as are energy-from-waste (EFW) facilities for food waste and combustible residual waste. At present the UK (England in particular) suffers from a shortage of landfills, with some parts of the country in danger of running out of void space within the next 5-10 years. For example, it is anticipated that by 2021 there will be no landfill space left in Kent.

Because landfill infrastructure is not being replenished, residual combustible waste is driven to the next available treatment option, EFW, of which the UK is also in severe deficit. This imbalance has driven over 3 million tonnes per annum of waste-derived fuel (the majority derived from residual C&I waste, for which virtually no dedicated UK treatment capacity exists) to European EFW facilities where power and heat are recovered and used locally.

In terms of linking waste management infrastructure with the wider economy, EFW and recycling infrastructure are “highest value” in the sense that they offer significant local and regional economic and environmental benefits. Thermal EFW generates electricity, and especially heat that can be used for district heating and for delivering heat to local industries. SUEZ supplies waste-derived fuel to cement manufacturer CEMEX, where it is used as a substitute for pet coke to reduce operating costs and greenhouse gas emissions. A number of thermal EFW facilities in the UK supply heat and power to surrounding communities and to adjacent industries and institutions – Coventry (district heating for Coventry City Centre), Nottingham (district heating network), LondonWaste (energy to the Eco Park), Lerwick (district heating network) and Sheffield (district heating network) being five examples. Biological processes such as anaerobic digestion convert food waste into biomethane that is also used locally or injected into the national gas grid. Sainsbury’s power their distribution centres and stores with biogas produced from waste food, the energy generated supplying 10% of Sainsbury’s entire national gas consumption for the year.

Recycling infrastructure serves as a source of secondary raw materials for local and regional enterprises – the supply of aluminium by Novelis to Jaguar Landrover for use in the latter’s REALCAR project being one example. In general, owing to a lack of demand-side measures that favour the use of secondary materials over primary raw materials over 50% of the recyclates collected and processed in the UK is exported. The recent announcement by Liberty House that it is to develop a UK business using domestically recycled steel has been welcomed by UK recyclers.

This issue is addressed further in our response to Question 4.

Q2. How should infrastructure most effectively contribute to the UK’s international competitiveness? What is the role of international gateways in ensuring this?

At the same time as interest in industrial strategy has re-emerged, environmental imperatives and the expressed interest of much of industry have driven a significant change in the resources and waste management sector. As noted above, the sector’s business models have moved from being disposal-led to being value-led. This model is consistent with reducing primary resource use in the economy: in most cases, the use of secondary materials, and the preparation of goods for reuse also help to reduce global greenhouse gas (GHG) emissions.

The UK exports secondary materials to be reprocessed overseas, and then imports processed materials use in manufacturing. In 2014 imports of ferrous metals and of aluminium were more than three times and five times respectively, relative to the mass of secondary materials exported.

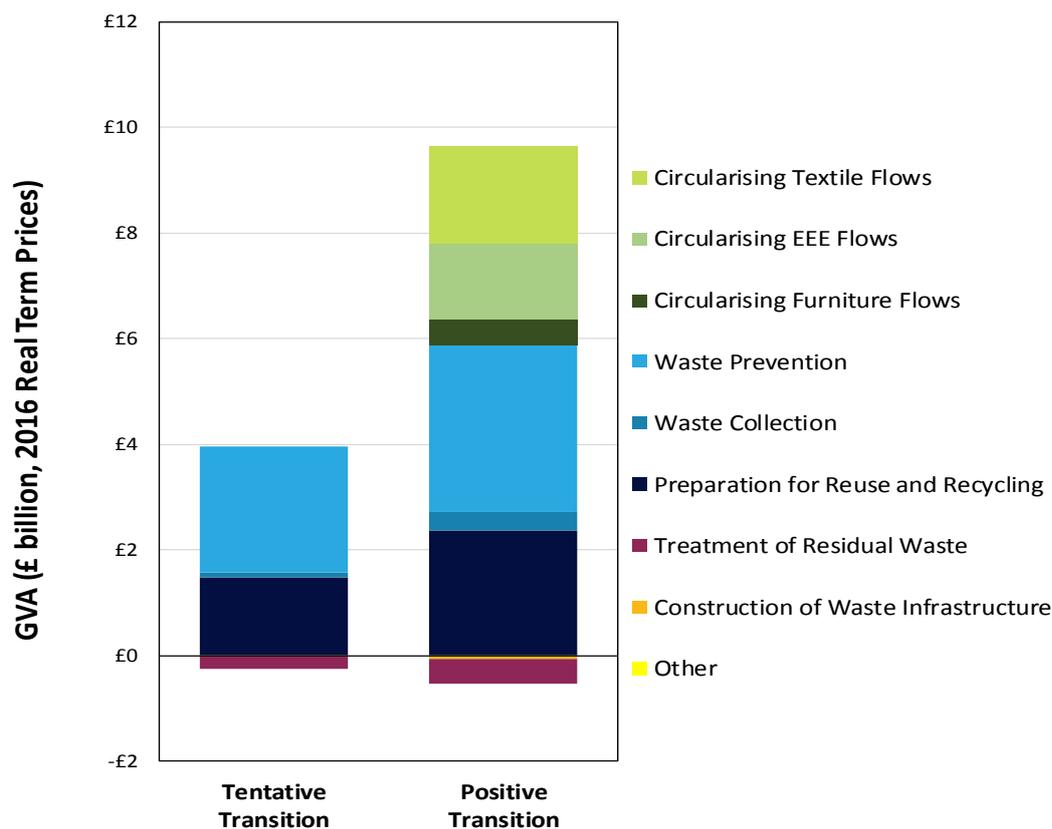
Analysis performed by consultants Eunomia on behalf of SUEZ suggests that re-shoring some of the materials that are currently exported for recycling could add significant value to the UK economy if they were processed locally, while boosting resource productivity and hence international competitiveness. In terms of Gross Value Added (GVA) as a result of changes in waste management and broader shifts in the consumption and use of furniture, electronic equipment, and textiles, the headline results indicate that significant additional gains result from measures which are more likely to result from embedding waste and resource management within a wider industrial strategy.

As shown in the figure below, of the two core scenarios modelled against the baseline ‘Business as Usual’ (BaU) scenario, the more ambitious ‘Positive Transition’ (to a more circular industrial strategy) scenario results in a total net gain in GVA of £9.1 billion in 2030. According to the ONS, the waste and resource management sector as a whole was responsible for generating an estimated £6.5

billion of GVA in 2014. The GVA uplift is considerable, with some of the modelled benefits in 2030 also being attributable to sectors other than waste management. It is estimated that the Net Present Value of the Positive Transition scenario (for the period 2016 to 2030) is £47 billion. This shows that there are substantial benefits to be gained over time under this ambitious scenario.

The Positive Transition scenario also generates savings in respect of GHG emissions. Improvement in waste management relative to the BaU scenario delivers reductions of around 4 million tonnes per annum by 2030, but the scenario also delivers substantial savings related to waste prevention. GHG savings are estimated to be 27 million tonnes by 2030.

Net Change in GVA Relative to BaU in 2030 (£ million, 2016 Real Term Prices)



The above analysis chimes with, for example, the London Infrastructure Plan 2050. An analysis of the waste infrastructure required for London showed the potential for £5 billion in cumulative resource efficiency and productivity savings to 2050 created by a more circular economy-style waste infrastructure focused on more repair, re-use and remanufacture.

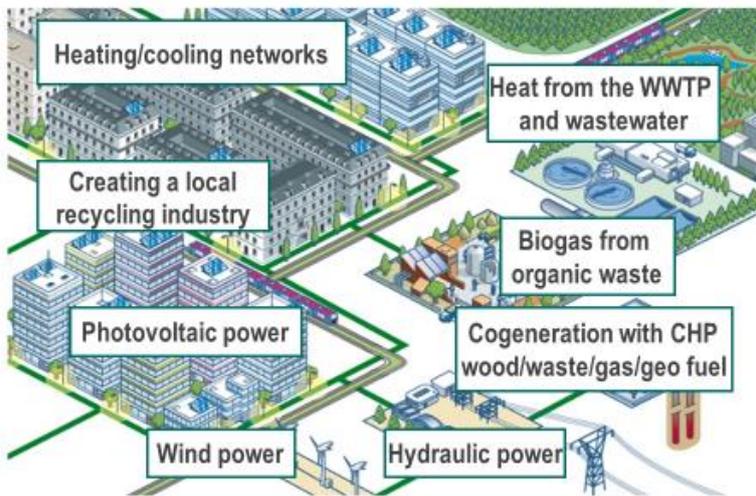
International gateways such as ports and their hinterland are well suited to the development of symbiotic industrial complexes, hubs and clusters, especially in the context of regional regeneration (for example, the ports within the Northern Powerhouse catchment), often zoned with special planning and tax concessions. The 2016 budget included a commitment to provide a further £1.8 billion of funding to Local Enterprise Partnerships during the course of 2016, on top of the £7.3 billion of Growth Deal funding that they had received by March 2016.

Rotterdam is an example of a successful integrated port-cum-industrial complex, which could be replicated in the UK.

Q3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated?

The “smart city” concept designs and integrates utilities with mobility, waste management, energy and other services into the urban infrastructure, as illustrated below.

The city of tomorrow – an integrated approach



Waste management services and infrastructure has not received as much attention as, say, transport and mobility, but there are considerable opportunities for innovation.

- Pneumatic waste collection infrastructure can be designed such that waste is transported through fixed aerial and underground conduits to central underground storage receptacles. Above-ground traffic movement is minimised because individual household collections are avoided, as is nuisance related to odour and littering.
- Drive-in waste collection centres can be linked to repair centres and sales outlets for recycled and refurbished goods.
- Waste-related vehicles can be fuelled by clean fuels such as biogas or waste-derived fuels. SUEZ produces vehicle fuel (LNG) from landfill gas, as well as diesel from waste plastics.
- The waste cycle can be integrated with the wastewater cycle to generate energy from waste. Electricity and heat generated can be used a source of decentralised power. Recovery of heat from the wastewater in pipes allows for less energy consumed for heating. Excess heat from wastewater treatment plants can be recycled to heat nearby neighborhoods. Sludge from these plants can be used as fuel outside of manure spreading periods for agriculture.
- Food waste can be combined with sewage sludge and digested to produce biomethane for heating. Digestate can be turned into a soil improver for local landscaping.
- Recycling facilities can provide secondary materials to support local businesses.

These innovations can best be implemented in new developments. The recent announcement of 14 new garden town and village developments in England provides an opportunity for architects and urban planners to integrate these considerations into their urban designs.

Q4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

“Demand management” as applied to the resources and waste management sector can take two meanings: firstly in terms of waste prevention, and secondly to create demand for secondary materials and recovered energy as a substitute for virgin raw materials and brown energy.

The waste management sector has undergone a huge transformation over the past 10-15 years. Traditionally disposal-led, the sector is now geared towards recovering value from waste, with ultimate disposal a last resort. Reusable products discarded by consumers are collected for repair and refurbishment, non-reusable products and materials are recovered in the form of recyclables, and value from residual non-recyclable waste is recovered in the form of energy. The estimated breakdown of the main value streams across the household and C&I sectors is as follows:

Value stream	Million Tonnes	Value
Material collected and processed for recycling	36	£10 Bn
Energy from waste (recovered in UK facilities)	6	£0.45 Bn
Energy from waste (in the form of waste derived fuel)	4	£0.4 Bn

The transformational technologies and processes have been constructed with the deployment of significant investment of £10-15 billion over the past 15 years.

However, as intimated in our response to Question 2, our sector is handicapped by a structurally dysfunctional market. Due to the almost complete absence of UK demand-led policies over supply-side measures such as recycling and landfill diversion targets, UK waste management companies rely heavily on overseas markets for the recyclates and waste-derived fuel our sector produces. Some 50% of recyclates and 90% of waste derived fuel is exported to overseas markets. This represents a direct annual loss of £6-8 billion to the UK economy and a drain on the UK’s balance of payments given that the UK is a net importer of primary raw materials and of energy.

Measures to reduce the production of waste focus on **influencing consumer behaviour** and include:

- Legislating to allow pay-as-you-throw schemes for household residual waste
- Alternatively, introducing targets to reduce residual household waste per inhabitant
- Broadening the scope of taxes on single use disposable products (beyond plastic bags)
- Introducing deposit refund schemes for beverage containers, as well as other items such as small waste electrical and electronic equipment.

Demand-side measures to promote secondary materials focus on **influencing industry**. Measures which could be used include:

- Mandated use of extended warranties for durable goods
- Requirements for products to be designed for repair and recycling

- Targeting a shift in Public Procurement so that 80% of spend is 'greened' by 2035
- Using agri-environmental payments to encourage use of compost and digestate
- Investing in collaborative research to support use of secondary materials
- Investigating the feasibility of a tax on raw materials, potentially linked to embodied carbon in materials.

The Government's industrial strategy and 25 Year Environment Plan provide the policy frameworks to pursue these and other demand-side policy measures.

Q5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Non-landfill assets typically have an operating life of 20-25 years, and over this period routine preventative repair and maintenance is carried out. Wholesale replacement of existing assets is not generally countenanced within the operating life of a facility except *in extremis* due to a fundamental design failure or change of law, since the return on capital employed is also factored over the same timescale, along with contract lengths for supply of waste. Technical modifications to existing infrastructure (such as improved sensing instruments) are routinely carried out.

New recycling and recovery assets are typically tied to municipal or commercial supply contracts, without which capital funding is difficult to source. Refer to our response to Questions 7 and 8 for further comments on financing.

Q6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Procurement of household waste collection services occurs under the procedure of Best Value, under which Competition is but one of the four Cs for reviewing service performance, alongside Challenge, Compare and Consult. Competitive tendering is now discretionary, so much so that according to the Audit Commission, "competition has been consistently the least applied of the four Cs in Best Value" (*Healthy Competition*, 2007). Studies conducted by the Office of Fair Trading in 2004 and 2006 raised similar concerns, recommending that when in-house providers were also tendering, local authorities should take care to ensure competition on a level playing field so that private suppliers were not discouraged from bidding.

In essence under Best Value, and invoking the exemption afforded to Teckal companies, Councils have increasingly taken service provision back into their Local Authority Trading Companies (LATCs) without first testing their service offer in fair and open competition. The intention expressed in the White Paper, that in the course of commissioning, commissioners should "seek and fully consider a minimum of three providers, from whichever sector, when they contract services", is unenforceable in the case of a Teckal company. This would also apply to the Right to Challenge under the Localism Act 2011 for services that pass the relevant control test.

Furthermore, individual collection contracts are often bundled together by partnering Councils, and are then taken in-house *in toto* without recourse to competitive tendering. If anything, the pace of transfer of waste collection services to in-house LATCs has accelerated over the past two years as Councils attempt to retain that revenue stream within their own organisations.

Arising out of our comments, we make three points:

- There is a discrepancy between the principles expressed in the White Paper *Open Public Services* (2011) regarding opening public services to competition, and the manner in which Best Value is being applied by Local Authorities when procuring waste services, especially in relation to the lack of competitive tendering, and transparency of Local Authority costs;
- Removal of ring-fencing of local government revenue grants from 2011/12 has given Local Authorities greater flexibility in moving costs between other budgets, which might obscure the "true" cost of waste collection to the Authority;
- Breaking up contracts into smaller lots is at odds with Government's call for joint working, and with the trend among Local Authorities to bundle-up collection contracts, while at the same time taking them in-house without recourse to competitive tendering.

It is noteworthy that waste management does not figure in any of the annual progress reports on Open Public Services published since 2011. Whereas Councils can track and monitor the performance of privately operated contracts through agreed performance indicators, it is virtually impossible for a private contractor to gain visibility of the service performance or costs of an in-house provider prior to the decision of a Council to retain a service. Costs shared across other public service sectors such as depreciation of shared assets, debt servicing and administrative overheads may not be fully isolated (or disclosed) when costing in-house waste management services.

Drawing on these general observations, some of the changes we would wish to see are:

- Waste contracts should be subject to (indeed, revert to) compulsory competitive tendering, backed up with robust and even-handed bid evaluation models that account for issues such as risk transfer.
- While Teckal companies will continue for the duration in line with the EU Procurement Directive 2014/24/EU, in the longer term, especially post-Brexit, we do not see why LATCs should retain or take in a service without recourse to competitive tender. This also applies to bundled contracts as part of a joint working agreement between local authorities.

Local Authorities should list well in advance their intention to transfer or take in-house a waste contract, including their reasoning behind that decision and their basic assumptions (including claimed savings), sufficient for interested parties to scrutinise the decision, exercise their Right to Challenge under the Localism Act 2011, or to launch other forms of legal challenge.

Q7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Q8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Ease of access to finance is dependent on security of feedstock supply, which in turn requires the company to secure supply contracts for the duration of the loan, or the ability to access new contracts over the period of the loan. SMEs are least able to fulfil these requirements, hence they are more reliant on venture capital and government support (for example through the Green Investment Bank or through WRAP), for infrastructure projects at the lower end of the scale.

In relation to funding of waste management infrastructure relating to obligated materials under Producer Responsibility legislation (such as packaging) the waste management sector has made a case for amending the present Packaging Recovery Note (PRN) system by requiring producers to bear the cost of downstream collection and waste management, in effect transferring these costs off Local Authority budgets. The move would draw more finance into the waste management system for funding new collection and processing infrastructure.

In terms of difficulties in attracting project funding, the overriding requirement is for regulatory certainty. For example the changes to feed-in tariffs for anaerobic digestion has resulted in a lack of confidence in the sector, which has affected access to funding. Lack of clarity in relation to the government's commitment to maintaining recycling targets has impacted adversely on investment for the upgrade of recycling facilities.

Q9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Actioning circular business models relies heavily on supply chain partnerships, in which the waste management sector is not merely a deliverer of end-of-pipe disposal services, but is also seen as a provider of secondary materials and recovered energy, along with the environmental and sustainability benefits that recycling and energy recovery offers. Collaboration across the supply chain is fundamental to the concept of the circular economy (Question 28) and for supporting the market-led business model and related infrastructure that is being adopted across the resources and waste management sector. The risk to the circular economy lies in individual actors not collaborating with or integrating their supply chain partners.

We have referred to some of the issues in our response to Questions 1 and 4. More detail is provided in our response to Questions 27 and 28.

Q10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The National Planning Policy for Waste (NPPW – October 2014) has been welcomed by SUEZ as a starting point for a “modern” strategy for waste and resources and related infrastructure. For example, the NPPW notes the ambition to deliver “sustainable development and resource efficiency”, the “positive contribution that waste management can make in the development of sustainable communities”, “ensuring the design and layout of new residential and commercial development and other infrastructure ... complements sustainable waste management”, and “looking for opportunities to co-locate waste management activities together and with complementary activities” – the last two harking back to Question 3 in the present Consultation. Some specific planning issues that merit comment are discussed below.

Planning for C&I waste management

Development plans should provide sufficient opportunities to meet the identified need for the management of *all* waste streams. As noted in the preamble, while capacity planning for waste under the responsibility and control of local authorities is adequately catered for, there remains a lacuna in relation to data for capacity planning in the management of C&I waste. The UK has historically relied on ad hoc campaigns to gather such data, which have been both costly and of

limited reliability. Data from such campaigns also rapidly lose their currency with shifting economic fortunes and the changing make-up of UK business.

With C&I waste tonnages exceeding that of municipal waste by a factor of 2 to 3, SUEZ advocates a more robust system of data capture delivering at least annual updates of waste arisings, which can be further analysed to discern sectoral trends. One such system would be the annual reporting by businesses of their waste arisings as part-fulfilment of their obligations under the duty of care, together with the mandatory use of the electronic reporting system EDOC.

Catchments and the proximity principle

While the NPPW enjoins local authorities to plan for new facilities “to serve catchment areas large enough to secure economic viability of the plant”, local authorities should be advised against restricting waste management developments within their boundaries to only deal with waste arisings in their areas. Catchment boundaries are not only anti-competitive and difficult to enforce, but fail to acknowledge that the business case for some waste facilities require a large catchment area extending beyond the planning authority’s administrative boundaries. Facilities with restricted catchments would be deemed a higher risk for investors, preventing the delivery of modern waste infrastructure. Defra publication *Energy from waste: a guide to the debate* (2014) notes:

“The ability to source waste from a range of locations/organisations helps ensure existing capacity is used effectively and efficiently, and importantly helps maintain local flexibility to increase recycling without resulting in local overcapacity”.

Strategic planning for resource management

While the NPPW stipulates that local planning strategies for sustainable waste management should be considered alongside other spatial planning concerns and integrate effectively with other strategies, planning bodies have little or no experience of producing integrated strategies of this type, or of linking waste and resource management strategies into the fabric of a broader, overarching economic development plan.

One exemplar of an integrated resource conservation and waste management strategy is the Material Resources Strategy (MRS) developed by Hampshire County Council. The publication *London: the circular economy capital* (London Waste & Recycling Board, 2015) applies these principles to the London Infrastructure Plan 2050, as does the Scottish government in its strategy *A Manufacturing Future for Scotland*, launched in February 2016.

Q11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Restoration of closed (mainly landfill) waste management sites has created a haven for flora and fauna. Under the Landfill Communities Fund (LCF) landfill operators have contributed a portion of their landfill tax liability towards community and environmental enhancement projects. Since the introduction of the scheme in 1996, the government reports that the LCF has provided £1.4 billion in total funds for over 52,500 community, biodiversity and environmental enhancement projects.

In addition to funding local environmental initiatives SUEZ’s Distributive Environmental Body SUEZ Trust has partnered with the RSPB to deliver biodiversity on a larger scale.

Q27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

The Association of Directors of Environment, Economy, Planning & Transport (ADEPT) warned Defra in July 2013 that a significant number of local authorities had experienced a reduction in recycling rates in 2012/13. With England's 2016 recycling rate at about 44% with the first signs of a downward trajectory, it is increasingly likely that the UK will default on its EU recycling target for household waste, of 50% by 2020.

The evidence suggests that the current suite of Defra policies has run its course, and that the target (or indeed higher recycling performance) will only be achieved by introducing a refreshed set of policies and policy instruments. These might have included, by way of example, an above-RPI increase in landfill tax, re-imposition of statutory recycling targets on local authorities, and an analysis of which particular waste streams should be targeted with landfill restrictions or with requirements for separate collection in order to accelerate recycling and diversion rates (for example, food waste). However, with just three years to 2020 it is now unlikely that policy fixes, even if expeditiously introduced, will have time to take effect.

Further uncertainty over the longer term has been introduced with the absence of signals from Defra, given the government's general reluctance to introduce "hard" regulation, as to whether the UK will honour or, in the event of a hard Brexit, mirror the higher recycling targets proposed in the EU's Circular Economy Package (65% of municipal waste by 2030). With no statutory targets, either for recycling or for landfill diversion, in the offing in England, investment in upgrading and replenishing the current stock of recycling infrastructure has been put on hold. The sector estimates that 15% of the UK's current recycling capacity will close by 2020.

In addition to the above, we have commented in our response to Question 4, some of the demand-side policy measures that are needed in the UK in order to drive a new generation of infrastructure growth in the resources and waste management sector as we transition from a traditional landfill/disposal-led strategy.

Q28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

We have largely addressed these issues in our response to Questions 2, 4, 10 and 27. Until virgin and secondary resource flows into and out of the economy are accounted for in economic terms (by Treasury) and integrated into other mainstream macroeconomic and sectoral fiscal flows, the bigger picture will continue to elude the UK government. A structured cost-benefit analysis can then be conducted by Defra, BEIS and Treasury – what monetised environmental and economic benefits accrue from substituting secondary materials for virgin (often imported) raw materials and from re-shoring exported secondary materials and energy-rich waste-derived fuel, what policy/government interventions are required to facilitate their achievement, how much would these interventions cost, and at what level should targets be pitched in order for the benefits to exceed the costs.

Businesses have a role in recycling and recovery, through the concept of Extended Producer Responsibility (EPR). In contrast to countries such as the Netherlands, the UK applies producer responsibility legislation to a relatively limited number of products and/or materials that end-up in municipal waste. The Packaging Recovery Note (PRN) system referred to in our response to

Questions 7 and 8 is an obvious example, though local authorities have commented that the distribution of PRN revenue is opaque, and relatively little revenue filters down to local authority level to support more and better collection systems.

SUEZ

10 February 2017

National Infrastructure Assessment Call for Evidence

Response from Suffolk County Council

This note supplements that provided by the Joint Suffolk Member Working Group which has already been sent on to you. Suffolk County Council is a party to that group and endorses the comments therein.

Cross cutting issues

1. What are the highest value infrastructure investments that would support long term growth in your city or region?

In Suffolk, we have produced a Strategic Planning and Infrastructure Framework that looks at the delivery of housing and jobs growth to 2050. This has identified key infrastructure requirements to help deliver this growth including,

- Improvements to the strategic road network to support our ambitious growth ambitions (as set out in the Joint Suffolk Member Working Group response).
- Improving the rail line from Felixstowe to Nuneaton and points north. This is not just about track but also about more efficient (digitised) signalling which allows for increased capacity using existing hardware.
- Improvements to the rail junctions at Ely which is a critical rail node for the whole region and is a significant constraint on growth.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Suffolk is home to the port of Felixstowe which handles 40% of the UK's container traffic and is the main container port for the Northern Powerhouse. We also have the largest grain exporting port in the country at Ipswich. Road and rail infrastructure to support these nationally significant assets is crucial. The new Industrial Strategy places a clear emphasis on the role of exporting in driving national growth so having a ports network with the right infrastructure for growth will be critical for the future economy of the UK

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

- 4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?**
- 5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?**

Simply maintaining and repairing assets will not support long-term growth. Our region has in the past done poorly compared to other regions for infrastructure investment – based on a repair and maintain policy. Despite this it has remained one of the three regions that are net contributors to UK plc. However, appropriate interventions at an earlier stage would not have led to the deficits identified at 1. above which are now acting as a brake on growth.

- 6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?**
- 7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?**
- 8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well- functioning markets?**
- 9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?**
- 10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?**

Forward funding of infrastructure to ensure provision is in place before development would make growth more acceptable and deliverable. However it would require more intervention from the public sector at national and local level.

- 11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?**

We welcome the inclusion of this question in the NIC consultation, as it demonstrates Governments' commitment to being the first generation to leave the natural environment better than we found it.

First, we should not lose sight of the natural environment's intrinsic value, nor our moral obligation to protect it. However, notwithstanding this, the role that the natural environment plays, through providing immeasurable natural capital, on which society depends, is a key consideration for NIC. Use of the mitigation hierarchy in infrastructure development is a tried and tested mechanism that supports good decision-making, as is a collaborative approach that involves appropriate stakeholders. However, we need to think more broadly about the definition of the natural environment, widening it from the traditional approach of evaluating impacts on protected sites, species and landscapes (such as through EIA), aspects that are, unhelpfully, still widely seen as constraints on growth, to the role these and other natural environment features, such as those covered by the definitions of natural capital, play in the sustainable future of society.

Infrastructure development should take full account of natural capital accounting in decision-making to ensure that our natural capital (the world's stocks of natural assets which include geology, soil, air, water and all living things) is not unsustainably depleted. This should be a fundamental principle in infrastructure development. Society depends, and will continue to depend, on the health and wealth of our natural capital, so it is vital that this generation does not unsustainably deplete stocks as we grow the economy. Natural capital audits and accounting will be increasingly important in the future, such that conservation (and enhancement) of the natural environment and thereby its ability to support life on earth, is properly considered in decision-making.

A further, more specific, area that NIC should consider is the role that the natural environment (and its conservation & enhancement) plays in a circular economy and as part of this in our health & wellbeing. There is much evidence, for example in the UK National Ecosystem Assessment, to demonstrate the benefits of the natural environment to mental and physical health and quality of life, and thereby to a healthy workforce, to inward investment in an area where the natural environment remains a strong asset, and to economic prosperity itself. In 2015 a Suffolk wide poll demonstrated that the countryside & coast is seen by the vast majority of respondents as the best thing about living in Suffolk. Similarly, Visit Suffolk's market segmentation analysis in 2015, showed that natural and heritage attractions were by far the most visited. Both are simple, yet powerful, demonstrations of the importance of the natural environment to contemporary societal agendas. This demonstrates that we cannot and should not separate the natural environment from wider decision-making, and in fact that across society we should see the importance of natural environment as a key building block of our economic prosperity and health & well-being.

- 12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?**

Transport

- 13. How will travel patterns change between now and 2050? What will be the impact of adoption of new technologies?**

High speed broadband availability across Suffolk will provide an increased opportunity for working from home for at least part of the week. This has the potential to reduce the level of commuting traffic to centres of employment, however the growth in population will still see an overall growth in traffic volume. It is also likely to increase the volume of local traffic (10-15 miles) with the opportunity for local shopping and socialising. The peak time commute is liable to spread over the day and the inter peak liable to grow in number levelling out the peaks across the day.

Local production of goods using 3D printing technology has the potential to provide a more distributed supply network. This has the potential to increase the demand on travel to the new local centres both for raw materials freight transport and customers visiting the sites.

Suffolk already has an above average older demographic and this is liable to increase. The short distance travel demand using new forms of mobility scooters and electric bicycles is expected to increase. Trips of 1-10 miles for retail and socialising will grow and place a demand on the infrastructure with new accessible purpose built "roads" being require to cater for this slower moving traffic.

Autonomous vehicles will provide the opportunity for higher volumes of vehicles travelling closer together and at consistent speeds. There is also the opportunity to reduce personal vehicle ownership with the related reduction in parking demand. The vehicles would also allow for greater usage of vehicles by those currently unable to drive due to infirmity or age (including under 17s), thereby increasing the numbers using the road network.

- 14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?**

On the assumption that economic growth will continue to develop in London, and the 3 major centres in the East i.e. Cambridge, Ipswich and Norwich investment is required in providing high speed and frequent transport between the centres. Improvements to the speed, reliable and frequent train links between the centres is key for both movement of both people and freight.

Pinch points on the trunk road require attention to improve the reliability of travel, this includes the provision of improvements at major junctions and interchange points on the network. These include the provision of new and enhancement of existing river crossings to increase the network capacity and to provide network resilience.

Within the urban areas sustainable transport improvements are essential to retain a working centre open for residential, commercial and leisure use. The provision of priority routes and areas for non- motorised and smaller sized/slower vehicles are key to achieving this.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

The continued growth of Felixstowe port as a centre for goods entering and leaving the UK requires investment in the connectivity of the port with the rest of the UK.

Short distance local travel in rural areas, needs to be improved, so that smaller sized and slower vehicle options are viewed as the normal means of getting around. The provision of routes segregated from the faster and larger vehicles is key to this goal.

With the potential for the growth of a more distributed network of local centres of production the transport network to these sites needs to be addressed. Improvements to the road and rail capacity and the requirement for improved maintenance as these routes become more heavily utilised.

16. What opportunities does “mobility as a service” create for road user charging? How would this affect road usage?

Mobility as a service is likely to drive down car ownership and with it parking demand. Associated with mobility as a service is the demand and requirement for full coverage and availability of real time on line data to ensure efficient movement.

In relation to road user charging this would need to be managed on a per mile basis which requires 100% accurate data coverage of vehicle movements to track, record and charge. Options to toll individual roads present a problem given the limited trunk road options and the potential impact from alternative routes through local roads and villages.

Management of the costs of travel could also be used to manage travel demand with peak time charging, emission charging and congestion zone charging. Freight road traffic to be managed along agreed corridors with penalties for non-compliance.

Digital communications

17. What are the highest value infrastructure investments to secure digital connectivity across the county (taking into consideration the inherent uncertainty in predicting long term technology trend)? When would decisions need to be made?

SCC believes that the UK requires both a breadth and depth of connectivity. There is no doubt that urban and business centres require to gigabit fixed fibre services to compete internationally, and likewise, the UK needs to be at the forefront of LTE and emerging 5G deployments for mobile connectivity. It is highly likely that the majority of this connectivity will be provided by the existing commercial marketplace, with all mobile operators currently signed up to 99% coverage of 4G by the end of 2017. SCC also believes however that policy needs to address the needs of the rural economy, and the platform for acceleration of the digital economy which can only be provided once ubiquitous broadband access is a reality. Therefore, given national broadband coverage will reach around 95% by 2019, our view is that we need to push on with the hardest to reach areas to ensure that full coverage is achieved as quickly as possible.

18. Is the existing digital communications regime going to deliver what is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

Since the inception of state intervention to increase fibre broadband rollout beyond the half of the country which was addressed commercially, Suffolk has been fully supportive and adoptive of government policy, led by the BDUK unit in DCMS. We were extremely pleased to sign our initial contract under the BDUK framework in December 2011, and completed that scheme ahead of target, under budget, and with an over delivery in terms of premises covered. This took us to the then policy commitment of 85% superfast fibre coverage, a considerable step towards eradicating the digital divide in Suffolk, and providing ubiquitous internet access required to live, work, consume services, and enable a digital economy to grow and become default in the UK.

Acutely aware that this scheme still left around 15% of Suffolk, or over 50,000 premises in the county who are unable to access digital services which the vast majority of the country take for granted, we were the first county nationally to

proceed under the BDUK Superfast Extension Programme, and now have a contract which will see us reach 96% coverage by 2019.

This does leave Suffolk County Council with two key issues to address. Firstly, there is no policy commitment or funding made available to address the circa ten thousand Suffolk premises who will be left behind after existing policy interventions are delivered. Secondly, for those who have now waited from 2011, through to 2019, there was a very high degree of frustration and disillusion felt.

To date, the solution proposed by DCMS has been the “Universal Service Obligation”, providing 10Mbps by 2020. In Suffolk, we remain concerned about the inadequacies within this proposed approach.

Firstly, the USO cites a speed of 10Mbps in 2020, based on the Ofcom Annual Report of 2015. Whilst 10Mbps is sufficient today for the market to sell current broadband packages, as the market develops and the connection has to cope with multiple devices, HD/4K content, VPN and other applications it will be insufficient by the time the USO comes into force in 2020. Therefore, our view is that this policy condemns a proportion of Suffolk residents to a second class service. Technically, long reach VDSL using the copper network also neglects to bring fibre close enough to these properties to provide a clear upgrade path beyond ~10Mbps, creating the serious risk of a need to intervene again as bandwidth demands increase.

It is clear from this proposed policy that government believes that completing the rural broadband rollout does not represent value for money as you reach the final few percent. We would propose that, rather than looking at the cost of the first premise upgraded with state funding, or the last one to benefit, we should instead look at the average cost per premise within the entire intervention from 50% to 100% as a single strategic programme, rather than the cost of the final premise connected. Fibre can reach 99% of the UK without being overly costly per premise, and the average cost per premise across the entire intervention should be where we focus our minds when evaluating value for money and shaping government policy.

In terms of the current policy and market composition, and the announcement in the Autumn Statement 2016, our key concern is that lack of policy and funding commitments in place to provide ubiquitous, upgradable superfast access. Whilst we can see the merit in committing £400m of government funding to intervene in urban areas and increase speeds further, we are aware that these areas have already been subject to commercial and/or state funded upgrades, and for which a healthy commercial market exists to provide further upgrades (eg CityFibre, Hyperoptic, MNOs)

Instead, we believe that funding should be committed to ensuring broadband access for all – this could be in addition to the money for extending full fibre access. We believe that until ubiquitous access exists, the digital economy can never truly embed and excel, not least in counties such as Suffolk. We have strongly urged government to communicate a clear and equitable strategy for those left behind after the delivery of current policy.

The recent DCMS consultation on this subject discusses the desire to stimulate market activity in rural areas. In Suffolk, our view is that this is a difficult commercial proposition which we have discussed with many alternative providers. Having spent close to £1bn of public subsidy to reach the areas between 50% and 95% coverage due to market failure, we suggest that it is abundantly clear that the only realistic, viable option is to extend and build that scheme for the final few percent, rather than to seek to create a thriving infrastructure market in the very hardest to reach areas at this point in time.

The consultation also discussed public sector demand aggregation. Having tested this extensively in Suffolk, it is quite clear that this does not form a viable solution for rural broadband access. Prior to the state funded Openreach FTTC rollout, public sector bodies were driven to spend vast sums of money funding private connections to rural primary schools and offices; connections which due to legal, commercial and technical reasons could never be “opened up” to provide to consumers. However, as the DCMS/LA funded schemes with BT have rolled out, we have been able to utilise the open access OpenReach infrastructure to replace these privately funded connections, saving money and negating the need for vast, privately owned public networks which duplicated spend (between private WANs and state funded Openreach FTTX networks). This model will continue in the market, and only the CityFibre style infrastructure build schemes will be viable, and by definition, these will be in urban areas, overbuilding existing state funded Openreach networks, or privately funded Virgin Media networks.

Energy

- 19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?**
- 20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?**
- 21. What are the implications of low carbon vehicles for energy production?**

Water and wastewater (drainage and sewerage)

- 22. What are the most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?**

Suffolk is considered to be in a state of severe water stress, although water companies currently have plans in place to supply existing projected growth this is very likely to increase and when combined with the projected impacts of climate change the future cost of supply is likely to rise. Future domestic demand needs to be tackled in all new build developments with increased requirement for housebuilders to install measures that limit demand, this needs to go beyond low water use taps and toilet and include grey water systems that will reduce demand as well as positively impacting the management of surface water.

Another intervention that would enable more sustainable water supply would be greater flexibility to be applied to current water resources regulations. Competition for water in availability in Suffolk is high and agricultural irrigation is vital to maintain the local rural economy, the regulations for control of groundwater and fluvial extraction are outdated and do not fit with some of the more innovative solutions. For example in order to drain low lying coastal farm land fresh water has historically been pumped over defences to the sea/estuary, our data suggests that for the Suffolk coast this is equivalent to the amount of water currently used to irrigate in the local area. Therefore, twice the water currently used is available, however, to use this water abstraction licences would be required but are not forthcoming under current regulations (designed to retain current resources), this is clearly not conducive to solving the issue of supply. Flexibility to recognise, this water pumped to sea as “wasted resource” would facilitate opportunities for it to be used to supplement irrigation demand and public water supply

- 23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?**
- 24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?**

Flood risk management

- 25. What level of flood resilience should the UK aim to achieve, balancing cost, development pressure and the long-term risks posed by climate change?**

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Natural Flood Management will be a vital tool to manage pluvial and fluvial flood risk reduction in Suffolk, we have a number of projects exploring the practical delivery of this technique. The merits are well understood locally and can be modelled effectively, a key barrier/opportunity is the involvement of landowners. Their agreement to “sacrifice” land to make room for water is a vital agreement and the current structure and management of the agricultural subsidy system is not flexible enough to enable schemes to be delivered easily. The review of the post-Brexit agricultural subsidy package should look to embed incentives for landowners to become partners in delivering public good by reducing flood risk to property.

Solid waste

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste.

The current financial regime is effective in encouraging diversion from landfill. However, the lack of national policy direction on waste and appropriate financial mechanisms is widely acknowledged to be the cause of plateaued/falling recycling performance. The current producer responsibility regime for packaging fails to support the costs of material collection from households and legislation confuses accountability for recycling. Greater clarity of roles would be beneficial to all and stimulate investment. Producer responsibility should mean just that, with industry taking responsibility for funding the full costs of recycling and ensuring that markets exist for the secondary materials that they generate. Local authorities are excellently placed to be the collection agents for industry, due to their unique position in already having a customer interface and relationship with householders; much of the necessary infrastructure in place to deliver the collection service; and an obvious operational synergy between recycling collections and refuse collections. By clarifying responsibilities in this way and removing duplication and ambiguity, government could also enable a move to greater consistency in service provision to residents. Many of the major producers affected would recognise this model, it being how they are required to operate already in many other markets across Europe.

28. What are the barriers to achieving a more circular economy. What would the costs and benefits (private and social) be?

Enhanced producer responsibility is an essential pre-requisite to moving towards a circular economy. Such a move will also require a significant cultural shift away from owning products to buying services, in order to better incentivise and reward investment in improved durability and design for re-use and recycling. Examples such as the move from buying media to subscribing to streaming services demonstrate that such cultural shift is possible.

Submission to the National Infrastructure Commission – National Infrastructure Assessment

10th February 2017

Joint Suffolk Member Working Group on the Strategic Planning & Infrastructure Framework

Page | 1

Introduction

The National Infrastructure Commission (NIC) was formally established as an Executive Agency in January 2017. As part of its National Infrastructure Assessment (NIA), which will become a once per Parliament statement on UK infrastructure need, the Commission has called for evidence on the strategic, long term priorities for infrastructure investment across the UK.

Specifically, the Commission has invited local government (along with LEPs and other organisations) to *share plans that are relevant to nationally strategic infrastructure, to help inform the evidence base for the NIA.*

This paper has been prepared by the joint Suffolk local authority member working group (MWG)¹ that is progressing work on developing a Suffolk wide strategic planning and infrastructure framework (the framework). Following the East Anglia / NIC session, held in Ipswich on 1st February and attended by a number of Suffolk members and officers, the MWG and officer team has prepared this high level overview of the process for developing Suffolk's framework and the authorities' approach to planning for strategic infrastructure investment over the longer term.

Suffolk's Strategic Planning & Infrastructure Framework

Suffolk local authorities, district, borough and county, are working together to develop an innovative approach to delivering long term growth and development across the region. Looking to 2050 we are preparing a joint framework that will deliver the region's economic vision, building rapidly on our position as a net contributor to the UK economy. Suffolk is an area with a reputation for delivery, as demonstrated by the unanimous support for Devolution, and we are well able to drive large scale regional growth – an '*East Anglian Energiser*'. The London–Ipswich–Norwich–Cambridge diamond encompasses seven airports and the two largest ports in Europe. Suffolk is, and will continue to:

- provide the largest gateway for UK plc trade through national and internationally significant ports;
- lead the UK in energy technology, delivering both significant generation from existing and new sources and innovative solutions to long term energy demand through renewables development;
- deliver world leading research, development and implementation of ICT solutions building on the success of BT and the existing cluster at Adastral Park.

¹ The Suffolk SPIF Member Working Group (MWG) includes representatives from Babergh District Council, Forest Heath District Council, Ipswich Borough Council, Mid Suffolk District Council, St Edmundsbury Borough Council, Suffolk Coastal District Council, Suffolk County Council & Waveney District Council.



The framework will set the direction of housing and employment growth over the coming decades and crucially, it will identify the infrastructure that is required to deliver and support this growth. Suffolk requires investment in its infrastructure to deliver on its own and Government's ambitions for growth. We are well placed to ensure the return on this investment is achieved through our partnership approach and joint prioritisation of needs. With support we can ensure Suffolk:

- operates an integrated transport network through investment in strategic and local roads and passenger / freight rail services leading to industrial and business growth, reduced journey times and housing development;
- has a highly skilled and flexible resident workforce that can adapt to changing technologies, working practices and production approaches; and
- ensures land for commercial, industrial and housing is "unlocked" due to sufficient investment in enabling infrastructure (transport, water, power, flood defences, digital communications) giving confidence to the development sector that Suffolk can deliver;

The public sector partners recognise that this framework for growth cannot be delivered in isolation. Extensive work with both the area's LEPs (NALEP & GCGP) is underpinning this framework and engagement to identify the types of infrastructure and development required by the business community is on-going with the support of Suffolk Chamber of Commerce.

Crucially, the Framework is not simply looking at Suffolk's growth and development need. We are working with neighbouring authorities in Norfolk, Cambridgeshire and Essex to ensure we understand the development priorities in these counties and the challenges they are facing to ensure that Suffolk's growth reflects these priorities and works in alignment with rather than competition to its neighbours. We are also responding to London's plans for growth and the opportunities and challenges this growth poses for the East.

The approach

The Suffolk authorities have initiated a review and collation of the evidence underpinning economic development and local authority land-use planning. Working with consultants we are developing a baseline that sets out the Suffolk demand for housing, employment and infrastructure provision over the coming decades.

The emerging Suffolk Framework identifies both enabling infrastructure, that is upfront infrastructure that needs to be in place in order to allow development to happen, and supporting infrastructure, the continued infrastructure that must be delivered and maintained to allow growth to be secured over the longer term. At a very basic level we have defined these as:

- Enabling: transport (road & rail), utilities (incl: water, energy), communications (digital & mobile), flood defences
- Supporting: educational & training, health & social care provision, amenity (green space), and waste treatment



Investment in enabling infrastructure will ensure that Suffolk will deliver on its ambitions to improve regional competitiveness and resident prosperity. By working with Government and securing increased levels of investment for infrastructure Suffolk can exceed its current levels of growth and compete on a level playing field with other UK regions.

In terms of identifying and planning these enabling infrastructure priorities Suffolk Authorities are working closely with partners (including the LEPs and infrastructure providers) to ensure common priorities are delivered. However, we do not simply want to develop a long list of infrastructure projects but rather Suffolk Authorities are committed to developing a step change in the approach taken to delivering growth and ensuring infrastructure investment unlocks housing and employment growth.

The framework is being developed to ensure it informs and reflects national and regional strategies and plans for growth and infrastructure delivery as they emerge and continues to present the concise, cohesive vision for Suffolk's growth. Alignment is and will continue to take place with:

- The recently published consultation *Building our Industrial Strategy*, the Green Paper, published January 2017 and setting out the Government's approach to improving the UK's economy, including through infrastructure investment.
- *Fixing Our Broken Housing Market*, Government's White Paper published 7th February 2017 setting out plans to increase the supply of new homes in England.
- New Anglia and Greater Cambridgeshire Greater Peterborough LEP strategies, 2017 onwards, due for completion summer / autumn 2017.
- Suffolk & Norfolk's Integrated Transport Strategy: currently in development.
- Regional infrastructure investment priorities as identified through regulated providers, such as Anglian Water, National Rail, Highways England, energy firms and BT.

The draft framework

Suffolk Authorities will deliver a draft framework for late Spring 2017. This framework will be taken to Suffolk Public Sector Leaders and following agreement will form the basis of a forward work programme that will be undertaken to provide further detail on key elements, such as a precise examination of the relationship between infrastructure investment and housing delivery and ensure continued alignment with regional / national priorities as they emerge.

The framework will be providing an assessment of different patterns of development across Suffolk and the extent to which these patterns enable greater benefit in terms of both "agglomeration" economies and, crucially, infrastructure investment.

Additional evidence

We have included the draft vision / mission / objectives of our framework and our emerging infrastructure priorities at the end of this submission.



Next steps

The Suffolk team will share the framework with NIC once it is in a draft format with indicative costings allocated to our priority infrastructure proposals and an assessment of the scale and timing of growth that can be enabled as a result of this investment.

The Suffolk framework team would like to work with the NIC as our framework develops and hopes that further discussions can take place over the coming months.



Appendix 1: Suffolk Framework DRAFT vision, mission & objectives

Vision

By 2050 Suffolk will be a premier location in which to invest, live, work and spend leisure time. People of every age will be attracted to and remain in the County because of its dynamic and connected urban, rural and coastal environment, and the education and employment opportunities available. In the words of Andy Wood former LEP Chair “It could be the powerhouse of Europe”.

Mission

SPIF articulates an ambitious, but sustainable growth agenda demonstrating a step change in Suffolk’s competitive position and the prosperity of its residents. It provides clarity on the scale and broad distribution of both housing and employment growth and prioritises the infrastructure investment required to deliver the growth ambition, including, in effect a ‘pan-regional superhighway’ that reflects the overall ambition of the region.

Objectives

By securing significant investment is enabling infrastructure Suffolk will:

- Deliver sufficient homes to meet both current need and future demand across Suffolk. (Targets: minimum of xxx by 2036, with a further xxx by 2050 – these will be set following finalisation of the evidence base)
- Achieve growth in key sectors and new / expanding industries, including significant new jobs, leading to increased productivity, higher wage levels and an increase in Suffolk’s contribution to UK plc (Targets: xxxx, to be set following finalisation of the evidence base)
- Prioritise investment in Suffolk’s strategic transport infrastructure leading to the delivery of the M14, the A12 trunk road, a northern Ipswich route and greater connectivity on the Felixstowe – Midlands rail route, via Ely.
- Work with neighbouring authorities, Cambridgeshire, Norfolk and Essex to ensure greater transport connectivity across the Eastern region is secured and complementary development priorities are delivered, e.g. cross border housing developments.
- Strengthen Ipswich and the surrounding area as the key economic driver of the County by investing to: support key growth sectors (ICT, financial services and education/knowledge economy); transform the cultural offer and quality of the town centre; and deliver ambitious housing growth within and around the town.
- Strengthen Suffolk’s role as the UK’s principal trading gateway to the rest of the world through continued growth of Felixstowe port and significant investment in the transport corridors (both road & rail) to facilitate access to the rest of the UK.
- Support sustainable levels of growth in the rural areas of the County, whilst protecting and enhancing the key environmental and landscape assets of these areas, and the important contribution that these make to Suffolk’s economy and quality of life.



- Support the coastal economy, including off-shore energy, nuclear energy, tourism and the sustainable use of marine resources through appropriate investment in infrastructure, housing and skills.



Appendix 2: Emerging infrastructure priorities for the Suffolk framework

Currently these infrastructure priorities are listed as a series of projects, however as stated above the aim of the framework is to ensure a step change in the approach to infrastructure delivery to ensure the investment unlocks further economic growth and housing delivery. As the framework is developed the relationship between funding infrastructure, in advance of development, and maintaining this investment to sustain growth will be explored with investment plans altered as required. This list of priorities is a starting point and is focused on unfunded schemes. It does not list projects that are currently in design / execution stages.

- Rail transport
 - o Haughley junction (on the Ipswich – Bury - Cambridge line) – doubling needed to improve both passenger and freight services across the County on East – West basis. This improvement is particularly important to deliver on the commitments in the East Anglia franchise.
 - o Ely area improvements to enable further development of Felixstowe line and increased freight traffic from Felixstowe Port onto the Midlands and the rest of the UK
- Road transport:
 - o Junction improvements on the A14, specifically junctions 37, 38, 43, 44, 55, 56, 57, 58
 - Junction 37: improvements to secure growth in Suffolk & Cambridgeshire and improve the interchange between the A11 & A14
 - Junction 43/44: improvements to unlock additional growth in Bury St Edmunds
 - Junction 55-58: junction improvements to deliver increased capacity for safer journeys across the south of Ipswich and provide resilience to the A14
 - o Improved radial / strategic routes to the North of Ipswich to improve traffic flow in Ipswich and provide resilience to the SRN, especially if the Orwell Bridge is closed
 - o Further A12 improvements to enable Sizewell C development, e.g. 4 villages bypass
 - o A11 technology corridor
 - Mildenhall Improvements – including the Fiveways Junction to enable a safer route with improved journey times and unlock growth in West Suffolk area
- Utilities: initial discussions have been held with Essex and Suffolk Water, Anglian Water and UK Power Networks to understand the existing infrastructure provision within Suffolk and the providers’ plans for the future.
 - o Water: Suffolk is an area of severe water stress and while supply and demand are currently in balance investment is needed deliver future growth.
 - o Power: current plans look to 2023 and we are currently working to identify where projected growth will impact significantly on the power generation and distribution network.



The strength of the local economy means that investment in Surrey has the potential to increase tax revenue to have an overall positive impact at the national level on Britain's Gross Value Added (GVA). Conversely lack of investment in Surrey is a main constraint to business growth and if it continues unchecked, it could have significant and wide ranging negative economic impacts.

Investment in Surrey's road and rail links is required to ensure that levels of growth in Surrey can continue to contribute to the local and national economy. Initiatives seeking to achieve sustainable travel patterns and modal shift have a key role to play in reducing congestion and the associated economic costs. In particular, improvements to the North Downs rail line are essential to achieving better connectivity across the county and beyond by providing an alternative mode of transport to the private car.

The county council has worked with borough and district councils to jointly commission a Surrey Infrastructure Study. This provides a comprehensive picture of the infrastructure needed to support planned growth in the county to 2030. The study found a significant funding deficit, particularly in relation to highways, rail and flood defence infrastructure. The evidence presented in the study provides the response to Question 1 of the consultation. The study can be downloaded via the following web page link:

<http://www.surreycc.gov.uk/environment-housing-and-planning/development-in-surrey/future/surrey-infrastructure-study>

We should be happy to respond to any queries on this response and look forward to responding to any future consultations.

Yours sincerely

[Redacted signature area]

[Signature redacted]
[Name redacted]
[Job title redacted]

Surrey County Council's response to the questions set out in the National Infrastructure Assessment Call for Evidence

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

The Surrey Infrastructure Study presents the anticipated infrastructure requirement for each element of infrastructure, including transport, schools, healthcare, social care, community facilities, green infrastructure, flood defences, waste, utilities and emergency services. It found that the cost of infrastructure to support planned growth is likely to be in excess of £5.37 billion and identified a gap of at least £3.2 billion in the funding required to meet these costs. A critical requirement is to ensure that fast broadband is provided and investment is urgently required in a fibre network across the area along with 5G connectivity

Surrey's top transport priorities are:

- The A3 improvements – there are areas of significant congestion on this strategic route and also on the adjoining network which impacts as a constraint to the deliverability of development in the borough of Guildford and potentially in the adjoining boroughs of Woking, Elmbridge and Waverley. It additionally has impacts for development in outer London boroughs.
- Woking Rail Junction – improvements here will have positive impacts on the capacity for this critical commuter rail link delivering an express service into and out of London as well as orbital services with links to the wider area of the South East region and beyond to the South West.
- North Downs Rail Line – investment is critically needed to improve orbital services across the county, particularly to Gatwick. This would be for additional services and also for the electrification of the North Downs Rail Line between Reading and Gatwick. This scheme could benefit from an East-West Rail delivery approach.
- River Thames Scheme – this is critical to reducing flood risk to 15,000 properties in communities both within and beyond the county and includes constructing a new flood channel, weir improvements and installation of property level protection.
- Southern Rail Access – even without the implementation of the Government supported proposal to expand Heathrow, the provision of direct rail access from Surrey to Heathrow is critical to reducing congestion in Surrey and around London and unlocking growth. Government should prioritise Southern Rail Access for Grip 1&2 completion.

• M25 and M30/M25/M11/M10 corridor – capacity or alternative north south corridor is important to accommodate wider growth in the region well

en the road to into enable the best
th a better po ined. first
er housing t se whork in

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Businesses located throughout the UK rely on connectivity to international gateways to reach international markets. Road and rail routes to Heathrow, Gatwick and the channel ports are congested, overcrowded and inefficient. This increases costs to UK business which impacts on profitability and therefore reduces the attractiveness of the UK as a location base for international business.

To maximise the potential of the international gateways, particularly the major airports at Gatwick and Heathrow, requires a level of national planning that is currently hard to discern. This should focus on high quality and reliable long-distance strategic routes. The NIC seems well placed to specify this work.

Specifically for Heathrow, in order to deliver the economic potential promised by airport expansion, there will be a need for significant additional transport investment over and above the Airport's immediate needs. This should be through a fully integrated approach to improving strategic infrastructure and the county council advocates a rail link to provide southern access to the airport. Otherwise, the investment at Heathrow Airport will fail to deliver on the potential to genuinely enhance the national economy.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Housing costs in Surrey indicate an acute and growing demand for new homes which is not being met. Residents are acutely aware that new housing development will add to existing pressures on already overstretched infrastructure. The timely and adequate delivery of infrastructure is therefore the fulcrum for making development more acceptable and deliverable. There are currently no formal mechanisms for achieving this across local planning authority boundaries although informal arrangements have been developed including local strategic statements. These are a step forward but it is doubtful that this informal approach will deliver the homes, employment and infrastructure required without greater and more formalised collaboration across wider areas.

In that context, the Government's Devolution Deals provide the opportunity to revitalise infrastructure planning. Whilst the National Infrastructure Commission has a leading role to play in assessing nationally significant infrastructure needs, at the regional scale the Government's Devolution Deals offer the opportunity to adopt a more integrated approach to the planning and delivery of infrastructure to achieve better outcomes for the people who live and work there. The Devolution Deals also offer the potential to accelerate and increase the scale of infrastructure development through new enhanced and pooled funding arrangements.

The twenty six councils in Surrey, West Sussex and East Sussex County Councils together with the three Local Enterprise Partnerships, East Sussex Fire Authority and the South Downs National Park Authority have joined forces as the Three Southern Counties (3SC) to prepare a bid to government for a Devolution Deal. Work is already underway on the development of an Infrastructure Strategy covering the 3SC area to promote the delivery of the transport, schools, healthcare and utility infrastructure required to support housing and employment growth that better meets local needs, in the context of national strategies. The Infrastructure Strategy will set out the overall scale and distribution of future housing and employment land requirements across the 3SC area and the infrastructure that will be required to facilitate this scale and pattern of development.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

Demand management can be an effective mechanism for optimising constrained resources. The maximum potential is difficult to ascertain as this is a dynamic issue and impacts would vary with circumstance. Scenarios are therefore likely to offer the best approach.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The balance between new and old infrastructure needs to be managed in such a way to ensure that future generations do not carry a higher burden for investment overall and so that assets do not deteriorate in a way in which they cease to provide a service to future generations.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Many of the current procurement routes favour larger players offering infrastructure services. This is because of the assurances required to do business. This reduces both competition but also in some cases access to knowledge in SMEs who may be offering far more intelligent solutions with a lower overall cost. How infrastructure is designed and delivered has a very great bearing on cost.

The Secretary of State for Transport announced a delivery model for East West Rail, whereby one organisation will deliver the design, construction and operation of the missing railway link between Oxford and Cambridge. This new approach is intended to accelerate delivery of the whole scheme from Oxford to Cambridge, as well as the Milton Keynes Aylesbury line. An East West Rail Consortium, established by local authorities and strategic partners, have committed to make a contribution towards the cost of the scheme and continue working alongside Government and the National Infrastructure Commission to ensure its delivery.

If successful, this model could be applied to other projects, for example, to advance investment in the North Downs Line. The county council has undertaken an assessment which sets out why investment is needed and what it will deliver in the way of employment opportunities, new housing, increase in GDP and other benefits.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: "funding", the Commission means who pays for infrastructure services and how they are financed in general terms.

Director of Infrastructure and Planning
Director of Economic Development and Regeneration

existing infrastructure. At present those that have a duty in many cases have to access funding from others to fulfill their obligations which is both time consuming and in many cases inefficient.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that "can be funded" but "will not be financed" refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

Current mechanisms do not encourage risk to be taken even when long-term returns can be shown. Revolving infrastructure funds operated on a devolved basis as have been proposed for a number of Devolution Deals may offer some scope to address this issue provided that they are of sufficient scale and operated in respect of a clearly defined infrastructure strategy for the relevant area.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

We have no comments to make in response to this question.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

This question and response relates closely to Question 3. The processes for funding and delivering infrastructure need to be better synchronised with the mechanisms for delivering development. It should also be recognised that lack of certainty about funding for investment in strategic infrastructure is a critical risk factor which can determine whether a strategically important development is delivered.

The strengthening of decision making processes at a strategic level for forward planning of development and the delivery of infrastructure is key to achieving greater efficiency in integrating the delivery of infrastructure to meet the needs of growth. A strategic planning approach would provide efficiencies in:

- Linking growth initiatives to wider strategies for infrastructure and housing provision; facilitating efficient decision-making and policy making on cross boundary matters relating to housing and infrastructure delivery;
- Enabling cost effectiveness in sharing resources to develop the evidence base for decision making;
- Providing a vehicle for engagement and cooperation with national, regional and local infrastructure delivery bodies such as Highways England, health authorities and education providers.

As set out in the response to Question 3, the Government's Devolution Deals provide the opportunity to revitalise infrastructure planning. Through the Devolution Deal, governance arrangements would be put in place to ensure clear democratic accountability and assurance at the local level for the delivery of the additional functions and responsibilities that underpin the devolution proposal, including the delivery of new infrastructure.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

It is appropriate here to refer to three of the core principles set out in the NPPF which relate to the natural environment. These principles are required to underpin both plan making and decision taking as follows:

- Contribute to conserving and enhancing the natural environment and reducing pollution. Allocations of land for development should prefer land of lesser environmental value, where consistent with other policies in this framework.
- Encourage the effective use of land by reusing land that has been previously developed (brownfield land), provided that it is not of high environmental value.
- Promote mixed use developments, and encourage multiple benefits from the use of land in urban and rural areas, recognising that some open land can perform many functions (such as for wildlife, recreation, flood risk mitigation, carbon storage, or food production).

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: "credible" improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. "Tractable" improvements are those that can generate usable quantitative outputs. "Transparent" improvements are those that do not rely on 'black box' modelling and assumptions.

We would reference an assessment of the potential economic benefits of investment in various strategic transport corridors commissioned by Coast to Capital, Enterprise M3, Solent and Thames Valley Berkshire Local Enterprise Partnerships (LEPs), along with partner local authorities.

The focus of the study was on the wider economic impacts of the strategic corridors and specifically, how these can help boost connectivity and productivity in the region. These corridors address the lack of orbital connectivity around London and the need to link better to ports and airports.

The methodology used in the study included the following features:

- The "building blocks" of the analysis use recognised guidance based on Treasury Green Book principles (i.e. DfT's WebTAG approach covering Wider Impacts is itself based on Green Book guidance);
- Although founded on WebTAG principles, several add-on economic impacts and metrics are derived (such as the impacts improved productivity has on regional GVA, employment and taxation revenues);
- The impacts were calculated in two ways: 1) firstly, as a "snapshot" of current impacts (i.e. what is the economic impact if the change took place now?) and 2) what is the "longer term" (or forecast) impact over time? – this is explained in more detail below;
- The approach is used at a high level to identify and prioritise corridors before more detailed analysis takes place for shortlisted corridors (i.e. to include proposed residential developments etc.); and
- The approach is designed to be flexible enough to be able to test several different strategic options.

This method was found to have several advantages:

- It is based on recognised methods and can be calculated relatively quickly given the information already available;
- It is flexible and can be used to assess different types and lengths of corridors (featuring different modes);
- Once the productivity impacts have been calculated, these can be applied to the latest ONS GVA data to give a regional and national impact; and
- There is sufficient flexibility in the input assumptions for each corridor so that these can be adjusted for sensitivity testing.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: "travel patterns" include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

We have no comments to make in response to this question.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

We have no comments to make in response to this question

13. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

We have no comments to make in response to this question

14. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

We have no comments to make in response to this question

Digital communications:

17. What are the highest value infrastructure investments to secure across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

There are a significant number of communities across Surrey that are difficult to reach into the more remote or hard to reach areas of the county, in particular in terms of broadband and financial services rollout.

support from the Government Better Broadband Scheme. However there is a clear need to extend the Better Broadband scheme beyond the planned closure at the end of 2017 and to provide a fibre network with 5G connectivity across the area to enable many more communities to take advantage of direct funding from central government.

18. **Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?**

Note: the existing "regime" refers to the current market, competition and planning frameworks. "Digital communications" includes both fixed and mobile connectivity.

See our response to 17 above.

Energy:

19. **What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?**

There are a wider variety of options for decarbonising heat, each with differing merits and feasibilities in different situations. Clearly efficiency improvements are key, including continued opportunity and need for retrofitting domestic properties with insulation (loft, cavity wall and solid wall). This requires further stable and long term funding, not a short term and On/Off approach which is the current case with funding in this sector, which is difficult (not efficient) for either the supply chain or the consumer.

In terms of decarbonising the residual heat demand, options include: electrification of heat (e.g. heat pumps) powered by an increasingly decarbonised grid; biomass including woodfuel, energy crops and Energy from Waste (which could be CHP or heat only boilers) and passive solar heating (i.e. building design considering orientation and glazing etc).

20. **What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.**

We have no comments to make in response to this question

21. **What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?**

We have no comments to make in response to this question

Water and wastewater (drainage and sewerage):

22. **What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?**

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

We have no comments to make in response to this question

23. **What are the most effective interventions to ensure that drainage and sewerage capacity is maintained and enhanced?**

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

Local Plans outlining future development must align with Flood Risk Management Strategies and Water Companies long term investment strategies. That way, investment in drainage and sewerage can be better matched with locations earmarked for future development. It is also essential that water companies are made statutory consultees.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

A whole catchment approach should be employed but the key parties must also be involved in a holistic approach to delivering solutions and managing current risks. The bodies involved among many are actively improving their joint working but commercial pressures (including LLFAs, Local Planning authorities, water and utility companies and the Environment Agency corporate sensitivity of data, OFWAT limitations), other planning pressures, the differing time scales for large scale planning (AMP periods vs Local Plans vs National & local FRM strategies) and the sheer number of parties involved mean that a truly holistic catchment approach is near impossible to achieve currently. A simple first start would be to make water & utility companies statutory consultees.

Catchment level boards could work and indeed the WFD approach of catchment partnerships for water quality should be seen as a model to joint pooling and coordination of resources, future planning and provision of joint innovative solutions.

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

The current levels of risk set out by the modelled flood maps for flooding from rivers and the sea and from surface water do not currently take into account the increase in risks due to climate change. Additional mapping should be produced to show these future risks. This would clearly demonstrate the likelihood of these risk to developers, planners and the general public and help decision making with respect to current and future development and protection of infrastructure. Similarly statistical analysis of the return periods used in flood modelling should be updated to ensure recent changes in our climate (and flood events) are being taken into account when flood risk models for new infrastructure development and flood risk management schemes are being planned.

The current focus is on building defences to reduce the level of risk. In areas of high flood risk the management of impacts can also be effective. Managing impacts through increasing community awareness is an approach which forms the foundation of Surrey's Flood Risk Management Strategy. This sets out the process undertaken by the flood authority of maintaining the existing systems and involves working with the community to build their resilience through awareness of responsibilities and local action and identifying opportunities to mitigate the residual risk once the local measures have been achieved. Through this approach we have been able to reduce the risk to a level which is tolerable to the community and infrastructure users whilst minimising the cost all round.

It is considered that infrastructure should be functioning within 24 hours of an incident being over and properties should be habitable within 6 months of an incident.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

There are distinct merits in using all available approaches to managing flood risk; especially as the requirement to understand the risk and live with water (using resilience and holistic management approaches) will become prevalent with climate change, an increasing maintenance burden and financial pressures.

Natural flood management has its place but due to the limited land available in key high risk areas (plus increases in demand for housing, agriculture etc), the variable topography and the limited impact these practices can achieve in the worst rainfall or storm events they should not be considered a panacea to the problem. A holistic catchment approach using innovative techniques, catchment scale planning (both for flood risk management and for new development), traditional engineering, property level protection and community resilience needs to be employed.

The Catchment Partnership Boards set up to deliver Water Framework Directive actions are a good example of how this can work. In Surrey we work with the Wey and Mole Catchment Partnerships to deliver flood risk management outcomes alongside habitat improvements.

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet land fill and recycling objectives and to assign responsibility for waste?

The largest barrier for developing waste infrastructure in Surrey remains the difficulty in finding suitable sites and obtaining planning consent. There is no easy fix to this but the national policy emphasis on housing must continue to emphasise the importance of waste management facilities as supporting infrastructure and the need to safeguard suitable sites for waste use. Competition for land in Surrey means that sites identified for waste use are often lost to higher value uses such as residential. Landfill tax has been the single most influential financial incentive to help drive the management of waste up the waste hierarchy. It is important that it is retained and continues to be increased, at the very least, in accordance with the retail price index.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Note: A "circular economy" is an alternative to a traditional 'linear economy' (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

Producer responsibility has been shown to drive innovation in the industry to develop products that are more recyclable and to develop recycling infrastructure. A good example of this is with regard to Waste Electrical and Electronic Products – where the industry bears the cost of recycling and has developed infrastructure and processes to recycle this waste. Waste streams such as soft furnishings, carpets and mattresses continue to end up in landfill as they are problematic or not cost effective to recycle – Assigning responsibility to producers to pay for and deal with recycling of this waste would enable innovative processes to be developed for these materials.

Sustainable Energy Association

National Infrastructure Commission – Call for Evidence

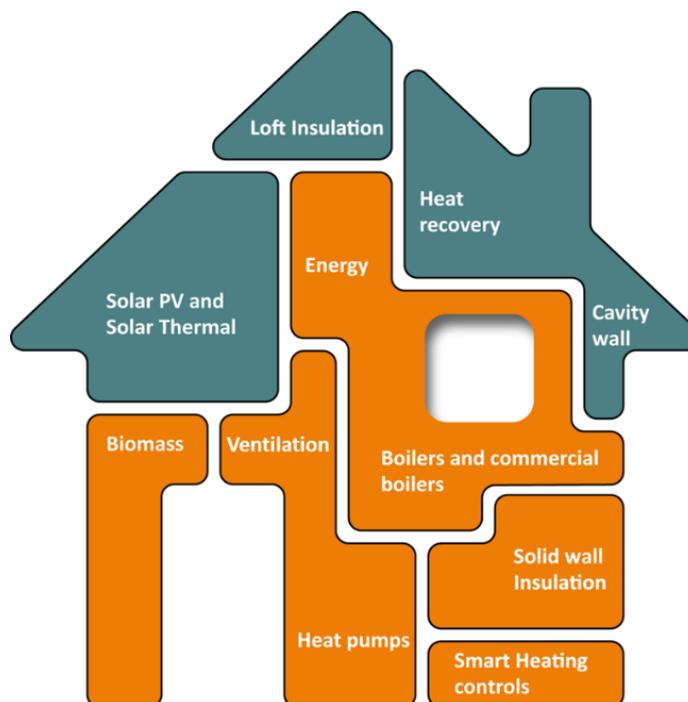
Date: 10th February 2017

Response submitted by: Sustainable Energy Association

For more information please contact: [name redacted]
[email redacted]

About the Sustainable Energy Association

The Sustainable Energy Association is a member based industry body. We are technology agnostic, taking a whole house and whole heating system approach which does not favour one technology over another but rather focuses on the right solution. We promote holistic approaches to developing heat policy ‘wrap then heat’ in line with our wide-ranging membership which covers energy efficiency as well as renewable technologies and non-renewable heating technologies such as gas boilers. Our members manufacture, retail or regulate a range of technologies including ones shown below:



Key Message

Improving our building stock, which is one of the least efficient in Europe, needs to be a priority. Our buildings are a significant physical asset and as such the Government should place buildings at the heart of delivering the United Kingdom’s energy policy goals. The delivery of energy efficiency including the deployment of low carbon energy sources is one of the most valuable, long term infrastructure investments that the Government could support. Investments of this kind, provide long term benefits to the economy and to society. Ensuring that our buildings are well-insulated, future proofed and able to accommodate low carbon heat sources is essential if the UK is to meet its carbon targets, address fuel poverty and improve consumer health and wellbeing.

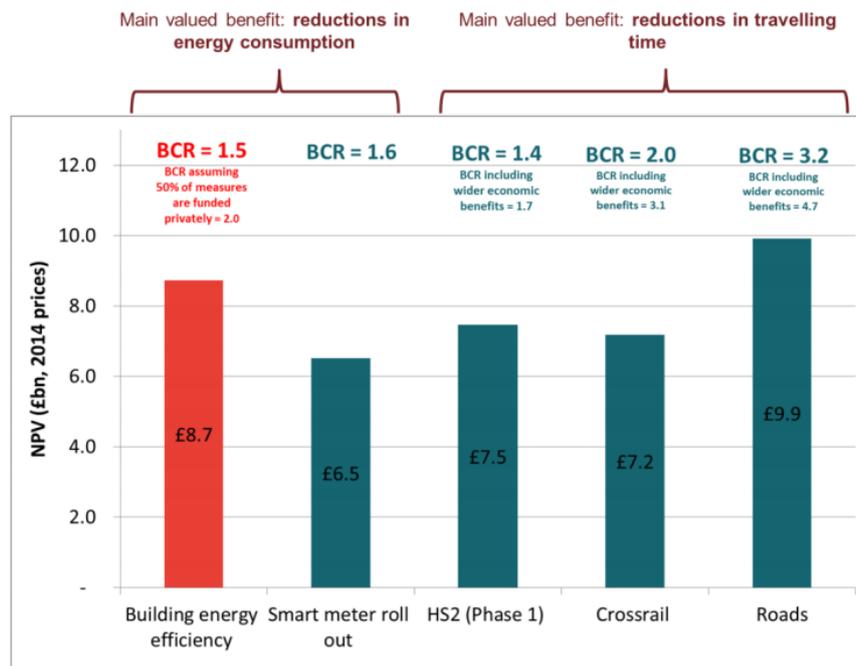
Cross-cutting issues

Q. 1. What are the highest value infrastructure investments that would support longterm sustainable growth in your city or region?

The SEA consider that the delivery of energy efficiency including the deployment of low carbon energy sources, is one of the most valuable, long term infrastructure investments that the Government could support. Investments of this kind, provide long term benefits to the economy and to society. Research produced by Cambridge Econometrics and Verco found that for every £1 invested in energy efficiency there is a £3.20 return to the Economy.

Figure 1 details this graphically, and shows that an energy efficiency infrastructure delivery scheme compares favourably with many other supported infrastructure projects when considered on a narrow cost/benefit perspective – without monetising the substantial health benefits that can be achieved. Here a major energy efficiency infrastructure scheme could deliver a net benefit of £8.7bn (2014 prices) to the UK economy¹. In addition such a project would reduce some of the £1.36 billion the NHS in England pays out to treat sufferers of ailments associated with cold homes.

¹ Frontier Economics (2015) Energy Efficiency: An infrastructure priority



Source: Frontier Economics, based on sources detailed Box 1 on page 17. The NPV is the present value of the difference between the stream of costs and benefits of each scheme. The BCRs represent the ratio of societal benefits to Government costs (In line with Webtag guidance). The NPV figures do not include wider economic benefits. The base year for the present values varies between 2010 and 2013.

Figure 1 - Estimated NPV of different infrastructure schemes (Frontier Economics, 2015)

Inefficient homes are expensive to heat and can have negative health implications with the risk of cardiovascular and respiratory illnesses being heightened by living cold and/or damp conditions. This means that poorly performing buildings are a drain on the NHS and on the economy as a whole. It is estimated that insulating all the solid wall homes in the UK could bring about health benefits worth £3.5bn - £5bn.²

Government should therefore make energy efficiency improvements a National Infrastructure Priority, and – where cost effective – move all homes up to EPC Band C. Such improvements will deliver significant environmental benefits and fuel bill savings and can have a transformative impact on those that live in fuel poverty – lowering NHS costs, improving social mobility (improving education and job prospects) and increasing wellbeing.

Improving energy efficiency increases productivity, reduces costs and provides jobs. The Scottish Government has declared energy efficiency a National Infrastructure Priority and as part of their Energy Efficiency Programme, the Government has estimated that for every £100 million spent on energy efficiency improvements in 2017, approximately 1,000 full-time equivalent jobs are

² UKGBC (2014) [A housing stock fit for the future: Making home energy efficiency a national infrastructure priority](#)

supported³. The Think Tank Bright Blue also highlights the job creation potential of energy efficiency, stating that “the sector of the UK low-carbon economy which creates the highest number of jobs is energy efficiency, employing 155,000 people in 2014” and that improving the energy performance of all homes to EPC band C would create 108,000 net jobs per annum between 2020 and 2030.⁴ It is important to note that job creation through energy efficiency is not area specific as the installation of energy efficiency measures requires local labour. The wide geographic spread of demand for energy efficiency measures means that the supply chains and manufacturers that support the energy efficiency industry are likely to be located outside wealthy areas and provide sustainable jobs across the country. No other investment can stimulate economic growth and create jobs in every UK constituency whilst helping struggling households and reduce the cost of decarbonisation⁵.

In off-gas grid areas/regions in particular, with limited heating options available for consumers, energy bills are typically higher than the on-grid average. Here the development of renewable heating infrastructure can help supply low-carbon energy to consumers, at lower and less variable costs. Currently, a barrier to such energy supply is the high upfront cost, of which a proportion is derived from the cost of ancillary measures (see Figure 2 below). This includes ensuring systems are specified to be ‘heat pump ready’ today (e.g. ensuring heat emitters are sized to enable low return temperatures). Figure 2 illustrates the high proportion of installation costs attributed to ensuring that the property has appropriate heat emitters and piping to enable the efficient running of a low flow temperature renewable technology. Government has a role to play in developing this energy infrastructure. Building regulations should ensure that heating systems are specified with renewable-ready infrastructure today, to ensure that the costs associated with installing low flow temperatures systems are lowered in the future.

³ Scottish Government (2017) [Draft Climate Change Plan](#)

⁴ Bright Blue (2016) [Better Homes](#)

⁵ UKGBC (2014) [A housing stock fit for the future: Making home energy efficiency a national infrastructure priority](#)

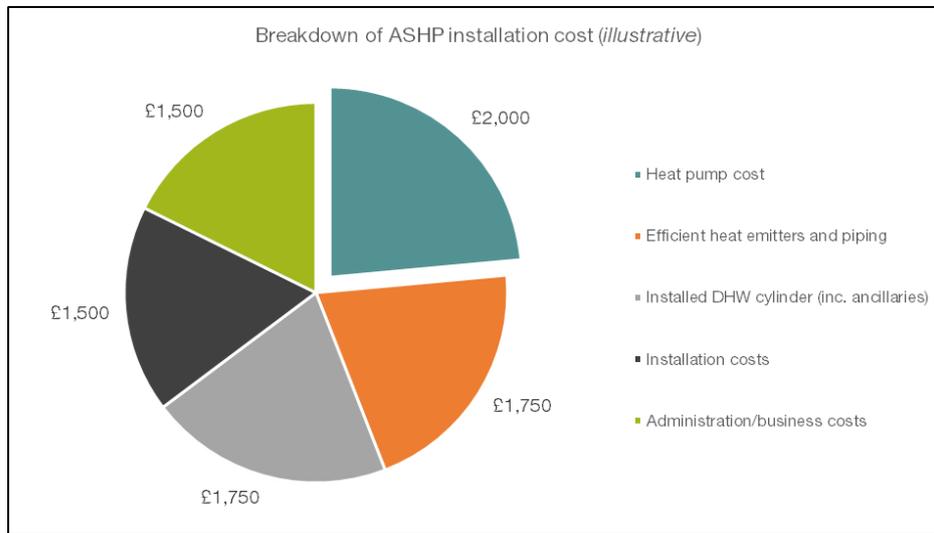


Figure 2 - Illustrative breakdown of Air Source Heat Pump (ASHP) installation costs.

Q. 2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Whilst there are many infrastructure investments which can improve the UK's international competitiveness, reducing energy costs is particularly pertinent for high energy users, such as companies operating industrial processes. Improving building fabric and installing energy efficient heating systems will deliver substantive energy savings and provide an enduring solution to energy demand reduction. Energy efficiency is key to maintaining the UK's international competitiveness as it lowers running costs, increases productivity and reduces carbon emissions. Moreover, it is estimated that in 2011-12, exports from the UK's energy efficiency sector were worth over 1.85bn⁶. Making energy efficiency a National Infrastructure Priority would put the UK in an advantageous position, as it should provide the necessary policy stability and investor confidence to enable industry to further increase skills and knowledge, and develop products for the domestic and export markets.

Q. 3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Energy requirements are consistent among places we live and work in, and indeed the impacts of hazardous conditions created by the lack of adequate heating, could be felt in either situation. When making the business case for energy efficiency measures, the first argument is often to highlight the reduction in energy bills; but efficient buildings also provide much greater and wider reaching benefits to companies and to the public. Studies have shown that fuel poverty and poor heating are correlated

⁶ DECC (2013) [Energy Efficiency Strategy](#)

with poor physical and mental health, lower educational attainment⁷ and lower labour productivity. Ensuring that properties are adequately ventilated can reduce the transmission of airborne illnesses which means that the number of sick days within an organisation could be reduced and the recovery time of individuals could be improved by addressing the building fabric. The UK Green Building Council states that offices which are designed and constructed to be ‘green’ are healthier and more productive places to work. Energy efficient schools and workplaces provide healthy, high performance environments to stimulate staff and students thus improving productivity. Improvements to building regulations and minimum performance standards can help deliver spaces which are better to live and work in.

The SEA advocate a Wrap then Heat approach to heating. By addressing heat without addressing efficiency could lead to a sub-optimal outcome, therefore the Government should ensure that the whole system is considered.

The Government has recently consulted on amendments to the domestic Building Regulations. The SEA responded to this consultation and proposed that the Government should develop a regulation roadmap outlining how energy efficiency and heating system improvements can reduce consumer energy bills and carbon emissions whilst leaving a legacy of more efficiently heating homes and low carbon ready infrastructure. We would like to see the Government mandate that heating systems are required to operate more efficiently and at lower temperatures. The technology and expertise to design and specify such systems currently exists. Such efficiency improvements would lower fuel bills, improve the distribution of heat within a building, and potentially allow for an improved standard of living in homes and office spaces that were previously under-heated because of costs.

In relation to the incentives that can deliver better energy efficiency and potentially improved living conditions in the places we work, a mixture of tools are needed. Market intervention is necessary to stimulate the wide scale adoption of efficiency measures. Regulations such as improved building standards, levies or taxation relief can obligate or encourage entities that otherwise would have been unwilling to invest to improve their energy efficiency. However, the composition of the solution needs to be tailored to the circumstances of the individual property; age, location, use and tenure (including the relationship between the owners and the occupants).

Energy efficiency should be a National Infrastructure Priority, but some decisions should be made and delivered locally. Local authorities and local actors (such as doctor’s surgeries and healthcare centres) have a good knowledge of their area and the problems faced by the local people. It is therefore important that local actors are involved in the decision making and planning process as they can help to ensure that infrastructure developments are designed to provide the most benefit to the local area. Allowing local authorities to set their own sub-targets, which could be set over and above the minimum national standard, will permit customisable objectives that take into consideration the profile of buildings within their remit. This approach would enable the Government to set the overall

⁷ Liddell, C. (2008) Save the Children: [The Impact of Fuel Poverty on Children](#).

Building Regulations or energy efficiency targets at a national level to ensure that minimum standards are met nationwide.

Q. 4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

The deployment of energy efficiency measures, improving building fabric and installing efficient heating systems will deliver more substantive energy savings and be a more enduring solution than encouraging behavioural change. There is a risk of slippage in energy performance gains with energy management and energy use options; particularly where buildings are in flexible use and subject to change in occupancy. Unlike behavioural programmes, improving the thermal efficiency of a building offers a greater chance of creating a lasting reduction in demand, independent of the occupiers. Research has shown that a combination of education and investments in infrastructure can foster new values which can lead to sustained behavioural change and participation in energy management activities. However, a holistic programme which addresses individual and social factors as well as ensures the provision of technology or infrastructure is needed to foster lasting change.⁸

It is important to note that the deployment of energy efficiency measures can make it cheaper for households to heat their homes and therefore they could increase energy usage. Prior to improvement, the cost of heating for some homes is too high due to the property being leaky and therefore, households opt not to heat at all. For low-income homes, Cambridge Econometrics use a rebound effect figure of 40% (i.e. reduce possible savings by 40%) to take account of comfort taking.⁹ Although this rebound effect exists, savings can be made and household wellbeing can be significantly improved as a result of energy efficiency take up. Rebound effects are often due to occupiers setting the room thermostat higher, increasing the heating period or the number of rooms heated. Smart technologies can be installed to overcome some of the rebounds effects associated with improved efficiencies.

The performance gap between energy performance and design has been extensively researched in domestic buildings and quantified under the ‘rebound effect’, however research into this effect in non-domestic buildings is lacking especially in the UK. A German study by Grossmann et al. found that non-domestic buildings saw comparatively low rebound effects but high energy performance gaps between design and performance.¹⁰ A further study assessing rebound effects in German non-residential public buildings found little indication of higher post-retrofit energy consumption.¹¹ The research noted that non-domestic building users or occupants, consume energy more carelessly at work than at home, this may be linked to the individual workers not being responsible for energy

⁸ Scottish Government (2012) [The impact of workplace initiatives on low carbon behaviours](#)

⁹ Vero and Cambridge Econometrics (2014) [Building the Future: Economic and fiscal impacts of making homes energy efficient](#)

¹⁰ Grossmann et al. (2015) [A methodology for estimating rebound effects in non-residential public service buildings: Case study of four buildings in Germany](#)

¹¹ Weiß (2016) [Rebound effects in non-residential public service buildings](#)

costs. The study found that rebound effects were near to zero, however it highlighted a high potential to improve user behaviour.

In non-domestic buildings, a recent BEIS survey of the UK's building stock¹² suggests that 63 TWh of consumption per year could be reduced through energy management, lighting replacement, and other energy efficiency measures - a 39% reduction. As a significant portion of abatement potential can be achieved through the installation of better energy management systems. It could be argued that significant rebound effects may not be great as many of these controls work automatically and optimise supply based on existing energy demands and are therefore not subject to user interference. Therefore the likelihood of users increasing consumption as per the rebound effect could be reduced by installing automatic controls.

As highlighted above, a holistic approach to energy use in buildings needs to be taken. The thermal efficiency of the UK's housing stock needs to be improved and the public need to be better informed to incite behavioural change. Long term, wide ranging benefits can be achieved by increasing the energy performance of buildings through the deployment of energy efficiency measures and low carbon heating. Behavioural changes are harder to encourage and maintain. The SEA would therefore advocate that the NIA adopts a whole house, wrap then heat approach to energy demand management.

Q. 5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Typically, it is more costly to retrofit a property with a new heating system or efficiency measure, than it is to install the same measure when building the property. Therefore the construction of new assets should be done to a standard which removes the need to retrofit in the future. Regulations should require the installation of cost effective and future-proofed infrastructure, which promotes low-carbon, efficient energy provision, and removes the need for expensive retrofitting in the future. Building standards should be incrementally strengthened, the SEA call for a long term regulatory framework to drive up new build performance. It is also important that new builds are built to current building standards and do not require additional retrofit in the near future and that performance better matches design estimates. Efforts in regard to new build should be focused on ensuring that buildings are built to a high standard and that installation quality is high.

The majority of today's housing stock will still be in place in 2050, by which time - as formalised in the Climate Change Act - the UK will need to have reduced GHG emissions by 80% from 1990 levels. It is therefore paramount that the current housing stock is improved and retrofitted to a high future-proofed standard. The UK has some of the least efficient properties in Europe and as such the Government needs to put in place a long term plan to improve the existing stock. The SEA is calling for the Government to bring all homes up to EPC band C by 2020, in doing so, the Government will help to reduce the risk of fuel poverty, improve wellbeing and lower healthcare costs whilst also

¹² BEIS (2016) [The Building Energy Efficiency Survey 2014-2015](#)

reducing carbon emissions. Heating is a key part of this, and making improvements to existing assets will be key to the UK meeting its legally binding climate change targets.

The challenge to maintain, repair and improve the UK's existing building stock is great and a range of financial and regulatory measures may be needed to achieve the goal of bringing properties up to EPC band C. Targeting moments when systems breakdown and require maintenance or repair, increases consumer appetite to engage with the construction of new energy infrastructure. At the point of system breakdown and repair, the consumer already faces some disruption and therefore some of the barriers to technology deployment are reduced. Policy should aim to target these trigger points. We would like to see Government provide a policy framework which encourages individuals to view their heating systems as a whole and incentivises them to carry out infrastructure upgrades. Moreover, the Government should help homeowners and businesses overcome the barriers to deployment such as access to finance and information.

Q. 6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Encouraging collaboration between businesses can provide significant benefits to all parties as energy efficiency can be improved. Companies that collaborate across the supply chain are able to realise significant reductions in costs and improvements in the speed of delivery, service and customer satisfaction.

Local authorities should also be encouraged to collaborate. Devolving powers to local authorities and enabling them to set their own targets will encourage local authorities to collaborate and undertake joint projects which will reduce the costs of implementation. At the same time local authorities will be sharing knowledge and maximising benefits from economies of scale.

If the Government is to adopt a 'whole-house' approach to energy, it may be increasingly necessary for supply chain actors to collaborate to enable multiple improvements to be made at the same time.

Q. 7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The ESCo model has been particularly successful in the USA however 80% is contracted to the public building sector, however there is a need to find ways to extend ESCo model to the commercial sector. Increasing the size of the Green Investment Bank and/or extending the remit of organisations like Salix Finance to the commercial and domestic sectors could help crowd private investment into energy efficiency and heating infrastructure projects.

At our recent Social Housing Roundtable, attendees highlighted the difficulties faced when navigating the existing sources of finance and information. A central funding portal may help reduce the complexities faced by organisations when researching available funding. This may reduce the time

spent assessing the available funding options at the beginning of a project and therefore mean that projects are implemented quicker and at less cost.

Q. 8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

In the renewable heating sector, uncertainty caused by political changes and alterations of incentive rates has hampered investment. Investor confidence in the renewable heating and energy efficiency sectors has been significantly impacted by policy instability and the removal of performance targets for example the zero carbon homes standard. Government needs to set and stick to clear, decisive, long-term policy to instil confidence and drive investment.

Q. 10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The Department for Communities and Local Government has recently published a paper¹³ focused on increasing the number of homes and improving the quality of those built. The paper highlights the need to ensure that homes are built quickly once planning permission is granted. This is something that our members feel needs to be addressed, builders should not be able to build to old building regulations thus delivering lower quality homes. If planning permission is granted, developers should be required to begin building straight away or within a reasonable timeframe to avoid land banking. The Government has proposed to plan for the right home in the right place, this is an approach that the SEA supports as we believe that there is a right solution for each home and there is not a silver bullet to improving housing quality - a range of solutions are needed to ensure that homes are fit for purpose, built to a high standard and are of enduring quality. These solutions are dependent on the local circumstances and therefore we would like to see the design of new homes incorporating local needs.

Q. 11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The installation of energy efficiency measures, is on average the most cost-effective way to deliver carbon emission savings, and protect the environment from dangerous climate change and air pollution. The SEA supports a ‘wrap then heat’ approach to low-carbon heating development. After energy efficiency, infrastructure investment should consider ways in which heating supply can be delivered with lower emissions. Here the most cost-effective areas to initially target are new-build properties and off-gas grid regions where heating alternatives include heavily polluting fossil fuels such as oil.

13

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/590463/Fixing_our_broken_housing_market_-_accessible_version.pdf

Q. 12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

The cost-benefit analysis technique needs to capture the disproportionately large and positive utility/wellbeing impact that energy efficiency improvements can have on those in fuel poverty/low income, and should seek to quantify the many significant, unmonetised benefits – including health improvements. In doing so, the Government could justify investing more into delivering energy efficiency improvements.

In addition, when considering the benefits of investing in future-proofed heating system infrastructure, the appropriate lifetime of the benefit should be calculated and used. Installing future proof technologies now will reduce the cost of moving to low carbon systems in the future and as such these benefits need to be quantified in cost-benefit analysis.

Energy

Q. 19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Commercial and domestic consumers should adopt a ‘Wrap then Heat’ approach– investing in cost-effectively reducing energy demand before addressing the heating system. All heating systems perform better in well-insulated properties. The cheapest energy is the energy we don’t use, therefore efforts should be made to reduce energy consumption.

Efforts should be targeted off-grid areas and in new build properties as these are seen as ‘low hanging fruit’ for low carbon investment. Building regulations are key to driving the deployment of energy efficiency and efficient heating systems, and are highly effective at doing so. It’s vital that new build properties are built to a high standard, to prevent unnecessary and expensive retrofit at a later date. Equally those times of renovation provide an intervention opportunity which should be exploited. During renovations it is important that property improvements are conducted to standards which are in keeping with energy efficiency and carbon targets.

In off-grid areas heat pumps and biomass can provide great solutions for a diverse building stock. It is important that the technology utilised fits the property characteristics and demand profile, as such there is not one superior technology. The SEA promote a technology agnostic approach which can deliver running cost savings for commercial and domestic consumers against fossil fuel derived heating in off-grid areas. There is no ‘silver bullet’ in regard to low carbon heating, each technology is suited to a particular niche and these niches should be exploited. It is important to ensure that consumers are opting for the most appropriate technology for their needs as this will increase the likelihood of the technology performing optimally and the consumer receiving maximum benefit.

As highlighted in our response to question 5, decisions in regard to the heating system are often made when a system breaks down, requires repair or replacement. At these trigger points, consumers are more aware of their heating system and have greater appetite to engage with energy infrastructure.

At these points, the consumer already faces some disruption and therefore some of the barriers to technology deployment are reduced. A further trigger point would be at the point of rent or sale of a property. The SEA has carried out research into a range of able to pay regulatory nudges and financial mechanisms which could encourage the uptake of energy efficiency measures including low carbon heating at the point of occupant change. Again at this trigger point, the barriers to deployment are reduced for example the occupant may be carrying out refurbishment work which means that builders will already be onsite. Also at the property sale or rent, the buyer or tenant is engaged in the performance of their property and therefore this period may provide a significant opportunity to deploy low carbon efficient heating systems.

Q. 20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

The SEA fully supports the Government’s intention to achieve the UK’s carbon targets. The UK has ambitious carbon emission reduction goals – an 80% reduction by 2050 – which can only be achieved with a co-ordinated and cohesive response addressing heat, transport and electricity.

There is no single solution to decarbonising the power sector, however the power sector must be decarbonised. The UK power sector will face significant challenges in the coming decades if it is to meet its binding carbon targets. Meeting the long-term carbon emission reduction targets will require the widespread expansion of low carbon generation technologies. A key consideration in regard to the uptake of renewable and low carbon technologies is the unpredictable supply and how to cost-effectively integrate the technologies into the grid. The Committee on Climate Change has found that “it is feasible to manage a future GB power system that is deeply decarbonised with high levels of intermittent renewables”¹⁴. The Government needs to assess the costs and benefits of all available options including more innovative technologies.

In order to accommodate a significant increase in intermittent renewables, there is a need for increased grid flexibility and reduced peak demand, this means making grid upgrades and maintaining current infrastructure as well as developing new solutions. Grids will need to be reinforced and smart technologies may need to be considered.

Demand side management has the ability to offer benefits in terms of reduced peak power demand and therefore reduce the stress on the grid. The electrification of heat and use of thermal energy storage systems in homes, can help provide this grid flexibility and peak load shaving when aggregated together. There are many technologies available to enable consumers to store thermal energy, for example hot water cylinders can be used as a means of storing excess heat generated. These stores can be installed alongside renewables to store energy for use during peak time and it is possible for thermal stores to take inputs from a range of different technologies. Demand side management

¹⁴ Committee on Climate Change (2015) [Value of Flexibility in a Decarbonised Grid and System Externalities of Low-Carbon Generation Technologies](#)

capabilities allow energy to be time-shifted, reducing wastage and helping to support a renewable-powered electricity network.

Q. 21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Greater uptake of low carbon vehicles, means that homes will play an increasingly important role. The home will become a recharging point and therefore will become a hub for all energy needs; heating, cooking, transport, leisure etc. The Office for Low Emission Vehicles has suggested that recharging at home is a viable option for the majority of the UK housing stock with 65% of homes having off-street parking. However, it is important that plug-in vehicle infrastructure is widely available away from the home; in towns, in rural locations and at workplaces.

The majority of plug-in vehicles are charged overnight; this means that consumers utilise off-peak generation which has a lower carbon intensity. The avoidance of peak demand, lowers the risk of stress on the electricity distribution networks and could reduce the need for potential reinforcement of the local grid¹⁵. Moreover, if plug-in vehicles are charged in off-peak periods, the need to increase supply may be reduced. The introduction of smart technologies mean that plug-in vehicles could be able to deliver demand side response, utilising additional capacity for example when high levels of renewable energy is being generated. It is also possible that these vehicles could, in the future, be used as energy stores and used to power homes during peak periods.

For more information on this Call for Evidence submission please contact
[email redacted]

¹⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3986/plug-in-vehicle-infrastructure-strategy.pdf

For the attention of the National Infrastructure Commission,

Thank you for the opportunity to respond to your discussion paper on 'The Impact of Technological Change on Future Infrastructure Supply and Demand.'

You are probably aware that the Infrastructure Client Group (ICG) is preparing to publish its report on new delivery models for infrastructure, and Digital Transformation is one of the key themes from the report that will be developed over the coming year. Mark Enzer has been asked to lead this theme and techUK will play a key part in its Steering Group. We are providing this joint feedback in advance of the official launch of the ICG's report.

Overall, we found the paper to be informative and helpful on the ways in which changes in technology could affect the UK's infrastructure in the future. However, there are a number of areas that we feel deserve more attention in further work:

1. **Information Value** – *The NIC should directly address the subject of data and the value of 'information' and not just as an adjunct to technology. While the technology may be eye-catching, the real value is in the data that it produces and the better processes and decisions 'information' derived from it enables. This is core to the value proposition for Smart Infrastructure. Such an approach would recognise the value of information as a resource. This provides a unifying theme and underlying purpose for innovation and disruption.*
2. **Technology framework** – *The NIC should create a structure or framework to support a better understanding of the way different types of technology fit and work together to deliver improvements in infrastructure, and outcomes for customers. Technology is not one homogeneous whole (it makes sense to separate propulsion technology from information technology or drones from AI for example), so it is important to identify this when exploring opportunities. However, there is real value in setting out interconnected categories for the technologies that are most relevant to infrastructure. Such an approach would help towards identifying the right type of technology for the right outcome and allow technologies (like satellite) that have not previously been associated with infrastructure to be included across multiple vectors.*
3. **Integration** – *The NIC should develop a systems-based narrative for technology in infrastructure. Infrastructure networks, by their very nature, are interconnected and much of the value of Smart Infrastructure is derived from enabling greater integration of systems. We feel that a system-based view of infrastructure technology would*

make greater sense of the way those different technologies fit together and highlight any system-based outcomes that can be obtained in existing and future infrastructure.

4. **Security** – *The NIC should give more emphasis to security and privacy. It is clear that the issues of security and privacy are fundamental to the management of information in infrastructure, and the related technologies too. It therefore makes sense to consider both 'security technology' and the 'security of technologies'. Such an approach would help to focus the infrastructure industry on this key issue by design.*

We would be very keen to explore any of these issues with you further.

Best regards,

[Name redacted]
[Job title redacted]

[Name redacted]
[Job title redacted]

10 February 2017

National Infrastructure Commission
1 Horse Guards Road
London
SW1A 2HQ

Dear Lord Adonis,

National Infrastructure Commission call for evidence

Tees Valley Combined Authority welcomes the opportunity to respond to the National Infrastructure Commission's call for evidence.

The Tees Valley Combined Authority is one of a small number of devolution areas, taking greater responsibility for the leadership of the economic development of our area. As a distinctive industrial region, we face particular challenges and opportunities in infrastructure development; including our role in the national and northern transport network, with one of the UK's largest ports; in supporting the transition to a low carbon economy; and as a host of many globally significant industrial and innovation facilities. As a flagship area for the UK's emerging Industrial Strategy, we recognise the contribution we need to make to national infrastructure priorities, and have developed a number of specific propositions in the areas of interest to your Commission.

Our response to the questions posed by the Commission is attached. We would be interested to engage with you further on these issues, and to provide more detail to the Commission's staff as required.

Yours sincerely

[signature redacted]

[name redacted]

[job title redacted]

Tees Valley Combined Authority

About Tees Valley Combined Authority

Tees Valley Combined Authority (TVCA) was created in April 2016 to drive economic growth and job creation in the area. It harnesses the economy-boosting powers of Tees Valley's five local councils (Darlington, Hartlepool, Middlesbrough, Redcar and Cleveland and Stockton) and Tees Valley Local Enterprise Partnership (Tees Valley Unlimited) to elevate partnership working between the public and private sectors to a new level in order to create an even more effective approach to building a stronger Tees Valley.

Scope of the Inquiry

The Government has given the National Infrastructure Commission (NIC) the following objectives to:

- Foster long term and sustainable economic growth across all regions of the UK;
- Improve the UK's international competitiveness; and
- Improve the quality of life for those living in the UK

The following document is TVCA's response to the NIC's call for evidence. TVCA has responded to only those questions which are within our policy remit:

Questions:

1. **What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?**

Response:

There has been a historic lack of investment in transport infrastructure in the north of England. This has resulted in lengthy, infrequent and unreliable journey times between and also within our key economic centres, which is a constraint to productivity, jobs, and housing growth. In economic terms city regions in the north of England are performing well individually but they are not realising their full potential partly as a result of this poor pan-Northern connectivity and also to other key destinations nationally. Where investments are made, it should be the case that these are created as part of an integrated transport system. Users view the transport system as a whole, crossing multiple modes and boundaries, rather than separate sets and investments should reflect this.

In terms of transport infrastructure investments, these can be broadly split by mode:

Rail

The East Coast Mainline (ECML) is an extremely important rail route to TVCA and to the nation as a whole and we are full members of the East Coast Mainline Authorities group (ECMA). Investments to improve capacity on the ECML along the route, but particularly

north of York, have been identified as essential by Network Rail, local authorities, operating companies and Transport for the North (TfN). The current two-tracking north of Northallerton represents a constraint on both inter-city capacity (linking the North East to Leeds and Manchester city-regions in the North and to the economic centre of London) and intraregional capacity, restricting the ability to increase the quantum of regional services and limiting local labour markets.

Further, it is expected that there will be future restrictions on the ability to assign freight paths on the route due to high demand for passenger services operating at high speed. As a result the growth of freight and logistics within the region faces future constraints, and some freight may switch to the highway network, with attendant negative consequences.

A cost-effective and short-term measure would begin with provision of passing loops for freight services north of Northallerton, as identified in CP5 and the Hendy Review. However, this does not represent a long-term solution to match anticipated growth, which is estimated at 144% for passengers up to 2043 and 13.2% annually for key biomass traffic or 11.9% for domestic intermodal up to 2043. The best way to match both estimated growth and the ambitions for the corridor would entail four-tracking the route between Northallerton and Newcastle and investigating capacity enhancements on the line north of Newcastle up to the Scottish border.

Of particular importance to the Tees Valley in this regard is the major upgrade and remodelling of Darlington Station which is a major rail gateway to our region. There are major constraints at Darlington which impact on both North-South and East-West rail connectivity and which have major implications for national, pan-Northern, regional and local passenger services and for freight services. This has been recognised by Network Rail through its emerging East Coast Route Study and TVCA has developed a wider masterplan for Darlington which will see the station develop as a major growth hub to complement the required rail infrastructure improvements. A key part of the masterplan is to ensure that Darlington is HS2 and Northern Powerhouse Rail (NPR) 'ready' as well as being able to cater for the forecast short-term growth through the existing franchises. More detail on the proposals for Darlington can be provided.

Another key strategic rail route for Tees Valley is the line from Northallerton to Middlesbrough (and on to Teesport) which carries important passenger services such as TransPennine to York/Leeds/Manchester/Manchester Airport and Grand Central to London. These will soon be boosted by new East Coast services between Middlesbrough and London and yet line-speeds and journey times are well below the required standard for such a strategic route. By way of example the rail journey time between Middlesbrough and York is double that for the rail journey between Darlington and York, which is of equivalent distance. Urgent steps must therefore be taken to increase these line-speeds. The line is also a key freight route but at the present time it does not have the capability to cater for large containers which is the significant growth market from Teesport, a nationally recognised economic asset. The upgrade of the line between Northallerton and

Middlesbrough/Teesport must also include W12 Gauge Clearance as a matter of urgency. The final element of the upgrade should be electrification and TVCA believes that electrification to Middlesbrough should become a fundamental part of the TransPennine Electrification programme. Linked to these line improvements is the upgrade of Middlesbrough Station itself to provide adequate capacity to facilitate this growth. As with Darlington there is insufficient capacity, so a similar masterplan study funded by TVCA is now underway involving key industry partners.

In his recent report of June 2016 – *Tees Valley: Opportunity Unlimited* - to support innovative thinking to secure a strong and sustainable economic future for the Tees Valley, Lord Hestletine made the following recommendations in relation to major rail infrastructure:

“Network Rail and Transport for the North are encouraged to recognise the importance of Darlington Station as the key rail gateway for the Tees Valley - at the heart of a commercial regeneration scheme - and to investigate the need for the station redevelopment to be included in the Network Rail and Transport for the North programmes for the period 2019 – 2024, which Tees Valley propose will allow train services in HS2 and Northern Powerhouse Rail to operate, maximising the growth opportunity afforded by the transformational rail packages.”

“The Department for Transport are encouraged to seriously investigate the inclusion of the Northallerton to Teesport Electrification rail scheme as an extension of the Transpennine electrification scheme already committed, driven by the benefits of simultaneously delivering W12 gauge clearance, to ensure that the economic benefits of PD Ports’ planned investment in 2018/19 can be maximised.”

High Speed Rail

As highlighted above, improvements to the ECML corridor are essential to the economic well-being of the North East and its contribution to the national economy. However, these improvements are unlikely to be sufficient to cope with forecast demand, both passenger and freight, and deliver the growth we seek in the long-term (defined in the Call for Evidence as up to 2050). Therefore, if these long term travel requirements are to be met, the existing commitment to deliver High Speed 2 needs to be developed further.

Working as part of Northern Powerhouse Rail, with Rail North, we support a link from HS2 phase 2b to the East Coast Main Line. This is planned at Church Fenton, linking HS2 phase 2b from Leeds to the East Coast Main Line.

In 2016 HS2 Ltd published its report - *Broad options for upgraded and high speed railways to the north of England and Scotland* - which explored options to:

- improve journey times from Edinburgh and Glasgow to cities further south, including options that could reduce journey times to London to 3 hours or under

- provide additional passenger and freight capacity where it is projected that future demand will not otherwise be met

TVCA advocates an Eastern route for HS2 Scotland, whether by a completely new route or upgrades to the existing ECML. The Eastern Route is ideal as it connects large existing centres of population more effectively, with fewer environmental constraints.

When HS2 phase 2b is delivered, stations need to be ready for the demands placed upon them by this additional capacity. As discussed above, Darlington Station has been identified as a future pinch-point by Network Rail and there is a need to make it ready for HS2 services and increase capacity. In a further report produced by HS2 in 2016 – *Changing Britain: HS2 taking root* – very useful narrative and data was provided highlighting the value of Darlington to the Tees Valley economy and its role as a HS2 Growth Hub.

Highways

TVCA supports the delivery of schemes identified and committed to within the current Road Investment Strategy (RIS) to 2020 and beyond in the North East. These schemes are integral to managing growth on the Strategic Road Network in the future and to addressing current, longstanding congestion issues. It is important that where funding has been secured for works, such as improvements on the A19 between Norton and Wynyard, timely delivery is ensured to enable the benefits to be secured as early as possible.

TVCA remains committed to support the further upgrades to the A19 strategic corridor that are required if it is to fully achieve the desired 'Expressway' status as outlined in the RIS. The most pressing priority, following the widening between Norton and Wynyard, then becomes on the section immediately to the South where the A19 crosses the River Tees. The current Tees flyover is only two lanes wide in each direction yet carries more than 100,000 vehicles every day meaning that it is one of the busiest routes in the region, if not the North. The lack of alternatives means that there is a real issue of congestion and network resilience in this area that is threatening to stifle economic growth and as a result TVCA has now committed development funding and is working closely with Highways England to develop a business case for a new crossing.

It is also the ambition of TVCA to achieve an upgrade of the A1 to provide continuous dual carriageway standard between London and the Scottish Border and we believe this should be a priority as it addresses identified weaknesses in inter-regional connectivity. We welcome commitments made by the Government as part of the RIS, City Deals and through other mechanisms to address existing capacity issues.

In terms of our East-West connectivity, TVCA has consistently supported the case for investment in the A66 to improve links between this region and North-West England/South West Scotland. We therefore welcome the commitment announced in the Autumn Statement to complete the dualling of the A66 between the M6 and A1. However the A66 needs to be treated holistically as it is a key route through the Tees Valley linking many of our main

economic centres and running all the way to Teesport which is a key pan-Northern and national asset due to the volumes of freight it handles. TVCA welcomes the development funding that has been awarded to work up improvement options between A1 and Teesport, and we are now working in close partnership with Highways England on this, but we remain disappointed that this was not included as part of the wider A66 improvement works.

In his recent report, Lord Heseltine also made some key recommendations relating to major highways infrastructure for the Tees Valley:

“Highways England are encouraged to seriously investigate consider adding the scheme to provide a new strategic road Tees Crossing to the existing scope of the A19 Norton-Wynyard widening scheme already planned by Highways England. This will maximise efficiency and ensure that the benefits of the committed investment are enhanced, thereby encouraging additional growth, as a result of improved access to Enterprise Zone sites.”

“Highways England and Transport for the North are encouraged to take account of the emerging improvements to east-west connectivity on the A66 east of the A1(M) being developed by the Tees Valley Combined Authority, as part of the wider North Trans-Pennine Routes study. Also, to seriously investigate the preferred option(s) from the east-west connectivity work within the recommended programme for trans-Pennine improvements to provide a holistic solution for the A66 through to Teesport.”

While delivering the above improvements is essential, there will still likely be future capacity issues on our network. In particular, this applies to capacity across our major rivers. We are looking to work with partners, particularly Highways England, to explore this issue.

Where improvements to the Strategic Road Network are prioritised, this must be done with consideration of the impacts this will have on the associated local road network. The interface between the two must be considered holistically to ensure the greatest possible support of growth from any intervention. This should also be a consideration with regard to asset management as well as new infrastructure.

Bus

Buses are the most well used form of public transport in the Tees Valley. It is essential that the needs of buses are taken into account when developing highway and pedestrian infrastructure and that needs of buses are integral to the masterplanning exercises such as those currently underway at Darlington and Middlesbrough Rail Stations. As outlined below, with the correct infrastructure in place, new legislation will make it possible for us to make sure the Tees Valley has an affordable, efficient and high quality bus network.

Active Travel

Investment in active travel, including walking and cycling, is among the most cost-effective forms of infrastructure investment. The relative proximity of the Tees Valley's towns means cycling infrastructure is well placed to replace car journeys for shorter trips. By removing many car based local commuter journeys, particularly on the Strategic Road Network, cycling infrastructure supports the efficient functioning of highway infrastructure in general.

TVCA would expect investment in the strategic road network to include cycling infrastructure improvements, including cycle routes along road corridors as well as reducing severance at interchanges. This will complement investment at a local level through local resources and the Government's forthcoming Cycling and Walking Investment Strategy.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Response:

Two of the ways in which international competitiveness can be addressed are to improve access to and from international gateways (such as ports) but also to improve connectivity within the country for freight and passengers. TVCA believe that both aspects need to be tackled equally to improve competitiveness.

The Tees Valley has a well-developed freight and logistics industry serving the import and export market as well as domestic needs.

Road

- The DfT's annual Continuing Survey of Road Goods Transport suggests that the average length of haul in the UK for an HGV in 2015 was 92 kilometres, having increased moderately (6%) since 2004 when it was 87 kilometres. The figure for Tees Valley-based HGVs, however, is 129 kilometres. This reflects the area's position as both a major centre for process and manufacturing and home to one of the UK's major ports.
- In terms of goods moved (tonnes lifted x kilometres), there have been significant increases for the Tees Valley in the movement of food, drink and tobacco products, coke / petroleum and waste in the last 10 years while at the same time there has been a slight decline chemicals and a more significant reduction in free-flowing dry bulk.

Rail

- The Tees Valley is a major hub for the movement of rail freight (100 freight trains per week) and we retain a number of rail-connected freight facilities operating at Middlesbrough, South Bank, Teesport, Redcar, Lackenby Wilton, Boulby Mine, Skinningrove, Port Clarence and Hartlepool (Hartlepool 20" Pipe Mill and the Power Station). These are supported by large marshalling yards at Thornaby (Tees Yard) and Middlesbrough;
- Much of these rail flows are linked to international trade through the Tees or other major UK ports;
- The Tees is the only port in the North of England with existing intermodal rail services operating directly from quayside facilities. Rail services for shipping containers currently operates between Teesport and Felixstowe, Southampton and Scotland.
- Redcar Bulk Terminal - this is the deepest port facility on the East Coast of England and is part of a rail-connected site that covers in excess of 125 hectares and is immediately adjacent to the ex-SSI steel-making site which covers a further 800 acres. Although historically used for dry bulk imports, the facility is well-positioned to diversify into new trades.

Sea

- Tees Valley is home to two ports: Tees and Hartlepool. PD Ports is the statutory harbour authority for both ports and also operates its own cargo handling facilities at Hartlepool Dock and Teesport;
- In 2015, Tees & Hartlepool handled 7% of all cargo tonnes through UK ports. The Port has consistently been in the DfT's UK Top Five in terms of cargo tonnes since the 1970s, following significant growth in the area's petro-chemical industry at that time following major investment in land reclamation, capital dredging and major new terminals;
- Much of the volume today is still handled by large, specialist terminals and driven by the needs of local industry with crude oil, other liquid bulks and dry bulk products dominating tonnages. A number of smaller wharves handle a mix of cargoes or operate engineering and support services to the offshore and shipping sectors. Freight ferries and container vessels carrying unitised cargo are the only ships using Tees and Hartlepool that operate as common carriers on the basis of a published timetable; and
- Nationally, 63% of cargo through UK ports is inward. Tees & Hartlepool, however, is an 'export port' whose higher outward tonnages largely reflect the trading activities and diversity of major local shippers. This is in contrast to a port such as Felixstowe which primarily handles container imports fuelled by UK consumer demand rather than local manufacturing industry.

Air

- Durham Tees Valley Airport, has daily scheduled flights to Schipol via KLM and regular flights through the week to Aberdeen. There are some chartered services at other times but no direct long-haul flights. Most airfreight is carried as bellyhold cargo and carried in wide-body long-haul passenger jets and planes that cover the short-haul market have less capacity to carry freight. Tees Valley airfreight is now mostly taken by road to other airports.

It is essential that the importance of these facilities is recognised in the plan and that they continue to receive adequate financial and planning support to secure their position as key gateways to the UK economy.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Response:

TVCA supports the Government's wish to see new development centred on brownfield sites as these are likely to be close to existing town and city centres and current transport routes. Where new housing or business developments take place outside these locations, it is essential that these are permeable, encouraging rather than deterring sustainable travel modes, and that, by use of the Community Infrastructure Levy where applicable, they are underpinned by investment in suitable transport links, including bus services and infrastructure, cycling and walking routes.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Response:

Being able to guide people and influence behaviour change is a key aspect of addressing congestion in urban areas where there are feasible transport alternatives.

Demand management may not be appropriate for all areas and should be part of an overall package of integrated transport where appropriate.

5. How should the maintenance and repair of existing assets be most effectively balanced with construction of new assets?

Response:

Prizing capital investment at the expense of revenue could lead to perverse incentives for local authorities to build new infrastructure at the expense of maintaining their existing

assets. In order to better balance this, revenue funding made available to local authorities to provide activities such as maintenance and planning should be increased.

Recent work from the Urban Transport Group indicates that increasing maintenance funding could provide returns of £6.50 for every £1 invested and TRL suggested that cuts in road maintenance budgets could result in wider costs to the economy of between £1.50 and £2 for every £1 saved²⁸. This has been backed up by the National Audit Office, which has called for long-term certainty in funding of road maintenance.

This should also be backed by more balanced investment in maintenance between the strategic and local road networks. The Highways England Network has a spend of £111,000 per km per year, while Local Authority B, C and U roads only spend £7,000 per km per year. While these are different types of road, these gaps should be narrowed

6. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Response:

One of the primary barriers to efficient transport funding is a preponderance of competition-based funding. While this may have some merit in allowing a more flexible approach from central government in terms of project selection, on the ground at a local level it produces challenges in terms of project selection and delivery. This means that it is challenging to bring forward projects which fall outside traditional 5 year funding envelopes or are at a very early stage and there is a bias toward 'shovel ready' projects, which may not be the most optimal to achieve long-term benefits.

As noted under Question 5, the preponderance of capital funding over revenue based funding means that there are significant challenges for authorities to deliver infrastructure services efficiently. The lack of revenue funding can mean that longer term priorities are not addressed efficiently.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Response:

At present a number of regionally impacting projects are put on hold, as they do not meet the funding threshold for national programmes. However a number of these are of a scale, that if progressed would use up all locally available funds (i.e Local Growth Funds). More weighting must therefore be applied to the wider impact along with a lower funding threshold.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Response:

This response can be broadly split into two points, one on the devolution of existing powers and another on alterations to the planning and governance structure.

TVCA is supportive of devolution of powers, which if developed appropriately, will have significant benefits for delivery of areas such as transport and housing in all devolved areas. Devolution of powers would mean that a long term programme of activity can be planned, rather than dealing with schemes on an ad hoc basis, therefore enabling projects with transformational impacts to be properly planned, appraised and delivered.

Transport for the North (TfN) is establishing unique governance arrangements to enhance its role as the voice of the North on Transport, bringing together representatives for the whole of the North through Combined Authorities and Local Enterprise Partnerships with an independent chair.

An embedding of the governance of TfN in its constituent transport authorities provides for the ability to better align strategic priorities both inter and intra-regionally. When allied to long-term planning and appraisal this presents the most effective governance to deliver transformative infrastructure.

In terms of alterations to the planning and governance structure, TVCA is a transport authority rather than a highway authority and does not currently believe highway authority powers would be appropriate over the large spatial area of the region. However, there are potential alterations to the planning and governance structure which would help ensure that infrastructure is delivered efficiently.

TVCA believes in delivering not merely transformational infrastructure, but public transport service delivery in the North and has pursued innovative governance and management solutions to enhance long term planning and outcomes for stakeholders. In terms of rail, it is anticipated that the North East Rail Management Unit, involving Tees Valley, the North East Combined Authority, Tees Valley, Cumbria, and North Yorkshire, will be integral to our ambitions to deliver a step change in quality for rail users in the North and support this model of more localised service delivery. This partnership, which includes train operators, is the first of its kind and will be helping the authorities in the North East ensure that new franchises truly deliver their ambitious upgrades for the regions trains.

12. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Response:

TVCA anticipates the following changes in travel patterns between now and 2050, resulting from the impact of new technologies and other trends:

1. Continuation of the trend away from traditional “Monday to Friday 9 to 5” working patterns, with technology enabling more homeworking, flexible working, video conferencing, dispersed employment locations and part-time working;
2. A readiness among younger people, especially in urban areas, to consider alternatives to the car, where these are supported by an adequate public transport, cycling and walking network. This has led to a fall in mileage travelled by these people;
3. Increased online shopping and banking, with consequent rise in delivery van traffic and reduced off-peak home to city centre or retail development travel demand;
4. An increasingly older population, resulting in : fewer work-related trips ; much greater focus on travel to health facilities ; more leisure journeys ; higher expectations of independent mobility ; increased need for appropriately designed infrastructure and services including door-to-door transport provision;
5. Increased expectations of the quality of public transport in terms of speed, reliability punctuality, comfort, seamless ticketing and comprehensive technology-based information before, during and after a journey; and
6. The potential for new technologies, such as driverless cars, to change the way in which we approach car ownership, mobility and the user of our time while travelling.

13. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Response:

In response to this question it is appropriate to refer to TVCA's Strategic Transport Plan framework (see <https://teesvalley-ca.gov.uk/transport-infrastructure/tees-valley-strategic-transport-plan/>). This sets the context for the full Plan which is expected to be published in Autumn 2017 and contains relevant details on our major transport infrastructure priorities:

National Rail:

What are we trying to do?

- We want to improve rail links between Tees Valley and the rest of the country and to key Airports and Ports.

- We want to improve the East Coast Mainline, Transpennine, Durham Coast and Tees Valley rail networks to cater for future growth in both freight and passenger numbers across the North; and
- We want to ensure that our main rail stations at Darlington and Middlesbrough are ready for major projects such as the new Inter-City Express trains, High Speed Rail and Northern Powerhouse Rail. Together these projects will radically improve train travel between Tees Valley and other major cities including London, Manchester, Newcastle, Leeds, Edinburgh and Glasgow.

Why is this necessary?

- To date, investment in the UK's major stations has not been focussed on the Tees Valley. meaning station facilities at Darlington and Middlesbrough are not sufficient for a major gateway servicing a region the size of the Tees Valley. For example, the layout of tracks and platforms at Darlington needs to be changed so that it can properly accommodate new High Speed and Northern Powerhouse Rail services.
- The railway line between Northallerton and Middlesbrough/Teesport needs to be upgraded so that bigger freight trains can access Teesport. Doing this will free up space on the East Coast Mainline for more and faster passenger trains in the future.

What are the priorities?

- 'Darlington Station Growth Hub', which includes new platforms and buildings at Darlington rail station will permit more long distance and local rail services to stop at Darlington This proposal will see around £100 million of public and private investment to develop Darlington station as an essential part of the town's heart. It will support the development of 30,000 sq m of new business space and 1,500 potential new homes. The investment will help to better integrate the station with Central Park and the town centre; and
- A major upgrade of the rail line between Northallerton and Middlesbrough/Teesport so that it can be used by bigger freight trains. This supports the ongoing development of Teesport, as a truly international freight gateway for the north of England. Funding is already in place to more than double existing container capacity, creating up to 4,000 direct and indirect jobs. The upgrade will also allow more trains to stop at Darlington and will see Middlesbrough station improved so that it can also handle more trains, prior to future electrification of the line.

Major Roads:

What are we trying to do?

- We want to improve road links within the Tees Valley and to/from the rest of the country, including to key Airports and Ports to improve access to global markets;
- We want to provide and maintain a high quality major road network that delivers consistency in journey time reliability, safety and standards and meets the needs of Tees Valley residents and businesses, whilst providing the capacity for future economic and housing growth across the North.

Why is this necessary?

- The A19 has been identified as a new high quality strategic route – an “expressway” – by Highways England, yet there remains a pinch point at the Tees flyover, where delays regularly occur because there are too few ways to cross the Tees.. At the point where it currently crosses the Tees, the A19 carries 96,000 vehicles per day – in contrast, the parallel A1(M) only carries 43,000 vehicles at the same point, emphasising how important the route is to the Tees Valley in connecting it to the rest of the UK; and
- Access to the A1(M) from the A66 south of Darlington is restricted for travellers to/from the north. This requires high levels of traffic, including heavy goods vehicles, to gain access via unsuitable residential areas to the north of Darlington. Sections of the A66 are also single carriageway and key junctions on the route are heavily congested. The A66 is only classified as part of the national Strategic Road Network and managed by Highways England up to the A19. Beyond this the A66 becomes the responsibility of the relevant local authority, so onward access to key strategic locations such as Teesport and Wilton International is essentially via a local road. Access to Durham Tees Valley Airport, our key hub for international connectivity is via the A67, a single carriageway local road.

What are the priorities?

- Providing an additional major road crossing of the River Tees – this proposal will ensure that the A19 expressway will meet the “mile per minute” objective for the SRN, address current issues with journey times and delays, as well as allowing the local road network to be improved in order to help deliver a number of new employment and housing sites. It will also help realise the full benefit of the A19 Norton to Wynyard widening scheme, due for completion by Highways England in 2021.
- Improving the east-west A66 corridor from the A1(M) to provide a consistent standard of route all the way to the international gateway at Teesport. This could be provided by a new all moves junction at Junction 57 of the A1(M), a new route around the north of Darlington, capacity improvements along the A66 around Darlington and Stockton, and junction improvements along the local road section of the A66 to Teesport, including at the Cargo Fleet and Port access roundabouts.

Connecting Centres:

What are we trying to do?

Tees Valley Combined Authority, Cavendish House, Teesdale Business Park, Stockton-on-Tees, Tees Valley, TS17 6QY

Tel: 01642 524400

Web: www.teesvalley-ca.gov.uk

- We want to better connect our town centres, economic assets (such as Teesport, Durham Tees Valley Airport and our major development sites) and key health, employment, education and retail locations, by frequent and high quality public transport services and improved private transport networks.

Why is this necessary?

- In addition to connections to the rest of the UK and beyond, linking together our town centres, economic assets and key health, employment, education and retail locations is vital for the Tees Valley to function effectively. Better transport connections within the Tees Valley and into our main rail stations will also allow us to maximise the opportunities afforded by committed/planned investment in the national networks; and
- To support our economic growth aspirations, people need to be able to travel easily around the Tees Valley to access jobs and training opportunities right across the area.. This is particularly important for the significant proportion of the Tees Valley population who do not have access to a car.

What are the priorities?

- An upgrade of the rail line between Northallerton and Teesport would also include major improvements at Middlesbrough station, to allow more efficient use by local and long distance rail services, including new direct rail services between Middlesbrough and London by 2022, as recently confirmed by the Office of Road and Rail;
- Station improvements at Darlington and Middlesbrough will allow increased frequencies, more evenly spaced stopping patterns, new trains and new stops along the local rail network to be considered as part of the next Northern Rail franchise;
- Buses are the most well used form of public transport in the Tees Valley. New legislation will make it possible for us to make sure the Tees Valley has an affordable, efficient and high quality bus network that is both easy and attractive to use and fully meets local needs. This includes introducing an integrated and simplified ticketing system for public transport in the Tees Valley and the continued development of network branding; and
- The Tees Valley Authorities will continue to invest in the maintenance and improvement of the local road network, as we recognise that for some people, the private car will be an essential mode of travel. We will continue to promote activities such as car sharing and the take up of electric vehicles so as to reduce the impact of private car use on health and the environment.

Supporting Economic Growth:

What are we trying to do?

- We want to address specific problems on the major and local transport networks to cater for future economic and housing growth across the Tees Valley; and
- We want to ensure that people and goods can travel around the Tees Valley more easily so that economy can grow effectively and sustainably.

Why is this necessary?

- The Transport for the North Independent Economic Review identified four key sectors of the economy in the north of England – Advanced Manufacturing, Energy, Health innovation, and Digital – that are seen as vital in supporting the desire for increased economic growth across the North. These are supported by three other key sectors – Financial and Professional Services, Logistics, and Further and Higher Education; and
- As outlined in the Tees Valley Strategic Economic Plan, The Tees Valley economy contains a growing number of companies and organisations across all these sectors, and all need effective and reliable transport connections, wherever they are located. However, there are currently a number of constraints on our existing transport networks, principally the road network, that act as a barrier to this growth for existing businesses, that are also delaying the development and delivery of key employment and housing sites that we need to meet our economic growth aspirations.

What are the priorities?

- There are two Local Major Transport Schemes already in development – Middlehaven Dock Bridge and Portrack Relief Road, which will continue to be progressed to support the growth of our major development sites. We will continue to build a detailed database of all predicted future housing and employment developments across the Tees Valley, which will inform detailed transport impact modelling analysis to identify future congestion points on the transport network. This will help us to identify and prioritise transport projects which will overcome these barriers to growth and support the levels of development and economic and housing growth envisaged in the Strategic Economic Plan. This process is known as the Tees Valley Area Action Plan; and
- There will also be specific transport infrastructure and sustainable transport provision requirements associated with individual large scale planning applications, such as those for large scale housing developments at Wynyard, South Stockton, South Middlesbrough and in West Hartlepool. It is important that the provision of appropriate access/services for all transport users is fully addressed when housing and employment sites are being planned and developed.

Local Journeys:

What are we trying to do?

- We want to ensure that the needs of pedestrians, cyclists and bus users are fully considered so that all aspects of the journey experience from door to door are covered; and
- We want to develop bus, cycling and walking networks that improve links between our: residential areas; towns and villages; hospitals; shopping centres; schools/colleges; centres of employment; key transport hubs such as Darlington, Eaglescliffe, Hartlepool; Middlesbrough and Redcar Rail Stations; and other key destinations across the Tees Valley. We want infrastructure to allow integration between all modes providing seamless door to door journeys.

Why is this necessary?

- We need to continue our work on improving walking, cycling and bus services that link housing sites to key destinations across the Tees Valley including rail stations, bus stops, town centres, schools, colleges, employment sites, hospitals and shopping centres.. This is important because census data shows that our car ownership levels are still lower than the national average and walking, cycling and bus trips continue to make up a significant proportion of daily journeys to work across the Tees Valley. Active travel options such as walking and cycling also offer major health benefits to residents and if more journeys are made by bus, on foot or by bike then we will have less congestion on our road network and lower levels of air pollution.

What are the priorities?

- Tees Valley cycle network – We will continue to develop a cycle network across the Tees Valley that offers as many direct, complete and safe routes possible, away from the strategic road network. this also includes providing cycle facilities at all of our key local destinations;
- Tees Valley walking network – We will provide safe and direct pedestrian links in and around residential areas and key destinations across the Tees Valley;
- Tees Valley bus network – We will work with Tees Valley bus operators to ensure the bus network provides the vital links from residential areas into our town centres, key local destinations this includes providing services to more rural or isolated areas; and
- Marketing and Information – We will provide residents with the information they need to make informed decisions on how they travel including the promotion of increased levels of physical activity through walking and cycling.

14. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Response:

The response and detail in Q13 also covers this.

Energy

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decision need to be made?

Response:

The introduction of novel, integrated renewable energy generation, storage and demand management systems is required to meet the UK's decarbonisation targets. It is also essential to build on the existing gas and electricity infrastructure as sources for heat and enablers of large grid scale energy storage systems to allow expanded renewable energy exploitation as well as supporting the decarbonisation of transport.

A major value creating opportunity for the UK is to supply heat via hydrogen. Unlike natural gas, hydrogen does not produce carbon dioxide on combustion. Recent projects, such as the H21 Leeds City Gate project have identified the potential to use much of the existing natural gas pipelines to supply homes and businesses at an affordable cost compared to electrification. Hydrogen production coupled with Carbon Capture and Storage used to heat homes and industry provides very significant value adding economic opportunities for the UK supply chain in any transition to a low carbon economy. Areas such as Tees Valley, Humberside, and the North West could all benefit from economic growth and industrial development as a result of hydrogen production for heat.

Due to the inherent similarities between hydrogen and natural gas, heating with hydrogen would require less change for consumers than other approaches to decarbonisation of heat. Public acceptance would need to be addressed but with a long history of industrial use and the earlier use of Town Gas, this is achievable.

The benefit of large scale low carbon hydrogen use on air quality is an additional benefit as it can displace petrol and diesel fuels in road and rail transport.

As noted above, the transfer to hydrogen, as part of a low carbon future, is dependent on the timely roll out of large scale carbon capture and storage. To date Government has been reluctant to identify priority locations for CCS even though there has been a clear and objective direction provided by organisations such as Teesside Collective. However it has to be recognised that this takes time, large scale industrial and infrastructure growth can take 10 or more years to achieve, therefore empowering local areas to play an active role should start as soon as possible but should continue over the long term.

In addition, comparative economic advantage accrues to the early movers and in this area the UK is well positioned to build on existing assets, skills and capability, compared to competing economies (Germany/Japan) where this technology is also being explored. The

UK currently develops and deploys many of the hydrogen production techniques, by utilising hydrogen as a heating fuel UK technology and supply chains will be supported. In addition Tees Valley has already designed and costed a CCS network through Teesside Collective which has been shown to be a cost effective method of decarbonisation.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved? (Note the zero carbon power sector' includes the generation, transmission and distribution processes)

Response:

The most effective zero carbon power sector will balance issues of affordability, security of supply and decarbonisation. This implies different ways, rather than one prescriptive path, through which this balance can be achieved, including the expanded use of renewables and continued use of base load and dispatchable gas power stations with grid scale storage. Whilst small scale generation/storage will become much more widely adopted (assuming support mechanisms remain) the security of supply offered by a national electricity network and the need to decarbonise heat will require the existence of a large scale network. As noted above, decarbonisation and security of supply, whilst adding value to the UK economy, is best achieved through the enhanced use of hydrogen and carbon capture and storage. Carbon capture and storage can provide a strategic piece of infrastructure to decarbonise energy and industrial sectors.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Response:

There are two principal barriers related to the use of the circular economy: Asymmetric information (i.e. individuals and companies are unaware or are sceptical as to the benefits of the approach and need independent validation) and secondly a coordination error (i.e. due to the need for one process to utilise the by-product of another process there is a need for a coordinated approach. This is often outside the control of one company or even a sector. There is therefore a need for external coordination of what in essence is a new supply chain).

Tees Valley has long championed the case for low carbon approaches to production as a means of meeting carbon reduction targets and improving long term competitiveness. This approach has now been fully incorporated into UK policy on the circular economy as a means of mitigating wastage, ensuring local sourcing of materials and enhancing productivity.

As noted in Lord Heseltine's review of Tees Valley, the area is:

“an ideal location to pilot and demonstrate the benefits and opportunities of the circular economy. With one of Europe’s largest integrated industrial complexes and national and internationally operating centres of excellence in processing, materials and biologics this approach is promising and together with targeted investment could help maintain the future of existing industries and to develop new economic opportunities.”

Tees Valley is already mitigating the two market failures cited above by:

- **Foresight design:** Examining all aspect of production and then looking (and validating) related opportunities for the use and reuse of by-products, waste and heat; and
- **Coordination:** Circular economies are most effective when based on integrated industrial locations, where industries producing heat, by-products and waste, together with agricultural production, combine with communities to provide opportunities for other industrial processes and enterprises, co-located to maximise collaboration. Wilton in Redcar is one of only a limited number of super-integrated locations, capable of dealing with heavy production and managing the environmental issues.

In line with our existing Smart Specialisation Strategy, major producers and the Tees Valley Centres of Excellence are already working with strategic partners across the North and this work will increase as demonstrator and pilot projects introduce new processes and products. New and innovative production processes are at the heart of the circular economy and this work is increasingly being led by major companies working with their supply chains. While Tees Valley has a leading interest in chemical processing, the impact of the circular economy has relevance across every production sub-sector, including traditional and advanced manufacturing.

Tees Valley has the company base and expertise to play a leading role in the adoption of the circular economy by the Northern Powerhouse and provides the opportunity for Tees Valley to be the leading region in England in the application of the circular economy- the exemplar region.

National Infrastructure Assessment

February 2017

Digital Transport: Thales Contribution

Road travel is taking longer each year in the UK. This has been true for the last four years. Travel times have increased by 4% in the last two years¹. Applying the principle finding of the Eddington Report 2006², this change over the last two years will cost the UK economy an additional £2bn per year going forward even without further deterioration.

Fuel tax revenues are projected to fall in the next few years “we forecast fuel duty receipts to fall from 1.6 per cent of GDP in 2013-14 to 1.5 per cent of GDP by 2018-19 reflecting improvements in fuel”³, so there is an additional need to review fuel tax.

This paper outlines a Digital Transport programme to improve travel times, decrease emissions and at the same time increase safety and resilience to disruptions. It proposes a switch of fuel duty to road usage charging. It also proposes a comprehensive national data warehouse of transport information regardless of transport authority boundary. This programme will take advantage of new connected vehicle technology and smart phone GPS tracking. A return on investment of tens of billions of pounds of GDP growth can be achieved over a decade.

This contribution to the National Infrastructure Assessment will concentrate on transport as infrastructure with the following themes:

- The latest connected vehicle technology and GPS smart phone data will be exploited
- Network Rail’s Digital Railway Programme’s techniques will be applied to roads, namely capacity improvements, safety improvements and resilience to disruptions
- Travellers’ journeys will be influenced to load balance the transport network better, taking the total cost of journeys into account
- Road capacity will be maximised
- New collaborations between government departments will be needed in operations and operational support, in planning for disruptions and managing incidents
- A new collaboration between government and consumer-focussed commercial companies is proposed
- Transparency of the total cost of roads and the burden of taxation will be established in order to increase public satisfaction and catalyse traveller behaviour change
- Better transport data will be available for public transport planning, civil investments and maintenance decisions
- The Digital Transport Programme will reduce congestion and overcrowding, encourage transport modal switch, improve safety and improve resilience to transport disruptions.

¹ “Travel time measures for local ‘A’ roads, England: July 2015 to June 2016” Department for Transport 25 August 2016

² Key Finding 1 “The Eddington Transport Study” HM Treasury December 2006

³ Office of Budget Responsibility, Fiscal sustainability report, July 2014

These benefits will in turn reduce travel times and make journeys more reliable and more resilient to disruptions. This will improve competitiveness of the UK economy and will result in GDP growth of tens of billions of pounds which will provide a return on investment.

This contribution will first expand on the proposed Digital Transport Programme and then answer the specific transport questions of the National Infrastructure Commission.

1 Situation

The situation on UK's roads presents a number of challenges that seem to be getting worse:

1. Unreliable journeys: road travel times are gradually getting worse on average in the UK. Regarding Highways England's Strategic Road Network (SRN) the DfT report: "For the year ending June 2016, 68% of additional time needed to be left compared to free flow, on average, on individual road sections of the SRN to ensure on time arrival. This is 2 percentage points (pp) higher than the year ending March 2016.⁴" The story is worse on main roads off the SRN: "The average delay ... represents an increase of 3.8% compared to the previous year (year ending June 2015)... average weekday morning peak speeds have been falling steadily for the past 4 years.⁵" This gradual decline of road performance needs to be reversed
2. Increasing congestion: Due to the increasing congestion and reduced average speeds noted above, road vehicle engines are running for longer resulting in avoidable emissions and noise
3. Road congestion holding back economic growth: Since the Eddington Report of 2006, it has been established that economic growth is linked to transport. In particular, as Sir Ron Eddington says in his key finding "a 5 per cent reduction in travel time for all business and freight travel on the roads could generate around £2.5 billion of cost savings – some 0.2 per cent of GDP⁶". Eddington stresses that the best transport investments come by focussing on relieving congestion points "In mature economies such as the UK, with established transport networks, the benefits from improved transport are likely to be greatest when focusing on congestion and bottlenecks."⁷ The importance of improved transport for economic growth is reflected in the formation of Transport for the North by the northern English cities to enable the Northern Powerhouse and the formation of Midlands Connect as part of growth in the Midlands
4. Poor quality of road surfaces: The Transport Focus reports in July 2015 "Road Users' Priorities for Improvement" from car, van, motorbike and HGV drivers consistently report drivers as wanting "Improved quality of road surfaces" and "Safer design and upkeep of roads" as their highest priorities. A recent report suggested that maintenance funding should allocate "funding in proportion to the volume of cars, buses, lorries, pedestrians and cyclists travelling on local roads rather than just in relation to road length"⁸
5. Poor management of disruptions, planned and unplanned: The Transport Focus reports of July 2015, cited above, list "Better management of unplanned delays such as accidents or breakdowns" and "Better management of roadworks" and "Better information about unplanned disruptions such as accidents" as the drivers' next highest priorities
6. A plateau of road safety: Reported road casualties in Great Britain: main results 2015 concludes: "The evidence, points towards Britain being in a period when the fatality numbers are fairly stable and most of the changes relate random variation." A Digital Transport scheme should aim to move off the plateau of road safety
7. Lack of road usage data: Away from the Strategic Road Network (SRN) there is no national model for gathering road usage or speed statistics

Given the fact that most journeys are on the roads and even most non-road journeys start on roads, the poor state of the roads is dragging down the UK economy, holding back growth.

⁴ "Travel time measures for the Strategic Road Network, England: July 2015 to June 2016", Department for Transport 25 August 2016

⁵ "Travel time measures for local 'A' roads, England: July 2015 to June 2016" Department for Transport 25 August 2016

⁶ Key Finding 1 "The Eddington Transport Study" HM Treasury December 2006

⁷ Page 11 "The Eddington Transport Study" HM Treasury December 2006

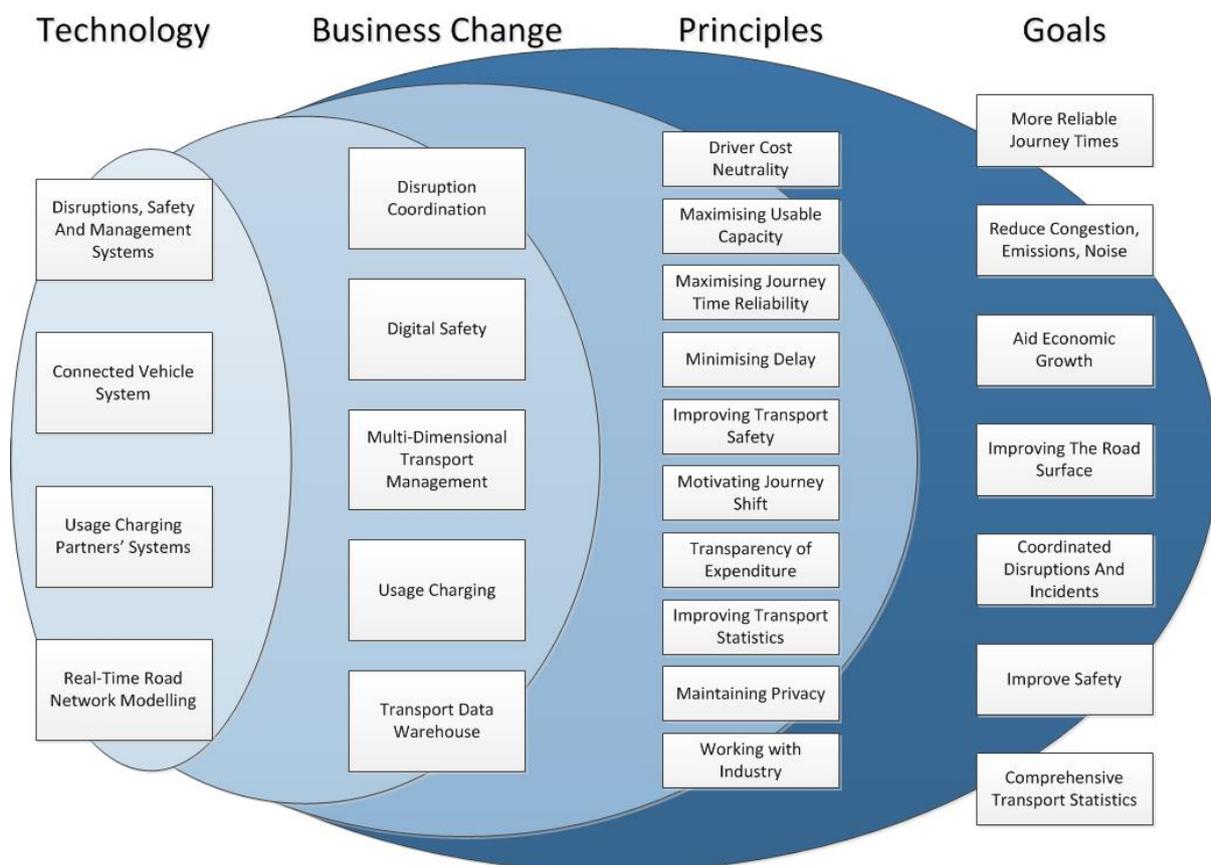
⁸ 'A Bumpy Ride': The Funding and Economics of Highways Maintenance on local roads in the English City Regions" The Passenger Transport Executive Group (PTEG), September 2015

2 Goals

In order to solve the outlined national challenges, the goals of a new comprehensive Digital Transport solution should therefore be as follows:

1. More reliable journey times – not just reduced average travel times but also travel times with little variation
2. Reduce congestion, emissions, noise – reducing stop and start, tackling high emitting and loud vehicles
3. Aid economic growth – increase GDP by reducing transport costs traversing bottlenecks and reducing time spent in transit
4. Improving the road surface – better detection of pot-holes but also fairer and more transparent allocation of whole-life transport infrastructure costs
5. Coordinated disruptions and incidents – better planning for disruptions and recovering from disruptions, together with better reporting of information about disruptions
6. Improve safety – a step change reduction in accidents, with a knock-on reduction in insurance costs
7. Comprehensive transport statistics – information and tools to plan building investments

This document describes a Digital Transport scheme to achieve these goals. Please see the following cause and effect diagram whose columns, from right to left, will be used to structure the next few sections of this document:



3 Principles

The principles recommended for delivering a comprehensive digital road system are as follows:

- Driver cost neutrality
- Maximising usable capacity
- Maximising journey time reliability
- Minimising delay
- Improving transport safety
- Motivating journey shift
- Transparency of expenditure
- Improving transport statistics
- Maintaining privacy
- Working with industry; not against it

Driver cost neutrality: It is essential that drivers back a digital transport scheme and therefore a clear principle of tax revenue neutrality should be announced and demonstrably kept.

Maximising usable capacity: Since building new roads or widening old roads are both relatively expensive, we must maximise current road capacity by either motivating journey shift, as above, or marshalling the traffic as to maximise traffic flow. It has been accepted that road traffic flow is similar in behaviour to fluid flow through pipes. In this way, maximising usable road capacity can be compared to maintaining laminar flow.

Maximising journey time reliability: Travellers need to be able to rely on their expected time to arrive without large variances.

Minimising delay: As noted above, delays are gradually increasing year-on-year. A digital transport scheme should improve delays by (A) encouraging journey shift through usage charging, (B) detecting and resolving incidents faster and (C) actively marshalling congested traffic.

Improving transport safety: Given the widespread availability of communication with vehicles, we should aim to gather alerts from vehicles and then pass them to other approaching vehicles in time to avoid an accident.

Motivating journey shift: There are a number of ways of reducing demand on the road, and therefore congestion and emissions, by changing the driver's journey

- **Spatial shift** – use a different route
- **Temporal shift** – go at a different time or on a different day
- **Modal shift** – take a different mode of transport e.g. walk, cycle, public transport, shared vehicle

Transparency of Expenditure: We should adopt the recommendation of The Passenger Transport Executive Group to openly pay road owners according to their roads' usage rather than their length.

Improving transport statistics: We should aim to extend the comprehensive statistics available for Highway England's roads to all A roads and bus routes in the UK. These statistics should include speed, usage, delays, transport mode and vehicle occupancy.

Maintaining privacy: A digital transport scheme must win the backing of the general public who would prefer that the government does not track their movements. Ironically, this is despite most people offering their detailed movements to social media and telecommunications companies in return for mobile services.

Working with industry; not against it: In order to take advantage of GPS data obtained by tracking mobile phones, either a road owner tracks vehicles directly or a road owner obtains this data anonymised from a social media company. We recommend the latter approach on the grounds that it avoids the need for government to track individuals. Similarly, we recommend the collection of road usage charges via private companies.

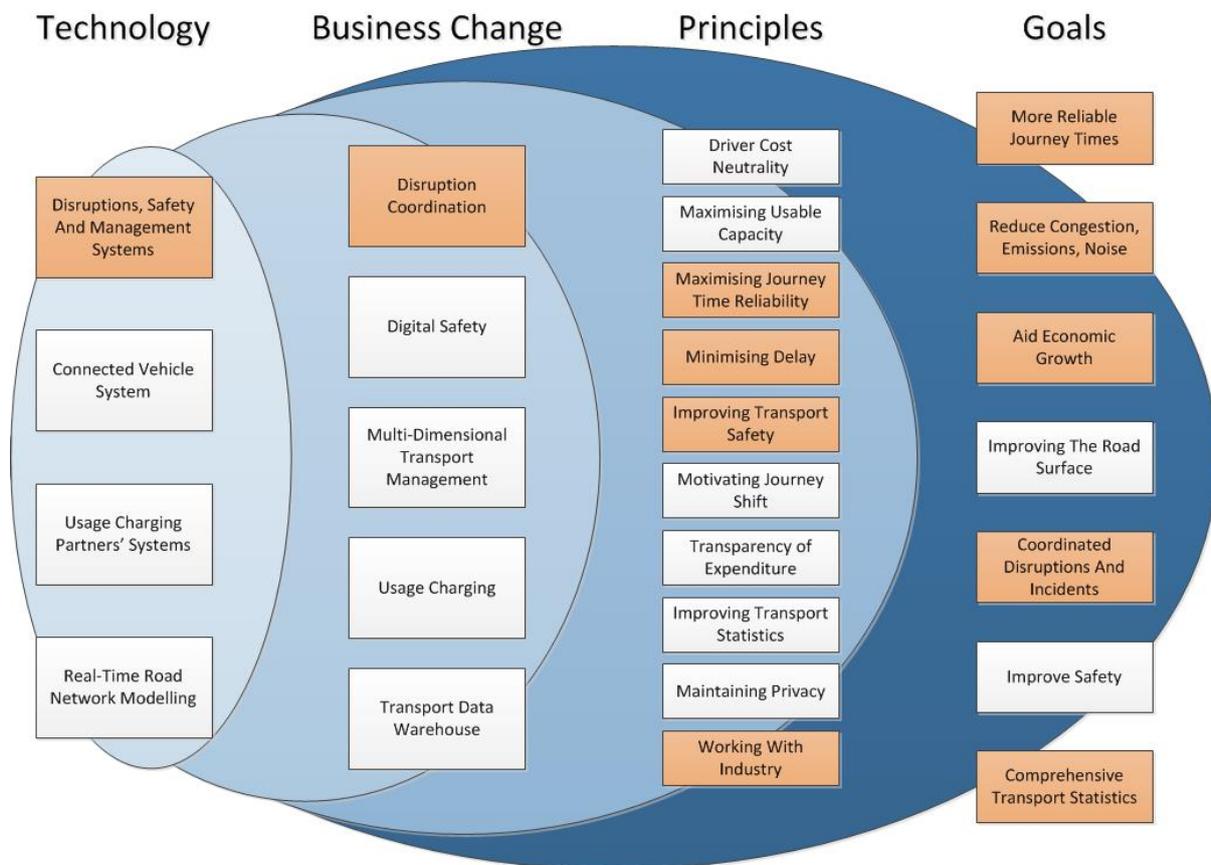
4 Business Change

4.1 Disruption Coordination

Disruptions, either planned (e.g. roadworks) or unplanned (e.g. accident) are a major source of delays and unreliable journeys. Also, disruptions to one mode of transport can affect other modes of transport as the demand changes when travellers look for alternative journeys.

To a traveller, accurate information about disruptions is hard to obtain and then harder to see & compare reasonable alternatives that provide backup journeys. Poor disruptions management adds to transport costs and is a blocker to improving a traveller's experience, also to mobility as a service.

Increased coordination between those involved in managing the disruptions must be established. Please see the diagram below highlighting the technology, principles and goals associated with the coordination of disruptions.



4.1.1 Coordination of Multiple Parties

Since all of the roads are connected, and many journeys cross more than one road owner, passing information between authorities allows more than one road authority to manage the impact of a disruption.

In addition, there are many types of road users, including public transport operators, taxi services and freight that also need an up-to-date view of disruptions. For example, an accident could block a road and therefore force a bus to divert from its planned route.

Unplanned disruption information is spread amongst emergency services, train operators, infrastructure maintainers, recovery services, highway authorities and their operational transport partners:

- Only police (and Traffic Officers on motorways) know when an accident will be cleared and when a section of road will open again after an incident
- Only police know when a police incident is resolved or when an accident investigation will be complete

- Only the fire and rescue services know when a vehicle is safe or a victim will be extracted
- Only the ambulance and air ambulance services know when the injured will leave the scene
- Only recovery services know when the broken vehicles will be cleared which are blocking a key road
- Only maintainers and utilities know when roadworks and trackworks will start and stop
- Only bus and train operators know when their faulty vehicles will be fixed

Therefore we propose a shared disruptions system for train operators, road owners, maintainers, emergency services and recovery services

- Disruptions knowledge can either be entered by hand by operators/dispatchers or can be transferred automatically from the organisations' command and control systems
- Each operational partner can see progress of partners' reactions to incidents (unplanned disruptions) and share their own progress
- Operational partners can plan together for major disruptions (roadworks, marathons, sporting events, political events) with coordinated responses or contingencies (e.g. major incident responses)
- Each operational partner must commit to manning this system, supplying their best information and taking into account other organisations' information e.g. additional buses and taxis can be deployed when a train line is disrupted or a when major public event is taking place

4.1.2 Public Sector Organisation Change and Commercial Partnership

Public and private sector involvement, both central and local, is essential in tracking disruptions: roadworks, accidents, police incidents, severe weather, and major public events.

Participation of road operators, emergency services, maintainers, utilities, transport operators and recovery services must be achieved by adding good disruption information flow to their organisational targets and contracts.

4.1.3 The Usefulness of Good Disruption Information

A shared disruption system can firstly detect incidents quicker, secondly coordinate incidents better, thirdly clear incidents quicker, and fourthly inform operational partners better. In this way, the transport system will be more resilient to disruptions. The results are that congestion due to disruptions will be reduced and average travel times will be reduced.

Accurate, up-to-date information should be given to travellers, so that they can take into account the current state of the transport network and avoid congested areas where possible. A driver may be able to take advantage of this information themselves, but also their SatNav will almost certainly be able to pick a revised optimal route given accurate disruption information. Good information about disruptions can not only increase traveller satisfaction per se, but can also provide resilience to their journey, allowing travellers to avoid disruptions. A further benefit is that informed travellers can load balance the network themselves.

Accurate historic disruption information can improve the disruption planning process and response plans.

There will be an increased cost of communication which will be rewarded by a significant reduction in travel times and a better resilience of the transport network, both of which bring increased UK competitiveness and increased GDP.

4.2 Digital Safety

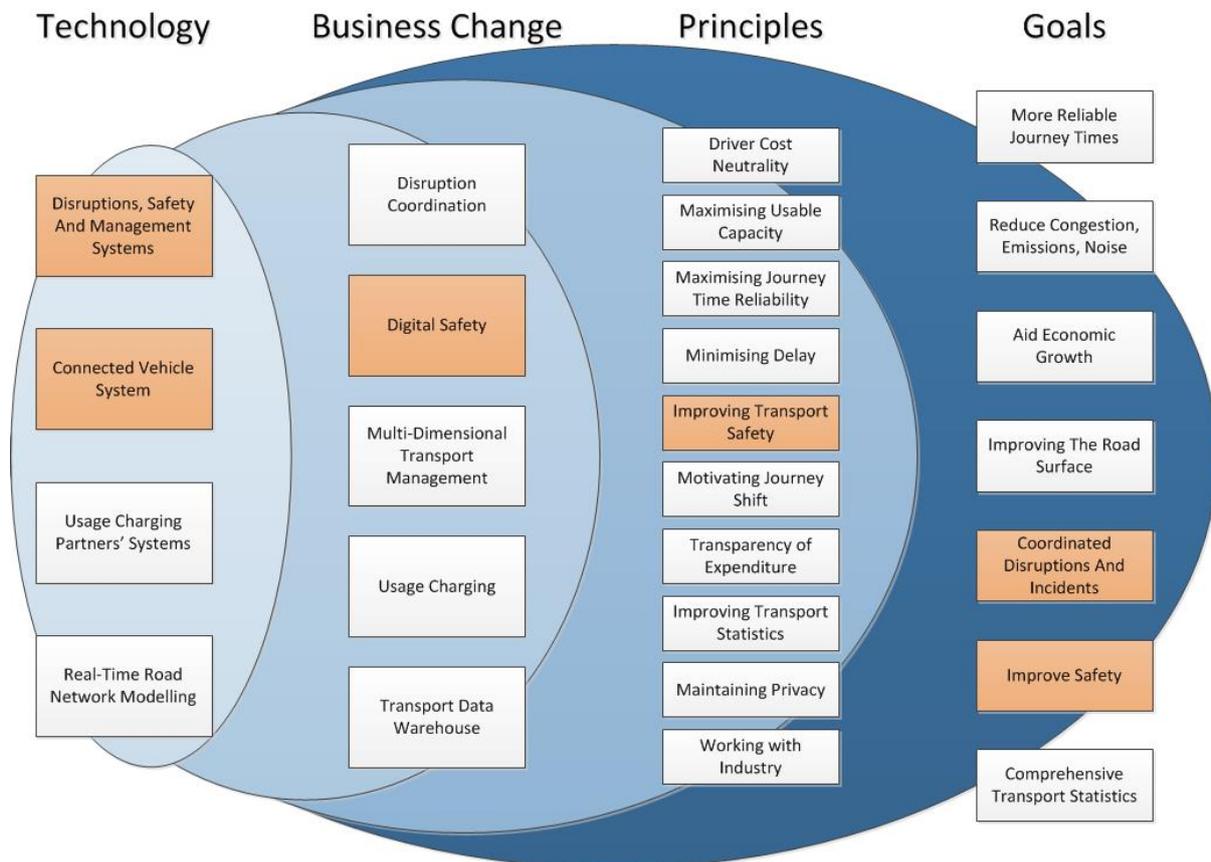
A new digital safety system can take best-practice motorway safety to smaller roads, without the need for expensive roadside equipment. MIDAS is the system which uses under-road loops and roadside variable message signs to warn motorists on many of England's motorways: "Queue Ahead Caution: 40mph".

The digital safety system is purely automatic and anonymous, taking advantage of the latest connected vehicle technology. A connected vehicle black box or smart phone app within a vehicle



can use the vehicle's telematics system (so called CAN Bus) to detect incidents. It can detect the vehicle being stationary, hitting debris or a pothole, breaking heavily, deploying its ABS or anti-skidding or air bag. The in-vehicle black box or app can alert a central system which will both send assistance and inform the black boxes of approaching vehicles. The in-vehicle black box or app can then alert the approaching driver with an audible message, e.g. "Debris ahead, lane 2". Please see the technology section below for further details.

The digital safety system achieves the following highlighted end goals while satisfying the highlighted principles:



The digital safety system can

- Alert drivers of approaching vehicles automatically in less than one second
- Bring additional safety to main roads without the need for roadside technology
- Bring additional precision to safety on motorways
- Provide early warning of incidents and immediate feedback on uneven road surfaces, such as pot-holes
- Pass key incident early warning information to drivers approaching from a greater distance e.g. "Accident after next junction, hard shoulder"
- A reduction in injuries and collisions will reduce in lower insurance costs, improving UK competitiveness and GDP growth

4.3 Multi-Dimensional Transport Management

Current best practice road management is single dimensional, taking a line of traffic and optimising its flow:

- Highways England's Smart Motorways is the combination of variable speeds and variable lane control, controlling lanes using signals above each lane



- SCOOT traffic light systems allow a line of multiple traffic light sequences to be optimised in one direction of travel so that flow is improved, for example into a city in the morning rush hour, and then switched to out-bound in the evening rush hour

These best practice systems can be replicated on smaller roads digitally; without the need for expensive roadside electronic equipment. In addition, by understanding wider route options, new multi-dimensional road management can be deployed to load balance the traffic in the light of current disruptions and congestion.

4.3.1 Widespread Capacity Improvements

Thanks to connected vehicle technology, control of variable speeds and lanes can be communicated to drivers using an in-vehicle black box or smart phone app which itself can take advantage of the vehicle's infotainment system. This means that variable speeds can be set without the need for roadside electronic equipment. Over time, more and more vehicles will support direct connections. Given sufficient percentage of connected vehicles, Smart Motorways' variable speed control could be extended to all major roads such as the North Circular Road.

4.3.2 Next Generation Smart Motorways

Given the current trend to increasing road use, and when the planned England Smart Motorways schemes have been completed, there will be a need for a next generation Smart Motorway scheme. Connected vehicle technology can provide this additional road capacity as follows:

- Certain of the busiest roads will be designated controllable by the road authority – a driver on these controllable roads agrees when joining such a road that the road authority can take control of the vehicles during congestion
- During congestion, the connected vehicle system takes control of the speed, lane and distance from the vehicle in front (so called "headway") for all vehicles
- The connected vehicle system will marshal the vehicles into optimal patterns, taking into account the road surface, weather conditions and types of vehicle
- Clearly, the road authority would be taking some of the driver's responsibilities under such a scheme, together with the legal and commercial responsibilities. Therefore, such a scheme should be investigated for use in the medium term
- Optimal patterns will need to balance safety and road capacity: the safest road would only have one vehicle on it! Therefore, there needs to be consensus on what level of risk of accident is acceptable given the economic need for many vehicles to use that road

4.3.3 Comparison to Network Rail's Digital Railway Programme

Road capacity improvements are complementary to the equivalent European Train Control System programme of Network Rail. Similarly, multi-dimensional responses to disruptions, described below, are complementary to Network Rail's Traffic Management System programme.

4.3.4 Multi-Dimensional Road Management

Multi-dimensional road management is a coordinated set of responses which may be pre-planned as contingencies or which may be ad hoc. Since the roads are all connected there is usually more than one alternative route available for drivers. Effective responses should take advantage of these multiple alternative routes.

Multi-dimensional road management takes advantage of the disruptions system which records the current road abnormalities, their impacts, and when they will clear. An expert system records responses in terms of appropriate processes for the various operational partners and a mixture of direct and indirect road management:

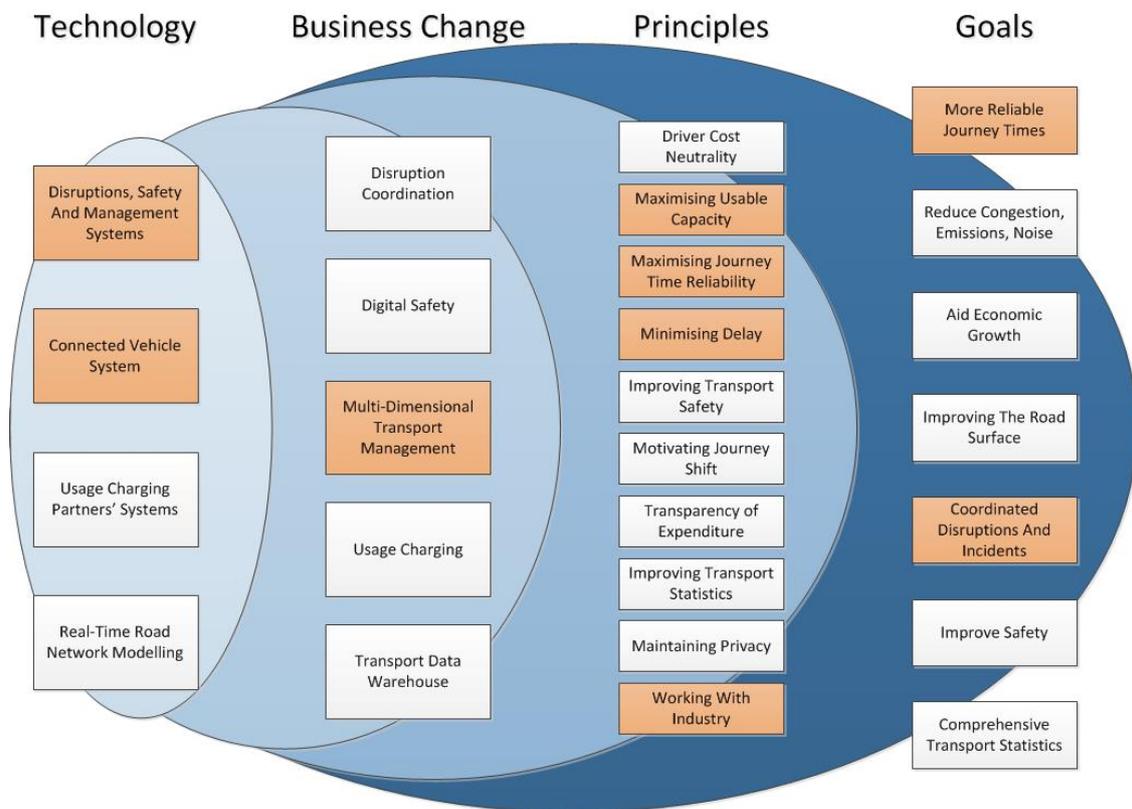
Direct Management: For the motorways and A roads, diversions can be chosen, displayed on variable message signs. Variable speeds can be set. For town and city centres, traffic light sequences can be changed to help traffic use diversions to go around the disruptions.

Indirect Management: The latest disruption information can also be sent to the SatNavs with the latest travel times, so that the SatNav can advise the driver. Note that only the driver and SatNav actually know where the vehicle is going, therefore indirect management is usually preferable to direct management.

4.3.5 Principles

Multi-dimensional road management can (please see the diagram below):

- Maximise the usable road capacity by varying the speed limit on roads, which has been proved successful in Smart Motorways, without the need for expensive roadside variable message signs and signals. In the medium term, use connect vehicle technology to take control of vehicles on the most busy stretches of road, marshalling them in patterns which minimise overall delay
- Maximise journey time reliability by informing drivers of their best way of avoiding current disruptions and congestion, through alternative routes
- Minimise delay by optimising centrally controlled traffic lights and Smart Motorways schemes to reduce the overall UK delay
- Effective road management responses should take advantage of more than one road authority and emergency services, but also coordinate industry partners such as maintainers and recovery services



4.4 Usage Charging

In order to motivate journey shift and transparency of taxation, usage charging should be introduced on major roads (A roads and motorways) and bus routes but not side roads. These usage charges should gradually replace fuel tax, so that the overall taxation on drivers is neutral. Tax neutrality must be clear to avoid drivers' sentiment that this might be "just another tax".

In the proposed usage charging scheme, each vehicle will report the sections of roads it uses to the driver's chosen Usage Charging Provider, a non-governmental company or commercial organisation. The Usage Charging Providers will, in turn, provide payment to the government and road owners. Fees should be collected according to a blend of a number of factors:

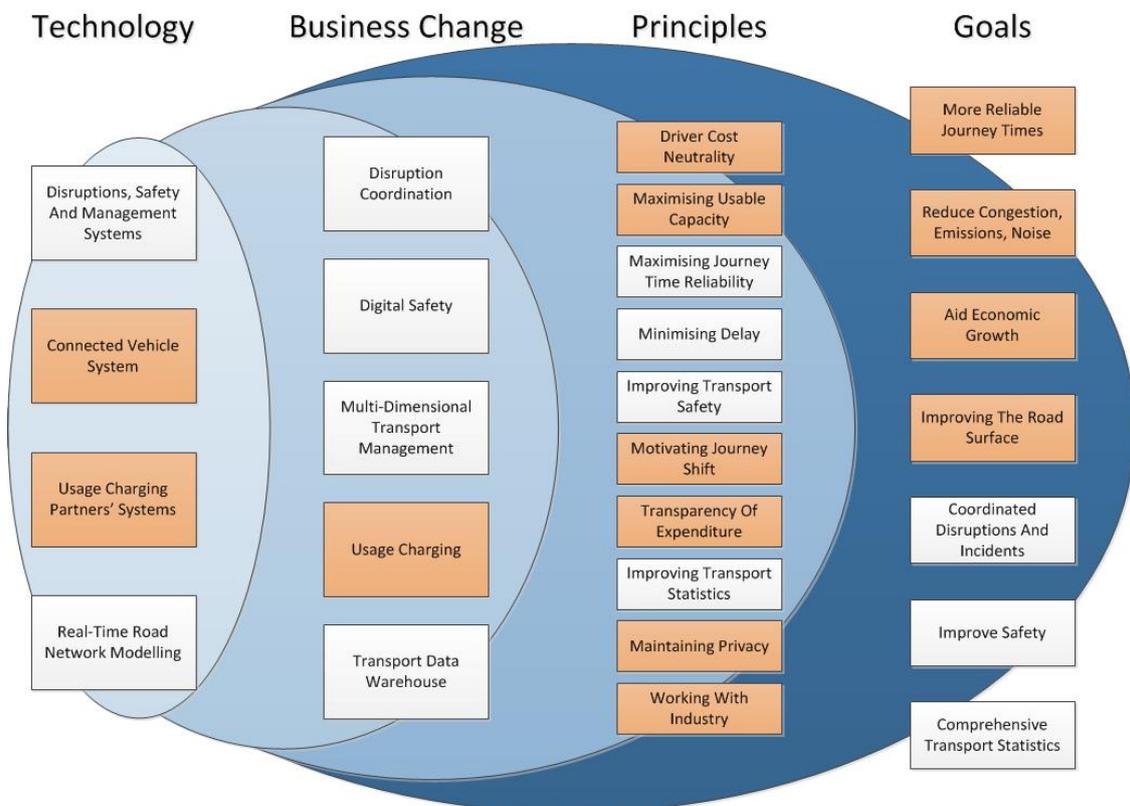
- **The section of road** – some roads are more heavily used than others, therefore apply a popularity premium which will encourage drivers to consider other roads which have lower fees – such a levy could be determined by the cost of maintaining that particular road (e.g. higher for bridges or tunnels)
- **The time of day or day of week** – all roads are more heavily used at certain times of the day, therefore apply a rush hour premium which will encourage drivers to consider travelling at different times of the day which have lower usage fees
- **The current laden weight of the vehicle** – the wear and tear on the road depends on the current laden weight of the vehicle which can now be measured real-time – the proportion of a usage charge which relates to current laden weight can be ear-marked wholly and transparently to road maintenance
- **The emissions of the vehicle** – this is currently levied by road tax through DVLA but could be levied partially or fully by a charge depending on the actual emissions as measured by the vehicle – this emissions charge could be higher when the vehicle is closer to areas of high population density
- **The noise of the vehicle** – this is not currently part of the formula for taxation but could be a factor in a future usage charging scheme – loud vehicles could be taxed when travelling through built up areas and when travelling at night
- **Current major planned events** – charges may be deliberately higher during major sporting events to discourage general traffic, as long as it is understood by the drivers

Note that this conforms largely to the recommendations of the 1964 report chaired by R. J. Smeed to the Department of Transport⁹ but is now practical through connected vehicle technology.

Connected vehicle technology is a key enabling part of usage charging, improved road safety and improved traffic management. The Government should ensure read-only access to the diagnostics of all new vehicles via USB connector. Please see the technology section below.

4.4.1 Principles Followed

Please see the highlighting in the diagram below:



⁹ "Road Pricing: The Economic and Technical Possibilities" HMSO 1964

- **Driver Cost Neutrality** – in order to help with acceptance by drivers, fuel tax should be gradually lowered; replaced by usage charges
- **Maximising Usable Capacity** – lower usage charges for less used roads and during less busy times of the day will encourage those roads to be used instead thus maximising the usable capacity
- **Motivating Journey Shift** – usage charges as above will motivate journey shift by avoiding that road, avoiding that time, sharing a vehicle, choosing alternative transport modes. A driver may also respond by changing job or moving house to avoid a regular commute triggering a usage charge. In order to help with the complexity of journey shift, each Usage Charging Provider should integrate with one or more SatNavs
- **Transparency of Expenditure** – billing by different attributes of the vehicle, its location and time could help win acceptance as people transparently see how their driving affects road and environmental costs: some road sections (e.g. tunnels and bridges) can be more expensive to maintain, some vehicles wear out the road more quickly than others. Therefore the road maintenance costs should be reflected in part of the usage charging fee. These maintenance costs can provide regular, sustainable finance to improve the road surface
- **Maintaining Privacy** – by using non-governmental usage charging providers, the drivers are not tracked by government, but rather tracked by their branded usage charges provider. All drivers connected to social media or using transport apps on smart phones will already be tracked by one or more trusted private companies. Only usage revenue and anonymised road usage statistics are passed to the government. This will win the backing of the general public who are worried by a “Big Brother” state

4.4.2 A Usage Charging Providers Market

In order to avoid unpopular tracking of vehicles by the government, it is proposed to create a new market of road Usage Charging Providers, paying to the government and selling to consumers and fleet owners – this market would be similar to that of electricity utilities or Internet service providers

- Each vehicle reports its road usage to the Usage Charging Providers who arrange billing
- Usage Charging Providers will aggregate the usage charges and could also mediate payments to multiple road authorities if necessary – they could also create simpler packages and services to drivers
- Such suppliers may come from the social media market, transport operators, taxi companies, utilities, telcos or any consumer brand e.g. Virgin
- Usage Charging Providers could finance their own road infrastructure at some point in the future

4.4.3 Enforcement and Adaptation

This system is dependent on accurate and truthful reporting of vehicle activity, emissions and weight. Therefore the in-vehicle app or black box should maintain a log of consistent telematics data by talking to the vehicle’s diagnostic system; it would know if the vehicle were up to date with payment and whether the box had itself been tampered with (e.g. shut down temporarily or disconnected). When refuelling, the app or black box will communicate with modified fuel pumps to prove the vehicle has paid usage charging. Tax-free fuel will be allowed to those who pass and fuel tax applied to those who cannot prove their payments.

This system is dependent on support fuel retailers. Each fuel retailers would need to deploy enforcement technologies at every service station. There will be additional cost and time to deploy such enforcement but it will be returned by shorter travel times leading to lower transportation costs and greater UK competitiveness and GDP growth.

Not all drivers will find it easy to adapt to the Digital Transport, therefore, the Digital Transport programme will proceed in phases

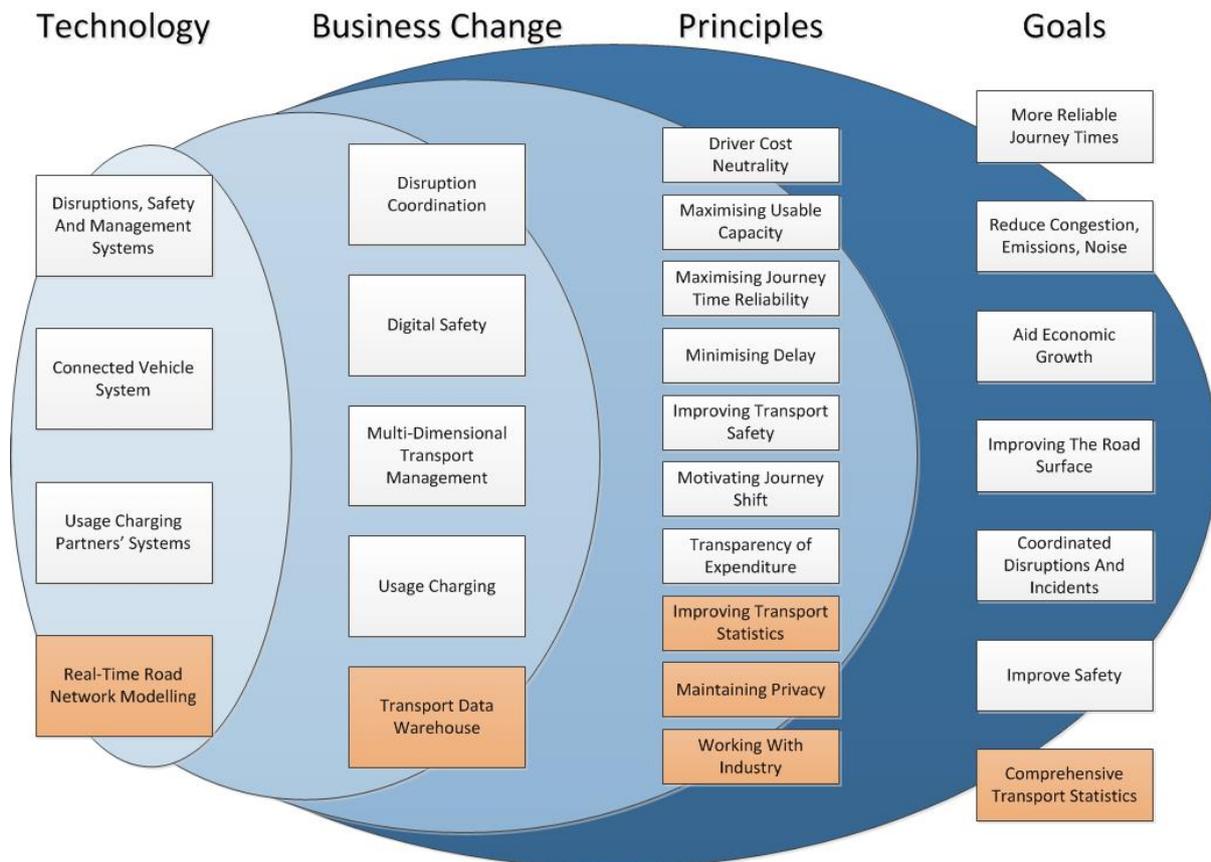
- Aim to connect all new vehicles and vehicles less than 10 years old initially
- In the initial phases the driver can continue to drive and buy fuel, but at rate including fuel duty. Later the price differential can be increased to ensure switch-over

4.5 Transport Data Warehouse

The importance of accurate, consistent transport usage and speed information is clear: business cases for road improvements and new roads need this information. Road data is needed about all motorways, A roads and bus routes, but is not needed for smaller roads.

The advent of GPS trackers in vehicles, whether gathered by fleet vehicle owners or gathered by social media companies from smart phones means that a national road data warehouse is now possible.

A national roads data warehouse will achieve the following highlighted end goals while satisfying the highlighted principles:



Since drivers are concerned about the UK Government tracking them, the Digital Transport programme recommends partnering with Usage Charging Providers who can provide aggregated and anonymised road statistics for each section of motorways, A roads and bus routes. It is feasible to gather this information every minute and only be a minute out-of-date.

Once gathered, real-time road behaviour can be deduced:

- Normal traffic travel times and road usage
- Vehicle occupancy
- Journey type e.g. commute, leisure, shopping, education, health
- Abnormal road usage and delays
- Incidents (unplanned disruptions) can be detected by looking for data abnormalities
- Predictions can be made
- Transport key performance indicators can be deduced automatically within hours
- Trends can be noted, and what if scenarios can be modelled, such as major sporting events, new housing investments, new roads, new bus routes

4.5.1 National Real-Time Road Network Modelling

A national road network model system should be established to provide definitive transport data:

- Maintain a list of all road sections and junctions for motorways, A roads and bus routes (note that not all roads will be modelled)
 - ◊ Geographical end points and a geographical polygon showing the road curvature and location
 - ◊ Each section of road has one or more names e.g. Oxford Street, A40
 - ◊ Each section has a unique direction of travel, therefore most road sections will be modelled by two sections, one for each direction
 - ◊ Number of lanes and speed restrictions are recorded
- Estimate each minute travel time and road usage for each section within the model
- Calculate daily profiles of normal travel times and usage for each day of the week and each time of day
- Calculate each minute the real-time delay from profile

Once such information is gathered then much useful information can be deduced

- Daily road usage data and road delay data, including trends
- Unusual congestion (worse travel time than profile) can provide early detection of an incident such as failed traffic lights or vehicle stopped reducing road capacity – unusual congestion should be passed to the disruptions system along with connected vehicle alerts to inform the operators using the disruption system
- Predictions can be made of future travel times and when travel times will return to normal

This will be a definitive national information asset, across road ownership boundaries, equally useful to planning, SatNavs, other modes of transport, and media: giving national road usage and road delay statistics.

4.5.2 Support from Road Owners and Ordnance Survey

This road network model must be supported by all road owners: updating road model data as road names, one-way streets and junctions are changed. Within Highways England a team with job title “Traffic Engineer” is already responsible for maintaining such a road model about Highways England’s Strategic Road Network (SRN). The Ordnance Survey should also be a partner in managing such a network model which could be based upon the OS-ITN data.

If all parties work together, it should be possible to have a road network model for UK’s roads which is completely up-to-date as new roads open, not just a few months out-of-date as at present. Such an up-to-date road model is essential in order to facilitate the Digital Safety, Usage Charging and Road Management services.

4.5.3 Usage Charging Providers are a Data Source

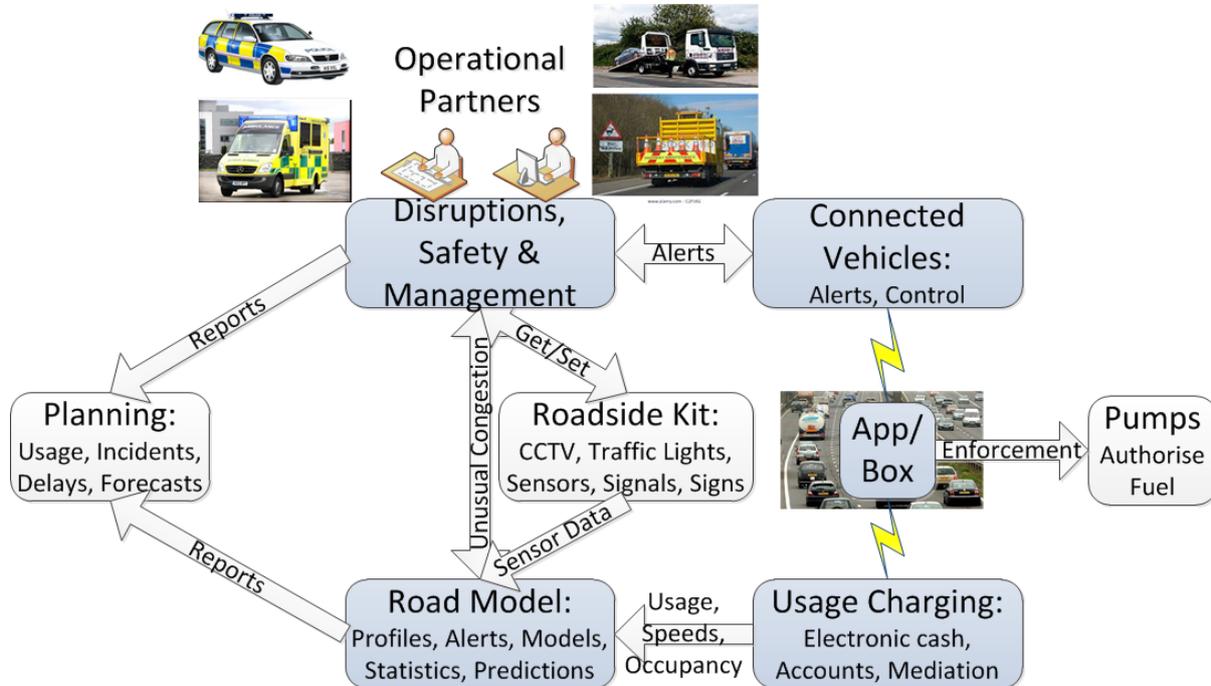
Aggregated, anonymised data should be received from all of the Usage Charging Providers. The data should be anonymised since the driver or passenger does not need to be identified. The data should be aggregated since statistics is all that is needed. In return for disruptions information, the Providers should supply within a minute:

- Average travel time per section of road
- Number of vehicles per section of road
- Number of each type of vehicle
- Average number of people in each vehicle
- Journey type
- Total laden weight of freight traffic

5 Digital Transport Technology

We describe our recommendations finally by focussing on enabling technology, which when added to organisational change, can deliver the Digital Transport.

Four connected central data systems, shown in the diagram below in grey, can take advantage of the two new discontinuous technologies to support this business transformation:



5.1 Discontinuous Technological Changes

There are two recent data technologies which offer help in creating a new national road infrastructure: connected vehicle technology and GPS tracking by social media companies.

5.1.1 Social media tracking and Personal Travel Assistants

Social media companies, mobile phone manufacturers, mobile phone operators and some travel applications currently track phones' locations using in-phone GPS technology. In return, services are provided:

- The various tracking companies mostly provide free services in return for permission to track, but can make their money by other means such as advertising
- Some of these suppliers use the data to inform their SatNav technology either real-time or historically
- Some of these suppliers sell on this data aggregated and anonymised
- This aggregated and anonymised data is of great benefit to government and infrastructure owners

5.1.2 Connected Vehicles Technology

New vehicles are being connected by wireless technology to the outside world for a number of commercial business reasons, such as remote diagnostics, insurance tracking, increased entertainment and information.

This connected vehicles technology offers new opportunities for improved safety, road management and usage charging:

- A new source of real-time big data
- Early incident detection: accidents, debris, flooding, black ice, pot holes
- Motorway safety and congestion management without costly motorway electronic infrastructure

Connected vehicles technology works without the need for roadside loop and message sign infrastructure; therefore it could be deployed economically on all motorways, A roads and bus routes.

5.2 Technology Needed within Vehicles

Real-time messages will be passed between vehicles and a central connected vehicles system:

- Read-only access to vehicle diagnostic information is essential. New vehicles are already supplied with standard CAN bus adapters, but there are variations about how diagnostic information can be accessed. A connected vehicle and usage charging app on a smart phone should preferably have USB read-only access to CAN bus statistics and the ability to pass messages to the vehicle's infotainment system. The Government should regulate to standardise this access to the vehicle over USB
- An in-vehicle black box or driver's phone app will connect the vehicle's diagnostic system, the CAN bus, so that it can receive the following alerts: air bag deployed, ABS deployed, traction control deployed, low temperature (less than 4 Celsius), debris hit, pot-hole hit
- The in-vehicle usage charging system will initially be an app on the driver's smart phone, but could later be a dedicated "black box" with the connectivity of a mobile phone (GPS, 4G, WiFi, USB, Bluetooth) – in the future a vehicle may be able to run the app if it could provide similar features to a smart phone
- In addition, the app or black box will regularly give the vehicle's rough location within an agreed grid – this is not to track the vehicle but rather to filter broadcast alerts only to nearby vehicles – a grid could be based on mobile phone cell or some larger geographical grid
- Upon receiving a broadcast alert from the national safety system, the app or black box will determine whether the vehicle is approaching the alert location – note that it is possible that the receiving vehicle is on a different road completely, the other carriageway or may have already passed the alert location
- The app will communicate with the infotainment system to raise an audible alert to the driver within 1 second
- The app (or black box) will keep track of location by using GPS and other phone location services to establish if the road being used is part of the usage charging – if so, which section of road the vehicle is currently on and in which direction it is travelling. The locations will be sent to the Usage Charging Partners' systems
- There will need to be an agreed list of sections of main roads, which is downloaded to the app from time to time. This is part of the national road model. The app would use the mobile phone's cellular technology to communicate a log of different sections of roads, timestamp, weight and possibly other telematics data

5.3 Central Technology

- Alerts from vehicles, together with section of road, distance along the section & lane will be sent to the Digital Safety System, passed to the Disruptions System and made available for road operators on a geographic map: ice, flood, pot hole, debris, sharp breaking, side wind, air bag. For example, pot hole alerts can be used to inform emergency maintenance
- The Digital Safety System will send alerts to nearby vehicles' apps: incident, slow traffic, skidding risk, debris, pot-hole, low temperature
- An initial Digital Safety System would be purely advisory, giving audible warnings to the driver. Later systems could automatically apply the brakes to vehicles sufficiently close to the site of the alert – such a change would involve a careful safety case and a part transfer of the driver's responsibility, therefore will not be available in the short-term
- The Multi-Dimensional Management System will send management information such as road closure, diversions, lane control and variable speed settings to the in-vehicle app or black box
- Usage Charging Partners' systems will receive vehicle locations and prepare billing. In addition, aggregate, anonymised road usage data will be sent on to the Real Time Road Network Model each minute
- The Real Time Road Network Model will be the definitive source of road names and locations for the in-vehicle app or black box
- The Disruptions System will send out definitive information about events real-time to multiple partners, including social media companies, SatNav suppliers, transport data suppliers and media companies

- The Real Time Road Network Model will receive anonymised road speed data from the Usage Charging Providers
- The Real Time Road Network Model will send alerts of unusual speed and usage on section of road to the Disruptions System, which can be used as advice for operators: “check out this abnormality”

5.4 Roadside Technology

No additional roadside infrastructure is needed such as the ANPR cameras deployed to support London’s Congestion Charge. However, other existing electronic roadside infrastructure can be used:

- CCTV will continue to be as useful as now to spot stationary vehicles, verify disruptions and inform the management of disruptions
- Traffic lights, ramp metering sites and Smart Motorways sections can be controlled according to response plans from the Multi-Dimensional Management System
- Variable message signs can be used to inform travellers, especially those without a connected vehicle in the short-term – these will be of less use in the future and can be phased out
- Much roadside sensor equipment can gradually be phased out, such as loops, radar, Bluetooth detectors and ANPR cameras. Even enforcement cameras might be replaced by connected vehicle technology

6 Answers to NIC Questions

6.1 Cross-cutting issues:

Question 1

What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region? *Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of “highest value” should include benefits and costs, as far as possible taking a comprehensive view of both. “Long-term” refers to the horizon to 2050 and should exclude projects that are already in the pipeline.*

The Digital Transport programme outlined above will:

- Encourage journey shift: to other transport modes, other roads, other times of day
- Increase road capacity: providing the next generation of Smart Motorways for all roads
- Improve average travel times on roads
- Improve reliability (spread) of travel times
- Improve disruption information and disruption responses
- All of the above will reduce emissions
- Improve road safety: providing the next generation of MIDAS systems for all roads
- Improve and standardise the transport statistics for the whole country

The unblocking of the roads will aid all modes of transport that utilise roads.

Together, these will enable agglomeration and improve the standard of life while travelling. There is potential to return tens of billions of pounds of cost savings to the British economy.

Question 2

How should infrastructure most effectively contribute to the UK’s international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Reducing travel times and at the same time making journeys more reliable and more resilient to disruptions will reduce the travel cost within the UK. This will improve UK’s competitiveness with other countries.

International gateways will be at the edge of the national transport network model, creating demand and receiving freight and passengers. Road usage charging will incentivise international gateways gradually to be located with the lowest mix of travel times, reliability, congestion and transport infrastructure costs for both their freight and passengers.

Question 3

How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

The National Transport Data Warehouse outlined above can provide transport statistics which are consistent and joined up across local government boundaries, bringing the current detail of the Strategic Road Network to all major roads & bus routes and across all modes of transport. Usage, reliability, vehicle occupancy, transport mode, origin & destination will all be available historically at most one day out-of-date. A mathematical model will be available to answer “what if” questions about proposed major housing, medical, educational and industrial projects. This transport model could be part of a wider UK national infrastructure model.

Question 4

What is the maximum potential for demand management, recognising behavioural constraints and rebound effects? *Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.*

The road usage charging outlined above gives ample opportunities for demand management. A traveller has a background financial motivation for journey shift. In addition, the disruption management system outlined above allows travellers the ability to react to disruptions by changing their planned route, thereby avoiding areas of disruption. As they improve their own journey, the travellers will load balance the transport network.

This Digital Transport programme may increase off-peak travel or travel on little used roads or little used transport modes, but the extra journeys will not be on congested roads. Since the journey’s total costs are transparent and are recovered, any additional usage will have any additional maintenance funded.

Question 5

How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

The Digital Transport programme recommends all transport costs are transparent and attributed to the traveller. This includes maintenance costs, geographic or peak bottleneck costs, emission costs and noise annoyance costs. Therefore maintenance costs can be recovered and travellers will be able to consider the cost of fixing pot-holes as they choose a journey and a mode of transport.

In addition, more accurate return on investment business cases for new assets can be made using the National Transport Data Warehouse statistics and modelling.

Question 6

What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Although this document only talks of transport infrastructure, collaboration and competition can be allowed. There will be competition between modes of transport, different transport operators and a new market of Usage Charging Providers. The collaboration and government leadership is possible by varying the road usage charges.

Question 7

What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

The Digital Transport programme describes a new method of motivating journey shift and greatly enhanced transparency of road transport costs, without increasing the overall road tax burden. These changes will reduce travel times and improve traveller satisfaction.

Question 8

Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets? Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

The programme outlined above, although clear in its return on investment, will not happen without central government leadership since

- There is a disparate budget for transport technology across modes of transport and across local government
- Local, even regional focus does not result in intelligent mobility, where a traveller often completes a journey across multiple transport infrastructure owners
- There have been deep cuts recently in operational transport spending
- Operational transport budgets are not normally set within a multi-year framework therefore transformational projects cannot be underwritten easily (Network Rail and Highways England do not have this problem)

Question 9

How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

Two things should be coordinated between different infrastructure sectors:

- A National Infrastructure Data Warehouse can be established by extending the National Transport Data Warehouse system proposed above – people and freight with their multiple locations and movement is best understood in a wider infrastructure context
- A National Infrastructure Disruptions system can be established by extending the National Transport Disruptions system proposed above – the resilience of infrastructure to unplanned and even planned disruptions should be coordinated across all infrastructure and emergency services: terrorism, major construction, natural disasters

Question 10

What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

- The planning system should have a National Transport Data Warehouse in order to provide consistent, cross-boundary statistics and “what if” modelling to aid efficiency
- Multi-year, transparent transport infrastructure funding is essential to address the crisis in congestion
- Some investments and transformational leadership must happen at a national level to address the crisis in road congestion

- Public acceptance by drivers and the freight industry to tackle congestion is best done at a national level and will be achieved only through funding transparency

Question 11

How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Emissions, noise and transport infrastructure wear & tear are best reduced by making their cost visible through road usage charging. Travellers and the freight industry will respond to transparency and financial rewards.

Question 12

What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent? *Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.*

Better transport data would help to better cost-benefit analyses. This would have to be consistent, across boundary and multi-modal as would be delivered by the proposed National Transport Data Warehouse above.

6.2 Transport:

Question 13

How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? *Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.*

Increases in the average length of journeys and average journey times will probably continue until an unacceptable crisis. This is chiefly because

- Estate managers of large organisations such as hospitals, schools, manufacturing plants and offices continually reduce the number of sites they manage to reduce costs – a smaller and smaller number of larger and larger sites – this causes longer journeys to work, hospitals, schools and work places
- Moving homes to be closer to work is too hard – stamp duty and the lack of guarantee for children during education to find new schools close to home e.g. regarding schools places, two primary school children may only be offered places in different schools, neither of which is closest to the new home

Not all technology change can be anticipated, but

1. Vehicles will gradually become more autonomous and more connected
2. The Digital Railway programme will
 - a. Increase the number of trains possible along a section of track by deploying moving block signalling
 - b. Increase the resilience of the national network after disruptions by deploying Traffic Management technology
3. The London Underground will
 - a. Increase its capacity through deployment of moving block signalling, as has already been achieved on the Jubilee and Northern lines
 - b. Increase automation to the point of not needing train drivers
4. There will be widespread Mobility as a Service as people increasingly live without owning a car but by using transport services instead
5. Personal travel assistants or SatNavs should become essential for all modes of transport, including walking. Their usage should increase even for familiar journeys, since better transport information will

help with the current state of the transport network, including disruptions. The latest transport information will also help make changing transport modes less stressful

Question 14

What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas? Note: “high value transport investments” in this context include those that enable ‘agglomeration economies’ – the increase in productivity in firms locating close to one another.

The Digital Transport programme outlined above. Please see the answer to question 1 for a summary of benefits.

Question 15

What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area? Note: *this includes travel in and between rural areas, as well as between urban areas and international travel.*

The Digital Transport programme outlined above will reduce journey times and increase journey reliability outside of an urban area, since it primarily helps road travellers. This programme could return tens of billions of pounds of cost savings to the British economy.

Question 16

What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?

The Digital Transport programme outlined above, which includes road usage charging, complements “mobility as a service”:

1. Road usage charging makes roads a consumable service
2. All transport modes can be compared by price which should increase the use of public transport
3. Incentives can be given for vehicle sharing
4. Buses consume less road infrastructure per head and therefore they will become relatively cheaper than cars, thus encouraging modal shift

Reduced car ownership, which is promised by mobility as a service, will save on parking. Also, autonomous taxis would in addition increase social inclusion.

The downside of reducing car ownership is additional trips for the vehicle: the rented vehicle must move from a pool to the traveller, then do the journey, then return to a pool. These additional trips would add to congestion. This is also true for ring and ride services unless origins and destinations are shared by multiple travellers.



NIA Call for Evidence
 National Infrastructure Commission
 11 Philpot Lane
 London
 EC3M 8UD

Via email to NIAEvidence@nic.gsi.gov.uk

10 February 2017

Dear NIA Call for Evidence

Please find below a response from Thames Valley Berkshire Local Enterprise Partnership. The response is confined to some of the questions in the Cross-cutting and Transport sections.

Where we have made no response it is because we lack access to specialist evidence or understanding of the issues as posed by your line of questioning.

We look forward to responding more fully to the draft NIA when it is published.

Thank you for the opportunity to contribute. If you would like to follow up on any of the topics please contact [name redacted] ([email redacted] [telephone number redacted])

Cross-cutting issues:	Thames Valley Berkshire response
1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region? Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.	TVB LEP has concluded that Labour Supply issues are the biggest threat to our economy ⁱ . Therefore, we would prioritise: 1. Enabling housing development and/or 2. Better transport systems which improve local, regional, national and international connectivity and/or 3. Promoting access to the best talent
2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?	TVB LEP has identified proximity to the world class airport at Heathrow as major competitive advantage for our economy. This encourages inward investment, HQ location and leads to better Trade Deals and aids exporting
3. How should infrastructure be designed, planned and delivered to create better places to live and	Please refer to " Being dense: it's the clever option " ⁱⁱ published in November 2015, which advocates master planning

<p>work? How should the interaction between infrastructure and housing be incorporated into this?</p>	<p>for high (50-100 dwellings per hectare) density with sustainable transport at the core of the plan. The report covers both greenfield and regeneration planning.</p>
<p>4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects? Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.</p>	<p>No comment.</p>
<p>5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?</p>	<p>No comment.</p>
<p>6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?</p>	<p>In order to achieve either large scale urban extensions, or comprehensive redevelopment of existing urban areas, public authorities need a range of planning, compulsory purchase and borrowing or other financing powers held in a single “(Re-)Development Corporation”.</p>
<p>7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered? Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.</p>	<p>As above</p>
<p>8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets? Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.</p>	<p>The “(Re-)Development Corporation” envisaged at the answer to Q6 (which would have CPO, master-planning and other statutory powers) above would need to embrace new responses to the challenges currently faced by local, regional or sub-national public bodies exercising borrowing powers against future tax or other income.</p>
<p>9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.</p>	<p>No comment</p>
<p>10. What changes could be made to the planning system and infrastructure governance arrangements</p>	<p>In order to deliver major urban extension or regeneration schemes there should be</p>

to ensure infrastructure is delivered as efficiently as possible and on time?	“(Re-) Development Corporations” with CPO, master-planning and other statutory powers combined with borrowing, investment and other financial freedoms.
11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?	Existing planning requirements for Environmental Impact Assessments and consequential mitigation or enhancements should be supported.
12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent? Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.	No comment
Transport:	
13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.	<p>The following is taken from an unpublished TVB LEP briefing document: However, three common themes stand out:</p> <ul style="list-style-type: none"> • although it takes different forms, the influence of London is clear and (perhaps with the exception of the SMEs) pervasive: TVB needs to recognise the complex links to the capital and the consequences of the enhanced connectivity that Crossrail will afford, particularly in seeking to recruit and retain specific groups of workers • enabled by IT, working practices are changing profoundly, and this in itself is creating different opportunities and demands in relation to sites and premises, and the infrastructure through which these are connected • patterns of service delivery are also evolving quickly, with an increasing emphasis on local service centres (reversing a long-term trend) and also on on-line services and home delivery. This is true for both for private sector services (like retail) and for healthcare delivery. In response, spatial configurations are changing – although there may, in practice, be a considerable time lag (particularly within the public sector in the context of limited resources) before these are fully realised.
14. What are the highest value transport investments to allow people and freight to get into, out of and	The following is taken from an unpublished TVB LEP briefing document:

<p>around major urban areas? Note: “high value transport investments” in this context include those that enable ‘agglomeration economies’ – the increase in productivity in firms locating close to one another.</p>	<p>Improving the transport infrastructure to enable and accommodate growth is essential. However, road capacity cannot indefinitely be increased to meet growing demand. Therefore, new development must be well served by public transport, preferably on dedicated routes. TVB is crossed by various rail lines, some of which are receiving very substantial investment to improve capacity and reliability. Looking ahead, maximum use must be made of the accessibility these lines afford. As a consequence, a high priority must be given to development in and around existing stations, to examining the scope for new or extended stations and increasing capacity on existing lines, and for other rapid transit solutions elsewhere.</p>
<p>15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area? Note: this includes travel in and between rural areas, as well as between urban areas and international travel.</p>	<p>TVB LEP has prioritised the Western Rail Link to Heathrow scheme as its top Infrastructure priority. This scheme has regularly appeared in the National Infrastructure Plan and in Network Rail Long Term Planning Documents. It was recognised by the Davies Commission report as being justified on the basis of a two-runway Heathrow Airport. Despite this good level of support for the scheme, it is not fully-funded, and now appears caught up as part of the necessary mitigation to be delivered by Heathrow as part of their 3rd runway Development Consent application.</p>
<p>16. What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?</p>	<p>No comment</p>

ⁱ http://thamesvalleyberkshire.co.uk/Strategic_Economic_Plan

ⁱⁱ <http://thamesvalleyberkshire.co.uk/Portals/0/FileStore/DocumentLibrary/Thames%20Valley%20Berkshire%20LEP%20TDEP.pdf>



National Infrastructure Assessment – call for evidence Response from Thames Water

Executive Summary

London and the south-east face a growing water supply-demand deficit, which left unchecked could threaten economic growth, and expose the region to an acknowledged increasing risk of severe drought, and undermine its international competitiveness.

Thames Water is already taking action to close this deficit through an ambitious and accelerated programme to help customers use less water. However, due to the size of the deficit, demand management alone cannot release sufficient water supplies, so new resources will also be necessary. The need is urgent – if London and the wider region are to grow as anticipated, and to reduce its exposure to extreme drought, work to construct new water resource supplies must begin in 2020.

The growing pressure on the sewage network, caused by housing growth, loss of permeable areas, and the anticipated effects of climate change necessitates reform. There is an opportunity to shift from piecemeal and largely reactive provision of wastewater infrastructure to one that anticipates and enables growth on a strategic basis. This can be enabled by reform of funding arrangements for wastewater infrastructure, changes to the planning system so that more new development is sustainably drained, and the closer involvement of water companies in the planning process.

Markets present opportunities for improvements in the sector. New water resources can become strategic resources for the wider region, rather than a single company, and collaboration between all stakeholders can provide strategic wastewater investment, which will facilitate growth.

The Government can play a key role by producing a Strategic Policy Statement that clearly sets out policy in line with known customer views on resilience. In our view, a National Policy Statement for Water should be brought forward prior to any public inquiries for water companies' Water Resource Management Plans so that any subsequent inquiry focuses on whether the water company in question has produced the best value plan in response to the resilience challenges it faces and not the already established 'need' to maintain water security.

We believe the Commission could help address the question of how best to provide a water supply network resilient to the risk of severe water shortages where the risk is increasing as a result of population growth and climate change. The cost of a severe drought would be high, estimated in 2012 to be £330m a day⁵ in London alone. The potential cost of a severe drought therefore heavily outweighs the cost of increasing resilience. The Commission could play a valuable role in finding the appropriate balance between resilience, affordability, and intergenerational equity. This may ultimately mean adding more weight to the need to invest in a combination of infrastructure and demand management that will provide a safer and more reliable service, which should not come at the expense of efficiency, or an imperative to keep costs as low as possible. We recommend a call for water companies to invest in infrastructure and demand management that enables economic growth and enhances resilience to a stated standard of at very least a 1 in 300 year drought. In comparison, UK Government currently invests in tidal flood defences to protect London from a 1:1000 year coastal flood event.

Our first step to reduce our supply-demand deficit is demand management⁶. Our progressive metering programme is the largest water efficiency programme ever to take place in the UK. In combination with the rollout of smart water meters, we are speaking one-on-one with customers, providing water saving devices and fixing leaks identified by the new meters on their property. Once there has been sufficient penetration, smart meters will improve our ability to pin-point leaks in our network and better direct investment. In addition, we plan to step-up work to tackle leakage and are planning to bring forward incentive and innovative tariffs as an option in our WRMP19. However, despite this unprecedented work to reduce demand, the size of our supply-demand deficit is such that new water sources will also be required.

The urgent need for new water resources is beyond doubt. The Commission can call for a National Planning Statement for water to be issued before any potential public inquiries into water companies' Water Resource Management Plans. This will enable work on new infrastructure to get underway in 2020, which is required if London and the south-east is to continue to enjoy water security.

To support the projected growth in London and the south-east we need wastewater infrastructure to be treated with greater urgency than it currently is. Urban creep⁷, loss of green space and climate change all put pressure on the sewer network. Development in the capital in particular has led to a 19% increase in impermeable areas in 40 years. Population growth adds to these challenges but the new development needed to accommodate it creates opportunities for improvements, provided the drainage is correctly designed.

However, the present funding arrangements for wastewater infrastructure are no longer fully efficient or effective to service the needs of new development. Successful reform would enable growth and allow all water companies to better support housing developers.

There is an opportunity for the Commission to assist in introducing an organisational and cultural shift in the way that wastewater infrastructure is planned for in the UK, towards a strategic system that facilitates growth. The Commission can encourage new development to be water efficient, including rain and grey water recycling where appropriate, and sustainably drained.

⁵ NERA 2012 A non-essential use drought order for London: economic impact assessment

⁶ Thames Water: [Demand Management Options Screening Report – Phase 1 Executive summary](#)

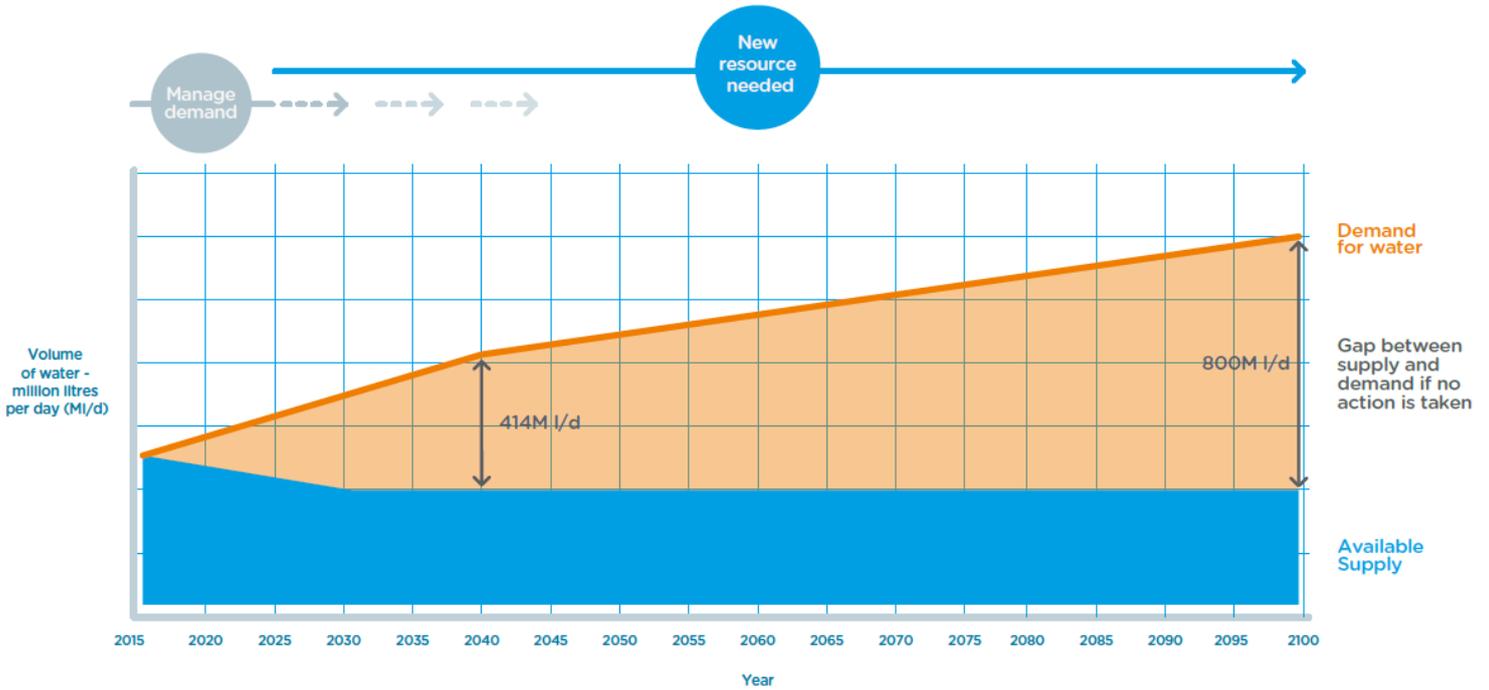
⁷ The loss of permeable ground through using impermeable materials in urbanisation.

Cross-cutting issues

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Our area of operation includes London and the Thames Valley, the UK’s most economically important and rapidly growing region. Unless the design and planning process for new water infrastructure begins in 2020, the capital will not have the water it requires for sustainable and secure growth⁸, and, after 2022⁹, will become increasingly exposed to severe drought.

Figure 2 – Potential deficit in London water resource zone without mitigating actions



Source: Thames Water

A rapidly increasing population, sustainability reductions, and the disruptive effects of climate change mean there is a growing gap between supply and demand. The predicted new housing in London and the south-east cannot be delivered without an increase in supply, even after ambitious demand management measures are implemented, including leakage reduction, universal water metering, and improved water efficiency.

The UK Climate Projections¹⁰ suggest that climate change is likely to have a disruptive effect on the availability of water in the UK. Whilst the average annual rainfall is not expected to vary, average and extreme seasonal rainfall is predicted to change, with significantly wetter winters and drier summers expected for the second half of the century compared with the baseline period. This could result in greater pressure on water supplies by reducing the amount of water available for abstraction, particularly in the south-east. The Thames is already the most intensively used catchment in the country, with more than 55 per cent of the effective rainfall licensed for abstraction. A requirement under the Environment Agency’s drought plan guidelines to be resilient to more extreme droughts confirms this national need, which is most critical in the south-east. We will need to properly account for these changing weather patterns in whatever supply-side measures we introduce.

Our existing 25 reservoirs are ageing and are expected to require significant maintenance activity in future to meet reservoirs act requirements, and to ensure they continue to provide reliable services for years to come. The

⁸ The long lead-in times for new water infrastructure (desalination, wastewater reuse, direct river transfer, interbasin transfer, reservoirs) require the planning process to begin in 2020

⁹ Thames Water [draft Drought Plan 2017](#)

¹⁰ [UKCP09, The MET Office](#)

Reservoir Act (1975) requires us to carry out detailed inspections once every 10 years, and act on the findings, often before the reservoir can be put back into service. Drawing levels down, inspecting the reservoirs, completing any work and refilling them can take a considerable amount of time, ranging from months to years if significant issues are uncovered, which has been demonstrated to become more likely with an ageing asset base.

While such exercises are planned to take place outside of periods of drought, there is a risk that the drawing down of a reservoir for statutory inspection could coincide with an unplanned outage at another reservoir - potentially putting the security of supply at risk if a lack of rainfall means that refilling cannot take place. This is not a hypothetical risk – we experienced lower than average rainfall last winter and, at the time of writing, are experiencing another dry winter. This coincides with the upcoming need for prolonged maintenance of one of our major reservoirs serving London.

London's existing water resources are not designed to cope with more intensive droughts than those experienced in the twentieth century, which had a recurrence interval of approximately 1:100 years. More severe droughts than these will reduce water availability to the capital. For example, a 1 in 500 year drought would mean our reservoirs had a yield 260-300 MI/d lower than during the twentieth century droughts.

The severe restrictions on water supply that would need to be imposed in a near worst-case drought scenario could cost up to £330m¹¹ a day in London alone. Severe water pressure reductions and rota cuts (where customers would experience a rota of temporary cuts in their water supply) could affect almost all areas of the economy, potentially forcing workplaces, schools, hotels and restaurants to temporarily close due to hygiene concerns (lack of toilets) and safety (fire suppression systems). The restrictions may also impact on other water intensive uses, such as the use of air conditioning for non-human health purposes, possibly affecting IT servers, causing IT systems to cease operating.

Water companies are required to ensure their plans are resilient to a range of hazards, which further supports the need for an improved supply and demand capability. Our Water Resource Management Plan (WRMP) for the period 2015-2040, approved by the Secretary of State in 2014, projects a supply deficit and identifies the need for a large water supply scheme from the mid-2020s. The plan identifies three potential options: wastewater reuse; the transfer of supplies into our region; and a large reservoir.

Like all water companies, we are currently developing our next WRMP. We are currently examining a range of options for new resources, including wastewater reuse; the transfer of supplies into our region; a Direct River Transfer (which would see treated effluent returned upstream of key abstraction points on the lower River Thames, rather than further downstream, as at present); desalination; and a large reservoir. There is associated infrastructure that enables these new water resources to function, including conveyancing tunnels, a possible extension to the London Ring Main, and water treatment works. These are subject to detailed studies to determine the best value combination of options for us to promote in the next revision of our plan, to be published for consultation in spring 2018. The plan will then be amended and sent to the Secretary of State for a decision in January 2019. A public inquiry may be required as part of this process.

Major new water infrastructure has long lead-in times. For example, it could take more than a decade from a WRMP being approved to a major new reservoir being delivered. However, a National Policy Statement (NPS) for water could shorten the timescale. A new NPS would have three main benefits – it would provide greater certainty and therefore lower costs, prevent delays due to the local planning process, and avoid a potential public inquiry unnecessarily having to address the issue of need.

The need for new water resources is not in doubt, as demonstrated by Water UK's long-term planning study¹² and WRSE regional modelling. According to our latest planning forecasts, as well as implementing demand management measures, we will need a large new water resource option from 2023/24. Our WRMP14 forecast an option needed by 2026/27, but since 2013 there has been an even further substantial increase in population in London. Of the new

¹¹ Analysis by NERA, commissioned by Thames Water in 2012.

¹² [Water UK, Water Resources Long Term Planning Framework](#)

resource options we are examining the very earliest could come online from 2025, assuming a NPS is introduced in time for the planning process to begin in 2020.

Once constructed, water infrastructure has the potential to be in use for centuries. For example, the New River was opened in 1613 to transport water to a rapidly expanding London and is still used today. The backbone of water and wastewater infrastructure in London was constructed by the Victorians, although it has been significantly improved and extended since,

The rapidly increasing population, particularly in London, will require significant and urgent investment in wastewater infrastructure. We are currently developing our plans for the regulatory period 2020-25, but our latest growth forecasts (GLA/Experian data) are indicating the need to **invest £750m to £900m during the five**-year period. Available space at our existing sites is a concern as the majority are 'land locked', which restricts the opportunities for conventional expansion and therefore increases costs. New major wastewater sites are unpopular with communities and elected representatives, and the necessary land is often unavailable. We are currently creating a team who will be dedicated to looking at London's long-term wastewater needs, taking a view of what is required to meet demand, where, and when up to 2100.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

London and the south-east account for 38% of the UK economy¹³. The economic engine of the country must be serviced by secure and reliable infrastructure if Britain is to demonstrate to the world that it is 'open for business' and attract investment.

A world city that cannot deliver new housing and businesses due to water shortages or inadequate drainage infrastructure, or suffers from economic chaos caused by severe drought, would not be able to achieve this.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

This question is answered through our responses to questions 1, 4, 7 and 11.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Demand management is the first step we are taking to reduce our supply-demand deficit. In WRMP14 we proposed the introduction of innovative tariffs from 2022/23 as a measure to ensure a sustained demand response by metered customers. We planned to undertake a trial of tariffs, between 2015-2020, to understand and quantify customers' responses to alternative tariffs. Over the past 18 months, we have completed a desk based review of tariffs, both in the UK and internationally, to understand the types of tariffs in use, the methods of implementation and the effectiveness of the tariffs (where this information is available).

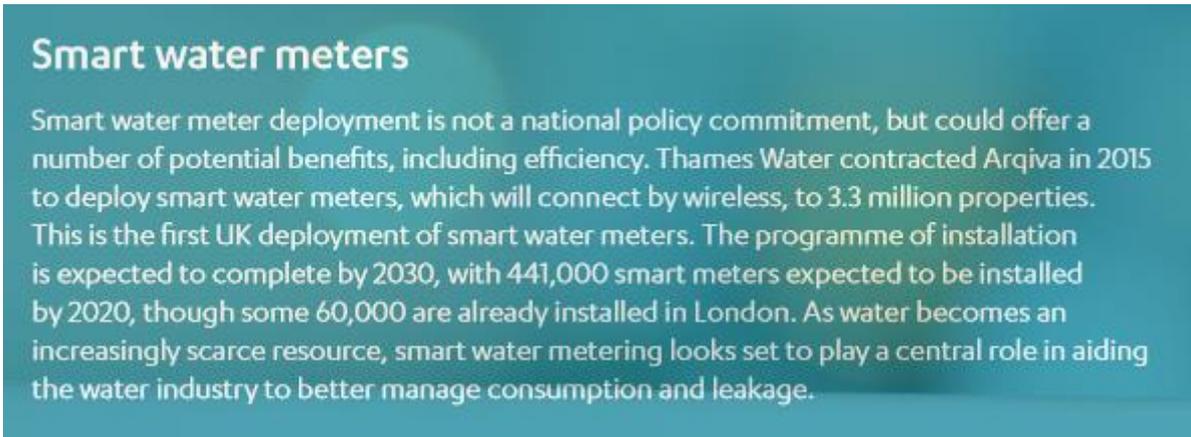
The research we have carried out with customers found that they are sceptical of tariffs; they believe that everyone should be on a meter before tariffs are introduced to ensure fairness; and education on water use is needed as a precursor for tariffs to work effectively. In response to the feedback received from customers we have developed a reward based incentive scheme and are currently trialling this in Reading. We plan to extend the trial to parts of London in 2017. The scheme is a positive intervention, to help customers understand their water use and encourage the efficient use of water through rewards. The effectiveness of the scheme will be assessed, using both quantitative and qualitative data, to inform our future strategy on incentives.

As recognised in the Commission's recent publication 'Connected Futures', we are the first water company to deploy smart water meters, which have the potential to improve how we manage leakage and consumption. Starting with

¹³ [House of Commons Library, Regional and local economic growth statistics, December 2016](#)

London, where the need is greatest, our ultimate aim is to roll-out meters to all of the 3.3million properties we supply.

Figure 3: Extract from the NIC’s ‘Connected Futures’ publication



Source: National Infrastructure Commission

In WRMP14 we included assumptions for demand reductions as a result of metering and wider demand management activities. We are currently rolling out the progressive metering programme in London, which is the installation of AMI smart meters. We are evaluating the programme as it is implemented, in respect of the costs and benefits. Customers are offered a 2-year period during which they can switch to a metered bill. At present we do not have a representatively lengthy data set on which to re-base our assumptions on the usage benefits of customers switching to a metered bill. We will share this information with stakeholders when we have a robust data set.

We are offering a free in-home water efficiency retrofit and tailored audit-advice service for every household in receipt of a new smart meter, with over 50,000 taking place in 2016/17. This Smarter Home Visit programme¹⁴ (advising customers one-on-one in their own homes, providing water saving devices and fixing leaks identified by the new meters on their property) is the largest water efficiency initiative ever undertaken in the in the water sector.

Unlike other developed nations, only a small proportion of domestic properties in London and the south-east have a water meter. On average, our metered customers use 12% less water than non-metered customers use – this represents our largest opportunity for behaviour change, by giving water an explicit value and providing our customers with the practical support and advice to reduce waste and manage usage.

The smart metering programme has recently passed an important milestone with the 100,000th meter being installed, but the current level of penetration means that the data has only just begun to be utilised. The benefits of the programme and the data available will steadily increase in the years ahead.

Currently, water companies are able only to estimate their leakage, and the figure includes leaks on customers’ properties, from pipes which the water company does not own. Only 2% of leakage is visible above ground, and we estimate that a third of our leakage occurs on customers’ land. Smart meters are a radical change for the water industry – once a significant proportion of customers have them, for the first time they will allow us to see in real-time where water is going in our network and enable us to pin-point the location of leaks.

Our smart metering programme is the largest water efficiency project ever to take place in the UK, and will improve our ability to tackle leakage, while delivering better insight for customers into their own water consumption. The programme forms a key part of our demand management, which also includes major and increased investment in our network to reduce leakage and use greater education and one-on-one proactive dialogue with our customers¹⁵.

¹⁴ Thames Water: [Smarter Homes Visits](#)

¹⁵ Thames Water: [Demand Management Options Screening Report – Phase 1 Executive summary](#)

Despite this unprecedented and highly ambitious activity to reduce demand, our optimistic forecast is for demand management to only make up half our water supply-demand deficit by 2040.

Looking internationally, there are examples from Australia and California that highlight the dangers of overestimating the extent that demand management can close water supply-demand deficits. This is set out in more detail in our answer to question 22.

The water demands and sewage generation from a number of major new development areas will exceed the capacity of our networks in some areas. We have been mapping the expected demands of major new developments onto our water and wastewater (including drainage) networks to identify where there may be insufficient capacity to supply or drain these developments. Where we have identified significant incapacities, we are working with the Local Planning Authorities to develop Integrated Water Management Strategies (IWMS) to understand the scale of the gap in more detail and to develop options, such as grey water and rainwater harvesting systems at community-level and for individual buildings, to close the gap. For example for Old Oak Common in London, the draft IWMS suggests that almost all the rain that falls on the site must be captured in sustainable drainage systems (SuDS) or used on site.

For wastewater, the roll out of sustainable drainage measures across the capital – both for new developments and retrofitted in areas prone to flooding – is an essential part of our programme to reduce the strain on sewerage infrastructure. Over the next five years we plan to retrofit sustainable drainage measures to remove surface water run-off from 20 hectares of impermeable area, including a large scheme at Battersea Nine Elms.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Since privatisation we have invested heavily in infrastructure, delivering major projects such as the London Ring Main and a new desalination plant, although much of our core infrastructure dates back to the Victorian era. Some of this, such as water treatment works, will continue to be used for centuries to come. Our investment for the past 11 years averages over £1bn per annum.

Our network of distribution and trunk mains are the oldest of any UK water company, and consequently require a sustained investment programme to reduce leakage and improve reliability of the network. Since they were laid, many in the 19th Century, the cities and towns above much of the network have been transformed, particularly in London, where arterial roads have been built on top of our pipes. The costs of replacing or relining pipes are therefore high and the necessary work causes significant traffic disruption. We use pressure management to extend the life of mains and aim to replace them once their performance drops below a critical performance threshold.

Against this backdrop, there is a falling rate of return from repair and replacement work, as illustrated by the graph below. The cost per megalitre (£M/Mld) rises as the pipes with increasingly smaller levels of leakage are fixed – those suffering the most leakage are fixed first, with work continuing down a priority list. There is a point where the level of investment required to reduce leakage even further provides customers with poorer value for money than, for example, investing in new sources of supply.

London's sewer network, designed by Joseph Bazalgette, served a city of two million people. Thanks to Bazalgette's foresight, it was built with a capacity for four million. However, it now serves a city of eight million. In response to problems caused by outgrowing existing capacity, we are building the Thames Tideway Tunnel. By rethinking the way that wastewater in London is managed we can ensure that this new tunnel is sufficient for centuries to come.

The rapid rate of growth in London means that new measures and approaches need to be introduced to provide support. New development provides an excellent opportunity to reduce the amount of surface water that enters the sewerage network through sustainable drainage measures. In London, many of the sewers are combined, that is, they convey both foul and surface water in the same pipe. Removing or reducing surface water serves to increase the available capacity in combined sewage networks to accommodate growth in foul flows without the need to construct new assets.

Extending this approach to address the requirements of others with drainage responsibilities such as Local Authorities, Highways Agency and the Environment Agency offers a unique opportunity to identify partnership projects that deliver multiple benefits. However there is no established mechanism for identifying and delivering such projects, albeit that the Thames Regional Flood and Coastal Committee has sought to encourage such thinking. As discussed later in this response we are currently examining what form a whole catchment approach should take, our role within it and in which catchments it might be most effective. However, in order for a whole catchment approach to be more routinely applied, responsibility for its execution might need to be vested in a single authority.

To enable the reduction of the amount of surface water that enters the sewerage network, water companies also need to become statutory consultees on major planning applications, the existing planning framework for SuDS requires strengthening, income from connections should not be subject to a revenue cap, and strategic investment in advance of development is required.

Many of the sewers that we operate were constructed in the Victorian era. Whilst the majority are still in good condition, collapses do occur, and the consequences of large diameter sewers collapsing can be significant. For example, many sewers in London and the south-east cross beneath railways and so have the potential to cause major disruption.

Our current approach is to survey and monitor our critical sewers, so that we can determine the exact location if and when we need to intervene to carry out repairs. We are also continuing to improve our understanding of deterioration rates to inform future rehabilitation programmes.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

The water industry in England and Wales has been regulated since privatisation in 1989, with services to households and non-households provided mainly by statutory regional monopolies. There have been attempts to introduce competition or mimic its effects, particularly the use by Ofwat of regulatory benchmarking (or 'yardstick competition'). The Water Act 2014 expanded the markets for non-household retail competition and upstream competition, both of which have struggled to develop since their introduction in 2005 due to flaws in the competitive framework. However, non-household retail competition opens for business in April this year and upstream competition is expected to come into force during the 2020s. Ofwat has recently, at the Government's request, reported on the costs and benefits of introducing household retail competition. The decision whether to proceed with household retail competition is with the Government.

For retail competition, existing water/wastewater infrastructure remains the responsibility of the regional water company (the wholesaler). Upstream competition, however, will allow entrants to provide the supply of raw or treated water into a company's network, or the removal of wastewater for treatment, without being obliged to also provide retail services.

We welcome the introduction of upstream markets, and believe it can play an important role for the industry as a whole, the size of our operation means. That said, it is unlikely to play a significant role in our future water supply

operations, either in the short or long term. For example, we supply 2,600 million litres of drinking water every day – it is extremely unlikely that another organisation would be able to create a new supply that significantly changes this figure.

There is significant opportunity for collaboration on water supply. We have existing water transfer agreements with neighbouring water companies and with private individuals and other companies. The introduction of a major new water source has the potential to act as a strategic resource for London and the whole south-east region, providing security to multiple water companies and other sectors, including farmers. For that reason we are open to the possibility of joint-ownership or another organisation owning any major new asset. Upstream markets could provide the regulatory mechanism to allow this to happen.

By not delivering major infrastructure ourselves, and instead opening the process to competition, the result can be lower costs. The Thames Tideway Tunnel (TTT) is an example of an innovative financial model that is delivering a £4.2 billion project with minimal impact on customers' bills. When originally proposed with a traditional utility model, the costs on customers' bills were estimated to be £70-£80 per year on average. Through the model used, bills will instead rise by £20-£25 per year by the mid-2020s.

The TTT model is a first for the UK water industry and involves the creation of an independent infrastructure provider (IP). The cost of capital is reduced by the external financing of a single significant asset with suitable protection against exceptional construction risks associated with deep tunnels that could not be insured against through the private sector, enabling the IP to attract substantial private investment, including from domestic institutional investors. The model is applicable to other forms of infrastructure, particularly other regulated or monopolistic assets such as transport infrastructure. Ofwat has recognised this in its proposals that encourage companies to deliver projects via direct procurement.

On the opening of a sludge market, we agree with Ofwat's proposal to set a separate control for sludge treatment and disposal. We consider this raises an opportunity to support greater efficiencies in sludge activities, for example a greater focus on sludge assets may limit poor quality liquor returns and improve the dewatering and quality of sludge for energy production. This therefore raises the opportunity to increase revenues from sludge, and reduce treatment and disposal costs.

However, the environmental regulations present a barrier to co-digestion. Overcoming this barrier may be difficult in practice and incur additional costs. We are supporting Ofwat and the sludge working group in examining how to overcome this.

As local authorities, highways authorities, the Environment Agency, and riparian land owners all have responsibilities for drainage, the potential for collaborative projects to address areas at risk of flooding is significant. Indeed, it is unlikely that water companies will be able to reduce flood risk on their own, in the face of climate change and increasing urbanisation, without working collaboratively with other drainage partners.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

There is a well-established framework of independent economic regulation which has remained broadly stable since privatisation. Although stable, this framework evolves over time, and with this evolution comes opportunities and challenges for the efficient delivery of infrastructure are created.

For example, recent changes to the framework that confer greater risk on companies in respect to population growth create challenges; whereas Ofwat's recent proposals to facilitate direct procurement of major infrastructure projects create opportunity.

The details of the regulatory arrangements are clearly matters for Ofwat, in the first instance, and therefore we are engaging with them on these topics in the lead up to the next price review.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Clear, stable Government policy and independent economic regulation reduces uncertainty and therefore lowers the cost of investment. As in all other sectors, risk is built into the cost of our borrowing and Government intervention has the ability to significantly reduce this.

Defra's Strategic Policy Statement (SPS) to Ofwat provides a mechanism for the Secretary of State to set out 'strategic priorities and objectives' to Ofwat. Its aim should be to foster a regulatory environment that has a clear strategic policy direction that supports long-term planning and investment. A SPS that focuses clearly on a small number of issues with the greatest significance, and identifies a priority, would likely be most effective.

In our view, the SPS should draw on and reflect the views of customers, as this would align it with Ofwat's primary consideration to act in the best interests of customers, and place long-term reliability of quality and service above other considerations. It should avoid treating these criteria as mutually exclusive. Beyond these strategic priorities, the views of customers can be applied to the majority of questions in the discussion document, including how the duties are balanced, the development of social tariffs, and ensuring solutions meet future risks.

A further example of Government policy would be the publication of a National Policy Statement (NPS) for water that recognised the need for additional water resources. As detailed above, a NPS would prevent proposed water resources being beholden to the traditional local planning system, therefore shorten delivery times, and provide greater certainty for investors and lower bills for customers than would otherwise be the case.

In addition, greater certainty can be provided by a commitment to maintain existing environmental regulation for a period of time as the UK leaves the European Union.

The Thames Tideway Tunnel (TTT) financial model (detailed in our answer to question 6) benefits from proactive Government involvement in new infrastructure.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

We believe that consideration of cross-cutting issues would result in a more strategic, innovative, and sustainable approach in delivering water and wastewater infrastructure. One model to overcome sporadic delivery of infrastructure at a regional level is the Mayor of London's infrastructure groups, which bring together devolved government, utility companies, and developers. This enables a strategic conversation to take place between all parties, presenting the opportunity for utility companies to identify issues in advance, for innovative solutions to be agreed, investment to facilitate development to be agreed, and ultimately speeding up the delivery of new housing.

In addition to considering the availability of water for public water supply, manufacturing, energy generation and agriculture, a predictable, affordable supply of water is essential to support the construction of new development (homes and workplaces), infrastructure (e.g. High Speed 2) and industrial processes (including fracking).

Water supply is dependent on a continuous, reliable, and affordable power supply. Without power to treat and pump drinking water and wastewater, companies would be unable to continue to supply customers, there could be sewer flooding, and environmental harm from untreated discharges, leading to economic damage. Desalination and effluent reuse are energy intensive and although we are increasingly producing our own power, for example through biogas from sludge or floating solar panels on reservoirs, we are reliant on a resilient energy sector.

The current water resource system lacks sufficient headroom to cope with a sustained period of low rainfall and this is being further reduced by the factors set out in the questions above. Absence of water supply prevents all economic activity and insufficient resilience against drought would result in severe financial damage to every sector of the economy.

The predicted new housing in London and the south-east cannot be delivered without an increase in supply, even after implementing ambitious demand management measures, including leakage reduction, universal water metering, and improved water efficiency. Although we understand that the Commission's remit does not extend to housing supply, we believe that new water sources do fall under the Commission's responsibility to coordinate the timing and delivery of new infrastructure with the delivery of new housing.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The Planning Act 2008 creates provision for a National Policy Statement for water, but unlike other NSIP-infrastructure types described in the Act, no NPS for water has been brought forward. Without a NPS, any major new water infrastructure would be subject to the traditional, local planning process, despite being of supra-regional or even national importance. This could lead to substantial delays in the delivery of major projects, which are unaffordable due to the growing deficit in supply.

We are not a statutory consultee on planning applications; we therefore have to proactively track key development sites that are coming forward in our region by liaising closely with local planning authorities. We work with councils to understand what is coming, but there are wide variations in the level of co-operation we receive, and getting clear visibility of the pipeline of future development can be challenging. This is why we are looking to develop stronger relationships with developers, to understand their portfolio of work at an earlier point to make sure we can prepare for it. However, water companies becoming statutory consultees would alleviate this issue.

Overall, we have a network of drains and sewers that were not designed to capture, convey and treat the amount of rainwater that they are currently exposed to and which we expect to increase in the future. A coordinated approach is necessary to provide greater certainty for those delivering strategic infrastructure, including the demands that would be put on the network through growth, the increase in impermeable surfaces in our cities, and the upcoming review of the NPS for wastewater, including resilience against surface water flooding from heavy rainfall. This could be considered in reference to the duty on Ofwat to act in accordance with the Government's Strategic Policy Statements (see answer to question 8).

Further consideration needs to be given to how the delivery of major long-term developments can be accelerated by better planning for water and wastewater infrastructure. For example, a significant upgrade of existing infrastructure may be required – costs for strategic upgrades need to be shared efficiently between multiple developers and existing customers, whilst avoiding a situation where the 'first mover', i.e. the first developer to begin construction, pays a disproportionate cost. We have successfully worked with the GLA on Integrated Water Management Strategies and believe this model can be refined and implemented elsewhere.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Our most recent Drought Plan¹⁶, a statutory document water companies in England and Wales are required to publish, explains that we could at present maintain supplies during a severe drought only by increasing our abstractions very significantly through the use of Drought Permits, seeing a return to the dried-out river beds that have been the feature of previous water shortages. Additional water resources have the potential environmental benefit of boosting the flow of rivers during times of comparatively low rainfall, protecting the ecology of the river, and reducing the necessity of abstracting at sensitive locations.

To reduce need for investment we need, where possible, to use SuDS to prevent rainwater from entering the sewer system, reducing the likelihood of sewer flooding. Rainwater is returned to the environment at source, rather than being transported some distance to a sewage treatment works, and passing through an energy-intensive process. A more appropriate balance between source control and an end of pipe solution would prevent the need for new or extended sewage treatment works.

¹⁶ [Thames Water draft Drought Plan](#)

Looking further ahead, there is a greater role that green infrastructure (using vegetation, soils, and natural processes to manage water in urban environments) can play as part of an integrated approach to catchment management. The natural environment can enhance infrastructure through the Payments for Ecosystem Services and natural capital, both of which can be further embedded into Government thinking.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Overreliance on conventional cost:benefit analysis alone is unlikely to lead to decisions (and outcomes) that are in the best long-term interests of the UK. In our experience, over-adherence to a framework that requires advance proof that the benefits from infrastructure investment exceed the costs can, over time, lead to under-investment in infrastructure. Costs are often uncertain, particularly for large water resource schemes, and estimating environmental, social cost, and benefits is an inexact science. We need to account for the broader benefits of an improved supply/demand balance outside of a drought. An example of these broad benefits would be using a major supply-side resource, such as a large reservoir or water transfer scheme to provide additional capacity that would allow us to reduce reliance on more environmentally sensitive abstractions.

In order to identify best value, we are using multi-criteria performance assessments, which considers cost, resilience, public acceptability, deliverability, positive and negative environmental impacts and sustainability issues. This approach is applicable across all types of infrastructure.

This approach is particularly suitable when examining investment in a future where there is significant uncertainty relating to some of the investment drivers, for example the forecast impacts of climate change, population growth and the requirements of the environment. In parallel, we are implementing an adaptive pathways approach to identify options which comprise part of a best value investment programme.

The Environment Agency has developed an approach for enhancing long-term resilience and enabling investment despite uncertainty. The Thames Estuary 2100 project¹⁷ provides a long-term strategy for managing tidal flood risk in a rapidly changing estuary. It sets out a series of flexible adaptation pathways, identifying different flood risk management options and defines the trigger points where rising sea levels require moving from one option to another. This allows options to be safeguarded and creates clear decision points on when to act. We are also applying this approach to our long-term water resources planning and, again, we would be happy to share our latest work with the Commission.

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

As set out in our answer to question one, London and the Thames Valley faces an increasing water supply-demand deficit, driven by a rapidly growing population, sustainability reductions, and the disruptive effect of climate change. Without intervention, this the gap between supply and demand would equate to the water used by 2 million people in London alone by 2040.

Our first measure to reduce the supply-demand deficit is greater demand management. As detailed in our answer to question four, we are aiming to install smart meters in all of the properties we serve, which is the UK's largest ever water efficiency programme. This will radically improve our ability to identify leaks, allowing us to target high levels of investment in order to reduce leakage, and work with our customers individually to reduce usage.

Since privatisation, investment in our network has tripled, averaging £1bn per year on average for the past 11 years. We have delivered major projects such as the London Ring Main and a new desalination plant, and replaced thousands of kilometres of Victorian mains. Despite this investment and our ambitious plans for the future, the size of the growing gap between supply and demand means it cannot be closed through demand management alone.

¹⁷ [Thames Estuary 2100 project](#)

Lessons from elsewhere in the world highlight the dangers of overestimating the extent that demand management can close water supply-demand deficits - for example, the Millennium Drought in Australia and recent ongoing drought in California¹⁸. The failure to introduce new water resources infrastructure led to exposure to severe drought, although demand management played a key alleviation role during the drought itself.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

The key issues facing wastewater are a requirement to take a strategic view of the existing system and future requirements as a whole, rather than focussing solely on capacity, and ensuring that investment facilitates development. It is neither possible nor desirable for water companies to meet unlimited demand. There is considerable scope for new developments to be more water efficient and sustainably drained.

The water industry, through Water UK, has produced a document setting out the long-term challenge facing drainage and sewerage¹⁹. The industry is now drawing up a strategic planning methodology, which is intended to inform the Price Review 2019 process.

Unlike water resources, there is no statutory requirement for strategic planning of companies' wastewater infrastructure. Water Resources Management Plans are a statutory requirement that drive coordination between the water companies, Government, regulators, stakeholders, and customers. We are forming our own London 2100 wastewater team to plan for the long-term, alongside the statutory WRMP process.

Without a statutory footing any five-year wastewater plans produced by individual companies would lack recognition from key stakeholders, such as local authorities, developers, and landowners and would differ significantly in scope across the country. A formal requirement for water companies to produce long-term plans would provide a greater impetus to plan strategically and invest to facilitate development, to the benefit of housing developers and local authorities, and would recognise the environmental responsibilities that all stakeholders have. Most importantly, it would alter the culture which arguably currently exists in the UK, where wastewater infrastructure is introduced in a piecemeal fashion, reacting to new development as it occurs, rather than strategically providing for the future.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Defra's 2016 guidance on planning for Water Resource Management Plans states that *'enhancing the natural resilience of the catchment by effective catchment management planning, to increase the amount and/or quality of water available for abstraction without posing unacceptable pressures on the environment.'*

Our work in this area is fragmented, so in October 2016 we arranged a lengthy roundtable discussion with Defra, Environment Agency, our regulators, environmental NGOs, and other experts from the sector, to explore what action we could take. We face unique challenges due to our lack of uplands and highly urbanised area of operation, illustrating that catchments vary substantially across the UK.

Whole catchment management has considerable potential but as our roundtable uncovered, there is currently a lack of evidence. It requires pilots in different catchments and using different forms of governance, in order to identify the model(s) that has the greatest benefits and can be rolled out elsewhere. We are examining which catchments to run pilots in now and what form the whole catchment approach should take.

¹⁸ [Managing Drought: Learning From Australia](#), Alliance for Water Efficiency & Institute for Sustainable Futures, University of Technology Sydney Pacific Institute

¹⁹ [Water UK, 21st Century Drainage](#)

APPENDICES

Appendix 1: predicting growth (population and properties)

In May 2016, the Department for Environment, Food and Rural Affairs (Defra) published their *guiding principles for water resources planning* to explain key policy priorities that the Government expects WRMPs to address. Page 1 of this document explicitly addresses how water companies are expected to plan for growth and states: “*Water supply must support the growth predicted by local authorities within an area. You should provide clear evidence of your engagement with local authorities on joint planning.*”

The Deputy Head of the Planning (Infrastructure and Environment) Division at DCLG has emphasised that plans should fully take account of local authority development plans and ensure that water supply infrastructure does not hinder economic development.

Thames Water are fully following this guidance and we have engaged consultants (Edge Analytics) to contact each local authority and using Local Plans to produce forecasts which align with Thames Water’s operational boundaries. They will also be providing a set of what are termed ‘bottom up’ forecasts to allow Thames Water to understand spatially where growth is expected. The results of this work will be peer reviewed by Professor Adrian McDonald of the University of Leeds to ensure they are robust.

Initial Results

Initial results are presented in the following table and chart, changes are expected prior to production of our plans but these should be relatively minor.

Table 1 - Total Population – Water (000s)

	AMP6	AMP7	AMP8	AMP9	AMP10
WRMP19 Total Population	10,284	10,740	11,050	11,317	11,593
WRMP19 Total Population Growth	425	881	1,191	1,459	1,734
WRMP14 Total Population	9,878	10,194	10,518	10,862	11,232
WRMP14 Total Population Growth	357	610	934	1,278	1,647

Table 2 – Number of Households – Water (000s)

	AMP6	AMP7	AMP8	AMP9	AMP10
WRMP14 Households	3,662	3,834	4,006	4,185	4,375
WRMP14 Household Growth	146	319	490	669	859
WRMP19 Households	3,731	3,988	4,196	4,379	4,554
WRMP19 Household Growth	276	480	688	871	1,046

Table 3 - Total Population – Wastewater (000s)

	AMP6	AMP7	AMP8	AMP9	AMP10
PR19 Total Population	15,491	16,186	16,637	17,032	17,454
PR19 Total Population Growth	616	1,310	1,761	2,156	2,578
PR14 Total Population	15,310	N/A	N/A	N/A	N/A
PR14 Total Population Growth	418	N/A	N/A	N/A	N/A

Table 4 – Households – Wastewater (000s)

	AMP6	AMP7	AMP8	AMP9	AMP10
PR19 Households	6,034	6,418	6,728	7,007	7,280
PR19 Household Growth	323	708	1,017	1,297	1,570
PR14 Households	5,537	5,820	N/A	N/A	N/A
PR14 Household Growth	210	493	N/A	N/A	N/A

Good infrastructure: a vital opportunity to improve health equity

*A joint **response from Health Foundation and Institute of Health Equity** to the National Infrastructure Commission's call for evidence on **National Infrastructure Assessment***

February 2017

About this response

This is a joint response from the Health Foundation and the UCL Institute of Health Equity. We welcome the opportunity to submit evidence to shape the development of the National Infrastructure Assessment (NIA) for Britain - exploring outcomes and opportunities for changes in infrastructure over the next 30 years. This submission sets out how investment and design for high quality infrastructure has the potential to positively and equitably shape health and wellbeing outcomes across the UK. Our aim is to provide evidence to show why improving health outcomes must be considered at the heart of decisions about planning and investing in infrastructure.

We have focused on the consultation questions that have the scope to include assessments of the social determinants of health and considerations of health, health equity and wellbeing.

Our response is structured in two parts.

Part 1 sets out our key points, a summary of our recommendations in response to the consultation questions, and a summary of how actions to improve infrastructure can be used to meet health equity policy priorities.

Part 2 presents evidence outlining the important role infrastructure has on health, with a background section outlining the principles of the social determinants of health (p6), followed by five sections responding chronologically to the six pertinent questions outlined by the NIC's call for evidence, these are:

- cross-cutting questions 1 (p8) ,3a (p9), 3b (p12) and 11 (p13),
- transport questions 14 and 15 (p16)
- digital communications question 17 (p19).

In each section, we set out ways that investments in infrastructure can be developed to have best possible impacts on health, health equity and wellbeing, with examples.

PART 1

Key points

1. **The National Infrastructure Assessment (NIA) is a significant opportunity to shape health in the UK.** The provision of good quality work and housing, environmental protections, accessible and inclusive transport in connecting people and places and improvements in digital communications can all significantly improve health and wellbeing. These factors are highly dependent on our infrastructure.
2. **Evidence clearly shows that infrastructure and policy changes in broad realms of economics and business have considerable and lasting impact on health, and health inequalities.** As highlighted by the Prime Minister in 2016, there are clear and systematic differences in health across England, which are closely related to socioeconomic status. These inequalities in health are largely determined by factors outside the health care sector.
3. **Infrastructure planning can improve this social class gradient for the whole of England.** A social class gradient in health is evident. There is not just a gap between the wealthiest and very poorest – everyone below the very top suffers from some degree of unnecessary health inequity – lower life expectancy and healthy life expectancy – than that enjoyed by the wealthiest.
4. **Good infrastructure investment will decrease health inequalities and release savings to the national purse.** Health inequalities are costly to the economy, individuals, families and communities. The 2010 Marmot Review¹ calculated that, annually, inequality in health accounts for productivity losses of approximately £31bn-£33bn, lost taxes and higher welfare payments in the range of £20bn-£32bn and additional NHS healthcare costs in excess of £5.5bn. In assessing best value for infrastructure investment an understanding of these substantial costs of health inequality and policy levers such as the ‘social value’ return on investments are essential.
5. **At present, this consultation misses the opportunity to raise considerations of health, health equity and wellbeing impacts from its scope and questions.** We also note that the advisory and technical groups to the NIC lack members with a health perspective. The NIC so far has not directly considered the potential to improve health as an outcome of the infrastructure investment strategy. To support this, we are interested in convening organisations with acknowledged expertise on national and international health, wellbeing and inequalities, and how to shape infrastructure to improve health, to support the important work of the National Infrastructure Commission.

¹ The Marmot Review Team. Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010. London: Marmot Review Team, 2010.

Summary of recommendations in response to consultation questions

NIC questions	Recommendations	Page reference for supporting evidence
1 'What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?'	<p>The NIC should encourage the government to:</p> <ul style="list-style-type: none"> • ensure national investment in infrastructure engenders positive social, environmental, economic and health impacts through the implementation of exemplar procurement contracts that emphasise social value. • work with companies that adopt corporate social responsibility and corporate citizenship models that emphasise the social impacts of spending. • assess and promote health and wider social value when awarding contracts. 	Pages 12-13
3: 'How should infrastructure be designed, planned and delivered to create better places to live and work? '	<p>The NIC should encourage the government to:</p> <ul style="list-style-type: none"> • provide new work schemes for the unemployed, and job training offered by organisations commissioned to deliver contracts. • provide good quality jobs, with commitment to a living wage and decent contracts embedded in infrastructure investments. • provide good working conditions which promote health, rather than harm it. • ensure employers offer a fair wage and are mindful of issues in balancing benefits. • ensure employers explore possibilities in work contracts for worker involvement and participation. 	Pages 14 -17
3: 'How should the interaction between infrastructure and housing be incorporated into this?'	<p>The NIC should encourage the government to:</p> <ul style="list-style-type: none"> • support and improve older properties and private rented properties, particularly in terms of improved energy efficiency and general repair and improved conditions. • work with housing colleagues to enable improvement in the physical quality of existing homes. • work with the health sector to gain evidence, data and expertise to ensure that the specifics of policy making on new homes (e.g. building regulations) promote health equity. 	Pages 18-19

<p>11: 'How should infrastructure most effectively contribute to protecting and enhancing the natural environment?'</p>	<p>The NIC should encourage the government to:</p> <ul style="list-style-type: none"> • effectively protect and enhance the natural environment by aligning closely with new concepts of 'green' rather than 'grey' infrastructure. • build infrastructure around increasing quality green spaces wherever possible and designing open spaces, street furniture and retail planning for maximum health benefit. • consider evidence that better stewardship of existing green infrastructure and attention to green infrastructure connectivity should be woven into infrastructure investment. • think broadly about the value of different possible infrastructure spending patterns. Having health as a centrepiece in decision-making is entirely compatible with efforts to mitigate climate change. 	<p>Pages 20-22</p>
<p>14: 'What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?'</p> <p>15: 'What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?'</p>	<p>The NIC should encourage the government to:</p> <ul style="list-style-type: none"> • focus on overall improvements to health through transport infrastructure projects, but also on reducing inequalities across the social gradient. • invest in infrastructure that supports an increase in public transport and reduced car travel. • ensure planning applications for new infrastructure developments always prioritise the need for people to be physically active as a routine part of their daily life, encouraging active travel such walking and cycling. • build investment in traffic restrictions into infrastructure development plans. 	<p>Pages 23-25</p>

<p>17: What are the highest value infrastructure investments to secure digital connectivity across the country?</p>	<p>The NIC should encourage the government to consider:</p> <ul style="list-style-type: none"> • infrastructure investment to redress digital exclusion by location (particularly rural) and to known socially disadvantaged groups. Digital infrastructure particularly needs to reach areas of high rented accommodation and social housing and those people living on low incomes. • potential social by-products of infrastructure installation in improving streets and local environments. 	<p>Pages 26-28</p>
---	--	--------------------

Summary of how actions to improve infrastructure can meet the health equity policy priorities highlighted by the Marmot Review

The Marmot Review² set out six high-level policy objectives to tackle, improve and reduce inequalities in social determinants of health. To realise these goals, action is needed across all sectors of society. This includes the policies of all government departments, the private, public and third sector, civil society and working with and for local communities and the national population. The importance of infrastructure is evident across all of the policy priority areas outlined by Sir Michael Marmot in his review, as shown in the following table.

Marmot Review Policy Priority	Action to Improve Infrastructure
1. Give every child the best start in life	<ul style="list-style-type: none"> • Boost active travel involving walking, cycling and public transport • Reduce car travel to decrease air and noise pollution • Restrict traffic speed and decrease child road accidents • Plan new roads that do not pass schools and play areas. • Create more green spaces and develop those that exist • Provide work place crèches • Employ parents under flexible working conditions
2. Enable people to have control over their lives and maximise their capabilities	<ul style="list-style-type: none"> • Instigate training and apprenticeships for new jobs resulting from infrastructure investment • Build individual resilience and mental health protection through good work, green environments and a more diverse range of environmentally friendly and health inducing transport options (particularly walking, cycling and public transport). • Support disadvantaged people into employment • Training for existing staff
3. Create good work for all	<ul style="list-style-type: none"> • Re-integrate vulnerable groups through employment • Employment of particular groups, for example, ex-offenders and those with long-term health conditions, • Ensure employers adhere to equality guidance • Make social and employment indicators part of the selection criteria for funding • Demand well managed jobs with opportunities for on job training and promotion and offer workers support • Maintain strict health and safety in the workplace, particularly regarding physically strenuous jobs • Where possible, protect workers from adverse conditions like shift work. • Implement guidance on stress management at work. • Encourage jobs where workers are valued, with participation in decision-making and implement board-level representation. • Develop security and flexibility in employment

² The Marmot Review Team. Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010. London: Marmot Review Team, 2010.

4. Ensure a healthy standard of living for all (income)	<ul style="list-style-type: none"> • Implement standards on a fair living wage and balancing benefits. • Provide flexible employment but avoid insufficient hours, temporary work, and work with constant risk of redundancy or job loss. • Longer term contracts with sickness and other benefits • Take collective bargaining on conditions and wages into account
5. Create and develop healthy and sustainable places and communities	<ul style="list-style-type: none"> • Embed social values in company contracts and engage companies that emphasis social and environmental impacts (not just cost) • Reduce air and noise pollution from transport • Encourage increase in public transport infrastructure and reduction in car use • Incentivise walking and cycling –active transport • Encourage green infrastructure and increase open spaces • Recognise green infrastructure as a productive asset. • Procure for green infrastructure conditions and outcomes attached to all contracts. • Improve access and quality of open and green spaces available across the social gradient, and reduce walking distance to quality green space.
6. Strengthen the role and impact of ill-health prevention	<ul style="list-style-type: none"> • Reduce sickness absence of employees through improved health and wellbeing support • Improve employee health through good working conditions • Develop open spaces to reduce incidence of pollution and sedentary activity related disease

PART 2

The impact of infrastructure on health, health equity and wellbeing

Modern infrastructure planning originated in the nineteenth century in response to basic health problems – such as supply of fresh water, drainage and sewages systems. Since then, planning our infrastructure has become largely divorced from health and often ‘we have been literally building unhealthy conditions into our local human habitat’.³ The manner of development activity in our built environment often compromises public health.⁴

For example, hierarchical road systems and segregated land use patterns prevent pedestrian street life and impede the development of the social networks vital to mental wellbeing for those who live locally. If housing supply is limited and prices increase, so does social exclusion in the housing market and health inequalities are exacerbated. If there is only investment in new housing, the poor quality of existing housing damages health. In cities, locating business, retail and leisure parks on the edge of cities, forces car-dependent travel, enshrines inequalities of access and decreases chances for regular exercise, while increasing pollution. If people and businesses in rural areas cannot access fast broadband it affects their health, their educational opportunities, social cohesion and cultural life. This document aims to show that the infrastructure that underpins where and how we live is vitally important to all our health and wellbeing.

The social determinants of health

The Marmot Review, commissioned by the Government to assess and make proposals to reduce health inequalities developed scientific evidence around “the social determinants of health” in 2010. “People’s health is affected by the nature of physical environments; living in poor housing, in a deprived neighbourhood with a lack of access to green spaces impacts negatively on physical and mental health.”⁵ Access to health care accounts for as little as 10% of a population’s health and wellbeing.⁶

The evidence showed that many of the drivers of avoidable health inequalities relate to inequalities in power, money and resources, and the way that these affect the conditions in which we are born, grow, live, work and age. The “social determinants of health” play out in the quality of early years experiences, of education, economic status, employment and quality of work, of housing and environment and effective systems for preventing ill health. Infrastructure planning has at its heart the attempt to manage those very same determinants of health.

³ Barton, H. and Grant, M., 2006, A health map for the local human habitat, *Journal of the Royal Society for the Promotion of Public Health*, 126 (6) pp252-261.

⁴ Larkin, M., 2003, Can cities be designed to fight obesity, *The Lancet*, 362, pp1046-7

⁵ The Marmot Review Team. *Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010*. London: Marmot Review Team, 2010.

⁶ The Marmot Review Team. *Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010*. London: Marmot Review Team, 2010.

The Marmot Review recommended adopting an approach to fully integrate the planning, transport, housing, environmental and health systems to address the social determinants of health in each locality. The recently published National Planning Policy Framework has similarly noted that: ‘The planning system can play an important role in facilitating social interaction and creating healthy, inclusive communities’.⁷

The social gradient

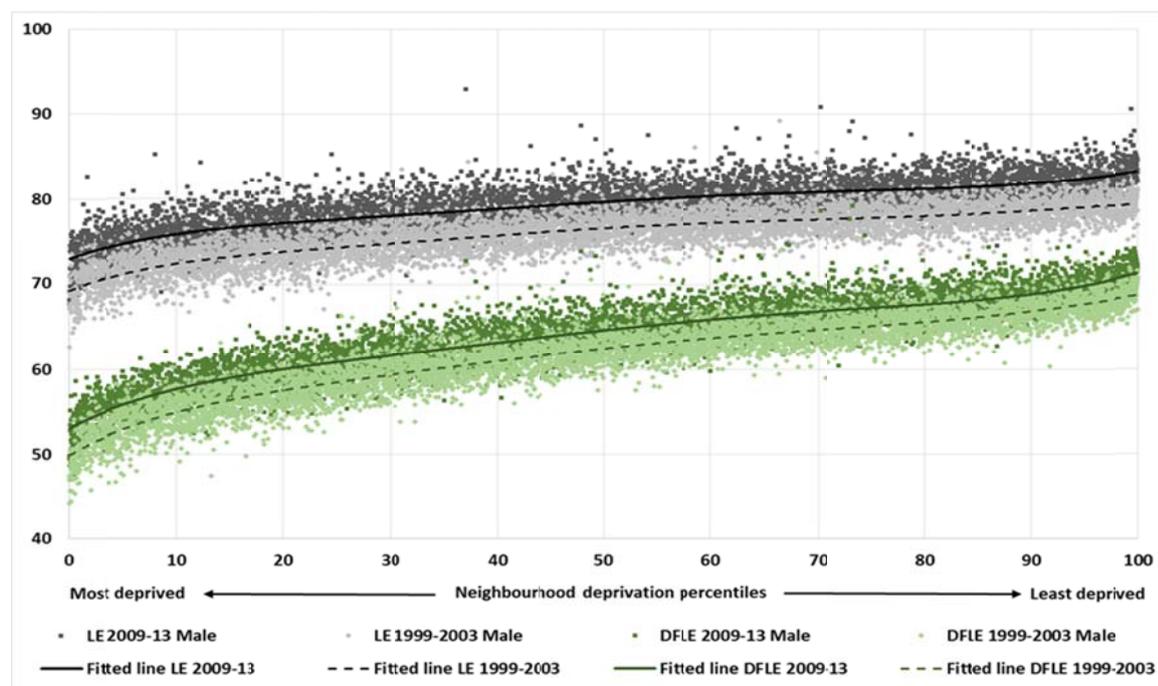
Within the same society, those lower down the socio-economic distribution in society have worse health than those higher up. The Marmot Review cited evidence showing that people living in the poorest areas die seven years earlier than people living in the richest. Health inequalities relate to life expectancy, infant mortality, healthy life expectancy, mental health, and a wide range of physical health conditions.⁸ In England there is a difference of 17 years in ‘disability free life expectancy’ – the number of years someone can expect to live free of life-limiting illness. These differences fall on a social gradient as shown in Figure 1. This is not just an issue of rich and poor. Everyone below the top 1% has slightly worse health than they could have. So although people are living longer, the same improvement has not been seen in healthy life expectancy, meaning that people are spending more of their lives with disease and disability⁹. It is therefore crucial to consider investment in people’s long term health to be integral to the long term investment which is necessary to build transport, housing, energy and digital infrastructure.

⁷ Department for Communities and Local Government, 2012. National Planning Policy Framework , p17.

⁸ The Marmot Review Team. Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010. London: Marmot Review Team, 2010.

⁹ Newton, J. et al (2015) Changes in health in England, with analysis by English regions and areas of deprivation, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013. Available at: [www.thelancet.com/journals/lancet/article/PIIS0140-6736\(15\)00195-6/abstract](http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(15)00195-6/abstract).

Figure 1. Life expectancy and disability-free life expectancy at birth, persons by neighbourhood income level, England, 1999–2003 and 2009–13¹⁰



Action on infrastructure to improve health, health equity and wellbeing

Strong evidence now exists describing clear actions we can take to plan for health and health equity as a key part of our infrastructure with potentially significant long term and large-scale impacts. In the 1930s, the United States embarked on a national infrastructure programme- Roosevelt’s New Deal. This initiative was in effect the biggest public health programme ever to be implemented in the US¹¹. It created good work for eight and a half million jobless Americans on the new construction projects and as has been repeatedly shown, poverty and unemployment are among the greatest risk factors when it comes to health. Further, the work was supported by wider social schemes such as making home ownership affordable and thus the impact on health was even more significant. The National Infrastructure Commission could make the case for a similar transformation of people’s quality of life and life chances by putting health, health equity and wellbeing at the centre of their deliberations. Tackling inequalities is an important current message, echoed by Theresa May, Prime Minister, in her maiden speech – for ‘a country that works not for a privileged few but for every one of us.’¹³

¹⁰ UCL Institute of Health Equity <http://www.instituteofhealthequity.org/Content/FileManager/Indicators2015/marmot-indicators-2015-background-document-final-26-11-15.pdf>

¹¹ Stuckler, D. and Basu, S *The Body Economic- why austerity kills*. 2013 Allen Lane

¹³ Statement from the new Prime Minister Theresa May, 13 July 2016. <https://www.gov.uk/government/speeches/statement-from-the-new-prime-minister-theresa-may>

A good case-study example of a recent, large-scale infrastructure planning campaign that acknowledged and embraced health, health equity and well-being is the World Health Organization's (WHO) Healthy Urban Planning Initiative.¹⁴ WHO Europe initiated a campaign for 'healthy urban planning' in the late 1980s. By 2003, a European Healthy Cities club linking 800 cities produced strategies showing:

- how health, planning, transport and regeneration agencies in the area could work together with citizens to improve quality of life
- how health objectives were to be integrated into planning
- how health equity criteria were going to be systematically used to assess development projects.

The WHO initiative showed one way that political and professional will to act on infrastructure and health can be galvanised. Integrated programmes, across departmental and agency responsibilities, with commitment from key decision-makers and awareness-raising at grass-roots level were all important factors for success. If public health and the NIC could form a real alliance beneath the banner of health, health equity and wellbeing for the NIA in this way, such programmes suggest it would be a powerful way to forge improvements to health, health equity and wellbeing and a range of other desirable outcomes – good quality employment and raised income for instance.

Question 1: 'What are the highest value infrastructure investments that would support long- term sustainable growth in your city or region?'

Social value

All infrastructure investments should, and have a legal duty to, take full account of the 2013 Social Value Act, which requires public sector commissioners (including government) to consider economic, social and environmental wellbeing when they procure services. It seeks these wider public benefits beyond just service provision and delivery. For example, a road construction company could contract with a social enterprise that employs and trains local unemployed young people. Recent studies show that, there has been more 'social value' action locally than nationally¹⁵. The NIC offers a real opportunity to take action on a national platform.

One powerful case-study example from the private sector is Landmarc Support Services Limited¹⁶. Landmarc is a commercial business which partners with the Ministry of Defence, 'to ensure that the military training estates deliver a safe and sustainable place to train for our armed forces'. Landmarc committed to increasing the economic, environmental and social value it generates through its activities, using the Social Value Act. Landmarc placed

¹⁴ WHO,2003, Healthy Urban Planning in Practice: Experience of European Cities. Eds Hugh Barton, Claire Mitchum Catherine Tsourou.

¹⁵ Public Health England, Institute of Health Equity, 2015, *Using the Social Value Act to reduce health inequalities in England through action on the social determinants of health*. Local Action on Health Inequalities Practice resource, p11.

¹⁶ CANInvest. The Landmarc Difference: Social Enterprise UK, Landmarc, 2013.

over half of its supply chain expenditure with small and medium-sized enterprises, including social enterprises; partnered with Recovery Careers Services to support wounded, injured and sick ex-service officers into employment; set up an apprenticeship scheme, a Rural Enterprise Hub; trained 1300 staff in sustainability awareness; and generated £90m gross value added (GVA) for the UK in the financial year 2012, and £474m GVA since 2008.

Landmarc also reinvested profits of almost £2m Environmental impact and reduced its CO2 emissions by 7% in the financial year 2012–13.

A public sector example is Oldham local authority. Oldham adopted a social value procurement framework to ensure that the £232m spent each year with 5,700 trade suppliers considered social value consistently. The framework included the themes ‘jobs, growth, and productivity; resilient communities and a strong voluntary sector; prevention and demand management; and a clean and protected physical environment’. Each of these themes had one or more outcomes and a range of examples of what this meant in practice for suppliers. Each procurement exercise and each contract included at least one of the outcomes from the framework.

Embracing social value within the NIA agenda means adopting ‘social value’ procurement processes like Oldham, commissioning companies like Landmarc with an ethical commitment to corporate citizenship, and encouraging Government to manage contracts and ‘bend the spend’ to influence a broad range of outcomes.

The NIC should encourage the government to:

- **ensure national investment in infrastructure engenders positive social, environmental, economic and health impacts through the implementation of exemplar procurement contracts that emphasise social value.**
- **work with companies that adopt corporate social responsibility and corporate citizenship models that emphasise the social impacts of spending.**
- **assess and promote health and wider social value when awarding contracts.**

‘Question 3: How should infrastructure be designed, planned and delivered to create better places to live and work?’

Good quality work

Programmes and policies on employment within the initiatives that the NIC proposes to fund are key to designing, planning and delivering better places to live and work. The NIC needs to ensure that initiatives and contracts that arise from the infrastructure projects it recommends tackle unemployment, provide good quality work, pay a fair wage and encourage worker participation in decision-making. The evidence in support of such measures and the impact on health and health equity is extensive and incontrovertible. Good quality work is of central importance to health and a range of other desirable outcomes¹⁷, providing skills, income, recognition and social status. The Marmot Review presented clear evidence that being in good employment is protective of good health, while unemployment and poor quality work contributes to poor health.

1. Tackling unemployment

Research shows that for all socioeconomic groups the unemployed had higher mortality than the employed¹⁸. Getting unemployed people into new work through the infrastructure initiative is therefore of critical importance for reducing health inequalities. Marmot Review evidence showed that participation in training programmes enhances skills and knowledge that help people gain entry into the job market and by having a positive effect on individual well-being and psychological health. The NIC should ensure the Government includes new work schemes for the unemployed in its commissioning strategy and encourages in job training, to be offered by organisations commissioned to deliver contracts.

2. Good quality work

Evidence shows ‘good work’ is linked to positive health outcomes. Jobs that are insecure, low-paid and that fail to protect employees from stress and danger make people ill. Getting people off benefits and into low paid, insecure and health-damaging work is not a desirable option. Jobs need to be sustainable and offer a minimum level of quality, to include, not only a decent living wage, but also opportunities for in-work development, the flexibility to enable people to balance work and family life, and protection from adverse working conditions that can damage health. When developing the country’s infrastructure, creating good quality, secure work opportunities will directly improve physical and mental health and reduce health inequalities.

The type of new work created across sectors is important. In the UK unemployment rates have been generally falling since 2011, to 5.6% for the period between March and May 2015¹⁹. However, this has been associated with more part-time employment, increased use

¹⁷ Goldblatt P, Siegrist J, Lundberg O, Marinetti C, Farrer L & Costongs C (2015). Improving health equity through action across the life course: Summary of evidence and recommendations from the DRIVERS project. <http://health-gradient.eu>

¹⁸ The Marmot Review Team. Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010. London: Marmot Review Team, 2010.

¹⁹ The Marmot Review Team. Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010. London: Marmot Review Team, 2010.

of zero-hours contracts and higher levels of in-work poverty. Poor quality jobs are an issue for health and health equity as they are concentrated at the lower end of the social gradient and have significant health impacts there. It is vitally important that good quality jobs are encouraged through infrastructure development to help reduce such health inequalities. This implies a need for commitments to a living wage and decent contracts being embedded in infrastructure investments.

3. Good working conditions

The conditions in which we work have a huge impact on our health. While there has been general decline in the incidence of workplace-related illness, it still affects millions of workers each year. Between 2013 and 2014, 1.2 million working people in the UK had an illness or condition believed to be caused by, or exacerbated by their current or previous work placement.²⁰ Ill health and injuries place a considerable burden on the NHS and result in significant costs to society, estimated at £14.9bn to the British economy in 2012-13.²¹ 23.5 million days are lost due to work-related ill health and 4.7 million days due to workplace injury in 2013-14.²² Research evidence across the EU demonstrated that low productivity is attributable to unhealthy work.²³ In economic terms, providing good quality working conditions pays.

People's health can be damaged at work by factors including exposure to physical hazards, physically demanding or dangerous work, long or irregular working hours, shift work, health-adverse posture, repetitive injury and extended sedentary work²⁴. Work-related ill health, including mental health, is a risk that affects lower occupational groups much more than higher occupational groups²⁵. Reducing stress and improving mental health is particularly significant to employers, employees and health services as 39% of the 27 million days lost to work-related sickness absence in 2011–12 were due to stress, depression or anxiety²⁶. Investing in health-protective and health-promoting work and employment conditions supports health and produces economic benefits. Such policies are investments that result in important returns to the national economy, rather than burdens on public spending. The NIC should ensure that all employment generated by investments in national infrastructure are in good working conditions and promote health, not harm it.

²⁰ Public Health England /Health Equity Institute, *Local action on health inequalities: Promoting good quality jobs to reduce health inequalities*, 2015.PHE publications gateway 2015329.

²¹ Public Health England /Health Equity Institute, *Local action on health inequalities: Promoting good quality jobs to reduce health inequalities*, 2015.PHE publications gateway 2015329.

²² Office for National Statistics. *Health and Safety Statistics: Annual Report for Great Britain 2013/14*.

²³ Goldblatt P, Siegrist J, Lundberg O, Marinetti C, Farrer L & Costongs C (2015). Improving health equity through action across the life course: Summary of evidence and recommendations from the DRIVERS project. <http://health-gradient.eu>

²⁴ The Marmot Review Team. *Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010*. London: Marmot Review Team, 2010.

²⁵ Hoven H, Siegrist J. Work characteristics, socioeconomic position and health: a systematic review of mediation and moderation effects in prospective studies. *Occup Environ Med* 2013; 70(9):663-9.

²⁶ Health and Safety Executive, 2014, Working days lost. <http://www.hse.gov.uk/statistics/dayslost.htm>.

4. Fair wages

Wilkinson and Pickett's recent book *The Spirit Level*²⁷, Michael Marmot's work and other studies have shown the adverse effects on health caused by having a low income. According to the Joseph Rowntree Foundation²⁸, insecure, low-paid jobs are leaving record numbers of working families in poverty, with two-thirds of people who found work in 2014 taking jobs for less than the living wage. By 2016, there were two million more people in working families in poverty, taking the figure up to 7.4 million, than a decade earlier. During that decade only a fifth of low-paid workers managed to move to better paid jobs. The living wage was calculated at £7.85 an hour nationally, or £9.15 in London – much higher than the legally enforceable £6.50 minimum wage.

Commissioners should ensure that all infrastructure project employers offer a fair wage. They should also be mindful to address the income gradient, as it is not always just those on the lowest incomes who find it most difficult to make ends meet. Living standards initially fall as income begins to rise, due to a loss of state benefits, creating 'cliff edges'.

5. Worker participation and involvement

Underpinning action to promote health and wellbeing is the idea of creating an organisational culture that enables individuals from all groups in society to have greater control over their working lives and participate in society. Included in this approach is the role of individuals and community groups in helping to shape the services they use and the jobs that they do. Evidence suggests that interventions to increase autonomy and control over work, provide in-work development, line management training, flexible working and staff engagement – can all be beneficial for health²⁹. Systematic reviews of the health effects of improvements to the work environment have found that interventions increasing participants' job control and degree of autonomy at work produced fairly consistent results showing positive effects on mental health and sickness absence.³⁰ It would be very valuable if any work contracts commissioned for infrastructure development involved workers in their development and allowed participation in decision making.

Case-study examples of good work programmes include the University of Manchester, the city's largest employer. In 2012 the university set up a programme to help unemployed local residents find work in non-academic sectors of the university and in other areas of business across Manchester. The university recently signed a recruitment agreement with three major construction firms. Laing O'Rourke, Balfour Beatty and Sir Robert McAlpine share the contract for a £1bn programme of building works for the university over the next decade. Under the agreement, the companies commit to hire 1,000 local unemployed residents every

²⁷ Wilkinson, W and Pickett, K, 2009, *The Spirit Level: Why more equal societies almost always do better*. London Allen Lane.

²⁸ Tinson, A, Ayrton, C, Barker, K, Born, T, Aldridge, H and Kenway P, 2016, *Monitoring poverty and social exclusion 2016*. Joseph Rowntree Foundation

²⁹ PHE/IHE, 2014, *Workplace interventions to improve health and wellbeing*. Health equity briefing 5a

³⁰ Bond FW, Bunce D. *Job control mediates change in a work reorganization intervention for stress reduction*. *Journal of Occupational Health Psychology*. 2001;6(4):290-302.

year.³¹ Another example is Whitehill Bordon Ecotown in Hampshire. In 2009 it used eco-town allocated funding to convert an exhibition house informing residents about low carbon living, provided a bio-mass boiler, free loft insulation to householders, over 50 green spaces around the town and hopes to create 5,500 jobs by 2028.³²

The NIC should encourage the government to:

- **provide new work schemes for the unemployed, and job training offered by organisations commissioned to deliver contracts.**
- **provide good quality jobs, with commitment to a living wage and decent contracts embedded in infrastructure investments.**
- **provide good working conditions which promote health, rather than harm it.**
- **ensure employers offer a fair wage and are mindful of issues in balancing benefits.**
- **ensure employers explore possibilities in work contracts for worker involvement and participation.**

³¹ Balfour Beatty (2015) *Balfour Beatty appointed to framework to deliver £1bn campus transformation for the University of Manchester*. Available at: www.balfourbeatty.com/news/balfour-beatty-appointed-to-framework-to-deliver-1bn-campus-transformation-for-the-university-of-manchester/?year=all&parentId=1247

³² *Whitehill & Bordon. What is the Whitehill & Bordon regeneration project?* Available at: <http://whitehillbordon.com/home/whitehill-bordon-eco-town/>

Question 3: 'How should the interaction between infrastructure and housing be incorporated into this?'

Housing

Housing is also an important social determinant of health. On average those in the least deprived neighbourhoods in England live seven years longer than those in the most deprived.³³ About three in 10 people in England live in poor quality housing, either non-decent or overcrowded, comprising 3.6m children, 9.2m working age adults and 2m pensioners.³⁴ Inequalities are clearly evident. There are differences in the quality of housing by tenure, with particular problems in the rented sector. Thirty per cent of homes in the private rented sector failed to meet the Decent Homes Standard³⁵ in 2013, compared to 19% of owner occupied homes and 15% in the social rented sector.³⁶ Issues include poor energy efficiency, condensation, damp and mold.

Cold houses are health damaging, especially for older people, but poorly heated homes also affect babies' weight gain and increase the frequency and severity of asthma symptoms in children. Teenagers who live in cold houses are five times more likely to risk developing multiple mental health problems than adolescents who have always lived in warm homes.³⁷ Fuel poverty is an increasing issue of concern. In 2008, 18% of UK households were estimated to be living in fuel poverty.³⁸ Fuel poor households must choose either to spend over 10% of their income on heating, which has a detrimental impact on other aspects of health and well-being, or to under-consume energy and live in a cold home to save money. Resultant health and social impacts are far-reaching and unequal –affecting physical and mental health, the ability to find a job or even do well at school.³⁹ There is also regional variation in the quality of housing across England. For example, in London 15% of the population lives in overcrowded conditions, compared to 3% in the East and South East. The interaction between infrastructure and housing needs to be incorporated into future planning at the national level to reduce such stark and regionally differential inequalities.

Poor housing is estimated to cost the NHS £1.4bn a year. If £10bn could be found to improve all of the 3.5m 'poor' homes in England, evidence suggests the investment would pay for itself in just over seven years and then continue to accrue benefits into the future.⁴⁰ However, public expenditure on housing has fallen considerably since the 2008 recession and it is unlikely that this will reverse in the near future. In considering the impact of infrastructure on housing supply, the NIC needs to be mindful of the need for innovative

³³ HEI, *The Impact of Physical Housing Conditions on Mental Health*, 2017.

³⁴ Barnes, M., et al., *People living in bad housing – numbers and health impacts* 2013: London.

³⁵ Department for Communities and Local Government, *A Decent Home: Definition and guidance for implementation*, June 2006 update. <https://www.gov.uk/government/organisations/department-for-communities-and-local-government>

³⁶ Department for Communities and Local Government, *English Housing Survey: HOUSEHOLDS. Annual report on England's households, 2011-2012*. 2013: London.

³⁷ Marmot Review Team, 2011, *The Health Impacts of Cold Homes and Fuel Poverty*. London: Friends of the Earth and the Marmot Review Team. Available at: <http://www.marmotreview.org/reviews/cold-homes-and-health-report.aspx>

³⁸ Marmot Review Team, 2011, *The Health Impacts of Cold Homes and Fuel Poverty*. London: Friends of the Earth and the Marmot Review Team. Available at: <http://www.marmotreview.org/reviews/cold-homes-and-health-report.aspx>

³⁹ HEI, *The Impact of Physical Housing Conditions on Mental Health*, 2017.

⁴⁰ Nicol, S., et al., *Briefing Paper: The cost of poor housing to the NHS*. 2015, BRE Trust.

solutions, which work across sectors at the national level and make best use of local assets and programmes. Poor quality housing needs to be upgraded. Insulating homes to stop them wasting energy would improve people's health and wellbeing and protect the environment at the same time. About £3- 8bn is needed annually to eradicate fuel poverty. New homes should be highly energy efficient, built with sustainable principles, good transport and social and community facilities.

Examples of housing infrastructure development projects that have been successful in health equity terms, include the Government 'Housing Market Renewal' programme which ran from 2003 to 2011, and aimed to tackle poor housing in areas of severe deprivation. Overall, over £3 billion was invested in the programme, and the National Audit Office concluded that the programme improved the quality of the housing stock, reduced crime, and increased jobs and training opportunities.⁴¹ The Decent Homes Programme aimed to make all social housing, and 70% of vulnerable households in the private sector, 'decent' by 2010. The programme improved housing conditions for approximately 1.4 million local authority homes as of November 2009, and the percentage of social housing that was 'non-decent' had been reduced from 39% to 14.5%. For housing with registered social landlords, the rate reduced from 21% to 8%. The number of vulnerable households in decent homes increased from 57% in 2001 to 68% as of April 2006.⁴²

The NIC should encourage the government to:

- **support and improve older properties and private rented properties, particularly in terms of improved energy efficiency and general repair and improved conditions.**
- **work with housing colleagues to enable improvement in the physical quality of existing homes.**
- **work with the health sector to gain evidence, data and expertise to ensure that the specifics of policymaking on new homes (e.g. building regulations) promote health equity.**

⁴¹ Audit Commission, *Housing market renewal: Housing, programme review*. 2011: London.

⁴² National Audit Office. *The Decent Homes Programme*. 2010 30/3/2015]; Available from: <http://www.nao.org.uk/wp-content/uploads/2010/01/0910212es.pdf>.

Question 11: How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Building healthy and sustainable places

The role of the built and natural environment as a determinant of health, and its relationship with health inequalities is again direct. Green spaces have multiple significant health and environmental benefits. Infrastructure can most effectively contribute to protecting and enhancing the natural environment by adopting sustainable development and building in specific interventions that we know can change health and reduce health inequalities as well as protect green and natural spaces. New infrastructure could effectively protect and enhance the natural environment by aligning closely with new concepts of 'green' rather than 'grey' infrastructure, helping to tackle health inequalities head on and improve quality of life and environments. The health evidence in this area is strong and gives clear direction for action.

Living close to green spaces such as parks and woodlands can improve health, regardless of social class.⁴³ Studies show green spaces are of clear and significant benefit to mental health and well-being as well as improved air quality (reducing urban heat island effects), physical health and activity levels. Green spaces are associated with mental health improvements including reduced stress levels and improved ability to deal with problems and physical health benefits like decreases in blood pressure and cholesterol.⁴⁴ Research increasingly shows green spaces also encourage social contact and integration through physical activity and play.

New research on healthy high streets shows that when designed well, high streets can support well-being in local communities, by improving the local economy, promoting social cohesion, improving mental health, and protecting people from toxic levels of pollutants, risk of traffic accidents and crime⁴⁵. Introducing and enhancing street furniture and communal spaces on high streets, improves well-being and health for a range of groups, including disabled people, older people, and children – particularly in the most deprived neighbourhoods. Proven street design principles, effective at improving health include: pedestrianisation, lighting, seating, crossings, pavement width and quality, shelters, street planting, blue space and water features, healthy and affordable food outlets, and limiting alcohol, betting and payday loan outlets. Infrastructure design and development should be built around increasing green spaces wherever possible and designing open spaces, street furniture and retail planning for maximum health benefit.

Better stewardship of existing green infrastructure (a network of multifunctional green space such as parks, playing fields and woodland) is also key to infrastructure development. The Chartered Association of Building Engineers note that many of the elements of green infrastructure in the UK are already in place, 'but (like roads) its value lies in being

⁴³ Mitchell R and Popham F, 2008 *Effect of exposure to natural environment on health inequalities: An observational population study*. The Lancet 372 (9650) pp 1655-1660.

⁴⁴ The Marmot Review Team. Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010. London: Marmot Review Team, 2010.

⁴⁵ PHE /HEI, 2017, *Healthy High Streets Good Place Making in an Urban Setting*. In press.

networked. So new skills are required to connect the different elements: the tree-lined streets, parks, gardens, allotments, cemeteries, green roofs, woodlands, rivers and waterways, so that they all work together as a functioning system.⁴⁶ Green corridors linking town centres and transport nodes to major employment and residential sites are important. Also critical is the role of river corridors and links to the green belt. An understanding of such green infrastructure connectivity should be woven into infrastructure investment.

Addressing climate change and issues around biodiversity are also important. Climate change is a fundamental threat to health.⁴⁷ Under the Climate Change Act (2008) reduction in UK greenhouse emissions by at least 34% in 2020 and by at least 80% by 2050 are legally binding targets. The UK Low Carbon Transition Plan (2009) proposed all government departments share responsibility for reductions, affecting planning for homes and communities, electricity generation, workplaces and transport. As a first step, the NIC needs to frame its plans within outcome focused targets on carbon emissions. Emission reduction measures include recycling 75% of waste, reducing waste by 25% reducing water consumption by 25% and increasing energy efficiency.

In November 2016, the government lost a High Court ruling over illegal air pollution targets, with evidence showing the UK needs a national network of clean air zones to be in place by 2018 in cities across the UK, not just in token cities.⁴⁸ Cities, like London, with the worst air pollution records are being seriously challenged. The NIC is encouraged to think broadly about the value of different possible spending patterns. Having health as a centrepiece in decision making will greatly influence what kind of plans for the environment are thought acceptable and are entirely compatible with efforts to mitigate climate change.

There are many examples globally showing green or environmental infrastructure investment makes sound economic sense, paying for itself many times over. For example, in Chattanooga, Tennessee, USA, the rust belt city was transformed by the decision to build a 10-mile park along each side of the Tennessee River, which inspired developers, and led to more investment. Other examples provide evidence describing new planning driven by reaction to the severity of current environmental problems and the urgency to do something about them, such as recent smog reports in London. Sadiq Khan's (London Mayor) current plans for London include expanding ultra-low emission zones and clean bus corridors, limiting new bus purchases to electric or hydrogen buses from 2020, installing electric charging infrastructure for increased electric vehicles, opposing a third runway at Heathrow Airport, reducing congestion around schools, instigating tree-planting, improving cycling and a diesel vehicle scrappage scheme.⁴⁹

⁴⁶ Chartered Association of Building Engineers (2009) *Grey to Green: How we shift funding and skills to green our cities*. <http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/files/grey-to-green.pdf> (Accessed 12 Jan 2017)

⁴⁷ The Marmot Review Team. *Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010*. London: Marmot Review Team, 2010.

⁴⁸ Client Earth, 2017, *ClientEarth wins air pollution case in High Court*, <http://www.clientearth.org/major-victory-health-uk-high-court-government-inaction-air-pollution/>

⁴⁹ Khan, S. 2017 *Manifesto: A Greener Cleaner London*. http://www.sadiq.london/a_greener_cleaner_london

The East London Green Grid⁵⁰ is a good example of good quality environmental infrastructure investment. The East London Green Grid was one of four sub-regional landscape frameworks developed for the Thames Gateway. The East London Green grid changed the environment and changed the perception that east London was characterised by post-war housing and poor-quality neighbourhoods, dominated by industry and highways. The East London Green Grid includes sustainable projects like Rainham Marshes, the Olympic Legacy Park and Barking Riverside, London's largest housing development site. It is one of the first spatial frameworks of its kind to use a landscape and human-centred approach to green infrastructure, designed to respond to climate change and future development. The programme is large scale, worth about £0.5 billion, and 300 projects have been identified, 70 of which are prioritised. Skills, training and employment have become a key priority.

The NIC should encourage the government to:

- **effectively protect and enhance the natural environment by aligning closely with new concepts of 'green' rather than 'grey' infrastructure.**
- **build infrastructure around increasing quality green spaces wherever possible and designing open spaces, street furniture and retail planning for maximum health benefit.**
- **consider evidence that better stewardship of existing green infrastructure and attention to green infrastructure connectivity should be woven into infrastructure investment.**
- **think broadly about the value of different possible infrastructure spending patterns. Having health as a centrepiece in decision-making is entirely compatible with efforts to mitigate climate change.**

⁵⁰ Chartered Association of Building Engineers (2009) *Grey to Green: How we shift funding and skills to green our cities*. <http://webarchive.nationalarchives.gov.uk/20110118095356/http://www.cabe.org.uk/files/grey-to-green.pdf> (Accessed 12 Jan 2017)

Questions 14 & 15: What are the highest value transport investments to allow people and freight to get into, out of, and around major urban areas? What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Connecting people and places – transport

The highest value transport investments that can be used to connect people and places and to transport goods are those that prioritise health and take a long term view. Transport gives rise to some significant public health and health equity challenges relating to road traffic accidents, physical inactivity, air and noise pollution, social exclusion and community cohesiveness and access to work and services. The single major cause of death in childhood for the over 5s is unintentional injuries on the roads.⁵¹ Like other social determinants traffic accidents are closely related to socio-economic status. The social class gradient is steeper for road traffic accidents than any other cause of death in childhood (eg leukemia, meningitis). Children in deprived wards are four times more likely to be hit by a car than those in the least deprived wards. Road deaths are particularly high for children of the long term unemployed. Poorer communities experience higher concentrations of pollution and associated cardio-respiratory diseases and socially disadvantaged people are more likely to live near busy roads and are at greater risk of the negative effects of noise pollution.⁵² Children who attend schools by busy roads are prone to vastly increased risks of health problems linked to air pollution.

Two in five job seekers say lack of transport is a barrier to getting a job and almost half of 16- to 18-year-old students experience difficulty with the cost of transportation.⁵³ Over 1.4m people say they have missed, turned down, or chosen not to seek medical help over the last 12 months because of transport problems. Transport-related noise pollution (predominantly from roads, railways and airports) can adversely affect the cardiovascular system (including increasing blood pressure and heart attack), mental health and school performance in children. There are age factors at play too as transport affects people differently over the lifecourse. For example, 12% of older people would like to visit their family more often and of these 76% cite transport or mobility as an issue.⁵⁴ Almost half of 16- to 18-year-old students experience difficulty with the cost of transportation⁵⁵

⁵¹ The Marmot Review Team. Fair Society, Healthy Lives: Strategic review of health inequalities in England post-2010. London: Marmot Review Team, 2010.

⁵² British Medical Association. 2012. *Healthy transport = healthy lives . Summary of the links between health and transport*. British Medical Association, <http://bma.org.uk/transport>

Comprehensive overview of evidence for the range of health issues relating to transport: Mindell JS, Watkins SJ, Cohen JM (eds). *Health on the Move 2: Policies for health-promoting transport*. Stockport: Transport and Health Study Group, 2011

⁵³ Social Exclusion Unit. *Making the Connections: The Final Report on Transport and Social Exclusion*. In: Minister OotP, ed., 2004.

⁵⁴ Steptoe A, Shankar A, Rafnsson S, 2015, *The Links Between Social Connections and Wellbeing in Later Life*. ILC-UK .

⁵⁵ Social Exclusion Unit, 2004, *Making the Connections: The Final Report on Transport and Social Exclusion*. In: Minister OotP,....

Transport also enables access to work, education and social networks.⁵⁶ The highest value transport investments that the NIC could consider are those that specifically describe and evidence how they link people and places to enable equality promoting, health enriching social cohesion and access for all to work and education, community facilities and other services across the social gradient. Transport also accounts for about 29% of the UK's carbon dioxide emissions.⁵⁷ There is now strong evidence that poor transport links can create barriers to social inclusion, whereas effective transport links can benefit social cohesion.⁵⁸ Those in more out-lying or rural areas are not surprisingly less likely to be able to access suitable transport. This impacts on employment across the social gradient. The Infrastructure Commission needs to focus on overall improvements to health through transport infrastructure projects, but also on reducing inequalities across the social gradient.

There are three specific health related imperatives that should drive transport investment linked to the social determinants of health.

1. Greater investment in public transport and car travel reduction

Changing transport systems can dramatically affect the travel choices of individuals, groups and businesses. The time that people spend travelling each day has remained remarkably constant over the years. Yet, as road transport systems become faster, people can travel further during that travel time. It is widely recognised that better roads encourage people to use them. The time perceived to be saved by getting somewhere more quickly tends to encourage people to find it acceptable to travel further. Long distance commuting is encouraged. There is also a dependency on cars to facilitate modern family living. These patterns are evident in many countries comparable to the UK and research suggests they link closely to public health travesties such as the increase in obesity across the western world. In Atlanta, USA, a study of 10,808 households in Atlanta found that every hour spent in the car raises the likelihood of being obese by 6%. However, each kilometre walked per day was associated with a 4.8% reduction in the likelihood of obesity.⁵⁹ The social gradient again has an impact. A health impact assessment in Edinburgh showed potential health and health inequality benefits from increased public transport use.⁶⁰

2. Increased investment in walking and cycling

As recently as the 1960s, roughly one in two children walked or biked to school. Today, only one child in ten gets to school under his or her own power.⁶¹ To increase active travel, the

⁵⁶ PHE /IHE. *Reducing social isolation across the life course* Sept 2015.

⁵⁷ Environment Agency. Addressing environmental inequalities <http://apps.environment-agency.gov.uk/wiyby/124274.aspx> (Accessed 11 Jan 2017)

⁵⁸ Iwarsson S, Wahl H-W, Nygren C, et al. *Importance of the Home Environment for Healthy Aging: Conceptual and Methodological Background of the European ENABLE-AGE Project*. *The Gerontologist* 2007;47(1):78-84.

Anciaes P, Jones P, Mindell JS. *Quantifying community severance - A literature review*, Street Mobility and Network Accessibility Series Working Paper 02 November 2014

⁵⁹ SMARTAQ, Frank, L., et al, Atlanta, GA, 2004.

⁶⁰ Gorman, D., 2003, Health Impact Assessment: of the City of Edinburgh Council's Urban Transport Strategy [www.HIAofEdinburghCouncilsTransportStrategy%20\(1\)](http://www.HIAofEdinburghCouncilsTransportStrategy%20(1))

⁶¹ Fleming Fallon and Neistadt (2006) *Land Use Planning for Public Health: The Role of Local Boards of Health in Community Design and Development*. National Association of Local Boards of Health.

NIC should invest to encourage more walking and cycling, reduce car speed, improve walking and cycling routes, and improve public transport. Many studies show that opening new sections of cycle trails leads to long term increases in cycling and reduces cycle accidents, especially when located in highly populated areas. Increasing the number of cyclists overall reduces the proportion who are seriously injured or killed. Investing in high quality surfaces of foot and cycle paths and pavements and street lighting increases the number of walking and cycling trips.

3. Increased investment in traffic restrictions

Action on traffic speed and volume is also important for health and evidence suggests clear measures that can be incorporated in considering new road structures. Lowering speed limits improves pedestrian and cyclist safety across the board, not just in high collision areas. In London, where 20mph zones have been introduced, injuries decreased by 40%. Modelling these figures suggests that in deprived areas this equates to 580 deaths prevented in one year. Re-locating and considering accessibility of crossings also helps dramatically. There is an age factor here. The elderly (over 65s) inhibit their travel due to crossing busy roads with good reason – this group tend to be injured more seriously, more often with fatal injuries than other age groups.

Examples of good transport programmes can be found in other countries. Curitiba is the capital city of the Parana state in Brazil and nearly 2 million people live there. The city has had an urban master plan since 1968 and part of that plan is the Bus Rapid Transport (BRT) System. A bus rapid transit system operates which is cheaper to run than a tube system and some employers subsidise their employees who use it. 80 per cent of travellers use it and it carries 2 million passengers a day. The bus fare is the same wherever you go and no-one lives more than 400 metres from a bus stop. Tall buildings are allowed only along bus routes. The system was revamped in 1991 and possibilities for increasing bicycling are now being integrated.⁶²

The NIC should encourage the government to:

- **focus on overall improvements to health through transport infrastructure projects, but also on reducing inequalities across the social gradient.**
- **invest in infrastructure that supports an increase in public transport and reduced car travel.**
- **ensure planning applications for new infrastructure developments always prioritise the need for people to be physically active as a routine part of their daily life, encouraging active travel such as walking and cycling.**
- **build investment in traffic restrictions into infrastructure development plans.**

⁶² Demery, L. W. (2004) Bus Rapid Transport in Curitiba, Brazil: An Information Summary. Available at: www.publictransit.us/ptlibrary/specialreports/sr1.curitibaBRT.pdf

Question 17: What are the highest value infrastructure investments to secure digital connectivity across the country?

Digital participation and communications

The highest value infrastructure investments to secure digital connectivity across the country are those that everyone can benefit from and at the moment, not everyone benefits to the same degree from good digital connectivity and some do not benefit at all. So a primary impetus is to consider very carefully who needs to be digitally reached for maximum benefit in terms of health and social outcomes.

With the rise in digital technology, we have seen an associated transformation in how we work, communicate, consume, learn, engage and think. Opportunities for improved wellbeing have been part of this, with people benefiting from wider connections, improved access to knowledge and new forms of communication. Digital innovation is also directly impacting on health care, enabling remote monitoring of health conditions and people with health conditions to be better supported in their own homes in the community. Improved education resources and access to them improve equality among students in different areas and remote working enables rural communities in particular to become less fragmented. Many people's lives are, in short, made easier and there are some early suggestions that internet access enables active living and cultural engagement. People with internet access are less likely to have poor mental health.

Yet sections of society still do not access this technology and are left behind in the digital revolution. According to Ofcom, around 2.4 million homes and small businesses in the UK are unable to receive broadband speeds above 10 Mbps, with 1.5 million of these in rural areas^{63 64}. Government figures show that the average broadband speed in rural areas is just 5 Mbps compared to some cities at 27 Mbps. As a result, research suggests that rural dwellers are more limited in their access to public services, to channels for civic and democratic participation, to a wide array of knowledge and information, to opportunities for cultural and social engagement, to the labour market and to opportunities for education and learning.

Addressing these disparities is an enormous social challenge and one in which infrastructure planning is key. Fast broadband needs modern infrastructure, but network operators struggle to make these economically viable in remote areas and so they miss out on upgrades. The broadband that is available is impacted by technological limitations. ADSL (asymmetric digital subscriber line) gets slower the further you are from the exchange, and latency, contention ratios and reliability are issues. The government's 'Broadband Delivery UK' policy⁶⁵ committed to a national minimum speed of 5Mb and is helping to fund upgrades, with £1.14bn placed in government funds in last month's Autumn Statement to improve fibre broadband and develop 5G. By the end of 2017, 95% of UK premises could be able to buy

⁶³ Ofcom (2016) The Communications market report. www.ofcom.org.uk/opensdata.

⁶⁴ Griffiths S, 2016, Broadband in the backwaters: rural Britain's fight for faster internet. Ingenia online, issue 58, Sept. <http://www.ingenia.org.uk/Ingenia/Articles/1034>

⁶⁵ Broadband Delivery UK (2013) Details of the plan to achieve a transformation in broadband in the UK by 2017. Available at: <https://www.gov.uk/guidance/broadband-delivery-uk>

superfast broadband – defined as 24Mbps, but critics say BT’s roll-out is slow, the broadband network delivered is only semi-fast and still leaves some communities isolated. The government has specified fibre direct into the home as the gold-standard (rather than reliance on copper cables) but progress here is acknowledged to be expensive and slow. One example of a rural area that has recently achieved superfast broadband is the Isles of Scilly in Cornwall, where the £132m Superfast Cornwall initiative repurposed a defunct undersea fibre cable to upgrade the islands’ network infrastructure to its 2,200 residents. Formally, the Isles of Scilly had relied on a radio link with the mainland to access the internet.

People who are most likely to be digitally excluded are the same people who are also most likely to be identified as disadvantaged or excluded and at risk of poor health according to a range of other socioeconomic and health indicators – such as those in rented housing, on low income and older people, particularly those over 75 yrs. Paradoxically, these factors also mean that these are the groups who could disproportionately benefit from the advantages of digital systems described above. A recent Scottish study showed that those most likely to have internet access are households with a working couple (non-working single adult households are the least likely), the more qualified the respondent is, the more likely the household is to have internet access and the younger the highest income householder, the more likely that a household will have internet access. Those least likely to currently have internet access include households without cars and/or in social rented accommodation and/or without children and those on lower incomes.

The NIA needs to consciously plan new digital infrastructure to better reach areas where social housing is predominant, where there is a higher proportion of rented accommodation and where a higher proportion of people on low incomes live. Careful consideration of increased need among older people, single parent families and those without children is also important. In considering infrastructure investment, the NIC needs to redress digital exclusion by location (particularly rural) and to socially disadvantaged groups.

The NIA could also usefully consider where by-products of the process of installing new digital communications might offer opportunities for increased social value. One example is in thinking about children’s play. The Street Play project⁶⁶ aims to activate street play in communities. Evidence has shown that children are three to five times more active outdoors than indoors – when outdoors, more time is spent with friends which increases opportunities for greater levels of social interaction for children and families. An evaluation in Hackney showed that the project was directly responsible for 8,100 hours of physical activity. Hence, infrastructure decisions about how services like digital connections are brought to a wider group of people through under street cables may have some impact in also creating, as a socially valuable by-product, increasingly safe and wider pavement and grass areas where children can play.

⁶⁶ A national project led by Play England in partnership with Playing Out, London Play and the University of Bristol

The NIC should encourage the government to consider:

- **consider infrastructure investment to redress digital exclusion by location (particularly rural) and to known socially disadvantaged groups. Digital infrastructure particularly needs to reach areas of high rented accommodation and social housing and those on low incomes.**
- **consider potential social by-products of infrastructure installation in improving streets and local environments.**

About the Health Foundation

The Health Foundation is an independent charity committed to bringing about better health and health care for people in the UK.

Our aim is a healthier population, supported by high quality health care that can be equitably accessed. We learn what works to make people's lives healthier and improve the health care system. From giving grants to those working at the front line to carrying out research and policy analysis, we shine a light on how to make successful change happen.

We believe good health and health care are key to a flourishing society. Through sharing what we learn, collaborating with others and building people's skills and knowledge, we aim to make a difference and contribute to a healthier population.

www.health.org.uk

About the UCL Institute of Health Equity

The Institute is led by Professor Sir Michael Marmot and seeks to increase health equity through action on the social determinants of health, specifically in four areas: influencing global, national and local policies; advising on and learning from practice; building the evidence base; and capacity-building.

The Institute builds on previous work to tackle inequalities in health led by Professor Sir Michael Marmot and his team, including the *Commission on Social Determinants of Health*, *Fair Society Healthy Lives* (the *Marmot Review*) and the *Review of Social Determinants of Health and the Health Divide for the WHO European Region*.

www.instituteofhealthequity.org

For further information:

[Name redacted]

[job title redacted]

[Phone number redacted]

[email address redacted]



By email to: NIAEvidence@nic.gsi.gov.uk

National Infrastructure Commission

National Infrastructure Assessment Call for Evidence October 2016

Response on behalf of The Peel Group

10 February 2017

Introduction

The Peel Group is one of the leading infrastructure, transport and real estate investors in the UK, with collective investments owned and under management of more than £5 billion.

Established by our Chairman, John Whittaker, over 40 years ago, The Peel Group has grown through an ethos of recycling capital and delivering long-term investment, primarily in the North West of England.

The family-owned Group is an investor in tangible assets comprising land, air or water. Our principal investments encompass the transport, retail and leisure, residential and commercial property, land, energy and media sectors.

Our investments are made either directly through Peel Land and Property Group or via a wide range of partnerships and shareholdings in private and public companies.

The Peel Group businesses with particular interest in this consultation are:

- Peel Ports Group: one of the largest port groups in the UK, handling over 70 million tonnes of cargo per year and has 15% of the UK's total port traffic moving through its waters. 50.1 percent owned by the Peel Group with 49.9 percent owned by Deutsche Bank's RREEF Infrastructure Fund. Peel Ports plays a major role in getting freight off the UK's roads, with six major gateways strategically located across the UK: the Port of Liverpool, the Manchester Ship Canal, Heysham Port, Great Yarmouth, Medway Ports and Clydeport's Scottish ports. Peel Ports is currently investing around £650 million in the North West including the recently opened deep water container terminal, Liverpool2, and biomass import terminal to support the decarbonisation of Drax power station. The century old Manchester Ship Canal plays an important role in sustainable transport with key sites to support logistics along the Atlantic Gateway corridor including planned investments at Port Ince, Port Warrington and Port Salford.
- Peel Airports: the Peel Group has invested more than £250 million in airports and associated infrastructure – our key airports are Liverpool John Lennon, Robin Hood Doncaster Sheffield and Durham Tees Valley. Our investment in Liverpool John Lennon Airport has helped grow passenger numbers ten-fold from 450,000 in the mid-1990s and the airport is a key driver of the economies of both Merseyside and the wider North West of England. Recent investments include the newly opened

£56 million motorway link road, Great Yorkshire Way, connecting the M18 south of Doncaster to Rossington and Finningley. The £12 million Peel Group and £10 million Harworth Estates investment (along with investment from Doncaster Council and Verdion) into this project will help to unlock a predicted £1.7 billion of investment, 20,000 jobs and 5,000 homes and support significant further opportunities for growth in the Sheffield City Region.

- Peel Logistics: the Peel Group's strategic approach to logistics is to combine the strength of our land holdings and transport investments to deliver a potential 60 million sq ft (5.5 million sq m) of new build logistics space across the UK, in partnership with Macquarie Capital.
- Energy: the Peel Group's energy and utility interests are driven by the delivery of a diverse energy portfolio. Peel Energy, Peel Environmental, Peel Utilities and Peel Gas & Oil work together to ensure that energy is sourced, delivered and utilized as efficiently as possible via low carbon, environmental technologies, gas and oil, local generation and distribution.
- Land & Property: placemaking through a series of large strategic destination projects, The Peel Group invests in regeneration and the revitalisation of communities across the UK. Key schemes in the North include MediaCityUK, Liverpool Waters, Wirral Waters, and Trafford Waters. Our pipeline includes the potential for 31,000 apartments and 41,000 family homes in the North.
- Harworth Group: the Peel Group holds a substantial shareholding in Harworth Group plc. that wholly owns Harworth Estates – one of the largest property and regeneration companies across the North of England and the Midlands, owning and managing 27,000 acres (11,000 hectares) across 200 sites, including some key logistics sites such as Logistics North in Bolton.

The Peel Group takes a long term view on its investments and development projects and has achieved significant growth over several decades through an ethos of recycling capital within its companies and across the Group. MediaCityUK, a £650 million scheme that was delivered through the last recession, and Liverpool2, a £400 million pound investment at the Port of Liverpool, are recent examples of the Group's commitment and ambition. Major regeneration and development schemes such as Liverpool Waters, Wirral Waters, Trafford Waters, Liverpool John Lennon Airport, Robin Hood Airport Doncaster Sheffield and the Advanced Manufacturing Park in Rotherham will be delivered using the same approach in the coming decades.

continued ...

National Infrastructure Assessment Evidence

The Peel Group welcomes the opportunity to respond to the National Infrastructure Commission's Call for Evidence for the National Infrastructure Assessment (NIA). We have set out below some overall observations and responses on specific topics triggered by questions raised in the NIA consultation document and a statement in the Government's Industrial Strategy green paper.

We appreciate we have not responded directly to many of the questions, however we believe we have much commercially sensitive information to share with the Commission if it can be done in a confidential manner. **We therefore request a meeting to explore the questions further and allow us to provide further information to inform the NIA.**

Government's Industrial Strategy Green Paper January 2017

The green paper states:

There has been an historic lack of clear long-term thinking in the Government's approach to national infrastructure strategy – in how we join up at a national level, and in a way that more consistently considers the interdependencies of infrastructure sectors.

This has contributed to the disjointed provision of infrastructure and a legacy of underinvestment. The recent introduction of National Policy Statements and the development of the National Infrastructure Plan (now the National Infrastructure Delivery Plan) has helped, but this underinvestment has led to low confidence among investors and undermined planning in the supply chain.

The absence of a clear national strategy has been compounded by the lack of joined-up policies to meet local needs. The fault lies partly in the poor coordination between central and local government, but also the lack of strong infrastructure institutions such as Transport for London outside the capital.

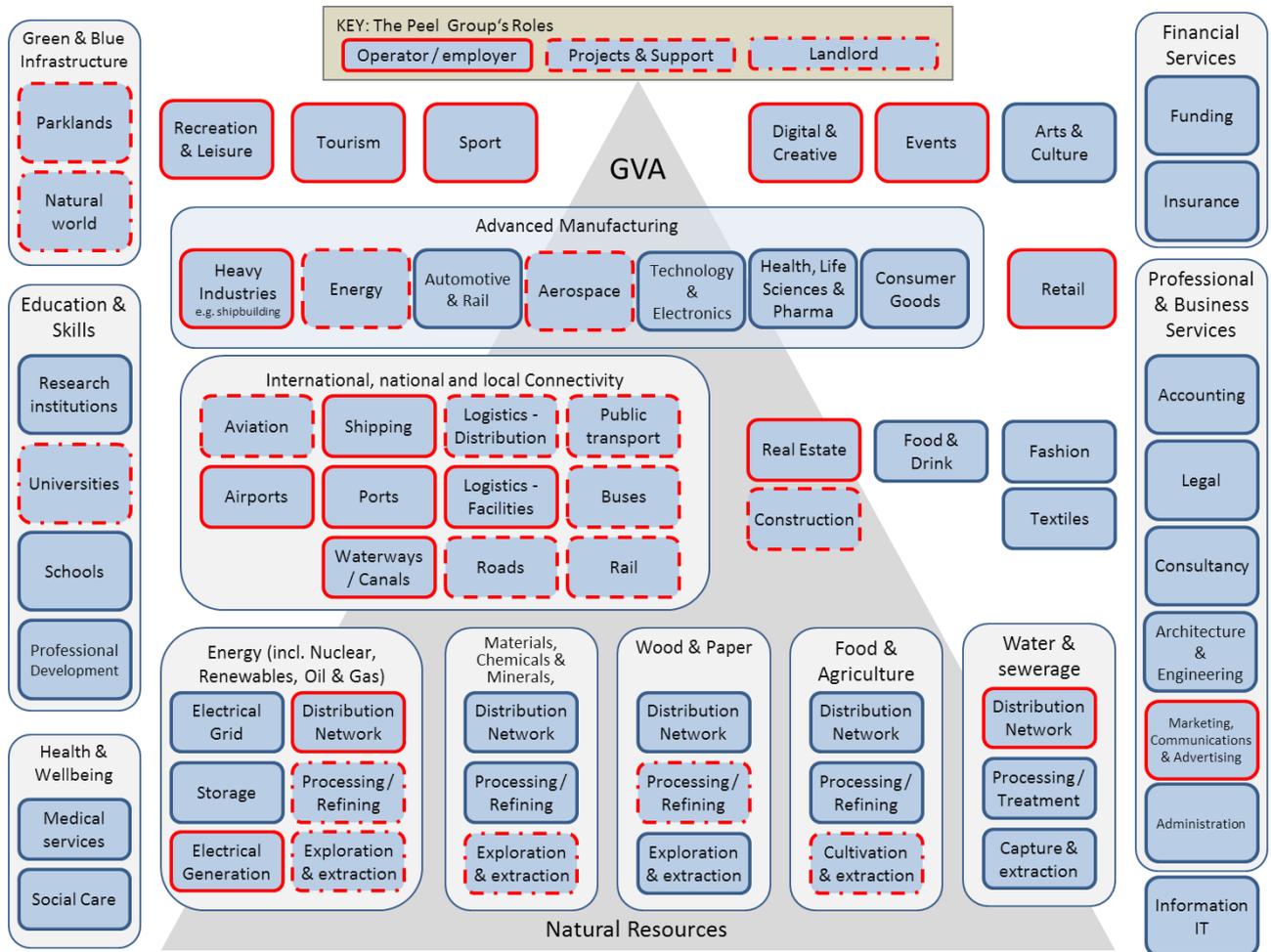
Peel's Pipeline of Infrastructure Projects

The Peel Group operates in a diverse range of sectors giving it a broad base of interest in the UK economy. We also perform a variety of roles from land owner, through developer, to investor and operator of infrastructure assets and businesses. We are a major investor in transport, property and energy infrastructure and have a track record of delivering ambitious visions with recent examples including the conversion of RAF Finningley to Doncaster Sheffield Airport, Salford docks to MediaCityUK and wind farms at Scout Moor and Frodsham. We also carry out major research to promote infrastructure including the recent Mersey Tidal Power feasibility study and the Ayrshire Power station planning application which was shortlisted in the Government's first Carbon Capture and Storage competition.

We are a private sector organisation with many public sector partnerships. Our investments are often highly dependent on national and local policies and public infrastructure. We also have many private sector partners and raise finance from international financial institutions and markets.

We therefore have a unique perspective on the relationship between the economy, placemaking and investment in infrastructure.

The Peel Group's economic sector interests



The Peel Group has a pipeline of projects, each with an infrastructure component, which we believe are 'high value' for the local and UK economy and align with the objectives of the National Infrastructure Commission ('the Commission'), namely support sustainable economic growth in many parts of the UK, improve competitiveness for local business and the UK as a whole, and improve quality of life for the local communities and visitors. Our latest Northern Powerhouse booklet (attached) provides a snapshot of our current priorities in the North. We also have a list of infrastructure projects ranging in scale from motorway signage (e.g. to ensure motorists follow the most direct route to Doncaster Sheffield Airport along the new Great Yorkshire Way) to the Mersey Tidal Power scheme. We would welcome the opportunity to share further details of our Northern Powerhouse projects and our wider UK pipeline with the Commission's team on a confidential basis to help inform the NIA.

Infrastructure spending and budgets

We welcome the current Government's commitments to infrastructure spending as seen in recent Budgets, Autumn Statements and as expressed in the Industrial Strategy Green Paper. However, the headline figures fall short of the level of funding needed to address the historic underinvestment across the country, particularly in the North of England. There is a significant backlog of local infrastructure projects that have not been funded, including refurbishment (e.g. potholes in the road, and stations and interchanges in state of disrepair), upgrades (e.g. additional capacity for freight and passengers on railways, and at road junctions), and new infrastructure (e.g. reducing journey times, relieving congestion, increasing resilience, and opening up land for housing and employment).

The impact of the Government's statement that infrastructure spending will be between one and 1.2 per cent of GDP between 2020 and 2050 cannot be assessed until there is a better handle on this backlog, alongside the pipeline of new opportunities driven by economic growth, housing and industrial policies. Work by some local authorities has helped to identify the backlog and devised an objective set of priorities in their area. However, this has often been done in isolation and without input from the private sector and local communities.

Similar issues exist with the National Infrastructure and Construction Pipeline – it does not contain many private and public sector projects, including many that we are involved with.

As far as we are aware, there is currently no single source of data to understand the investment required to bring our transport system up to modern standards, let alone keep apace with changes required due to technological shift such as decarbonisation, electrification, and digital transformation, including smart ticketing and metering.

We recommend the Commission spreads best practice in preparing and characterising the project pipeline at a local level and then amalgamating this at a national level so there is greater transparency for both the public and private sector at the local and national level.

This will then serve to determine what level of spending is required to maintain current levels of productivity in each area, and what additional investment is required to raise productivity and support economic growth in line with Government policies on matters including the Northern Powerhouse, Housing, Aviation and Industrial Strategy.

This will also help to ensure there is a clear and transparent process for identifying transport investment priorities at a local, regional and national level that will allow the private sector to engage effectively.

Research and Development funding

The state of existing assets and pressure on local budgets means most authorities have not been able to set aside funds to develop their business cases for their pipeline of projects, let alone work with the private sector on growth opportunities. Access to the level of development funding required to progress a WebTAG compliant business case therefore needs to be taken into account in the funding and budgeting process to enable

all authorities, and private sector promoters of public infrastructure schemes, to put forward their case for further capital investment.

The loss of funding through schemes such as ERDF and TEN-T will be a big loss to research, feasibility studies and early stage development of infrastructure technology and schemes as the UK exits the EU. We strongly recommend that the Commission assists the Government in identifying programmes that need support to advance not only the development of infrastructure technologies but also the deployment of infrastructure to ensure the UK seizes economic opportunities and does not lag behind its international competitors.

Approach to prioritising investment

As the UK prepares for a new future outside of the European Union, a new approach to support regional investment will be essential to grow the whole of the UK economy. We must end the practice of distributing public sector funds based on current population and historic trends and consider how we reverse the endemic under-investment in some parts of the country while others are overpopulated and congested. We support the work of this Government and the Commission as it looks ahead and considers the opportunities and needs of the future economy, and future populations, and how proactive investment in infrastructure associated with key projects can lead the transformation.

The Chancellor was correct to observe in the Autumn Statement that “no other major developed economy has such a gap between the productivity of its capital city and its second and third cities, so we must drive up the performance of our regional cities”. However, modelling growth based on current population and historic trends fails to account for some of the biggest potential growth areas – looking along transport corridors or between cities can often yield the sweet spot of available land, expertise, ambition and infrastructure potential. Spending commitments should be strategically developed and coordinated to catalyse transformative place-based growth, and injected into individual projects where there is consideration of their wider impact.

The WebTAG method of evaluating “Highest Value” and ranking projects by their benefit to cost ratio favours projects in congested productive areas, leading to higher concentration of activity in the overheated centres, higher costs to ensure resilience and bigger impact when failures occur. A new approach to prioritisation of funding is needed in order to rebalance the economy, not only between the South and North, but also across the North.

There will also have to be a change in emphasis from National meaning central or South East, as recently exemplified in the recently published “Airports National Policy Statement: new runway capacity and infrastructure at airports in the South East of England”. Promoting long haul routes directly from airports with spare capacity in the North of England, therefore requiring significantly less investment than would otherwise be required to increase capacity in the already congested South East, would:

- reduce the pressure on Heathrow and Gatwick
- avoid leaking value to other European hubs

- reduce road congestion caused by passengers and freight traveling from the North, and
- increase the economic activity, productivity and competitiveness of the North.

Truly national policies, along with other measures to prioritise investment in the North, would help to rebalance the economy and reduce pressure on other infrastructure in the South East.

There also needs to be a greater focus on forward looking opportunities, and identifying wider benefits through an integrated approach to different modes of transport and types of infrastructure. This will require greater levels of engagement with the private sector across the country, often on a confidential basis, in order to reveal the opportunities and threats to productivity and growth in each area. This would also allow for better co-ordination between public and private investment and ensure that public investment delivers in the same timescales as the private investment, thereby avoiding delays to private sector investment, and maximising the positive impact on the economy while avoiding any negative effects, e.g. relieving rather than adding to congestion in existing local communities.

Spatial and Scenario Planning

Peel appreciates the spatial dynamics which influence both the demand for infrastructure and the operation of the planning system, which each seek to accommodate and plan for future growth.

Peel is equally aware of the limitations and challenges which need to be taken into account in planning for future growth. We commissioned Turley to undertake a review of the scenario planning aspects of the NIA. Turleys have suggested areas of further analysis and consideration by the Commission as the NIA is developed. We have included an extract of their report in Annex 1.

Infrastructure as a catalyst for growth

Peel has long been a champion of integrated development projects – coordinating public and private sector partnerships that bring together businesses, public bodies, communities and third sector organisations to deliver regeneration and innovation. One of our best known examples is the delivery of MediaCityUK in Salford which is now a major employment site housing national brands like the BBC, ITV and Coronation Street, and the University of Salford. We worked closely with Salford City Council bringing in £700 million of public and private sector investment, to deliver a thriving creative and digital hub, now employing and housing more than 7,000 people, and providing 400 new homes. We are now working with L&G Capital and other partners to deliver the next phase of investment and growth.

In this example, the Government's decision to relocate BBC departments was a major economic catalyst which allowed our organisation, working with public sector partners, to

create the vision and investment in the physical and digital infrastructure to drive the growth and productivity of the digital and creative sector in an underperforming part of the city.

The last mile

While the National Infrastructure Delivery Plan and Government announcements focus on the 'big ticket' projects [and ribbon cutting opportunities], productivity and growth in the UK economy is impacted by 'the last mile' as much as the major trunk routes.

For example, development at Port Salford – our £138 million investment, creating the first tri-modal freight hub on the UK's inland waterways, served by ship, rail and road, which received planning consent in 2009 – has been delayed by lack of budget and prioritisation of investment in the local road network to alleviate historic congestion on local roads and the M60.

Our investment in the Port of Liverpool will not unlock the potential benefit to the Northern and wider UK economy if the Government does not deliver a long term solution to the congestion on the A5036 Princes Way/Dunningsbridge Road, a project which has not been delivered despite years of strong collaboration between the local private and public sectors.

Improving connections between the city 'hubs' is only part of the solution; the hubs need better connection to the 'spokes' of local commercial districts and residential communities. Most successful international cities have the benefit of urban transport infrastructure that allows mass rapid transport to ensure short journey times to destinations within their city regions. Large schemes such as HS2 and HS3 are important to provide better connectivity between cities but they will only connect the hubs. They will not deliver the anticipated benefits and connectivity improvement if the spokes are neglected. Major hubs in London are already served by buses, the underground and overland trains. New high speed hubs in other UK cities will not serve the people of those cities if the connections from their homes are not improved. For example, anyone currently travelling to London from the south of Manchester or Cheshire has the option of using any one of Wilmslow, Stockport, Crewe, Warrington or Manchester Piccadilly stations to get to London – local journey times are therefore short. These passengers will not be inclined to use HS2 if the saving of time on the high speed journey is lost in the time (or convenience) of getting from their home to the hub. This is equally true of HS3, whereby it is typically just as quick to travel across the Pennines in your car than make all the necessary connections on public transport. Increased investment in local transport is therefore crucial to address these and other existing issues and thereby achieve the benefits from the High Speed Rail programme.

In addition there is no point in delivering savings in one leg of the journey if increased congestion increases the journey time, or reduces the reliability and resilience, on another leg. Any large programme such as HS2 must therefore include a funding package to ensure the integration to existing networks is also delivered.

Public vs Private Sector Infrastructure Investment

Through years of successful partnership working with the public and private sector, Peel has a clear view on where the responsibility for public and private investment lies; this view is backed up by others, most recently in the Independent International Connectivity Commission Report: “The role of the public sector is to work with the private sector, particularly to ensure that the right surfaces access is in place and the conditions for the industry to thrive and deliver the required growth are created.”

The business case and viability of new developments across the North are often challenged by local market conditions and the uncertainty of rents, prices and take up of new developments, buildings, and services.

At a local level, historic underinvestment in infrastructure and a shortage of investment capital within local authority budgets means that ‘normal’ levels of contributions from development (through s106 agreements and Community Infrastructure Levy) often do not go far enough to deliver the required transport links or upgrades.

This puts pressure on the private sector to fund the gap, thereby worsening the viability gap and slowing investment and growth in these areas. Areas where the Government is targeting productivity improvements and growth will therefore need a disproportionate amount of investment capital.

The move from grants to loans does not address the viability gap nor scale of investment often required to overcome legacy issues due to historic underinvestment in the local infrastructure, particularly with the local transport network. This problem is exacerbated by the reduction in EU grants. A combination of grant and loan is therefore required, with a recognition that loans may be repaid from the increase in business rates and council tax that will be generated in the short to medium term. This will help to unlock developments that have already stalled and are often overlooked when determining local spending priorities for limited local resources.

Infrastructure funding governance

As a private sector organisation dependent on public sector organisations we have to navigate the myriad of sources of funding for transport schemes; recent example that we have been engaged with are:

- Department of Transport: Pinchpoint, Large Local Majors
- Highway England: RIS
- Network Rail: Control Periods
- Local Authority/Combined Authority/Passenger Transport Executive funds
- Local Enterprise Partnerships: Local Growth Funds.

The governance surrounding each of these sources of funding, and the approach adopted by each of the accountable bodies to engage through public sector bodies makes it difficult

for the private sector to engage in the process of identifying and promoting projects, particularly when competing with local public sector priorities.

We recommend the Commission identifies and spreads best practice in consultation processes to ensure the private sector has a route to engage directly with the accountable body to maximise the impact of infrastructure investment programmes.

This is particularly important where sources of funding are specifically targeted at unlocking private sector investment, such as housing and employment development.

Private sector involvement/ownership of infrastructure

Inconsistent interpretation of current State Aid rules drive inconsistent approaches to investment in public transport depending on the ownership of assets. The precautionary approach adopted by the public sector transport bodies disadvantages assets owned in the majority by the private sector that are competing with assets owned in the majority by the public sector, e.g. airports. We have been collecting evidence of such investments and are willing to share this once available.

In a post Brexit world, there is an opportunity to resolve this issue through a review of the applicability of State Aid rules and provision of clearer guidance for all parties involved in such investment decisions.

Our ambitions by 2050

Peel's pipeline of projects – a potential £53 billion total capital investment, building new hubs for trade and logistics, delivering 105,000 new homes, 86 million square feet of employment floorspace and supporting more than a quarter of a million new jobs – underpins the scale of our commitment to a new industrial vision for the UK. Delivering on this commitment, however, depends on the right support from public sector partners, and the right conditions for investment.

Our pipeline in the North comprises 41,000 family homes, 31,000 apartment, 2,800 hotel rooms, 30 million square feet of industrial and logistics space, 18 million square feet of office space, 6 million square feet of retail and leisure space and 229 MW of electrical generating capacity.

We would welcome the opportunity to share our experiences and work with you to ensure the NIA is built on evidence from the grass roots, not just supporting the major infrastructure projects, working in tandem with the Industrial Strategy such that, in the Prime Ministers words:

“It will help to deliver a stronger economy and a fairer society – where wealth and opportunity are spread across every community in our United Kingdom, not just the most prosperous places in London and the South East.” Industrial Strategy Green Paper, January 2017

Other useful references for NIA

1. The Peel Group's Response to National Infrastructure Commission call for evidence: Connecting Northern Cities, January 2016
2. The Peel Group's Response to Greater Manchester Transport Strategy 2040, October 2016
3. The Peel Group's representations to HM Treasury Spring Budget 2017, January 2017
4. Transport for the North's Independent Economic Review, June 2016
5. Transport for the North's Northern Freight and Logistics Report, September 2016
6. Transport for the North's Independent International Connectivity Commission Report, February 2017

Annex 1

Scenario Planning : Extract from Turley review of NIA scenario development commissioned by The Peel Group

Peel commissioned Turley to review the proposed inputs to scenario development in the NIA. The focus of the review was on the economic, demographic and planning based influences on the demand for infrastructure. The recommendations from the review are captured below.

Taking Account of Economic Factors

- 1.1 The NIA should take into consideration the transformative potential of the Northern Powerhouse, Midlands Engine and a succession of devolution deals which will collectively support the Government's ambitions to rebalance the UK economy, to which it has committed unprecedented levels of investment. The resultant growth and distribution of economic growth, labour force and businesses will directly generate a demand for infrastructure, which should be taken into account to ensure that the supply of infrastructure will meet demand and support such transformational economic growth.

Taking Account of Demographic Factors

- 1.2 While it is recognised that negotiations over the UK's exit from the EU could be expected to reduce current levels of international migration, the central population projection developed by the ONS itself allows for a significant reduction in net international migration from current levels and is considered to be representative of a plausible outcome of this negotiation. Caution should be exercised in assuming that a still more fundamental change will materialise, given that this could lead to underestimation of the UK's population and future demand for infrastructure. Limited weight should be attributed to any theoretical low migration variant on this basis.
- 1.3 Nationally, there is evidence that the worsening affordability of housing and undersupply has suppressed household formation rates historically, and trend-based official projections can assume that the formation of younger households will be suppressed in future. This contrasts with the Government's commitment to boost the supply and housing and fix the housing market, which must be expected to support and enable a return to more positive market conditions for younger households. Consideration should be given to developing a sensitivity which allows for a local return to more positive levels of household formation for younger households, providing an alternative position on the number and size of households distributed throughout the country which captures the Government's ambitions.

Taking Account of Planning Factors

- 1.4 The NIA should take full account of the level and distribution of housing growth planned in assessing the future demand for infrastructure. Population projections

produced by ONS form the 'starting point' for establishing the level of housing growth needed, but cannot in themselves be uncritically viewed as an accurate or representative picture of the growth likely to occur. Local Plans provide a clearer position on how local authorities are planning for future change, and a variant scenario should therefore be developed which takes full account of adopted housing requirements and objective and robust evidence of local needs. The Government's commitment to introducing a new standard methodology for calculating 'objectively assessed need', as set out in the Housing White Paper, should ensure a consistent platform for strategic plan-making as long as the proposed methodology is robust and captures needs in full. The Government's recognition that this methodology must be consistent with the modern Industrial Strategy in this context is important in ensuring that planned requirements reflect not only historic trends but future driving factors.

- 1.5 Caution should also be exercised in using historic trends in house building as the basis for any future redistribution of growth, given the recognised longstanding imbalance between housing supply and demand. The scale and distribution of housing provision delivered in the past cannot be viewed as representative of that which needs to be delivered in the future, and greater weight should therefore be given to the level of future growth planned and needed to fix the housing market and significantly boost housing supply.
- 1.6 The approach proposed by the Commission also risks perpetuating the growing regional divide between the North and South of England, without considering the step change from historic trends required if the Northern Powerhouse is to be successful and the national economy is rebalanced. The demand for infrastructure should therefore be assessed to reflect and support the transformational change that will result from the successful delivery of the Northern Powerhouse, ensuring that infrastructure supply will meet demand and support the economic growth and potential of the North.

National Infra-Structure Assessment Consultation

Response from The Riverside Group Ltd, 09 February 2017

Riverside is one of the leading registered providers of social housing in the UK, offering affordable housing and support to people of all ages and circumstances.

We manage of 52,000 homes in 150 local authority areas in England and Scotland and house 90,000 people.

Approximately half of the homes we manage are in Lower Super Output areas ranked in the lowest 10% index of multiple deprivation.

Fuel poverty and affordable warmth is a major issue for many of our customers.

Supply

Whilst our primary expertise does not lie within the energy supply market, we can see the opportunity in distributed energy resources that could be owned or operated by Riverside.

It is currently feasible for us to invest in local energy generation that can reduce our customers' energy costs, but the regulatory complexity and cost of becoming an energy supplier is a major barrier to this. Infra-structure support for load aggregation and peer-to-peer trading is recommended.

The rate of technological change and cost reduction in generation technology and energy storage makes it likely that we could become increasingly involved in energy provision.

This will require energy infra-structure that is flexible and robust and that will allow connection of local energy resources without unfair regulation or cost.

We have already encountered infra-structure problems with a Distribution Network Operator limiting the density of solar PV systems.

Demand

There is an obvious strong correlation between the requirement for heat and the energy performance of buildings.

Riverside has undertaken numerous retrofit projects to improve fabric insulation of the homes we manage with funding through CESP, CERT, ECO and ERDF and have seen the impact this has had on energy reduction and improved comfort and health for residents.

One of the main challenges to investment in energy efficiency as a social landlord is the inability to recover costs of investment through adjusted rent or other charges.

The energy savings from insulation measures are well researched and typical monetary saving figures are published by organisations such as [Energy Saving Trust](#).

Whilst the method of decarbonising the supply of heat and the associated costs of energy are uncertain, we consider improving fabric energy performance of buildings with existing proven insulation methods is the most predictable way of reducing heat demand, carbon emissions and helping fuel poverty.

We would refer to the report commissioned by E3G '[The economic and fiscal impacts making homes energy efficient](#)' which details what economic impact a retrofit programme at scale could deliver.

The health risks of living in a cold home are well researched, particularly for vulnerable groups including the young and old. There were 24,300 excess winter deaths in England & Wales in 2015/16 with an estimated 10% of this figure linked to fuel poverty.

We would refer to '[The Health Impacts of Cold Homes and Fuel Poverty](#)' prepared by the Marmot Review team. A further report prepared by [NHS Oldham CCG](#) provides a cost benefit analysis of lifting people out of fuel poverty. A new study by Energy Saving Trust will research the poverty-illness links with a study of over 500,000 homes in the South West of England.

With reference to emissions, it is difficult to see how the binding carbon reduction targets can be met without a significant reduction in heat demand.

[The Review of Potential for Carbon Savings from Residential Energy Efficiency](#) report for The Committee on Climate Change in 2013 assessed the annual carbon savings from residential energy efficiency measures of around 49Mt excluding any uptake of low carbon heating technologies.

Riverside has gained significant expertise in the delivery of community wide energy efficiency measures using its trusted brand. We are able to mobilise resources quickly to deliver similar schemes through EU compliant procurement supply chains.

Summary

The combined benefits of reduced emissions, fuel poverty and improved health leads to recommend a large scale project to improve the fabric insulation of the UK housing stock as a national infrastructure priority.

The economic and employment benefits of this scale of project have been documented in this response and add weight to our recommendation.

The market has not responded to the challenge of residential retrofit making clear government policy with associated regulation and incentives essential.

[name redacted]

[job title redacted]

The Riverside Group Ltd

Three
Star House
20 Grenfell Road
Maidenhead
SL6 1EH
United Kingdom

T +44(0)1628 765000
F +44(0)1628 765001
Three.co.uk



9 February 2017

Rt Hon Lord Andrew Adonis
Chair
National Infrastructure Commission
1 Horse Guards Road
London
SW1A 2HQ

Hutchison 3G UK Limited (Three) response to National Infrastructure Assessment: Call for Evidence

Dear Lord Adonis,

1. Three (Hutchison 3G Ltd) welcomes the opportunity to respond to the National Infrastructure Commission's *National Infrastructure Assessment*.
2. Three is the UK's challenger mobile network. Since we launched in 2003 we have focused on ensuring that our customers are able to make the most of their devices through market-leading propositions such as 4G at-no-extra-cost and Feel at Home, which allows Three customers to call, text and use their data allowances abroad at-no-extra-cost in 42 destinations. As a result, Three is the largest carrier of mobile data, with our network carrying 35% of all the UK's mobile data.
3. Three welcomes the creation of the National Infrastructure Commission (NIC). As noted in the Commission's recently published *Connected Futures*, the UK is currently languishing in the 'digital slow lane' and is ranked 54th in the world for 4G coverage. The deployment of digital communications infrastructure in the UK is the slowest and most costly in Western Europe. In simple terms, the UK builds smaller and more expensively than comparator nations.
4. This has to be addressed – and fast – if we are to turn the UK back into a world leader when it comes to digital communications. We believe that there is a clear role for the NIC to play in driving long needed reform of the legislative framework around digital communications and to simplify the current complicated and fragmented legislative structures, which militates against the efficient investment in network infrastructure.

5. Ultimately, the responsibility - and the solution to this predicament - sits jointly across sectors, regulators and Governments. However, for these stakeholders to work together effectively a coordinating body is needed, ideally one with a long-term strategic focus. Three believes that the NIC is ideally placed to fulfil this role.
6. Three has previously met with the Commission to provide our insight on the infrastructure needed to meet the future data demand, and we welcome this opportunity to provide further thoughts.
7. This submission sets out Three's priorities for a National Infrastructure Assessment (NIA); provides additional context on the current status of the mobile market and associated longer term consequences; and then answers specific questions in the NIC's call for evidence.

National Infrastructure Assessment.

8. Three fully supports the Commission's ambition to produce a NIA once in every Parliament, setting out an assessment of long-term infrastructure needs on a 30-year time horizon. We also agree that this NIA should span the work not just of Government departments but sub-national and regional bodies, as well as regulators.
9. As we note above, the UK mobile market is currently not delivering the best outcomes for UK consumers. In Three's experience, many of the regulations (or lack of) that have contributed to problems in the sector are as a result of Government and regulators favouring immediate political expediencies over tackling the most significant bottlenecks that inhibit competitive growth. Three has long been critical of this short-termism and we have set this out further detail below.¹
10. Three also welcomes the inclusion of digital communications as one of the individual sectors the NIA will focus on. Mobile communications – especially mobile data – is already integral to people's lives. More than nine in ten adults own a mobile phone, with two-thirds now owning a smartphone.² Ofcom has found an eight-fold increase in mobile data volumes between 2011 and 2015.³
11. Improved 4G services – and particularly the rollout of 5G – have the potential to further this reliance and with time replace fixed-line infrastructure. In the near future, it is highly likely that 5G will form the spine of many of the UK's key services, whether through e-health,

¹ Pages 2-6

² Ofcom, Communications Market Report 2016

³ Ibid.

internet of things or driverless cars. However, without significant reform progress will likely be expensive, patchy and slow.

12. Although Three welcomes the Commission's decision to include digital communications as a core sector, we also agree with the decision not to tackle sectors independently from each other. Undoubtedly, a cross-sector approach is the most efficient and resilient way to build a high quality and reliable mobile network – as is the case with all types of infrastructure. Three has long argued that communications requirements must be hardwired into all building regulations and long term infrastructure planning processes, be it the rolling out of energy or transport infrastructure, or the building of new commercial or residential estates.

The Future of Communications Infrastructure.

13. It goes without saying that mobile services are becoming increasingly important to the lives of UK consumers. The demand for always-on and high-quality mobile services is rapidly increasing, with consumers now expecting consistently good network performance, regardless of location or time of day. Mobile data traffic is growing at a rate that outstrips all expectations; in the month of October 2016 Three's network carried more traffic than in the whole of 2011.
14. However, it is clear that mobile infrastructure is struggling to meet current needs. Ofcom has found that only 62% of the UK landmass has access to voice coverage from all operators – and only 40% has access to 4G services.⁴ 98% of NFU members own a mobile phone, yet only one in six of surveyed could receive a mobile phone signal across the farm.⁵
15. However, it is not just coverage and the need to extend infrastructure that restricts access to mobile data services. Capacity too is also an issue. In many parts of the UK mobile networks are becoming congested as a consequence of the almost exponential growth in mobile data. Three's customers alone now use on average almost 6GB of data in a month, and this continues to grow.
16. As the operator that has consistently carried the greatest share of the UK's mobile data usage,⁶ we are acutely aware of the infrastructure that is required to deliver the ubiquitous high quality mobile services that customers expect – both now and in the future. We also understand the current problems inherent in the communications and infrastructure market which are preventing this rollout and inhibiting investment.

⁴ Ofcom, Connected Nations Report, 2016

⁵ National Farmers Unions, Spotlight on Farm Broadband and Mobile Networks, 2016

⁶ Enders Analysis, Q3 2016

17. Going forward these problems will only become more acute. For expectations around 5G to be realised, an extraordinarily dense network of small cells will be required in addition to existing mobile infrastructure. Although the full extent of any new infrastructure requirement is not yet understood, the additional equipment required will be extensive, and will likely go way beyond what the existing legislative framework for mobile envisages or enables.
18. In London alone it is estimated that as many as 500,000 small cells will be needed to support 5G services, a number far greater than the UK's entire existing stock of 37,000 mobile masts. For this to be possible - particularly in a way that maximises the benefits to not only the UK economy but also its consumers and citizens - a corollary step change in the legislation around digital communications infrastructure will be required.
19. If the UK is to become a leader in digital technology, then future NIAs must look to address the following areas
 1. The uncompetitive nature of the mobile market, underpinned by unequal spectrum holdings.
 2. Competitive bottlenecks for key infrastructure inputs, especially transmission.
 3. Government and Regulator's approach to regulation. UK mobile infrastructure is currently the smallest but most expensive infrastructure in Europe,⁷ and is inefficient in delivering connectivity needs.

Below, we set out more detail on each of these issues in turn.

1. Addressing the imbalance in spectrum holdings.

20. Spectrum is the fundamental input for the provision of mobile services. Its importance was recognised by the NIC in its 2016 report on 5G readiness. Prior to 2010, Ofcom had structured spectrum auctions to ensure that all operators had equitable spectrum holdings. In their Strategic Review of Digital Communications discussion document, Ofcom deemed this approach a success:

"In mobile, competition has cut the price of a typical bundle of mobile services by two-thirds in real terms, from around £40 in 2003 to £13 in 2012. Access to spectrum has kindled this competition [...] Lower prices have been accompanied by innovation: for example, Three, as a challenger brand, introduced 'all you can eat' data tariffs and use of Skype voice over IP (VoIP) services, and scrapped roaming charges from a number of countries."⁸

⁷ Mobile UK

⁸ Ofcom, Strategic Review of Digital Communications, Discussion Document, 2015, p2.

21. However, this situation changed consequent to a series of regulatory decisions post 2010 – in particular the liberalisation of 2G spectrum for 3G services without any remedies, a 4G auction with weak competition measures and the merger of EE and BT – has led to significant asymmetry in the UK’s spectrum holdings.

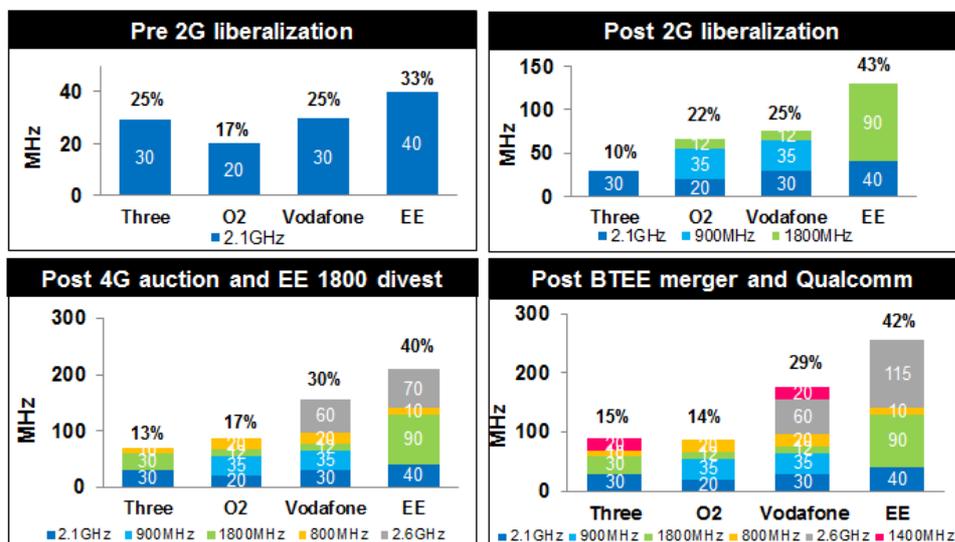


Fig 1: UK spectrum holdings.

22. Following the merger of BT and EE the UK now has one of the most extreme spectrum asymmetries in the developed world; spectrum is disproportionately concentrated in the hands of just two Mobile Network Operators, with one player – BTEE – holding 42% of spectrum usable for mobile.

23. To put into context, the UK now has the most uneven distribution of spectrum in the G20 and sits 48th out of the top 50 economies by GDP, bookended by Vietnam and Malaysia.

Table 1: The UK has one of the worst distributions of spectrum in the developed world

Group of countries	Number of countries	UK ranking (from best to worst)	Countries with larger spectrum imbalance than UK
Top 50 world economies (by GDP)	50	48 th	Thailand, Malaysia
G20	20	20 th	-
Western Europe	20	19 th	Iceland

Source: Three

24. As a result of this asymmetry, spectrum is not only concentrated in the hands of two operators, but it is effectively 'land banked' through none use or underutilisation. Irrespective of competition concerns, this is an inefficient use of a critical national resource.
25. Moreover, spectrum banking deliberately circumscribes the ability of smaller operators to price data packages competitively, denying their customers the benefits of increased capacity and speed, and constraining competitive drivers in the market more widely. Spectrum inequalities needs to be addressed to allow for greater competition in mobile markets going forward, with lower prices and a wider range of services for our customers.

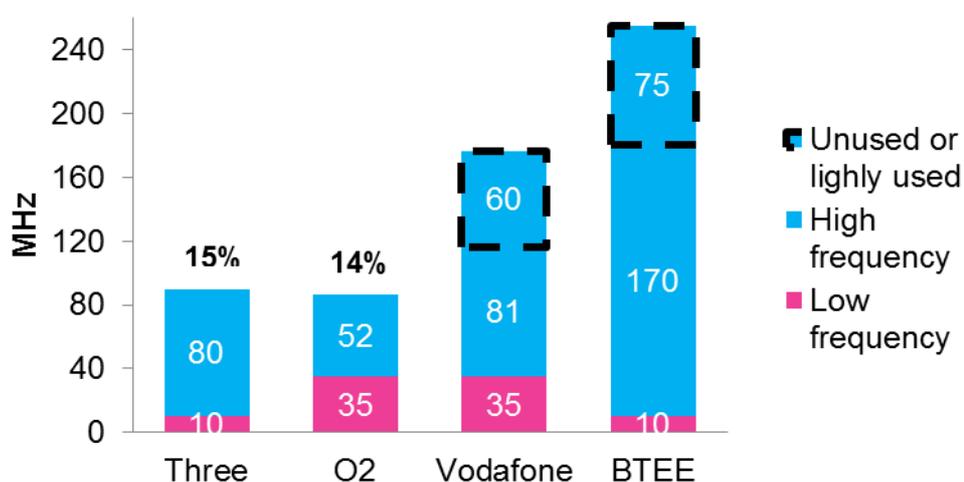


Fig 2: Unused or lightly used spectrum holdings.

26. This erosion of competition has significantly damaged the market, and has led to higher prices for UK consumers when much of the rest of Europe has seen significant price decreases. The EC's Mobile Broadband Prices in Europe 2016 Report says that UK handset plans have increased by an average of 4% between 2015 and 2016, compared to a 7% decrease on average across EU Member States.⁹
27. However, the impact of spectrum asymmetry is not confined to the poor quality services and higher prices consumers experience today. It also will impact the future of mobile services, including 5G, unless it is addressed quickly and lessons learnt from the failed approach to the 4G spectrum auction. This is why it must be considered as part of the NIA process.

⁹ European Commission, Mobile Broadband Prices in Europe, 2016, Paragraph A7.55

28. Fortunately, Ofcom has a unique opportunity to address the current asymmetry in the upcoming PSSR spectrum auction. Unfortunately their preferred competition measures for this auction are extremely weak, and would do little to address this imbalance.
29. Three therefore welcomes that the NIC has recognised the importance of this auction in their *Connected Futures* report, and believes the NIC must have a key role in holding Ofcom to account during this PSSR and subsequent auctions, to ensure that these auctions deliver the right outcomes for UK consumers and a market that can underpin the UK's future infrastructure needs.
30. Three has supported the Make The Air Fair campaign,¹⁰ which has called for a 30% cap on spectrum usable for mobile. The campaign not only gathered support from a range of industry stakeholders, but had the support of over 170,000 individual consumers, who have responded to the Ofcom consultation on the structure of the PSSR auction.

2. Uncompetitive Transmission Market

31. While spectrum is the key input, mobile networks also require transmission (or backhaul) between sites and the core network. Currently, this market is struggling to provide access to the high-capacity backhaul needed to meet the UK's future data demand. In as much of 80% of UK postcodes and a great proportion of UK physical geography, there is only one provider of transmission, BT. This fundamental lack of competition in a key wholesale market is driving up costs, inhibiting rollout and upgrades. Crucially, its impacts are felt most acutely in rural, remote and hard to reach communities, where the economics of mobile service provision and network extension are already most challenging.
32. Ofcom has failed to deliver the equal and competitive access to BT's Openreach network that is needed and in many areas BT Openreach remains an enduring economic bottleneck, one from which competition is unlikely to emerge.
33. Ofcom have repeatedly concluded that BT continues to exploit its ownership of Openreach to make strategic decisions that favour BT's interests over its rivals. BT has regularly shown that they will act on this incentive, and over the years has successfully discriminated against rivals in the provision of wholesale access to Openreach.
34. However, Ofcom's announcement in November 2016 to require the legal separation of Openreach from BT does not address these concerns. In Three's view, Openreach will not behave like a truly independent company while BT continues to own and oversee it. Instead, Three would like to see Openreach's strategic and operational independence from BT strengthened, to increase competition in the mobile market.

¹⁰ See www.maketheairfair.org

35. Three is also concerned that Ofcom needs to do more to create the right incentives for investment in the infrastructure that underpins much of the fixed and mobile markets. The introduction of dark fibre will bring benefits to the UK communications markets; greater opportunities for innovation and product differentiation, which will in turn stimulate cost efficiencies, lower pricing and allow for future deregulation of active markets. To deliver these benefits Ofcom must take a more proactive approach towards the implementation and operation of its Dark Fibre Access remedy.
36. Ofcom have highlighted the difficulties they face in tackling the dominance of BT. The NIC must have a role in scrutinising Ofcom's activities in this area and where appropriate, calling for more effective competition measures. Otherwise this infrastructure, which will underpin the extension of better quality 4G and the rollout of 5G services, will simply not be available.

3. Approach to Communications Infrastructure Regulations

37. The current planning and building regulation regime do not facilitate the necessary infrastructure to meet today's mobile data demands, for either large scale infrastructure projects or other small-to-mid sized developments. There needs to be a radical review of approach if the UK is to achieve the ubiquitous, reliable mobile data coverage that future technologies will require.
38. The current planning regime means that it is disproportionately expensive to build mobile infrastructure in the UK. It also leads to MNOs building much smaller (and therefore less efficient) infrastructure. For example, the average mast height in the UK is 17m. In France the comparable figure is 30m, in Sweden it is over 70m.¹¹ There have been some welcome changes to facilitate the building and upgrading of new infrastructure, notably planning reform in England (and proposed reform in Scotland) and reform to the Electronic Communications Code (ECC), currently being debated as part of the Digital Economy Bill.
39. However, progress towards these reforms has been painfully slow. For example, ECC reform was intended to help 4G rollout – yet the provisions are still not even passed into law. If they do come into force, the reforms will only apply to new or renewed contracts, meaning that for many sites it will be ten or fifteen years before the industry begins to see the benefit of these changes.
40. It is also worth noting that the recent planning reforms, although welcome, only provided additional height and rights within the existing framework. The infrastructure required for 5G is likely to be significantly different from that required for 3G and 4G, most notably the use of small cells.

¹¹ Mobile UK.

41. As this technology is still in development, regulation in this area cannot be simply created by providing Government with dimensions for current equipment or by estimating the likely density requirements. In fact, it will be completely the wrong approach to think of 5G planning regulation in this way. Instead, Government must look at developing a new policy, which embeds the need for ubiquitous and high-capacity mobile coverage into its provision. It must also give maximum flexibility to manufacturers and operators, to ensure the new technology develops in a way that is most effective at delivering that coverage – rather, as happens with masts, limiting the design and location of infrastructure to best fit the regulations. The NIC, with its cross-industry focus, will be an ideal position to develop this new approach to decision-making.
42. Three also believe that communications requirements should become embedded in Building Regulations. We have commented further on this issue in the answers to specific questions below.
43. It is also worth noting that planning and building regulation decisions relating to mobile infrastructure currently reside at local authority level, including across 32 Boroughs in London. As a consequence of this fragmented method of decision making, there is a lack of strategic policy direction. This has hindered mobile rollout and could have real implications for how 5G is deployed.
44. Three hopes the above provides useful context to the Commission. Our answers to specific questions in the Call For Evidence can be found below.

Answers to Specific Questions

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

45. Three believes that housing and infrastructure plans must take into account the growing demand for improved capacity, speed and coverage. This cannot be the responsibility of communications providers alone. A holistic approach to communications, with the necessary infrastructure requirements considered as part of the earliest stages of the planning process, is the most efficient and effective way to meet future demand. For example, if a developer is building a new business park or housing estate, then it makes sense that the communications requirements of future occupants are hardwired into the initial planning process. The same should also be true for road and rail infrastructure. The cost of providing high-capacity indoor coverage is not one the industry alone can bear.
46. Yet currently, not only does this rarely happen but developments are the most common reason for operators to be given NTQs (Notice To Quit), meaning we have to remove our

existing infrastructure. It is very difficult – and in some cases impossible – to find an alternative site nearby which provides the same coverage footprint. Even if a suitable replacement can be found, it can lead to a break in service while this replacement site gains the necessary planning permission to be built. Furthermore, such activity can drastically reduce the capacity on nearby sites – either because a hub site is being removed or because nearby sites have to cope with a significant increase in traffic.

47. Three believes there is scope to review the current planning and building regulation processes, to ensure that communication considerations are taken into account – both in terms of the impact of development on existing infrastructure and more importantly, how the connectivity needs associated with the new development will be met.
48. This approach must also be at the heart of large scale infrastructure projects, like HS2, A greater focus is needed to ensure that all such future strategies have a digital component, where likely communications needs are addressed. Otherwise, industry and Government will be left in a situation where they have to retrofit costly and often ineffective solutions
49. Three also believes that consideration must be given to the current process of decision making, which is undertaken at a local authority level. This fragmented approach has resulted in a lack of strategic direction inconsistency in decision-making, which has inhibited investment and rollout. If the UK is to become a leader in mobile communications, this lack of strategic leadership needs to be addressed.
50. Three, supported by Mobile UK – the mobile industry trade association – would be very happy to work across national and sub-national Governments, as well as other stakeholders, to scope out specific changes that are needed. However, from our experience such work will need someone to take a leadership role. The NIC, with its long-term focus and its understanding of future demands, would be a powerful voice influencing strategy in this area. Therefore, Three hopes the NIA also covers these considerations.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

51. Three believes that demand management is not a realistic strategy for digital communications.
52. As already stated, the demand for mobile data is growing at an exponential rate. On Three's network alone, our customers already use 5.9GB per month – a 31% increase since 2015. Any attempt to throttle this growth will have a detrimental impact not just for consumers, but for UK productivity and the wider economy.

53. Instead, Three believes that the mobile market will be able to meet this demand, but only if the current asymmetry in spectrum holdings is addressed. As shown in Figure 2, we are in a situation where not only is spectrum concentrated in the hands of two operators but a significant proportion of that spectrum is being either lightly utilised or not used at all.
54. To have any chance of meeting the capacity challenge, it must be ensured that all assets available are being used to their maximum.
55. This effective use of spectrum should also be a consideration in any NIA, as well as how additional bands could be identified and cleared for mobile use.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

56. As discussed above, the current planning regime does not promote the rollout of the infrastructure best suited to meet consumers' current connectivity needs. It is also worth reflecting that this process, even when successful, is incredibly time consuming. On average, it can take 18 months to build a site – and the planning regime is a significant contributor to that time. It is to note that the Government's Mobile Infrastructure Project, which aimed to build masts in mobile not-spots, had to radically scale down their ambitions, partly due to the requirements and delays associated with gaining planning consent.
57. The problems encountered trying to build new infrastructure in areas that were in desperate need of connectivity must be seen as a wake-up call. The planning system does not encourage investment in new infrastructure and hinders the upgrading of existing infrastructure. This must be addressed before the rollout of 5G.
58. Three believes that a new approach to planning regulation and processes should be explored. Again, while we continue to support Mobile UK in discussions with specific Government departments on specific changes to existing rules, we would like to see the NIC lead a strategic discussion about the direction and objectives of future planning policy.

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

59. Investment in high-capacity fibre backhaul – if access to it can be delivered on a competitive basis – will be crucial in improving 4G services and laying the groundwork for 5G.

60. Three also believes that the upcoming PSSR auction is an opportunity for Ofcom to influence investment levels in 4G and 5G networks and the associated consumer outcomes. If Ofcom continue to take a laissez-faire approach - content to sell spectrum to the highest bidder regardless of the long-term competitive impact -then the UK will fall even further behind the leading digital economies.
61. It must also be recognised that due to geographic or demographic realities, there are some areas in the UK which will never be reached by the market alone. Invention will be needed if connectivity is to be extended in these areas.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

62. The mobile market is failing, and is currently not delivering the reach or quality of services that consumers need. The NIC is right to say the UK is in the digital slow lane – and we risk falling even further behind. In particular, rural and semi-rural areas – not to mention hard to reach areas – are not receiving the service that they should. As pointed out in *Connected Futures*, road and rail networks also do not have sufficient access to data services.
63. These are not easy issues to solve. As outlined above, ensuring a competitive PSSR spectrum auction and effective action in the transmission market, must be the key priorities in relation to mobile networks. Leadership is needed to ensure the UK has a regulatory framework fit to facilitate competitive investment in all emerging communications technologies, including 5G.
64. The current fragmented nature of planning systems – and the decision-making within that – will make it incredibly difficult to roll out the infrastructure needed to provide a ubiquitous, high-quality and reliable mobile service. Scale is needed for such decision making that reflects the nature and geographic spread of the investment.
65. Three hopes the NIC will be successful with their ambitions and work closely with Governments, regulators and industry to secure the UK's 5G future

Yours sincerely,

[signature redacted]

[name redacted]

[job title redacted]



NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

NIAEvidence@nic.gsi.gov.uk

10 February 2017

The National Infrastructure Assessment (NIA) – call for evidence

Introduction

Tidal Lagoon Power is driving a critical change in the UK's energy mix with the development of low-cost, low carbon, predictable electricity sources that are sustainable, UK based and deliver long-term energy security for 120 years. Swansea Bay Tidal Lagoon, the pathfinder nationally significant infrastructure project (NSIP), gives the UK a necessary new energy generation option, required now and into the future if we are to secure a low carbon transition to meet 2050 emissions reduction targets, foster economic growth and competitiveness, and achieve quality of life aims. Although a tidal lagoon is a power plant, as our plans for Swansea Bay demonstrate, a tidal lagoon can deliver and enable a range of significant additional national, regional and local economic, social and environmental benefits.

We welcome this call for evidence consultation as the latest step towards preparation of a National Infrastructure Assessment.

We have previously responded to consultations by the National Infrastructure Commission (NIC); on the call for evidence on delivering future-proof energy infrastructure (8th January 2016), and governance, structure and operation (17th March 2016); the process and methodology of undertaking the National Infrastructure Assessment (5th August 2016). More recently we have submitted ideas on specific studies (2nd November 2016, relating to energy and flood risk management).

Independent Review of Tidal Lagoons

The Independent Review of Tidal Lagoons, led by Charles Hendry (“Hendry Review”) has concluded, a final report was published in mid-January 2017. The Hendry Review concluded



positively about the pathfinder project at Swansea Bay, and the potential for lagoons to make a significant contribution to the energy sector and the economy:

“tidal lagoons would help deliver security of supply; they would assist in delivering our decarbonisation targets; and would bring real and substantial opportunities for the UK supply chain.”

“they could play a competitive role as part of the UK’s energy mix”

“a pathfinder lagoon is, I believe, a no-regrets policy”

We now await the UK Government’s response to the Review’s findings.

Call for Evidence

We refer you to the Hendry Review report, which provides a comprehensive and relevant body of evidence to inform the development of the National Infrastructure Assessment. Below is some commentary in response to the key questions in the consultation paper, with cross reference to the Hendry Review report. Also, please refer to our previous consultation responses which continue to be relevant (referenced at the introduction of this letter).

Energy

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

The UK’s decarbonisation commitments are challenging. By 2030 the UK will have closed 82% of its existing fossil fuel based power station capacity¹. At the same time electrification policy calls for more transport (cars, trains) and heat fuelled by electricity – all net new demand.

¹ Tidal Lagoon Power (2016) *The New Power Cost League Table: A clear view of the consumer cost of new build power stations.*

Bircham Dyson Bell (2016) *The Energy Crunch: Will decreasing capacity in UK energy cause the lights to go out?*



Decarbonising the electricity sector may be progressing better than other sectors (e.g. heat and transport), however predicted energy scenarios to 2030 (by National Grid) coupled with new demand from transport and heat sectors means that *'the search for low-carbon sources of electricity generation becomes more urgent'* (see Hendry Review section 3.3). The Hendry Review concludes that tidal lagoons would contribute positively to the UK's decarbonisation goals. A new tidal lagoon industry, established by the pathfinder lagoon at Swansea Bay, is aligned with the Government's emerging Industrial Strategy, across many of the identified pillars including *'delivering affordable energy and clean growth'*.

The Hendry Review report includes analysis of the *'valuable and cost competitive'* role of tidal lagoons in the electricity system, the value from longevity of operation, and the significant potential value to the UK economy (and regional economies) from industry², jobs, supply chain, regeneration, coastal and flooding protection.

The Green Paper *'Building Our Industrial Strategy'* recognises the importance of decisions that provide long-term certainty to investors in the renewables sector and realise opportunities in terms of securing jobs and supply chain benefits, illustrated by the success of the offshore wind industry. The Hendry Review report refers to the example of offshore wind in relation to realising the job creation and supply chain opportunities offered by a tidal lagoon industry.

Cross-cutting Issues.

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

The infrastructure investments that will realise the most value for regional economies to drive sustainable growth will be infrastructure that can realise multiple benefits. No doubt this would be recognised in a number of studies.

A recent report by the Cardiff Capital Region City Deal Growth and Competitiveness Commission³ (led by Professor Greg Clarke) provides analysis of different city region growth strategies and the relationship with infrastructure investment. The report provides a comprehensive suite of recommendations to drive forward sustainable growth of a city region; highlighting investment principles, growth sectors and specialisation potential, and the importance of energy infrastructure and assets as a driver of growth, particularly large-scale energy projects.

² *Tidal Lagoon Power (2016) Ours to Own: From First Mover to Mass Manufacture, Building a New British Industry from Our Natural Advantage, October 2016.*

³ *Cardiff Capital Region City Deal Growth and Competitiveness Commission (2016) Report and Recommendations.*



In the case of tidal lagoons, the sustainable growth opportunity will be at local, regional and national scale. As stated in the Hendry Review report *'I think it is beyond question that, in the case of Swansea Bay, local economic regeneration would follow a tidal lagoon'* (section 3.5.2). The Centre for Economics and Business Research⁴ estimates that the development of six tidal lagoon power plant in the UK, including the pathfinder at Swansea Bay, would contribute £27bn to UK GDP during construction and a further £3.1bn in each year of operation.

The UK industrial opportunity arising from tidal lagoons is addressed in some detail by the Hendry Review. With reference to *'Ours to Own'*, the immediate opportunity is for the UK's engineering, construction, steel and manufacturing industries to win contracts totalling over £800m for a world first tidal lagoon project at Swansea Bay and over £6bn for the first project to employ its template at full-scale at Cardiff. An effective partnership between industry and Government can sustain and grow this opportunity as the tidal lagoon market scales, with potential for further projects in Wales, the south west and the north west of England. On top of significant value captured through project design, services and operations, and more than half a billion pounds of investment in new UK industrial facilities, the potential value of the tidal lagoon sector to UK industry is:

- Domestic market for tidal lagoon turbines and generators: £17bn;
- Domestic market for tidal lagoon turbine housings: £24bn
- Exports to international tidal lagoon market: £30bn

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

Please refer to the global opportunities set out in the *'Ours to Own'* report, and analysis in the Hendry Review.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

As our plans for the Swansea Bay tidal lagoon demonstrate, if approached in the right way, a tidal lagoon can also deliver a wide range of economic, social and environmental benefits. As the scalable blueprint and pathfinder for larger fleet lagoons, the Swansea Bay tidal lagoon is a

⁴ Centre for Economics and Business Research (2014) *'The Economic Case for a UK Tidal Lagoon Industry'*, report to Tidal Lagoon Power, July 2014.



demonstrator of the potential of tidal lagoons; a pathfinder project that demonstrates the energy potential of tidal lagoons, the multi-functional potential, and how to make infrastructure relevant and appealing to local communities, as well as providing a long-term positive legacy.

Effective engagement is central to achieving a sustainable development outcome and public support. The public support for the project is well documented (referred to in the Hendry Report). In addition to public support, the integration of the Swansea Bay tidal lagoon with strategic initiatives in the region is an endorsement that tidal lagoons can support long term economic development and regeneration to create better places to live and work. The project is considered a catalyst for regeneration in the Swansea Bay city region. Local development plan policies are focused on *'capturing the benefits of the planned Tidal Lagoon'* to regenerate the waterfront and attract investment for offices and homes.

5. How should the maintenance and repair of existing assets be most effectively balanced with construction of new assets?

The Hendry Review report includes analysis of the longevity benefits (such as security of supply and cost effectiveness) of tidal lagoons that are maintained to operate for 120 years.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Competition, collaboration and the potential for tidal lagoons to be hybrid infrastructure (across sectors) are all matters considered by the Hendry Review, therefore please refer to the report.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Please refer to the Hendry Review, particularly part 2, and section 12 on financing structures.

9. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Please refer to section 11.2 of the Hendry Review for commentary on the role of policy and process in supporting the consenting of infrastructure.

In previous correspondence we have referred to the importance of working with the Devolved Administrations on the matter of UK infrastructure (e.g. NSIPs situated in Wales). For instance,



there are distinct issues for consenting NSIPs in Wales (if this is a matter that NIC are able to consider further, we can provide more information, other infrastructure developers, the Royal Town Planning Institute and the National Infrastructure Planners Association may also be well placed to advise).

10. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Accelerating progress towards decarbonising the economy, including energy and transport sectors, meet decarbonisation targets will have a strategic contribution to protecting the natural environment. This is commonly understood, though not directly integrated with policy on protecting and enhancing the natural environment (therefore logic is often lost when it comes to local level implementation).

Planning policy provides clear frameworks for decision-making to ensure sequential steps are taken to minimise, mitigate, compensate and offset impacts, particularly in the case of priority habitats and species. Enhancement opportunities should also be encouraged, for example our Ecosystem Enhancement Programme⁵. Increased strategic integration of infrastructure planning with planning for the natural environment may be a way to facilitate such opportunities (see also response to questions 25 and 26).

Flood risk management

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

We were recently involved in the workshop held by the NIC on flood risk management. There is an important difference between resilience to flood and coastal erosion events, and the management of flood and coastal erosion risks. It is unclear if there is a common understanding of how resilient the UK is now to events that could cause flooding and coastal erosion, which in turn could damage property and infrastructure, cause significant economic disruption (especially true given dependencies on infrastructure), and risk to life. Understanding the baseline situation must be the starting point, including what the main vulnerabilities are, where

⁵ *Tidal Lagoon Power (2016) Ecosystems Enhancement Programme: Strategy, June 2016.*



they are, and how they might change with the effects of climate change. It is a cross-sectoral issue (relevant to transport, energy, water etc) and for public and private sectors.

There are multiple drivers to developing natural flood risk management, which means it has significant cost avoidance merits. Natural flood risk management is capable of being delivered by different sectors if plans are pulled together to identify priorities and coordinate action. For example, energy infrastructure providers may wish to invest in natural flood risk management schemes as a way to address environmental impacts⁶, water and wastewater industry may wish to invest in upper catchment initiatives, agriculture sector could be incentivised to invest in schemes through a post BREXIT settlement.

Innovation should also mean looking at alternative solutions. Tidal lagoons can act as a barrier to potentially damaging and disruptive storm surge and waves that threaten coastal communities and infrastructure vulnerable to flooding and coastal erosion, likely to be exacerbated by climate change and sea level rise⁷. Tidal lagoons:

- Are designed to be resilient to at least 1 in 500 year storm surge and wave;
- Have an asset life of 120 years, with the ability to increase the height of the structure to adapt to sea level rise;
- Have the potential to support FRM with the operating cycle.

Also, Tidal Lagoon Power's model for delivering lagoons includes creating a strategic network of wetlands through managed realignment along the coast, a natural approach to coastal protection and flood risk management.

Please note that the Hendry Review report also includes analysis of the potential of tidal lagoons to support flood risk and coastal erosion management.

Tidal Lagoon Power welcomes further engagement involvement with the process of preparing the NIA. If you have any queries, wish to discuss further or be provided with further information (as indicated in this letter), please contact me at [telephone number redacted] or [email address redacted].

Yours faithfully,

⁶ See response to question 10, and the EEP strategy.

⁷ See appended report on how tidal lagoons can support flood risk and coastal erosion management.



[signature redacted]

[name redacted]

[job title redacted]



NIA Call for Evidence
National Infrastructure Commission
11 Philippot Lane
London
EC3M 8UD

10 February 2017

Dear Sir / Madam,

The National Infrastructure Assessment: Call for Evidence

We are pleased to respond to the National Infrastructure Commission's call for evidence for the National Infrastructure Assessment. This assessment is crucial to infrastructure planning and the long-term success of the UK economy.

Our response focuses on a small number of questions where we can offer insights based on our experience. The Tideway model was developed in response to unique circumstances (for example in relation to construction complexity, size of investment, and risk profile) but could provide lessons that are applicable more widely.

The response is high-level but we are happy to discuss any part of it further with the National Infrastructure Commission. Please do not hesitate to contact me if you have any questions or would like to arrange a further discussion.

Yours faithfully

 (signature redacted)

 (name redacted)
 (job title redacted)

 (phone number redacted)
www.tideway.london

3

How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Given the importance of infrastructure to the UK economy, it is important that it is planned and delivered in a way that maximises value for money. Beyond the direct costs and benefits of the infrastructure there are a number of considerations that need to be taken into account, including economic and social sustainability (for example minimising lorry movements in peak hours during construction to minimise disruption).

Design and planning processes need to take into account the balance between the long-term benefits of the infrastructure and the short-term disruption and other construction impacts. In the case of the Thames Tideway Tunnel (TTT), the long-term benefits accrue to a wide group of people (for example all those who live in or visit London over the next 100 years or more) and a much smaller group of people are affected by construction impacts (largely residents close to Tideway's construction sites).

Broad and deep consultation is crucial to ensuring that this balance is considered and the right infrastructure is delivered in the most efficient way. For the TTT, there were 114 days of public exhibitions and over 200 meetings held across London as part of the planning process. Consultation should cover the need for the infrastructure, the solution, and then design and delivery. Helping people understand the need for the infrastructure is important for facilitating a smooth delivery. For the TTT, the Development Consent Order (DCO) phase 1 consultation focused on the need and the solution. Consulting at this stage also ensures that the infrastructure delivers the required functionality.

Furthermore, it is important to include people living where the infrastructure is built and operated so they have a chance to feed in their views. When designing and planning, consulting those affected can lead to better value for money. The approach to the TTT was influenced by the DCO consultation process in two important ways: firstly to move construction sites from greenfield to brownfield sites where possible, and secondly to increase the proportion of construction materials and excavated material moved by river.

It is also important that infrastructure is not designed and planned in isolation so that value for money can be assessed in the round and efficiencies and synergies can be realised. For example, joined-up planning at an early stage led to changes in the design of the TTT to allow it to connect to the Lee Tunnel, which saved nine kilometres of tunnelling with knock-on cost and carbon savings of around 200,000 tonnes CO₂e and reduced disruption. Joined-up planning between similar projects may also drive higher productivity, for example by facilitating skills and knowledge transfer between projects.

In relation to the wider benefits of infrastructure, a number of obligations related to the project's legacy after the tunnel is constructed were volunteered by the

project and included in the DCO. In addition to this, Tideway has published a Legacy Statement which outlined a wider set of commitments that will ensure that we deliver a lasting legacy for London. We are now delivering against these commitments.

Our commitments include

- delivering an infrastructure that supports a more resilient biodiversity (on top of the direct environmental benefits of reducing the sewage discharges on the Thames);
- delivering three acres of new public realm along the foreshore: enhancing the Thames Path; and collaborating with local developers to enhance local space where our activities overlap;
- specific economic legacy benefits for London, including to the river economy and local businesses; and
- specific skills legacy: for river skills by supporting the launch of the Thames Skills Academy; for apprentices (1 in 50 commitment) and for the next generation of engineers through our STEM (science, technology, engineering and mathematics) programme.

We have outlined our legacy aims and objectives, and updated on the progress of our legacy delivery, through a dedicated section on our website and our Annual Report.

The integration of these commitments into planning, design and delivery supports the creation of better places to live and work. Building environmental considerations into planning conditions and then cascading these obligations into construction contracts is important to protect from cost-cutting or programme pressures during delivery. Obligations should be set on an outcomes basis where possible, to allow flexibility for efficient delivery, and should be consistent with current best practice to ensure they are appropriately stretching.

As discussed in our response to question six, competition can be used to ensure value for money, both in relation to construction costs and financing. It is important to consider how the timing of procurements relate to the planning process. This will depend on who is best placed to manage the planning process and bear the associated risk.

6 What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Both competition and collaboration play a role in the Thames Tideway Tunnel delivery model. To ensure best value for money, both the financing and construction (main works) contracts were competitively procured. The procurement of the financing was an innovative approach introducing competition for the market resulting in an overall lower cost to customers. For the main works procurement process, the works to be delivered were divided into three packages (West, Central, East) to create package sizes that were readily biddable by a wide field of contractors and to spread delivery risks.

The project also has a number of collaborative elements. Firstly, the project involves working closely with Thames Water, whose network the tunnel will be connected to once operational. Once completed, the above-ground assets, structures and equipment will be transferred to Thames Water leaving the main tunnel, connection tunnels and shafts under the Tideway's ownership. Thames Water will operate the Thames Tideway Tunnel, while Tideway will maintain and make available the deep tunnels and shafts.

Tideway has also established an overarching Alliance in order to manage and incentivise collaborative working between Tideway, its contractors and Thames Water. The aims of the Alliance are to realise the sharing of best practice, synergies between activities and the benefits of economies of scale.

Prior to commencing detailed design and construction work, an optimised contractor involvement process took place, with the purpose of providing an opportunity for the Alliance members to review the specification, information and interfaces to realise synergies, programme savings and risk mitigation. The result of this process was the identification of a number of concrete opportunities to maximise value for money, for example in marine logistics savings related to spoil disposal. In addition, the optimised contractor involvement process provided the opportunity to develop a plan to optimise and de-risk the construction programme. These plans are currently being implemented and have already led to the works starting on-site ahead of schedule.

The optimised contractor involvement process also provided the opportunity for the Alliance to review and enhance its strategy to maximise the use of the river for logistics, an initiative known as 'More by River'. Tideway believes this strategy brings several benefits, including minimisation of disruption to local communities which will facilitate the consenting process, enhanced health and safety performance due to reduced HGV use and minimisation of environmental impact with respect to carbon emissions.

Tideway is committed to continuous improvement in environmental sustainability and has joined the Infrastructure Carbon Review, a joint government and industry initiative to support carbon reduction in infrastructure.

In addition, Tideway is working with its Alliance and the wider industry to deliver a sustainable legacy of innovation by capturing and sharing our solutions via

The Great Think, hosted on i3P (Infrastructure Industry Innovation Platform).
This is intended to support the UK Construction 2025 vision of an industry that is
efficient and technologically advanced.

7 What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Infrastructure can be funded by customer charges, government, or a combination of these sources, and the source of funding may differ from the source of financing. Where infrastructure is primarily funded by customers, it is generally accepted there will be a role for regulators (in determining funding) and/or government (either in funding elements of the infrastructure or supporting efficient financing, as set out in our response to question eight).

One way in which funding policy can affect efficiency of delivery is through the arrangements established for the funding of the development phase of the project. Appropriate incentive arrangements should be put in place to address development phase risk and provide incentives for efficiency.

Funding policy during the delivery phase can also affect efficiency through its impact on financeability and the cost of finance. Well-developed and predictable regulatory funding arrangements are important. As set out in our response to question 10, the Tideway delivery model was developed collaboratively between Ofwat, government and Thames Water, with market testing of the arrangements.

Tideway benefits from a bespoke regulatory regime, which is based on the existing framework for the water sector with adaptations for Tideway's unique circumstances. In addition to the regulatory mechanics included in Tideway's licence, Ofwat has issued economic guidance which sets out the approach it intends to take in making determinations, including in determining the ongoing weighted average cost of capital (WACC) during the operational phase.

Providing a yield during construction improves financeability through attracting certain classes of investors. For example, Tideway receives a regulated revenue stream during the construction period based on a series of building blocks set out in its licence, which contributed to the 2.497 per cent competed WACC.

Tideway is not subject to periodic reviews during construction. Setting price controls to match the longer duration of projects (rather than the five year cycles of some regulated industries) reduces political and regulatory risk for investors and helps reduce the cost of finance. In the operational phase, Tideway will fall into the water industry periodic review cycle.

Furthermore, there are clear arrangements for the funding of the project under a variety of circumstances. Tideway's licence includes mechanics to address delay/overrun (as well as to incentivise delivery under budget). This regulatory certainty promotes efficient financing.

Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

In certain circumstances, risk could lead to projects not being financed, or not being financed efficiently, in particular if it is not allocated appropriately or adequately rewarded. It is important to consider what risk the market will bear and where this can be most efficiently allocated through a process of market testing. For Tideway, this process involved both consultation of the rating agencies and soft market testing.

There may be particular difficulties around the financing of greenfield projects as risk is likely to be higher than for brownfield projects. Construction risk may mean target cost contracts are more suitable than cost pass through contracts for greenfield projects. In turn this may increase risk to investors, mean the risk is difficult to price, or even lead to a lack of interest in financing the investment. Careful consideration should be given to the risks associated with projects and the overall package of legal, political, regulatory and commercial arrangements. In the case of Tideway, the design of the regulatory regime, contractual arrangements and the government support package provided a platform for the efficient pricing of finance.

Tideway's innovative delivery model was designed to mitigate some of the project's specific risks and make the project attractive to deep and liquid infrastructure investment. The design of the arrangements and the competitive procurement process led to a bid cost of capital of 2.497% for the period to 2030.

Various aspects of the Tideway delivery model have contributed to the efficient financing of the project including:

- regulatory framework that addresses some of the project's characteristics. Key elements of the framework include the provision of funding during the construction period and regulatory mechanics to address delay and/or overrun (as well as to incentivise delivery under budget); and
- government support package (GSP). The government will support Tideway in a limited number of carefully defined extreme circumstances that the market is not able to price efficiently.

The GSP improved the financeability of the project by mitigating the impact of low probability but high impact risks. Similar government interventions for infrastructure projects facing high impact-low probability risks might improve financing without distorting well-functioning markets, particularly where market testing indicates the market will not bear the risk efficiently. There may also be opportunities to introduce risk-sharing mechanisms with customers, where infrastructure is funded by users.

Government might also intervene by providing leadership during the development phase for the infrastructure, by ensuring arrangements to improve financing are developed. The appropriate scope and extent of government's role

In this process is likely to depend on the infrastructure in question and the policy and regulatory framework within which it is being built. Regardless of the exact form of government intervention, it is important for there to be collaboration between all parties involved, which may include government, one or more regulators, incumbent companies, investors and others.

10 **What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?**

Planning permission for the Thames Tideway Tunnel was granted under the Planning Act 2008 through the Development Consent Order (DCO) process. Tideway supports the aspirations of the Planning Act 2008 to optimise the planning process and reduce delays in planning, which proved beneficial for the project. For example, the naming of the Thames Tideway Tunnel as a Nationally Significant Infrastructure Project (NSIP) ensured the planning process could focus on how the project would be delivered rather than whether it should go ahead.

The Planning Act 2008 streamlines the process for getting planning permission, as although there are more steps before submission of the application, once the application has been submitted there is a fixed two year timetable. For Tideway, this created a helpful level of predictability which allowed for efficient planning and staffing of the organisation.

In order to ensure infrastructure is delivered as efficiently as possible, it is important for government to feed into the process at an appropriate time (e.g. with any required primary or secondary legislation, or other policy documents). Timely government involvement helps to minimise costs by avoiding delays to the development phase.

The Thames Tideway Tunnel project was developed in a governance framework involving government, Ofwat and Thames Water (among others). Close collaboration over a number of years allowed the delivery model for the project to be developed in line with the needs of a number of stakeholders, aided by the tension between the interests of the different parties. The discussions drew on evidence and experience, including previous regulatory arrangements, and included a process of market testing. Regulatory and political commitments also formed a key part of the process. These features ensured value for money for customers.

During the construction phase, the delivery of the project is subject to government oversight through a "Liaison Committee" comprising government, Tideway, Thames Water and the Environment Agency. The oversight stems from government's role in providing a support package (as described in our response to question eight), and is an efficient way of allowing government to monitor the project with pre-agreed reporting and governance arrangements. Agreeing reporting and governance arrangements up-front for projects where government has an interest could be replicated in similar projects.

Another element of planning and governance is the use of independent bodies, which promote credibility of the project and contribute to efficient delivery. For the Thames Tideway Tunnel, compensation under the project's non-statutory compensation policies are governed by an Independent Complaints Panel (ICP). The project also has an Independent Technical Assessor (ITA), which has a duty

to review, evaluate, comment, verify and advise on various issues including Tideway's reporting.

Transparency is important for infrastructure projects, particularly where the infrastructure is government-funded or the provider is not subject to competition. For example, transparent and appropriately assured annual reporting is important to Tideway, including transparent disclosure of governance arrangements in line with best practice.

11 How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The provision of additional infrastructure is one possible route to protecting and enhancing the natural environment. Different approaches may be most appropriate in different circumstances and may include large infrastructure projects, small infrastructure projects, or non-infrastructure solutions. It is important for decisions to be taken on a case-by-case basis with careful consideration of the options. In the case of the Thames Tideway Tunnel, the infrastructure solution provided best value for money to clean up the River Thames.

The Thames Tideway Tunnel is a major new sewer, urgently needed to protect the tidal River Thames from pollution. London's sewerage system is no longer fit for purpose and spills tens of millions of tonnes of sewage into the tidal section of the river every year. The sewers built by Sir Joseph Bazalgette in the 1860s form the backbone of London's sewerage system today. They are in excellent working condition, but have simply run out of capacity. Built when London's population was two million and designed for four million, they are now struggling to serve a capital city with more than eight million people; a figure that continues to rise. After years of study, the Government decided a new 25 kilometre interception, storage and transfer tunnel running up to 65 metres below the river was the best solution.

In addition to direct environmental benefits of the infrastructure itself, legacy commitments can usually be integrated into the planning and design of an infrastructure project in such a way as to include environmental protection or enhancement with those commitments.

In addition to the more obvious commitments or obligations (for example, for quality, integrated design of physical structures, or for environmental protection measures during construction) large infrastructure projects can best protect and enhance the natural environment by being encouraged to take a wide perspective from the outset, looking over and above their basic remit. Tideway has worked closely with a number of organisations, including London Boroughs, English Heritage, the Environment Agency and the Port of London Authority, to understand existing issues and how the project can contribute.

Our vision is to 'reconnect London with the River Thames'. This has informed how we are approaching the project, supporting activities and projects that encourage communities to engage with / use the river and which raise awareness about its health. One example is Thames River Watch, a 'citizen science' project run by environmental charity Thames21 and funded by Tideway. This project trains members of the public to collect water quality and litter surveys from the Thames and the data is used to raise awareness of issues around the health of the river.

To whom it may concern.

The Torbay Council welcomes the opportunity to respond to the National Infrastructure Commission (NIC) call for evidence for its national infrastructure assessment.

The TC adopted its Local Plan 2012 to 2030 in December 2015 which provides a policy framework for the proposed Torquay, Paignton and Brixham Peninsular Neighbourhood Plans currently being prepared. Local Masterplans that have been adopted for key growth areas will help deliver the policies of the Local Plan at a detailed level. The Council is working with partners to deliver sustainable infrastructure and develop resilience within its boundaries whilst creating a prosperous and healthy bay and a council fit to meet the challenges of the future. The Council has plans in place to create more and higher value employment in Torbay and will be looking to secure further investment in the right infrastructure, business support and skills for economic growth. Our response to this call for evidence is focused around transport requirements, energy efficiency and generation opportunities and flood resilience measures to achieve the benefits identified above.

Flooding and weather extremes

Torbay has suffered from severe weather incidents over the last few years which has highlighted the poor resilience of our local infrastructure, culminating in the events of flooding cliff collapse, seawall and harbour damage and rail network closure.

Torbay Council is the Lead Local Flood Authority (LLFA) for the Torbay as defined by the Flood and Water Management Act 2010. It has responsibility for managing local flood risk from [surface water](#), [ordinary watercourses](#) and [ground water](#) and is required to investigate all significant flood events (more than 5 properties internally flooded during a storm event). The responsibility for [consenting and enforcement on ordinary watercourses](#) within Torbay has also transferred from the Environment Agency to Torbay Council under this act. The council maintains, applies and monitors a Local Flood Risk Management Strategy (LFRMS) to address potential flood risk arising from local sources.

The occurrence and severity of flooding in Torbay has increased over recent years. Torbay is exposed to the combined potential flood risk from main river (formerly critical ordinary watercourses), tidal and coastal flooding. Both the urban drainage systems and surface water run-off also contribute significantly to the historical flooding within Torbay. In recent years flooding from surface water run-off, main rivers, ordinary watercourses, combined sewers and highway drainage has occurred in Torquay, Paignton & Brixham.

The majority of the flooding affected coastal areas of Torbay was due to overtopping of coastal defences. In many areas this flood water resulted in the closure of highways, many of which were closed during every storm event. In addition to the flooding across the whole storm period, a considerable number of fallen trees and branches on Torbay's roads, together with three embankment slips caused as a result of saturated ground and excessive rainfall

Transport infrastructure

Torbay Council will continue to enhance partnership working through the Peninsula Rail Task Force and Network Rail to further develop resilience and connectivity to ensure that the impact future extreme weather events are reduced

Transport spending in the South West peninsula is trailing behind other areas in investment, a situation that will only get worse as a result of current and planned UK rail infrastructure projects.

Torbay is served by the single mainline running west of Exeter and was severely economically impacted upon by the well reported impacts of flooding on the Somerset levels, the collapse of the seawall at Dawlish and the landslip between Dawlish and Teignmouth. Torbay as a key partners in the PRTF supports the view that the South West peninsula has suffered from under-investment in the railway network, with a resultant loss of quality, reliability and contribution to the peninsula economy. Our trains are some of the oldest in the UK, with an average age of 32 years old and currently unable to meet the regulatory requirements from 2020.

Rail growth over the last 21 years has reached 128%, and continues to grow. It is clear that both network and train capacity will not be sufficient in the future. Growth in rail travel within the region has outstripped industry forecasts, with average growth of 5.7% over the last 7 years, anomaly means that capacity will not be planned and delivered early enough to meet predicted demand. An example of this variation for 2014-15 saw passenger numbers rise by 8% within Devon and 13.1% to Torbay.

Torbay Council has recently invested £0.5M in developing plans for a new station located close to Torquay Gateway Future Growth area. Awaiting national funding to deliver the project the authority is linking new transport infrastructure with housing development. Rail and bus improvements have been delivered in recent years contributing to travel to work improvements.

Major road infrastructure projects in Torbay have recently included Western corridor and the £110M South Devon Highway which all contribute towards the long term economic development of Torbay by providing fast and reliable connectivity to national and international markets. Local travel to work studies have been based on 2001 census

data. The Council wishes to support other local authorities in the development of solutions to the A303.

Paignton railway and bus station redevelopment and town centre regeneration is being considered by the Council, NR and private developers.

Energy efficiency and generation

Torbay Council wants to accelerate the development, use and value of its energy resource, energy efficiency potential, and capitalise on its natural and physical assets by working with a partner/s to develop a way forward. The Council's new Efficiency Plan wishes to create an infrastructure investment portfolio that generates a return on investment. In the current market it is unlikely that energy projects would give a quick return on investment, but they may well be able to generate long term revenue of significant value to the Council. The viability and revenue generating capacity of projects will need to be confirmed by going out to the market and 'soft testing' any proposition.

Work on district heating networks in Torbay, as well as regional work on offshore wind, wave and tidal technologies show that there is currently limited scope for large scale deployment schemes. There is, however, some generation capacity, investment potential and market interest in solar PV in Torbay.

Solar PV projects could provide a modest income, support local supply chains and further enhance the security of Torbay's energy supply. Energy efficiency measures to reduce fuel poverty and improve wellbeing whilst stimulating demand from local installation businesses could be an area worth investing in. However, direct financial benefits are difficult to assess and the Council would not be able to generate cashable incomes. Renewable heat in the domestic and non-domestic sector supports both local supply chains and energy security with limited income potential.

Beyond renewables the decarbonisation of the UK's energy market will require the development of smart energy systems. Electricity storage could be used to reduce exported energy from distributed generation and reduce the load on the grid and entrepreneurs are already investigating the potential for 'energy barns' where rent is paid to landowners for hosting buildings with large banks of batteries. While it is possible that Torbay could host such facilities the lack of large scale renewable capacity means that there is no obvious reason why it would be a preferred location.

The highest value solution for decarbonising heat, for both commercial and domestic consumers is a mix of renewable technologies and investment in heat networks.

Torbay Councils Energy and Climate Change Strategy includes a short, medium and long term action plan considering a wide range of technologies that would contribute towards the aspiration of a zero carbon power sector.

Masterplan and Neighbourhood planning

These Council owned town centre sites are being promoted for private sector investment to deliver transformational regeneration schemes. A range of opportunity sites have been identified in Torbay including Brownfield sites, business parks, innovation centres, squares, plazas and harbours.

Delivery of improved digital infrastructure

Torbay DA is working to secure improved broadband speeds and capacity.

Waste disposal

The EFW plant in Plymouth is used for disposal of Torbay's residual waste and this method is secure for at least 30 years, but recycling position is less secure. The main problem with recycling is that central government pass the responsibility to the local authority to find the solutions and continually improve its performance. There is little effort to make the producers pay for the end of life items they make. For Instance Mattresses and Carpets are increasingly difficult to either find a market for, and often cost significantly more to dispose of than to recycle.

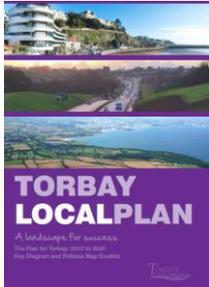
Basically if it is cheaper to dispose of than recycle why in such times of austerity would authorities make the more expensive choice.

The barriers to a circular economy are purely cost based and as said above if it is cheaper to dispose of goods than recycle then there is only likely to be one option. Unless central government put more pressure on producers (Producer pays principle) then it will be difficult realistically to improve recycling rate much beyond current rates. European countries like Germany support recycling in a more forceful way than our government and with legislative support to force people to recycle more progress will continue to be minimal.

[name redacted]

[contact details redacted]

Torbay Local Plan 2012 to 2030 Published



Torbay Council has published its new Local Plan which forms part of the development plan for Torbay and provides the basis for decisions on spatial planning within Torbay up to 2030.

*The **Torbay Local Plan 2012 to 2030 – A landscape for success** can be [viewed online](#) or purchased as a hard copy or USB memory card. Card payments will be accepted via 01803 207801 quoting the ‘new Local Plan’.*

To whom it may concern

I would be grateful if you could add the following to the response from Torbay Council.

Flooding and weather extremes

Torbay has suffered from severe weather incidents over the last few years which has highlighted the poor resilience of our local infrastructure, culminating in the events of flooding cliff collapse, seawall and harbour damage and rail network closure.

Torbay Council is the Lead Local Flood Authority (LLFA) for the Torbay area as defined by the Flood and Water Management Act 2010. It has responsibility for managing local flood risk from [surface water](#), [ordinary watercourses](#) and [ground water](#) and is required to investigate all significant flood events (more than 5 properties internally flooded during a storm event). The responsibility for [consenting and enforcement on ordinary watercourses](#) within Torbay has also transferred from the Environment Agency to Torbay Council under this act. The council maintains, applies and monitors a Local

Flood Risk Management Strategy (LFRMS) to address potential flood risk arising from local sources.

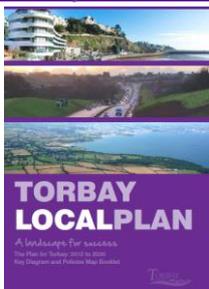
The occurrence and severity of flooding in Torbay has increased over recent years. Torbay is exposed to the combined potential flood risk from main river (formerly critical ordinary watercourses), tidal and coastal flooding. Both the urban drainage systems and surface water run-off also contribute significantly to the historical flooding within Torbay. In recent years flooding from surface water run-off, main rivers, ordinary watercourses, combined sewers and highway drainage has occurred in Torquay, Paignton & Brixham. In addition overtopping of coastal defences during Easterly storm events has resulted in significant flooding affecting coastal areas of Torbay.

In many areas flood water has resulted in the closure of highways, many of which have had to be closed during every significant storm event. In addition to the flooding, during storm events in recent years the highway network within Torbay has been affected by a considerable number of fallen trees and branches, together with three embankment slips caused as a result of saturated ground and excessive rainfall.

[name redacted]

[contact details redacted]

[Torbay Local Plan 2012 to 2030 Published](#)



Torbay Council has published its new Local Plan which forms part of the development plan for Torbay and provides the basis for decisions on spatial planning within Torbay up to 2030.

*The **Torbay Local Plan 2012 to 2030 – A landscape for success** can be [viewed online](#) or purchased as a hard copy or USB memory card. Card payments will be accepted via 01803 207801 quoting the 'new Local Plan'.*

Transport for the North's Submission to the National Infrastructure Assessment - Call for Evidence

Context of Transport for the North

Transport for the North (TfN) is empowered by a pan-Northern Partnership Board representing political and business leaders from all 11 Local Enterprise Partnerships (LEPs) across the North, working together with Highways England, Network Rail, High Speed Two (HS2) Ltd and the Department for Transport (DfT). Under the provisions of the Cities and Local Government Devolution Act, TfN has submitted a proposal to become the first Sub-national Transport Body in England, with the expectation to gain statutory status in 2017.

TfN allows the North to speak with a collective voice on its strategic transport priorities, providing a crucial role, adding substantial value through enhancing the existing relationships between local and central government, whilst filling an important gap to plan and deliver the connectivity across the North required to underpin transformational economic growth. The outcomes of this approach is a stronger performing, coordinated pan-Northern economy where people and business can fulfil their full potential.

Through collaborative working with government, business, industry, and academic partners, TfN is currently developing a Strategic Transport Plan for the North. This will include an accompanying long term, sequenced Investment Programme, in order to align transport investment across the North in pursuit of delivering the economic objectives of the Northern Powerhouse. As part of developing the first version of the Strategic Transport Plan, TfN is pleased to respond to the Commission's Call for Evidence. The responses are limited to those questions that directly relate to TfN's ongoing activities within its current role and remit.

We would also like to make the Commission aware that during 2017, we will be publishing a range of information and evidence supporting the Draft Strategic Transport Plan, as referenced in the responses to the questions that follow. Much of this evidence is not available at the time of this submission, but we will share this evidence with the NIC at the most appropriate time, as we feel that it will assist the Commission with its task of preparing the first National Infrastructure Assessment (NIA) over the coming months.

Response to Call for Evidence

Q1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

The success of the UK in the global marketplace, and the achievement of the Government's Industrial Strategy, will be dependent on the transformation of the Northern economy. The Northern Powerhouse Independent Economic Review, published in June 2016, provided the first ever pan-Northern economic analysis and demonstrates how investment in transport can stimulate and sustain economic prosperity.

The Review set out that by 2050, in a transformed North:

- **GVA would be 15% (£100 billion) higher than business as usual projections;**
- **Productivity would be 4% higher; and**
- **850,000 additional jobs would be created.**

The Review also identified the world class, international prime and enabling capabilities that contribute around 23% of the North's GVA, that if supported can grow, increase productivity and create more jobs. Achieving this would have substantial benefit to the UK economy.

Specifically, the Review identified that improving connectivity is key to seizing the economic prize, making the North a more attractive and buoyant marketplace, and hence investment in transport infrastructure is of particularly "high value" in supporting long term growth.

Improving pan-northern connectivity is the most critical issue facing the North's ability to transform its economy. TfN wants to deliver more efficient, reliable, resilient and faster strategic transport networks that are better integrated with spatial and economic policies. This is about delivering the enabling infrastructure that will stimulate and sustain economic growth and improve productivity.

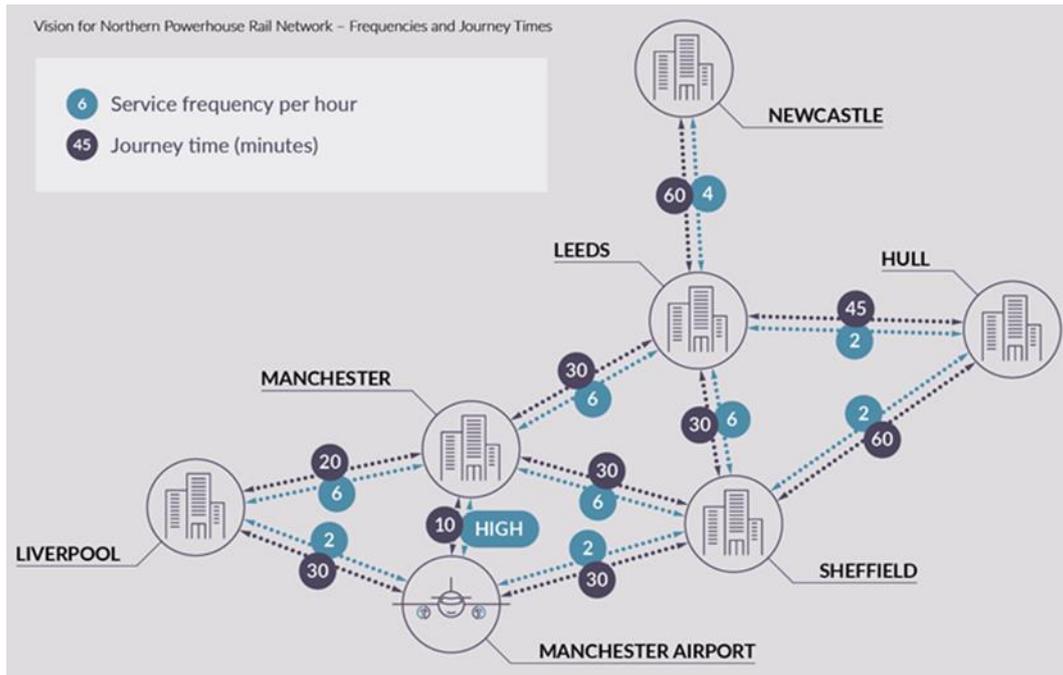
Strategic, pan-Northern transport investment to support the transformation growth scenario would also complement the Government's recently published Green Paper on its Industrial Strategy. This identified the importance of infrastructure, such as transport to drive growth and support businesses and trade, making the most of the North's world-leading sectors. Transforming the Northern economy will also require investment in a number of other critical areas, especially skills, innovation and inward investment, alongside transport infrastructure and services.

The North's businesses and local political leaders have set out the benefits of increased investment in connectivity across the North, starting with the **One North** prospectus in July 2014, through to the publication of the **Northern Transport Strategy** in March 2015, and subsequent **Spring 2016 Update**. All of these documents clearly set out how vital transport infrastructure is to drive the transformational economic growth to which the North aspires.

As highlighted in the Northern Transport Strategy in March 2015, we can see how an efficient and effective transport system in the Northern European urban areas of the Randstad and the Rhine-Ruhr unite smaller cities into one economic area and increase overall performance. Faster, more frequent and more comfortable trains will connect city centres to each other and to the rest of the country.

The need for faster and more frequent rail travel across the North was recognised by the Commission in Recommendation Two of the **High Speed North** Report in March 2016. TfN and its Partners welcomed this, with work now progressing to develop **Northern Powerhouse Rail (NPR)**. Northern Powerhouse Rail will provide the essential core for the North's rail network, potentially serving and connecting 15 economic centres, with faster, more frequent, resilient and reliable services. Northern Powerhouse Rail has the potential to:

- Change the way labour markets work, where people live and work and how businesses collaborate and will enable the North to attract and retain the people and skills it needs;
- Integrate with High Speed Two (HS2) to maximise connectivity and demand on the planned new fast north south connections. Northern Powerhouse Rail and HS2 will together deliver the North's vision of city to city links, both east-west and north-south;
- Improve access to Manchester International Airport from across the North to enable it to act as a global gateway for whole of the North of England; and
- Free up capacity for other rail services including local and commuter passenger trains and greater east west freight capacity supporting current and planned private sector investment in Northern ports.



A world-class rail network will make journeys more frequent, faster, more reliable and less-crowded, as well as ensuring it can accommodate and support growth in all sectors. It is essential for the North's economic growth ambitions to be realised.

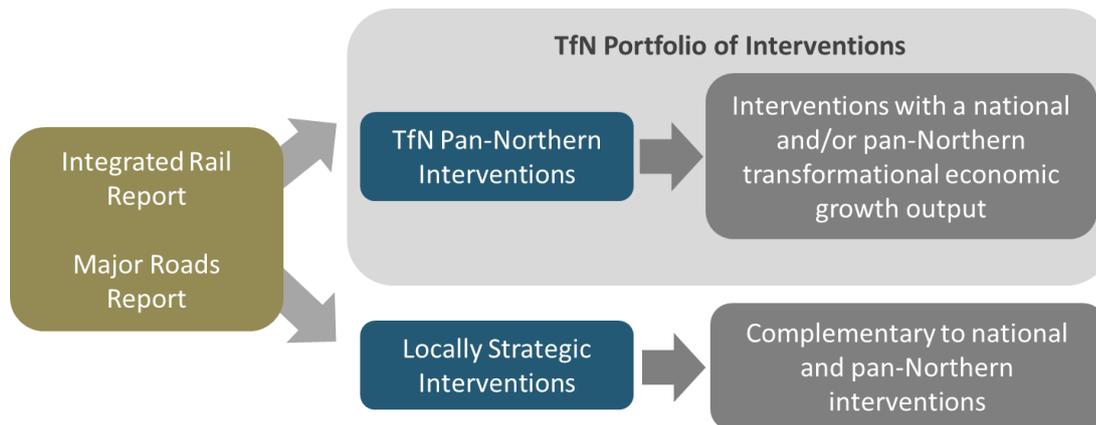
However, in addition to NPR, the need to improve the North's transport infrastructure is no longer being debated by our Partners. They understand why it needs to happen and, therefore, TfN is now focused on establishing the solutions needed and the most effective means for delivery.

TfN is aiming to publish the Draft Strategic Transport Plan and Investment Programme for public consultation in Autumn 2017, alongside the establishment of TfN as a Sub-National Transport Body. When adopted in 2018, the Strategic Transport Plan will become the statutory document for TfN, defining the priorities of TfN as a Sub-National Transport Body, and containing the most up-to-date version of the Investment Programme.

The Strategic Transport Plan and Investment Programme, and its supporting evidence, will be used to agree with Government, Network Rail, Highways England and HS2 Ltd the investment priorities that would transform the economy of the North. This Plan will be a multi-modal plan that sets out an evidence-led case for investment, focusing on smart ticketing and integrated travel, major highway improvements, pan-Northern rail enhancements, strategic access for freight and logistics, and interventions to support international connectivity. It will have a wide ranging and ambitious scope, setting out a portfolio of strategic transport investment interventions to transform economic performance up to 2050.

TfN's Investment Programme will represent the set of prioritised and sequenced transport interventions that are required to deliver transformational economic growth across the North. To that end, they should all be considered as "high value" and important.

In developing the Strategic Transport Plan, between now and Autumn 2017, TfN will also be working closely with its Partners to take forward the extensive and innovative evidence base that has been developed, and to confirm that this is sound and robust for developing the long term TfN Investment Programme, comprises a mix of pan-Northern and more local interventions, as shown below:



Q2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

The North is aiming to increase international business activities, including global trade, inward and outward investment, to deliver its transformational economic growth objectives. Improving international connectivity can make a substantial contribution to increasing productivity and supporting effective agglomeration through global proximity.

In 2016 TfN's Chair, John Cridland CBE, launched an Independent International Connectivity Commission of business experts to identify the international connectivity needs of the North, taking into account the needs of key capabilities and the opportunities arising in global markets.

The North's airports handle 15% of the UK's airport passengers (39.6 million air passengers per year up to October 2016). International passenger connectivity contributes £5.5 billion towards the North's GVA. This is 1.7% of the £317 billion GVA contributed by the North to the UK economy. Achieving the targeted NPIER transformational growth will require the economic contribution of international connectivity to grow and air connectivity to become more of a priority than it is today, reaching £13 billion, £2.1% of GVA. This would require passenger's in the North to reach 75 million per year by 2050, 90% of which would be via direct routes. An increase in direct routes would also see an increase in high value bellyhold freight from around the world. The Commission highlighted the need to harness a capacity, available now, of 60 million across Northern airports to support this growth.

Northern ports directly contributed (through both global and domestic freight) £1.5 billion, or 20% of all GVA generated by UK ports (£7.7 billion) in 2014. This represents a contribution of 0.5% to the North's GVA in 2016. TfN is currently undertaking further work on the opportunities of freight and logistics in the North. It is clear that Northern ports can play a key role in the transportation of goods across the North and the UK. Improving East-West connections would make the business of trade more cost effective and reduce congestion of North-South distribution routes. Both airport and port GVA contributions noted here do not account for the wider business and leisure supply chain impacts across the North.

The Independent Commission believe that transformation will not be achieved by simply continuing to trade with our traditional partners and markets. They noted a key issue for the North is how to secure innovation and open up new markets, as well as attracting new sources of foreign direct investment FDI. Particularly in the context of Brexit, achieving transformational growth will require businesses to maintain important links to traditional core partners in Europe and North America,

but also be able and willing to trade with more distant markets which are forecasted to see growth in trade, FDI and business travel.

The Independent Commission recently published its recommendations to improve the North's access to the global economy through its ports and airports, stating that, in order for the North to achieve transformational economic growth, there should be:

- More support of the North's highly productive, internationally regarded prime and enabling capabilities as set out in the Northern Powerhouse Independent Economic Review, many of the sectors that will drive growth have a higher dependency on international connectivity and travel than more traditional sectors;
- Beneficial consequential effects on the supply chain across the North;
- Agglomeration effects from faster more reliable connections between key areas of employment;
- Improvements in both productivity and a higher employment rate;
- Improvements to the North's position in the global market place through profile raising activity; and
- A leveraging of the benefits of a higher income population in to private and public services.

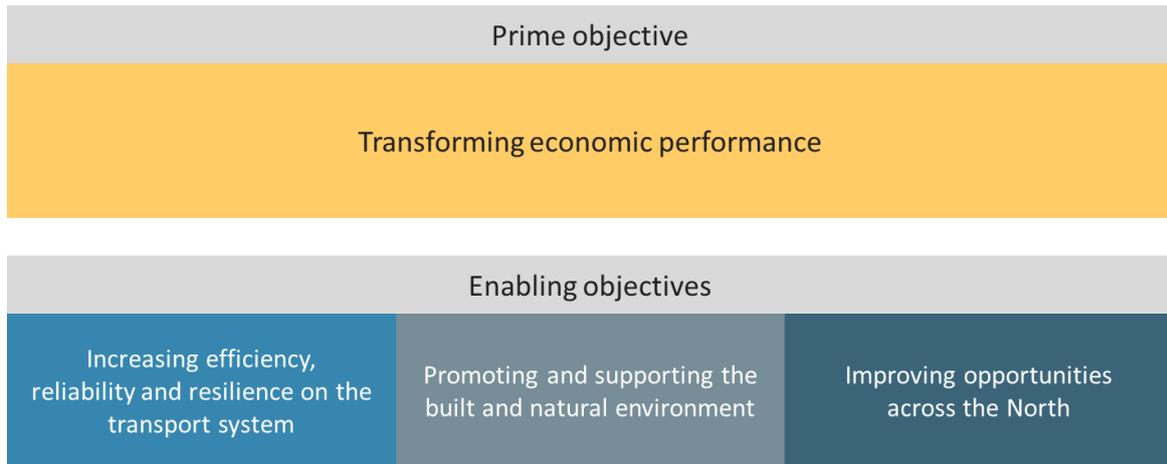
The Independent Commission's report makes it clear that enhancing global connectivity starts on the ground, and sets out the key landside enablers for ports and airports. The North's ambitions for improved global connections would increase the proportion of trips which have the choice of direct international connections from the region's airports and ports. Improving surface access to these key international gateways, will ensure that the potential of the North's airports is exploited for the benefit of the wider economy.

TfN will ensure that the Strategic Transport Plan and supporting Integrated Rail and Major Roads reports, along with the freight and logistics analysis incorporate the Independent Commission's recommendations for surface access improvements and interventions to airports and ports across the North.

Q3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Creating and sustaining transformational economic growth, that goes beyond business as usual, requires a high quality environment in which the businesses of the future will want to invest and where individuals have access to a wider range of opportunities including employment, skills, education, healthcare and other services. The long term sustainability impacts of transport infrastructure investment is therefore a key consideration for TfN.

The following objectives have been agreed for the Strategic Transport Plan:



These objectives will be used to understand and drive the development of what interventions are required within the long term Investment Programme, and demonstrate how TfN will try and address the issue about creating better places through its work.

TfN's remit is related to transport, but we recognise the inter-relation between housing, jobs and transport, since the latter is a derived demand. In our answer to Q13 below, we explain some of the innovative work that TfN has been doing to understand the travel demands between now and 2050 in a transformed Northern economy.

These travel demands will inevitably relate to housing and employment locations, determined by TfN's Partner authorities. This is why we will be working with Partners over the coming months to refine the forecasts based on the economic and spatial growth priorities of individual authorities.

Q4. What is maximum potential for demand management, recognising behavioural constraints and rebound effects?

No response.

Q5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

TfN's long term Investment Programme will contain a mix of upgraded and new transport infrastructure, and the approach taken in the initial Integrated Rail and Major Roads reports has been to identify where best use can be made of existing assets in the first instance.

At a strategic level across the North, the approach taken in the initial Major Roads Report has been to conceptualise the North's major road network as a ladder that will only support transformational growth by ensuring strong north-south routes alongside multiple "rungs" for east-west connectivity. At present, north-south connectivity in the North is generally seen as better than east-west connectivity, with one only one "rung" – the M62 providing a continuous east-west dual-carriageway road in an area stretching from the Midlands in the south (A50 corridor) to the Edinburgh/Glasgow (M8-A8 corridor). Prioritised interventions in the initial Major Roads Report seek to strengthen east-west links to reduce demands on the M62, while at the same time providing better access to a series of the North's economic assets.

However, under a transformational economic scenario, there will also be a need for new infrastructure, particularly to significantly improve inter-city region connections. For example, the rail network in the North is severely constrained by geographical challenges, urban history and track capacity. Rail travel has grown rapidly with a threefold increase in passenger journeys since the mid-1990s, and the existing largely 'two-track' network in the North is no longer able to cope reliably with existing demands, and has no practical capacity for significant growth in passenger and freight services.

Projects such as HS1 and Crossrail have shown the transformational impact of new infrastructure is supporting economic growth, and TfN's proposals for Northern Powerhouse Rail, along with the plan for HS2, aim to replicate this approach across the North, to improve commuting, business to business, and leisure travel across the North.

Q6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

TfN's view is that increasing collaboration will certainly help bring forward the necessary transport infrastructure investment in the North at the right time, aligning it with spatial and economic policies. TfN is all about working in partnership across the North, with 19 local authorities and 11 LEPS, plus DfT, highways England, Network Rail and HS2 Limited taking a collaborative approach to develop proposals for strategic transport intervention.

TfN's Smart North programme of work, which aims to transform improve the customer experience on public transport, is a good example of collaborative working across the public and private sectors. It has a vision for simplified fares, integrated ticketing and payments and improved passenger information. This will mean allowing someone to make a contactless payment for their train travel, arrive in a northern town or city, and make a further contactless payment to take a tram or bus journey to their final destination. All of this will be possible with the confidence of a 'fair price promise' and real-time journey planning information available for passengers.

Integrated and Smart Travel is TfN's first investment programme funded by government, and will start to deliver tangible benefits for passengers before the end of this Parliament. The programme is being delivered in four separate but related tranches as a means of managing the risk and complexity associated with the programme, meaning that customer products and benefits will be incrementally rolled out across the North.

In addition, Rail North has demonstrated the potential of strong partnership working between the North's local authorities and the DfT. Transformational investment is being made in the North's two new rail franchises, Northern and TransPennine, which will provide more frequent services to more places, with improved journey times.

Investment includes 500 brand new carriages for the North of England as well as removal of the unpopular, outdated Pacer trains. The economy will be boosted by the operation of an additional 2,000 services per week and space for an extra 40,000 passengers at peak times. The Northern franchise will provide nearly a 40 per cent increase in capacity and introduce a new, faster, higher quality Northern Connect service on 12 routes between major centres.

Over the next year, TfN will feed into Highways England's and Network Rail's industry processes, RIS2 and CP6, using the prioritised portfolio of interventions in the initial Integrated Rail and Major Roads reports, which incorporate investments that would be delivered by the national agencies in

the early years of the Strategic Transport Plan, and through agreeing a joint narrative with Highways England and Network Rail on the content of these two investment programmes across the North.

The Strategic Transport Plan will also contain proposals for a number of corridor studies to where investment is needed in future years. This will involve TfN and Partners working together to identify interventions and to develop business cases needed for funding them. TfN is also engaging with cross boundary organisations, including the Welsh Assembly Government, Transport Scotland, and Midlands Connect, to ensure that pan-Northern transport interventions in the North are aligned with those being undertaken in adjacent areas.

Q7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

TfN is exploring with Partners different possible funding and financing options. Much remains to be done in the area, particularly once TfN is established as a Sub-National Transport Body.

Unlike London, the North does not have as democratic or revenue raising entity. Once it is established as a statutory body, TfN will encompass the geography of the North but will have limited powers associated with its remit. There are currently no democratic, governance or administrative mechanisms that would allow material funds to be raised directly on a pan-Northern basis.

In addition, TfN will not have the ability to borrow. Therefore, its ability to raise revenue will be highly restricted (effectively voluntary from TfN Partners) and it is very difficult to envisage how this could be used to fund infrastructure investment.

Moreover, the economy of the North is significantly less productive and robust than that of London and whilst projects in the latter generally seek to tackle congestion or address pent up demand, TfN interventions are more likely to be about providing infrastructure that will allow the North's economy to be transformed.

In addition, the economic benefits arising from inter-urban interventions will be more diffuse and harder to localise, reflecting the larger and more diverse geography of the North, whilst land values and commercial and residential property prices are significantly lower across the North as a whole than in London. It is clear, therefore, that models which might be successful in London and the South East are not necessarily applicable in a Northern context. In particular, there is a strong possibility that imposing value capture mechanisms will undermine the economic transformation the North needs to achieve.

For these reasons, "the North's" ability to contribute to TfN programmes needs to reflect these differences and challenges, the scale, timing, and structure of any contributions would need to be aligned to the strategic policy objectives of the North and its ability (economically, politically or practically) to generate funding.

The current systems for raising revenue available to central and local government are not structured in such a way as to allow an organisation like TfN to raise or 'capture' revenue (particular in the absence of specific TfN revenue raising powers). As part of developing the Strategic Transport Plan, TfN intends to discuss with Government and the private sector ways of testing new and innovative approaches to the funding the infrastructure identified in the plan.

Q8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Much of TfN's current position with regard to funding principles are outlined above. Going forward, the North should also explore opportunities for systematically raising revenue that do currently exist, largely through the levers that already exist in relation to the two Northern rail franchises. Such an approach has the benefit that it incentivises the North to make decisions that optimise outcomes from the franchises. In addition, pan-Northern rail usage could be seen as an effective proxy for the health of the economy as a whole and therefore, in addition to straightforward pricing opportunities, growth that is facilitated by strategic interventions should impact on the volume and length of journeys being undertaken across the network.

Similarly, revenue raised on a national basis, such as Vehicle Excise Duty, could be allocated to support Northern programmes broadly in proportion to how it collected. This would allow future Highways England and Network Rail investment programmes to be managed more effectively on a programme basis across the North.

Q9. How can we most effectively ensure that our infrastructure system is resilient to the risk arising from increasing interdependence across sectors?

As noted in the answer to Q5 above, TfN's remit is related to transport at this time, and the Strategic Transport Plan and long term Investment Programme will focus on transport investments, although the former will consider the possible impacts of social, technological, economic, political and environmental change.

Two recent documents from the Institution of Civil Engineers (ICE) provide some potential answers for how the interdependence across sectors can be addressed. The National Needs Assessment provide a sector-based analysis of infrastructure needs up to 2050, whilst the State of the Nation 2016: Devolution report recommends the development of regional infrastructure strategies.

Taking a regional approach to infrastructure planning, as is being done with the Strategic Transport Plan, but then examining interdependencies at this level, is more likely to identify key risks and bring forward the necessary mitigation measures.

A key factor in the North of England is poor resilience in the strategic transport networks due an overall lack capacity and choice. Providing more capacity such as that proposed through NPR will deliver a wider range of benefits than just faster journey times and better connectivity.

Q10. What changes could be made to the planning system and infrastructure governance arrangements to ensure that infrastructure is delivered as efficiently as possible and on time?

In October 2016, TfN submitted its formal proposal to the Secretary of State for Transport to become the first Sub-National Transport Body in England. The proposal was endorsed by all of TfN's Partners and sets out the range of powers which TfN needs to ensure that the required connectivity improvements can be delivered. It is seen as a model for future governance arrangements relating to transport in other parts of England, and could well be applied to other infrastructure sectors over time.

The integrated longer term approach to economic, spatial and transport planning at a Northern level that TfN is adopting in the Strategic Transport Plan is unique for the UK, and enhances the ability of the North to capture additional investment and align funding streams. Having a long term programme will provide greater certainty, thus providing greater confidence to public and private investors and supporting the development of the wide range of skills needed to develop, deliver, operate and maintain the transport investments.

Multi-modal planning by bodies such as TfN, will also provide better value for the taxpayer by developing the right interventions, regardless of modal basis, through more efficient analysis, modelling, appraisal and commissioning.

TfN's Strategic Transport Plan is to be seen as adding value to Local Transport Plans, supporting business cases through pan-Northern economic growth and transport demand analysis, to ensure planning at a local level can support and complement pan-Northern transport infrastructure. In addition, strategic interventions delivered by TfN could free up or create capacity for local enhancements thereby supporting the local economic and spatial plans of local authorities and LEPs.

Q11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

As noted in the answer to Q3 above, TfN has agreed a set of objectives for the Strategic Transport Plan including a specific one relating to the environment. Our view is that establishing this as an objective at the outset should provide the means by which environmental considerations are at the forefront of the planning of all transport infrastructure.

In addition, TfN has commissioned an Integrated Sustainability Appraisal of the Strategic Transport Plan. At this point, an Integrated Sustainability Appraisal - Scoping Report has been prepared and used for consultation with the relevant statutory bodies. This process will ensure that TfN meets all legislative requirements in producing the Strategic Transport Plan, recognising that as the first Sub-National Transport Body, we are leading the way in establishing the boundaries between roles and responsibilities for setting transport policies at a national, sub-national and local level.

Reducing greenhouse gas emissions, improving air quality, protecting the landscape and heritage, enhancing transport choice, enabling access to opportunity and improving economic prosperity are some of the key considerations for the Integrated Sustainability Appraisal. However, TfN also recognises that meeting government targets such as carbon reductions by 2050, will involve many other organisations than just TfN and include issues that TfN has no direct control over, and so our approach will be one of understanding the impact of our work on the natural environment and ensuring mitigation where appropriate.

It should also be noted that a more detailed consideration of environmental issues is likely to be undertaken at a scheme-specific level by the delivery organisation(s) involved.

Q12. What improvements could be made to current cost-benefit techniques that are credible, tractable and transparent?

The current DfT consultation on the application of Wider Economic Impacts (WEIs) within the WebTAG suite of appraisal documents is a welcome addition to the debate on understanding the much wider benefits to the economy arising from transport investment. Also the approach taken to

appraise individual schemes often does not reflect the contribution of that scheme to a wider programme of measures.

TfN is developing its long term Investment Programme on a pan-Northern, multi-modal basis, with the aim of identifying interventions that will deliver the long term economic growth set out in the Northern Powerhouse Independent Economic Review. Given that this will be a 30 year programme, some of the interventions will be relatively well-defined, but others later in the programme, will be less specific. Yet all of the interventions will be needed to deliver and sustain the overall levels of growth required to transform the economy in the North.

The challenge for TfN and Government over the coming months will be to work together to develop a method that appraises the overall programme of interventions against the wider economic objectives, but that allows flexibility for individual schemes to come forward as and when necessary, with an appropriate value for money assessment.

Q13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

TfN has been undertaking some innovative work to investigate the likely range of future travel demand scenarios that a transformed Northern economy will place on the transport network across the North, as well as to and from other key regions. These scenarios reflect the economic growth potential envisaged in the Northern Powerhouse Independent Economic Review.

A Northern Transport Demand Model is being produced using a baseline of demand for road and rail based on current travel patterns. TfN is also creating dynamic simulation model of how activities at locations would generate demand for travel, including understanding better the relationship between jobs and labour markets.

The initial results from this model show a significant uplift in both population and employment across the North when compared with a “business as usual” scenario in the core DfT transport models, as shown in the table below.

	Business as Usual 2015	Business as Usual 2050	NTEM 2050	NPIER 2050
Population	15.6m	18.1m	17.8m	19.6m
Employment	7.6m	8.3m	8.8m	9.2m

The outputs of this work will inform the overall strategic case for the Strategic Transport Plan including future growth predictions, and also provide the supporting evidence base for developing interventions.

To reflect future uncertainty, and to add robustness to our forecasts, two future influencers of travel needs have also been modelled to understand future transport demand across the North in the transformational economic growth scenario:

- Technological and socio-cultural change: meaning the relative impact of technology and socio-cultural attitudes to travel demand.
- Enabling policy and plans: meaning the relative impact and focus of local transport and land-use policy and planning on the drivers of travel demand.

These factors were specifically chosen as having significant impacts on future travel demand that need to be understood and allowed for within any forecasting work, but which sit outside the current remit of TfN's work. Therefore, TfN is exploring what the impacts of Mobility as a Service (MaaS) solutions will have on future travel demand, and would be pleased to share the results of any research with NIC when it is available.

The forthcoming Economic Growth and Transport Demand Analysis report will set out the analysis that has been done to date, and how the work will be taken forward with Partners to refine the forecasts based on specific economic and spatial growth priorities.

Taking into account these factors, the Strategic Transport Plan is aiming to deliver a transport system that is user centric, smart, autonomous and connected, as well as resilient and sustainable. However, more importantly given the uncertainties that surround how and when things will change, the policy measures and interventions proposed must be flexible.

Q14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

As explained in the answer to Q15 below, TfN's remit is to concentrate on pan-Northern investments that help deliver transformation economic growth, with Partners bringing forward complementary local investments. We are fully aware, however, that such local investments will help build the business cases for the larger scale investment, and are fundamental to improve the door-to-door journeys of the workers, residents and visitors across the North. In addition, carefully planned strategic interventions can also help unlock local transport solutions.

Mindful of this, TfN commissioned a report on Strategic Local Connectivity as part of the early evidence base for the Strategic Transport Plan, which identified a series of over 120 transport interventions across the North. TfN's role will be one of supporting in Partners in making the case for such investments at the appropriate time.

Rail North has also developed its Long Term Rail Strategy, which contains a mix of national, Pan-Northern and local interventions across the North's rail network, all of which are considered necessary to support the economic growth set out in the Northern Powerhouse Independent Economic Review. Over the coming year, Rail North will develop proposals and a business case for the next phase of devolution, localised 10 year plans that will be owned by Partners, and an approach to possible re-openings of closed railway lines.

Q15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

TfN's long term Investment Programme will be a key part of the Strategic Transport Plan, and the outputs from two new and important pieces of evidence are providing a prioritised portfolio of interventions. Initial versions of an Integrated Rail Report and Major Roads Report have been produced to complement the previously published Freight and Logistics Report and the

International Connectivity Commission's independent report. These can all be made available to the NIC as and when they are made public.

The Integrated Rail Report has identified interventions for long term investment in the North's rail network, encompassing the latest proposals for Northern Powerhouse Rail, Rail North's aspirations and franchise specifications, and the new Network Rail Northern Area Programme, as part of a single plan for improving capacity, connectivity, coherence and cost effectiveness across the North of England.

The response to Q1 highlighted the importance of Northern Powerhouse Rail, and the recognition from the Commission of the importance of this package of transformational to the North's rail network.

Working with the DfT, Network Rail and HS2 Ltd, TfN has identified a number of feasible engineering options that will either deliver, or move substantially towards meeting the conditional outputs for the Northern Powerhouse Rail network. The next stage of development of the Northern Powerhouse Rail programme aims to identify preferred options for different components of the network, including:

- A decision on options for connections to important economic centres outside of the six major cities of the North and Manchester Airport;
- Interfaces with HS2 Phase Two to allow single options decisions and inclusion in the HS2 Phase 2B Hybrid Bill;
- Phasing of delivery for the preferred network options and developing a Strategic Outline Business Case; and
- Working with industry partners to present proposals for integration of Northern Powerhouse Rail into the redevelopment of Manchester Piccadilly station, as noted in the Commission's previous report.

The Major Roads Report has developed the concept of a Major Route Network for the North, which incorporates the Strategic Road Network, plus other major pan-Northern routes that connect the North's important economic centres to provide a logical, coherent and integrated network that needs to be resilient, reliable and efficient.

TfN has been working with the DfT and Highways England on three Strategic Road Studies that reported in Autumn 2016:

- **Trans Pennine Tunnel** – looking at options to improve road connections between Greater Manchester and Sheffield City Region by building a road tunnel under the Peak District National Park;
- **M60 North West Quadrant** – looking at options to relieve congestion on one of the busiest parts of the national motorway network, the north-west section of the M60 motorway around Manchester; and
- **Northern Trans Pennine Routes** – identifying options for a new east-west strategic road corridor in the Northern Pennines, linking Cumbria and the North East by upgrading the A66/A685 and/or the A69.

In the Autumn Statement 2016, the Government confirmed that the recommended A66 and M60 North West Quadrant schemes would be implemented during the RIS2 period, and TfN is now working with the DfT and Highways England to complete Strategic Outline Business Cases for the two schemes and begin to look at option identification.

TfN is also completing the Strategic Outline Business Case for the Trans Pennine Tunnel and the Wider Transport Connectivity Assessment of the benefits of a tunnel beyond the Sheffield City Region and Greater Manchester.

In each of the Integrated Rail and Major Road Reports, an evidence base has been developed to identify where improvements are needed to achieve a set of conditional outputs. Conditional outputs have been developed with a view to creating a transport system that can support the economic growth envisaged in the Northern Powerhouse Independent Economic Review.

More efficient movement of goods is also important to the growth of the North. Further freight and logistics analysis is being undertaken by TfN to understand why the sector adds such significant value to the Northern and UK economy. To ensure freight is considered as a fundamental part of the Strategic Transport Plan, TfN has integrated the freight analysis into both the Major Road and Integrated Rail reports to understand the key priorities in the North. Greater understanding of how the markets work, with more intelligence about road and rail freight choices and decisions, and this will inform the development of more sustainable freight movement options across the North in the future.

The initial reports set out those interventions that TfN has prioritised to meet the economic aspirations of the North, and also identify the business cases and strategic investment studies that will be developed by TfN to support future iterations of the long term Investment Programme. They will be used to inform the development of the upcoming Road Investment Strategy 2 (RIS2) programme with Highways England and the Control Period 6 (CP6) programme with Network Rail, along with providing inputs to the Initial Industry Advice.

Q16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Mobility as a Service (MaaS) solutions are increasingly based around individual preferences and specific daily travel needs – journey planning and management, optimised travel choices, lowest cost options, personalised service and flexible payment. As the use of mobile technologies and applications increases, MaaS will challenge conventional attitudes towards travel and create wider opportunities for the personalisation of services. This will present both challenges and opportunities for transport planning in relation to future service provision and capacity, and is one of the reasons why TfN is considering various future scenarios for transport demand to support its development of strategic investment programmes, as described in our answer to Q13 above.

Lord Andrew Adonis
Chairman
National Infrastructure Commission
1 Horse Guards Road
London
SW1A 2HQ

Our ref: RL/LS/OSH
Your ref:
Telephone: [phone number redacted]
Email: [email address redacted]
Date: 10 February 2017

BY EMAIL & POST

Dear Lord Adonis

Transport for West Midlands (TfWM) response to the NIC National Infrastructure Assessment Call for Evidence

On behalf of Transport for West Midlands, we would like to thank you for inviting us to respond to the National Infrastructure Assessment call for Evidence.

On the back of the NIC's January visit to the Midlands, we are working with you to further explore:

- Congestion, Air Quality and Network Resilience;
- New Technologies and their impact on Capacity and Utilisation; and
- Next Generation Operational Infrastructure, with a potential focus on freight.

Our response builds from those issues and raises a number of related points which are summarised below:

1. For the UK to prosper in the future global economy, the West Midlands, and the UK's other city regions must have high performing economies, which are underpinned by attractive, healthy, liveable urban environments with good air quality. Achieving this will require a per capita spend on urban transport solutions which is closer to that of London and European cities, recognising the historic long term underspend in the UK.
2. City region high performing economies and attractive, liveable urban environments need high performing city region transport systems and effective inter-urban links, especially when growth and increased population are factored in. These must be resilient networks, with effective use of adequate capacity.
3. Investment planning for these links needs to be less siloed with more scope for investment in strategic (heavy and light) rail capacity to directly accommodate demand for additional road capacity constraints that might otherwise occur.
4. City regions such as the West Midlands need effective, high capacity rail and rapid transit networks to get workers to work, and students to skills, across the city regions (integrated with effective local bus networks).



5. Smart mobility has a key role to play in assisting the development of effective city region and inter urban transport systems – strategic planning and investment needs to make better account of changes in models of car ownership and technology with a greater emphasis on enabling investment to support emergent technologies like Connected and Autonomous Vehicles.
6. The UK needs to significantly enhance the offering of existing inter-urban infrastructure, including rail rolling stock capacity and technology. There is a need to explore and implement new technology for capacity utilisation, network resilience, improving air quality and next generation infrastructure operation.
7. The West Midlands is keen to explore this aspect of future transport requirements with the Commission.

Please do not hesitate to contact Laura Shoaf, Managing Director, TfWM if there are any queries related to our response or in relation to how TfWM can collaborate further with you as work developments.

Yours sincerely
[Signature redacted]

**Signed on behalf of [Name redacted]
[Job title redacted]**

c.c. [Name redacted], [Job title redacted] – [job title redacted]
[Name redacted], [Job title redacted]
[Name redacted] – [Job title redacted] – by email

Transport for West Midlands (TfWM) Response

NIC - Infrastructure Assessment Call for Evidence

Key Points from TfWM

1. For the UK to prosper in the future global economy, the West Midlands, and the UK's other city regions must have high performing economies, which are underpinned by attractive, healthy, liveable urban environments with good air quality. Achieving this will require a per capita spend on urban transport solutions which is closer to that of London and European cities, recognising the historic long term underspend in the UK.
2. City region high performing economies and attractive, liveable urban environments need high performing city region transport systems and effective inter-urban links, especially when growth and increased population are factored in. These must be resilient networks, with effective use of adequate capacity.
3. Investment planning for these links needs to be less siloed with more scope for investment in strategic (heavy and light) rail capacity to directly accommodate demand for additional road capacity constraints that might otherwise occur.
4. City regions such as the West Midlands need effective, high capacity rail and rapid transit networks to get workers to work, and students to skills, across the city regions (integrated with effective local bus networks).
5. Smart mobility has a key role to play in assisting the development of effective city region and inter urban transport systems - strategic planning and investment needs to make better account of changes in models of car ownership and technology with a greater emphasis on enabling investment to support emergent technologies like Connected and Autonomous Vehicles.
6. The UK needs to significantly enhance the offering of existing inter-urban infrastructure, including rail rolling stock capacity and technology. There is a need to explore and implement new technology for capacity utilisation, network resilience, improving air quality and next generation infrastructure operation.
7. The West Midlands is keen to explore this aspect of future transport requirements with the Commission.

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

Connectivity across the Midlands is essential for supporting people and businesses, as well as highly skilled workers. To fully deliver on their potential - areas such as the West Midlands need efficient and effective local transport networks as well as good connectivity with each other and wider. Connectivity with other cities, and with the wider world, attracts investment and skills and enables access to domestic and international markets.

Cities need to be smart, and embrace and facilitate transformative social and technological change, such as the electrification of transport, growth in cycling and the way in which open data, smart devices and Connected/Autonomous Vehicles can revolutionise transport information, access and planning. This in turn will draw in investment and skills whilst also, improving air quality and making cities more attractive and dynamic places to be.

The West Midlands Combined Authority (WMCA) is playing a major role in strategic and devolved approaches to pan regional infrastructure like better east-west transport connections – through Midlands Connect, as well as on planning and development of regional rail services through West Midlands Rail.

The WMCA area has a clearly defined strategy for growth, aligned to a robust and deliverable transport strategy. This is summarised in 'Movement for Growth' and is articulated in the ambition and subsequent delivery plans of stakeholders across the region.

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

It is crucial that Government continues to back the Midlands in promoting jobs and growth, boosting productivity and attracting inward investment whilst recognising the importance of improving infrastructure to increase connectivity. The Midlands Engine region has an economy of £222 billion each year and is home to over 11.5 million people.

The West Midlands population is forecast to grow by 444,000 people by 2035 (Office of National Statistics). The number of new homes which will need to be built to help accommodate this growth over 20 years is in the order of 165,000.

The West Midlands lies at the heart of the UK's road and rail networks, the mix of long-distance, regional and local travel needs is placing heavy demands upon them. There are connectivity challenges that will constrain the ability of the West Midlands to realise its ambitions for growth.

Road

The West Midlands motorway network is subject to heavy congestion, with traffic delays and poor journey reliability, meaning that businesses, commuters and leisure travellers have to schedule additional time into the journey to give confidence that they can arrive at destinations on time.

The analysis completed to date as part of Midlands Connect highlights that we will need to tackle congestion and resilience and quality of journeys provided by the Strategic Road Network. Particular pressures include the South East of the West Midlands, the M6 between M54, usage of the M6 Toll and Birmingham Central (A38M). There needs to be targeted strategic highway capacity to support connectivity to modal interchanges and network resilience to the A5 to rail-freight, A46 to support Birmingham Motorway Box, wider HS2 access, long term M5 Capacity and Strategic Park and Ride.

Rail

There are fast, frequent rail links connecting large parts of the Midlands to the north and south, via the West Coast, Midland and East Coast Main Lines. However, there are major challenges travelling by rail between the Midlands cities and there is an increasing problem of capacity and crowding on services entering and crossing Birmingham. This will cause problems both in accommodating growth in Birmingham and in improving rail connections across the whole Midlands.

To ensure that our transport network provides the future capacity it needs, Government needs to work more collaboratively with TfWM, West Midlands Rail and Midlands Connect. Future service

improvements and infrastructure enhancements such as the Midlands Rail Hub need to be delivered faster to cope with the existing increase in rail patronage, unlock early benefits of HS2 and to offer credible alternatives to the private car.

HS2

The importance of integrating growth plans and transport plans should also be recognised. Improving sustainable connectivity across the West Midlands will create investment opportunities but will also tackle development viability and issues such as poor air quality.

HS2 will transform north-south travel and will also significantly improve connections between East and West Midlands. However, it is critical that the Commission fully support the WMCA in delivering HS2 Local Connectivity Package to fully capitalise on the opportunities provided by new stations serving the West Midlands.

Aviation

Enhanced global aviation connectivity will help grow our export led economy further, securing extra benefits and opportunities for the region. HS2 will see Birmingham Interchange station built in close proximity to Birmingham Airport.

Birmingham Airport is a local, regional and national economic asset, a gateway for our businesses to export their services around the world. In the long term Birmingham Airport has the ability to provide a wider national and global function. Birmingham Airport is well placed to support the UK aviation capacity needs up to 2043.

HS2 brings Birmingham Airport closer to the rest of the country and can provide immediate capacity up to 27 million passengers.

CAV and Technology

The UK and Midlands based automotive industry is a significant part of our overall economy, but is intrinsically global in nature. CAV initiatives can offer opportunities for the Midlands transport system and economy as well as continuing to raise the already established West Midlands profile and UK leadership in the field.

CAV technology will and is entering the system irrespective of any action by Government or a local authority. Failure to support and nurture emerging automotive technology as part of the Midlands and UK transport system will lead to inevitable global investment migration.

The UK and Midlands would specifically benefit from putting in place a coordinated programme of support working closely with those Authorities and companies which have already established activity in order. The Commission may be required to investigate the upgrading of intelligent infrastructure and energy supply capacity to support CAVs and wider advanced manufacturing development.

Freight

Freight and logistics are vital to our economic activity and development. They support people and businesses in their daily activities, ranging from deliveries to homes and shops through transferring goods to and from factories or getting supplies to offices.

WMCA would like to work with the Commission to explore planning for major strategic rail freight capacity enhancement to central Birmingham rail capacity above and beyond the Midlands Rail Hub. As well as providing extra strategic freight capacity including autonomous platooning freight which are being explored in main land Europe.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Infrastructure should be delivered at the outset for new developments, with sustainable transport capacity completed and public transport operational when new housing becomes occupied. Best practice from the Netherlands should be considered for sustainable urban extensions in relation to this.

Consideration should also be given to innovative financial vehicles where key infrastructure and services are delivered to unlock development and costs are then paid back once occupied. There are examples where this has been successful, such as the Birmingham City Centre Enterprise Zone and Bond financing in the US.

The design of infrastructure and opportunity for physical activity has a major impact on health. Obesity is predicted to be an increasingly major public health issue by 2050. Based on current trends, the Foresight report on obesity (Tackling Obesities: FutureChoice) predicted that by 2050, 60% of the male population and 50% of the female population (aged 21-50) are predicted to be obese with an additional 35% of the adult population in both groups predicted to be overweight.

This will increase the amount of people who develop serious medical complications and impact on economic growth. Designing and delivering the right physical environment plays a role in preventing that scenario. The Foresight report specifically highlights the walkability of living environments, reducing the dominance of motorised transport, and providing opportunities for the promotion and safety of unmotorised transport as part of the system that causes obesity.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

There needs to be extensive market research exploring views of different demographic groups of the extent of their "love of the car" and the potential role of demand management of some private car and road freight demand for urban and inter urban journeys, allied to improvements to different models of car use and ownership and to public transport, cycling and walking.

Consideration of what demand management has achieved in other comparable industrial countries would also be of value. The role of technology and information on travel choices available has much potential in relation to deploying demand management measures.

Thought also needs to be given to planning for demographic changes which is seeing significant changes in travel behaviours. For example, fewer younger people are driving but the level of over 65s driving has increased significantly.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

A useful overarching principle is to make best use of existing capacity and create new sustainable transport capacity. Making best use of existing capacity includes effective planned asset management of highways, footways, cycle paths and street lighting.

The condition of the road network for example can have an impact on congestion in terms of traffic speeds, the impacts of remedial or emergency maintenance work and the knock on effects for congestion or damage to vehicles as well as road accidents. Research in the West Midlands suggests that an accelerated maintenance programme would generate economic returns of £6.50 for every £1 of public funding invested¹.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

The WMCA, the design consortium of Egis, Tony Gee and Pell Frischmann and contractor Colas Rail have come together as the Midland Metro Alliance. The Alliance will implement a 10 year programme of tram system enhancement works to deliver a lasting legacy for the West Midlands that will enable social & economic regeneration, and deliver local jobs and training. This longer term partnership will help to address skills shortages – enabling consultants and contractors to plan and grow more strategically rather than to cycle through shorter term contracts.

Alliancing is a form of relationship contracting often used for complex projects or programmes which require speed of delivery and cost certainty. Pure Alliances include the owner, designer and contractor as alliance members who collectively seek outstanding outcomes through an integrated team, characterised by aligned goals, innovative thinking and collaborative behaviours.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The greater certainty that has been brought to national rail and road spending through five year funding periods and investment programmes as well as Devolution Deals is welcome, as is the creation of the National Infrastructure Commission.

The availability of capital funding for Combined Authorities to tackle transport problems fluctuates and there is a strong case for capital spending to be agreed over a long term (10-20 year) period. We would like to see the widening of the devolved Single Pot funding approach to the WMCA.

In addition, the proliferation of competition funding creates additional pressures on declining resource funding in terms of uncertainty around when such funding competitions will emerge. Bidding for grant funding have non-negligible cost (Urban Transport Group estimates the amount of up to 1.8% of total costs for a £5 million scheme), and creates unpredictable peaks and troughs in workloads which are difficult to plan for efficiently.

To help improve the efficiency of planning, financing, developing and delivering infrastructure, Government and the Commission must commit to fiscal devolution and avoid competitive bidding processes.

¹ CH2m Hill, (2015), Highways Maintenance Challenge Fund - West Midlands Road Condition Maintenance Improvements

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

An area to consider with this issue is how an active state can quickly increase diesel rolling stock capacity much more effectively than that provided by existing mechanisms in the rail industry.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

There is a growing awareness of the scale and timing of a series of major infrastructure works which particularly impact the Strategic Road Network and West Midlands Key Route Network (WM-KRN) across the West Midlands. This includes:

- HS2 Phase 1: with significant rail, local road and motorway interfaces and diversion works;
- Network Rail and Highways England investment programmes;
- WMCA investment as well investment in major maintenance and utilities works; and
- Major development in Birmingham city centre and other locations such as Cannock.

This infrastructure investment will bring many significant direct benefits and unlock further regeneration and growth opportunities. However, during the delivery period there is a risk that un-coordinated delivery undertaken by different agencies working in siloes could generate significant short-term adverse construction disruption impacts, as well as negatively impacting upon air quality.

TfWM and the HS2 Growth Strategy Board commissioned a study and the headline preliminary findings identify the probable loss of 1 or 2 lanes (approximately 12.5 to 25%) capacity from the SRN at multiple locations during the same period, with potential for 20 mins plus delays for each vehicle for extended periods across significant elements of the network.

Based on the consultants findings and the most impactful mitigation options focus on:

- **Making use of empty seat capacity in cars:** There is a high proportion of single occupancy car trip making over the local and strategic highway network, with significant level of short distance motorway travel (often referred to as junction hopping);
- **Shifting the time of travel and mode choice:** Through a mixture of technology enabled incentives (easy payment systems and public transport pricing; traveller information; and Mobility as a Service solutions) and intelligent management of parking supply and pricing. These would be most effectively implemented through targeted engagement with main traffic generating areas and organisations, and at pinch point hot spots;
- **Traffic management** - Physical and enforcement measures: Introduction of temporary measures such as High Occupancy Vehicle Lanes; Clearways (or Red Routes) and making best use of underutilised highway capacity such as the M6 Toll; and rigorous traffic enforcement (including moving traffic offences); and
- **Communications, data, technology and intelligence:** The use of optimised Urban Traffic Control systems and systems performance monitoring within an environment of open data shared between agencies and published openly. This would be used to optimise construction planning and scheduling; as well as to drive joined up public information through multiple communications channels.

The issue has been raised as part of the Devolution Deal 2 discussions. This has been with a view to securing Central Government support for the strategic response, recognising that the scale and importance of the issue has impacts which are beyond the West Midlands.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The role of elected Mayors for city regions is critical to any changes to the planning system and infrastructure governance arrangements to improve the delivery of infrastructure. Please see points raised in question 3.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

Creating city region transport systems with much lower private car modal share and much greater use of low emission or emission free power sources will be a great contributor to protecting and enhancing the natural environment.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

The ability to capture more effectively the wider economic benefits of transport schemes and the economic public health benefits of transport schemes would be very positive improvements.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? Note: "travel patterns" include both the frequency and distance of trips taken, as well as the mode of transport

Within the urban environment, travel will have to cope with increased density as the population increases both from growth and agglomeration. The key aim will be to maximise asset efficiency to best utilise road, cycle, rail, tram, air, etc. in terms of the number of passengers, the frequency of services, the delivery of goods and the "always on" transport system. Tailored personal services for transport are seen to be the ultimate approach to mobility, this will have to be balanced with mass-transit although mode choice may affect this. The use of information, location, incentivisation and machines understanding our daily life patterns will be the enablers that will encourage uptake of new technology and increasing mode choice, all combining to make movement easier as a result of convenient transport based on personal preference.

The opportunities that platooning of autonomous vehicles bring to rapidly enabling transport systems to develop will lead to changes in inequalities within the urban environment. There will be opportunities to enable people with mobility problems to move around more freely with mobility on demand. Potentially tackling isolation for the elderly or access to jobs for deprived areas. The important aspect of this will be to manage private sector business models with public policy to develop solutions that work for the city-region.

The impact of a more digitally aware citizen, as the millennials grow older, combined with improved communication technologies via the internet will be a major factor in altering travel behaviours – the impact however is difficult to predict. The current unreliability of

communications, the desire for face to face interactions and the ability to keep in touch with people more often over wider distances has in fact led to greater travel demand and movement.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Significantly enhancing the offering of existing inter-urban infrastructure through exploring and implementing new technology for capacity utilisation, network resilience, improving air quality and next generation infrastructure operation is one aspect. The second is to invest in city region rail and rapid transit networks, integrated with local bus networks, alongside high quality cycling infrastructure and decent conditions for walking.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Initiatives to improve the West Midlands economy, air quality and quality of life all need to be supported by transport improvements. This is in the context of the - still valid - strategic economic priorities for transport policy identified in the Eddington Review:

- Supporting the UKs successful agglomerated urban areas and their catchments;
- Maintaining or improving the performance of the UKs key international gateways; and
- The key inter-urban corridors between these places.

In line with the above, there is a need for a successful integrated transport network supporting the growth and development of the West Midlands. Support to deliver the HS2 Local Connectivity Package will maximise the benefits for the West Midlands.

As previously mentioned, a key infrastructure challenge we face is ensuring the effective and reliable operation of the Strategic Road Network in the West Midlands. This is to serve the West Midlands regional and national needs whilst simultaneously serving movement of people and goods traversing the West Midlands. Wider use of the M6Toll is required as part of the solution to this challenge. This also improves our issues around Network Resilience, as highlighted in Question 9.

Better utilisation of the M6Toll is of importance to the WMCA area and the Commission should acknowledge that the M6Toll has a critical role to play nationally.

As part of overall corridor approaches, the role of national and regional rail, including HS2 and rail freight, also need to be considered as priorities, including the Midlands Rail Hub improvement which is the main rail passenger and freight bottleneck of the Midlands and national network. Midlands Connect, TfWM and Network Rail has strengthened the proposal to undertake a joint business case for central Birmingham capturing the wider economic benefits underpinning the case for investment.

The Midlands Rail Hub will bring national, regional and local benefits to the rail network and help support the economy and reduce air quality.

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

MaaS removes the consumer traveller from directly paying the transport operator or infrastructure provider (i.e. car parking charges or indeed tolls). It is a single payment for the end to end activity

with the incentive to minimise the costs against the experience received with the MaaS service provider.

Once a MaaS platform is established and the MaaS service provider can call on transport services as the consumer needs, to get them from where they are to where they really want to go. This has the potential over time to remove some inefficiencies in the transport network.

The other dimension for MaaS is disruptive providers such as Uber, who enter the market and provide a customised service that can be priced on demand. When the network is very busy Uber prices are higher. This could allow for demand pricing on road charging. We will also see more disruptive services like Uber and Slide in Bristol starting up across our urban networks that could take advantage of road user charging by providing a tailored ride sharing service.

Digital communications:

17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

Digital infrastructure is the poor relation in terms of profile compared to traditional infrastructure, however it is vital to support more effective existing infrastructure. The growth in use of digital communications related specifically to the digital railway and connected vehicles allied with the potential impact of cyber security breaches are being researched through projects such as the UK Connected Intelligent Transport Environment (UK CITE).

The key infrastructure investment to prioritise is through fibre backhaul to offload data as quickly as possible to a rapid, resilient network. This supports 4G/5G, small cell, mesh networks and even new approaches such as Mobile Edge Connectivity, where the processing is localised but ultimately the information has to feed back to elsewhere in the ecosystem. It is only through a more rigorous understanding of the traditional infrastructure, allied to real time decision making using data, that an effective, resilient and maximum use of the existing assets can be achieved.

18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?"

The difficulties related to the deployment of digital infrastructure are well documented. The urban environment is known to have "not-spots" especially where it has been deemed commercially unviable, often this is in the location of agglomerated businesses where there is need and gain to the economy, but perhaps not directly to the digital provider.

To facilitate this it requires the opportunity for the public sector to help manage the gaps where the commercial sector is not working, without implications to state-aid rules. A body similar to that of Network Rail is required to manage the infrastructure network, divorced from the content / digital providers. This would aid the deployment in commercially unviable areas and create a competitive market for the digital services provision.

The resulting uplift in economic activity, allied with the benefits of a wider use of digital infrastructure in traditional infrastructure would be directly reflected in the national economy.

Energy:

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

WMCA asks the Commission and Government to accelerate and relax the rules around the adoption and roll out of alternative fuels such as Hydrogen.



UK HFCA Response to 'National Infrastructure Assessment Call for Evidence'

The National Infrastructure Commission is seeking views on the development of a National Infrastructure Assessment of the UK's long-term needs over a 30-year time horizon.

Introduction

This response to the 'National Infrastructure Assessment Call for Evidence' is submitted by the UK Hydrogen and Fuel Cell Association (UK HFCA). The UK HFCA works to ensure that fuel cell and hydrogen energy can realise the many benefits offered across economic growth, energy security, carbon reduction and beyond. Through the breadth, expertise and diversity of our membership, we work to trigger the policy changes required for the UK to fully deliver the opportunities offered by these clean energy solutions and associated elements of the supply chain.

A future national infrastructure must include a cost effective, low carbon, resilient energy system which builds on synergies across and convergence between heat, transport, industrial processes and power sectors. Hydrogen and fuel cells are innovative solutions which can deliver all the above, and are thus crucial components of the future infrastructure.

As per our earlier submission to 'National Infrastructure Commission National Infrastructure Assessment plan' in August 2016, we urge the Commission to provide specific recommendations for the development of nation-wide hydrogen infrastructure.

Please see our detailed answers to questions 9, 19, and 21.

Questions

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

To achieve a resilient infrastructure system, the Government needs to adopt a holistic approach to energy which takes into account the interconnection between heat, power and transport. There are synergistic opportunities to use hydrogen to contribute to the decarbonisation of these three sectors without requiring major changes to the existing gas or electricity infrastructures.

Game changing solutions such as hydrogen and fuel cells offer a range of benefits for the flexibility of the system - please see Figure 1 below. Clear understanding, and their interconnections, of these will help to optimise outcomes. For example, hydrogen is an excellent energy storage medium - avoiding the cost of renewables curtailment and simultaneously decarbonising heat, power and transport. Similarly, fuel cells as stationary power or CHP sites are delivering substantial benefits to the energy system - better grid resilience, increased use of renewables, localised carbon reduction, air quality benefits etc. as highlighted by a recent European study¹.

¹ http://www.fch.europa.eu/sites/default/files/FCHJU_FuelCellDistributedGenerationCommercialization_0.pdf

Alongside the recently published UK Hydrogen and Fuel Cell Roadmap², three evidence based White Papers will be published in March 2017 by Hydrogen and Fuel Cell Research Hub (H2FC Supergen)³; these will cover:

- i) The role of hydrogen and fuel cells in the future energy system;
- ii) The economic impact of hydrogen and fuel cells in the UK; and
- iii) The role of hydrogen and fuel cells in delivering energy security for the UK.

We encourage careful consideration of these as evidence.

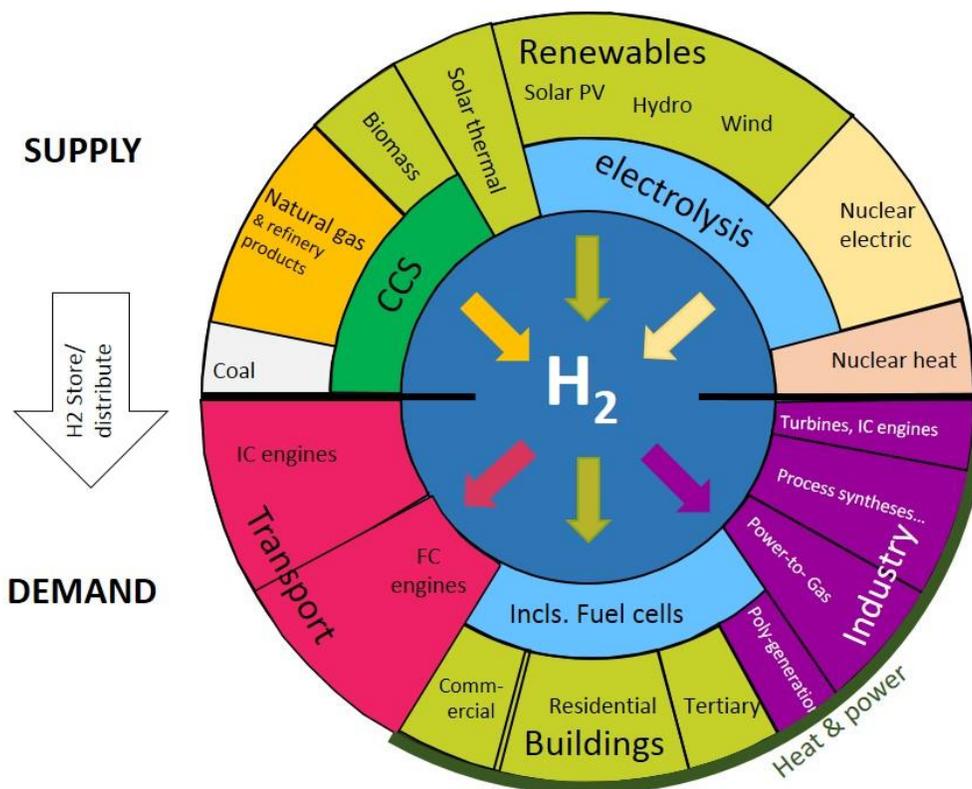


Figure 1: Hydrogen and Fuel Cells into as Innovative Solutions for a Resilient System⁴

The rollout of hydrogen as an alternative energy vector would maximize use of existing infrastructure, decarbonise at lowest social cost, increase innovation options, and maximize consumer value with the lowest regulated system bills. The role of hydrogen as an energy vector is summarized in Figure 2 below. This allows the UK to exploit existing assets and known skills to deliver low carbon, non-polluting energy for heating homes and businesses, transport, and energy security across the UK. It should be noted that an initial tranche of hydrogen refueling stations is now being rolled out in the UK, based on either the

² <http://www.e4tech.com/wp-content/uploads/2016/11/UKHFC-Roadmap-Final-Main-Report-171116.pdf>

³ <http://www.h2fcsupergen.com/our-work/whitepapers/>

⁴ Adapted from: <http://hho-hydrogen-energy.com/html/abouthydrogen.html>

delivery of hydrogen to the station or the production of it on site by electrolysis, and that the UK H2Mobility project⁵ called for 1150 HRS to be implemented by 2030.

In addition, storage is critical to guaranteeing the resilience of the energy system, particularly given that the main indigenous energy sources left to England, Wales and Northern Ireland are renewable sources such as wind, solar and waves. Thus, a key factor in system resilience is the development of these sources and the means of integrating them into the energy system. Hydrogen can play a key role in maximising the benefits for the national economy of indigenous energy sources.

Hydrogen represents an excellent storage option and, therefore, route to delivering resilience, as it can act as both a short and as a long-term energy store to balance supply and demand at different scales, geographies and weather conditions. As the UK moves to a low carbon economy, hydrogen is a cost-effective and technically proven solution to distributing energy between sectors, addressing the intermittency of renewables and managing variation in demand.

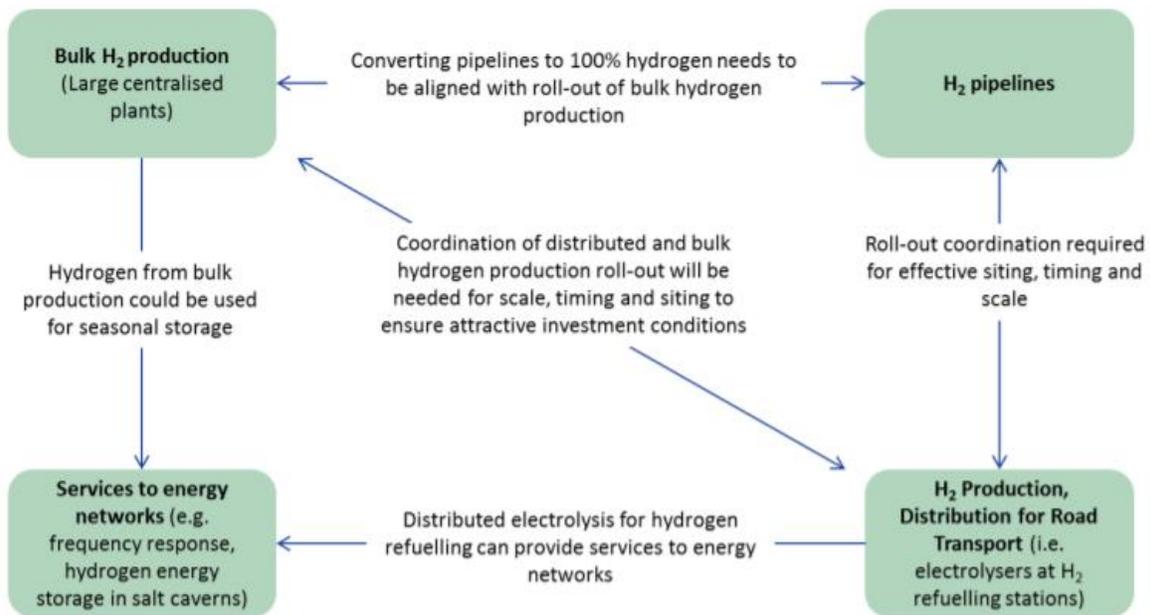


Figure 2: Role of hydrogen in the future energy system, UK HFC Roadmap

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

As per the recent H21 Leeds City Gate project, hydrogen represents an optimum solution for low carbon heat. The evidence based report showed that a UK-wide conversion to hydrogen gas will reduce carbon

⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/192440/13-799-uk-h2-mobility-phase-1-results.pdf

emissions associated with heat by a minimum of 73%.⁶ This conversion of the natural gas distribution network in a city the size of Leeds to hydrogen would reduce by over 0.9million tCO₂/year the emissions from present consumers, as well as facilitating hydrogen supply for transport – delivering further CO₂ reduction and ultra-low air quality emissions. Scenarios produced for the Committee on Climate Change show that by 2050 around 60% of heat demand in domestic, commercial and industrial applications could come from hydrogen, reducing GHG emissions from the residential sector from 29 MtCO₂/yr in CCC's central scenario to 3 MtCO₂/yr.⁷

The report also highlighted the necessary steps that the Government would need to take and a timeframe for their completion. As explained, it is imperative that the decisions are taken now (before 2020) for a UK wide transition to a hydrogen based system by 2050.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

While we believe that different types of low carbon vehicles will be part of the future mix, we would like to emphasize that different options have significantly different implications for the future energy system. By way of example, a Battery Electric Vehicle (BEV) constitutes a very large electrical load in comparison to the entire electrical load of a typical domestic dwelling. Additionally, the timing of each recharge event is under the control of consumers. Thus, if a significant amount of BEV users choose to recharge their vehicles on the basis of lifestyle schedules or range anxiety concerns, rather than upon time-of-use electricity tariffs, then very substantial increases in power flows will occur in distribution networks at peak times and often at locations that do not currently have adequate electrical supply (such as car parks etc.). This will lead to increased use of high-carbon power plant, and will soon require distribution network reinforcement. Hence, there is an intrinsic incompatibility between BEV recharging and achieving a cost-effective low-carbon power system, simply because many consumers will wish to exercise control of when their BEV is recharged and how fully charged it is before they use it. Conversely, electrolytic hydrogen production can occur during off-peak hours by design, and the hydrogen storage tanks of a Hydrogen Refuelling Station (HRS) enable production and demand to be decoupled in time phase. Electricity networks can utilise electrolyser (HRS) to provide grid balancing services and assist use of renewable and nuclear power to offset present and future peak power demands.

In addition, it is worth noting that while BEVs are suited to smaller vehicles and shorter trips, hydrogen fueled vehicles are the lowest carbon solution for medium/larger vehicles (including passenger cars and buses and longer trips as showcased by various reports⁸.

There are opportunities to produce hydrogen, and fuels derived from hydrogen (such as SNG), via power-to-gas systems which utilise excess renewable energy to produce hydrogen by electrolysis. The wide adoption of such systems would enable a much greater exploitation of the UK's substantial renewable resource without incurring substantial wind/solar curtailment.

⁶http://www.kiwa.co.uk/uploadedFiles/Our_Services/Energy_and_Carbon_Advice/H21%20Report%20Interactive%20PDF%20July%202016.pdf

⁷ <https://www.theccc.org.uk/publication/e4tech-for-ccc-scenarios-for-deployment-of-hydrogen-in-contributing-to-meeting-carbon-budgets/>

⁸ https://www.hydrogen.energy.gov/pdfs/htac_02_2011_mckinsey_thomas.pdf

Hydrogen is a low carbon fuel which can be delivered from a range of production methods, including fossil fuels. Currently, the majority is produced from natural gas through steam methane reforming (SMR). It is anticipated that all hydrogen production methods will be part of the future energy portfolio; this will provide greater flexibility and resilience to the system than would be the case with any single method.

Hydrogen fueled vehicles offer significant carbon reduction and air quality benefits when compared to conventional vehicles:

- Fuel Cell Electric Vehicles (FCEVs) powered with renewable hydrogen have zero well-to wheel (WtW) emissions (of all types, CO₂, NO_x, SO_x etc). Those powered by hydrogen produced from natural gas produce ~85g of CO₂/km on a WtW basis. In comparison, a gasoline fuelled internal combustion engine produces approximately ~170g of CO₂/km on the same basis. By 2030, increasing FCEV deployment could lead to total annual projected CO₂ abatement in the UK of 3 million tonnes. In addition to CO₂ reduction benefits, FCEVs offer significantly improved general air quality by eliminating all oxides of nitrogen and particulate matter from vehicle exhausts, thus addressing a growing area of societal concern.
- As well as FCEVs fueled by hydrogen, adapted conventional engines can also run on hydrogen. In air, particulates and many other by-products of combustion with hydrocarbon fuels are reduced significantly; however, the combustion process needs to be controlled to prevent by-products of the presence of nitrogen (e.g. NO_x). If emission control strategies are implemented and the combustion is carefully optimised it is possible to gain the benefits of very low carbon and improved air quality from hydrogen within conventional engines.

Consolidated thinking is needed between the transport and power teams in Government to appropriately manage the greater adoption of BEV and hydrogen vehicles in the UK. In the context of a holistic energy system, it is important for the Government to recognise the attributes of hydrogen vehicles when fuelled by electrolytic hydrogen produced outside of peak times and as a means of absorbing excess renewable electricity.

Thus, we would encourage the Commission to highlight the importance of the development nation-wide HRS network in the National Assessment Plan, building on the recommendations of the UK H2Mobility report as mentioned above.

National Infrastructure Commission: National Infrastructure Assessment call for evidence

United Kingdom Onshore Oil and Gas response

A. Introduction

- 1) United Kingdom Onshore Oil and Gas (UKOOG) is the representative body for the UK onshore oil and gas industry for both developers and supply chain companies. We welcome the opportunity to provide evidence to the National Infrastructure Commission's call for evidence for the National Infrastructure Assessment.
- 2) As an energy trade association, we are responding to the energy part of the call for evidence. This includes the interplay between energy production, storage and distribution and the transport system.
- 3) As an industry, we would like to make clear that we believe that UK energy policy should provide secure, affordable and climate-friendly energy, with an emphasis on home-grown energy, primary fuels and innovation for the future. To achieve this, we will need a balance of natural gas to provide heat, electricity, essential chemical feedstocks and to improve air quality; renewables and nuclear to generate electricity; and oil to power transportation and provide essential chemical feedstocks.
- 4) Our **response** is centred on four areas:
 - The need for **more UK energy production**, including oil and gas onshore, renewables and nuclear;
 - The critical importance of the UK's **gas infrastructure**;
 - The role of **oil**;
 - The potential to **decarbonise the gas system** in the longer term.

B. Executive Summary

- 5) As we detail below, all the UK energy scenarios and forecasts see oil and gas demand remaining roughly stable for the next 20 years. **In that timeframe, we therefore have a choice of whether to import that requirement or produce it ourselves.** This has major implications for our economy and the environment:
 - Producing oil and shale gas onshore in the UK could together provide more than 100,000 jobs at peak and deliver more than £50 billion of investment, together with substantial tax revenues;
 - By contrast, without onshore production, imports of gas and oil could cost the UK economy £20 billion per year by 2030;
 - Lifecycle greenhouse gas emissions from UK-produced shale are around 10% lower than for gas imported by LNG or long-distance pipeline;
 - Producing oil in the UK also reduces greenhouse gas emissions as it does not require the use of long-distance tankers and pipelines, together with the corresponding inherent energy requirements.

- 6) In the longer term, the **UK's heating needs to be decarbonised**. At present, there are two clear choices:
- Electrify heating, which would require an order of magnitude increase in low carbon power and electricity grid capacity well beyond anything thus far imagined, and which would lie idle in summer, would result in the gas network becoming obsolete, and would lead to major disruption to people's homes costing an average of £10,000 per household.
 - Use the existing gas network, which carries far more energy than the electricity network and can store it seasonally, to carry hydrogen made from methane in an industrial fashion with the carbon stored or used in other processes. This has the benefit of less cost, less disruption and probably a quicker roll-out.
- 7) In order to decarbonise heating, as the Committee on Climate Change and others have concluded, a proper strategy needs to be developed, which includes the prioritising of methane reformation and carbon capture and storage (CCS). At the same time, we need to ensure that the UK maintains the option of our own indigenous gas sources for the same reasons as given above.
- 8) We have two key **recommendations**:
- i. Allow **onshore oil and gas production** to reduce import dependency, generate significant tax revenues and support jobs, the balance of payments and UK industry, while reducing global greenhouse gas emissions by producing more of our energy needs ourselves.
 - ii. Support the progressive **decarbonisation of the gas system**, including through hydrogen and CCS.

C. UK energy production

- 9) Alongside cost-effective decarbonisation, one of the crucial energy infrastructure questions is the **security of supply** of the UK's energy. Security of supply can partly be addressed by a diversity of sources, and a range of gas and electricity interconnectors and oil and gas import terminals. But the **proportion of energy produced indigenously** is also critical.

From a net energy exporter to a big net importer

- 10) Over the last two decades, the UK has shifted from being a major exporter to a **major importer of primary fuels and related energy**, as Chart 1 and Table 1 below show.¹ In 2000, UK net energy/primary fuel *exports* were equivalent to 23% of UK consumption. By 2015, net *imports* had reached 36% of UK consumption, although this was a slight fall from the previous three years.

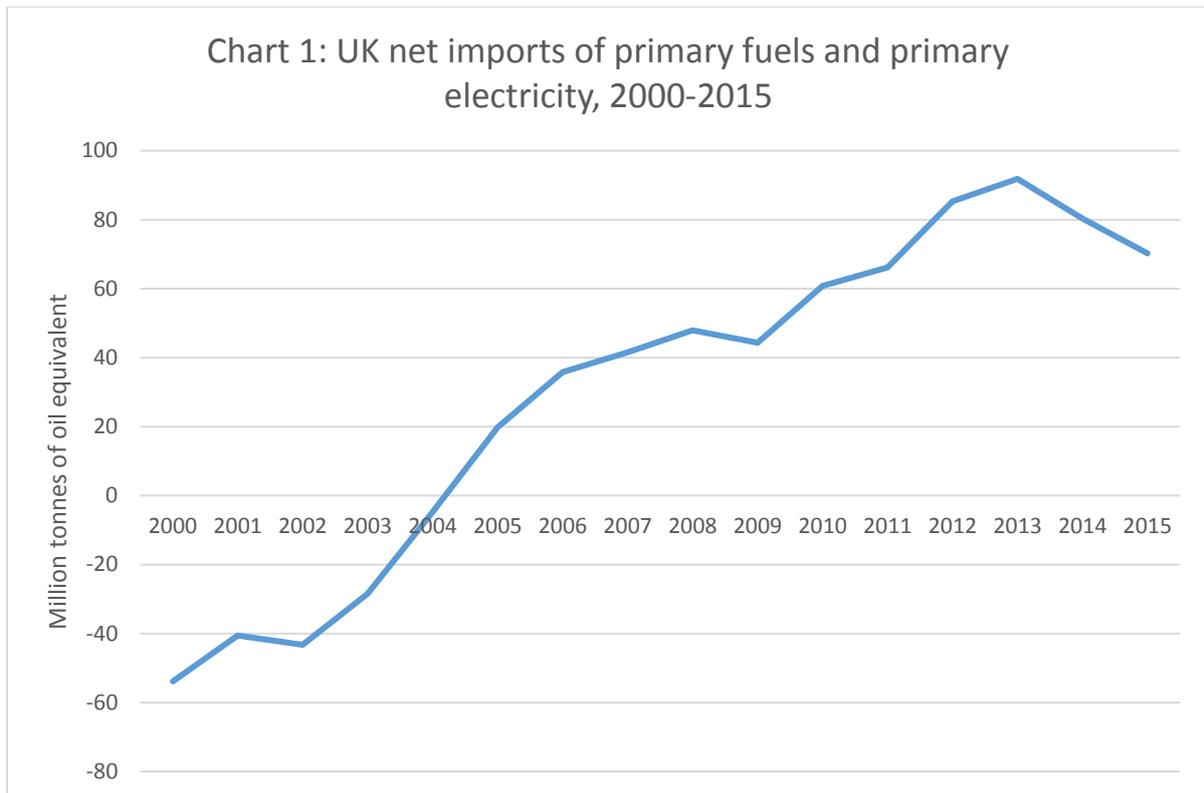


Table 1: UK net imports of primary fuels and primary electricity, 2000 and 2015

	2000		2015	
	Net imports (mtoe)	% of UK consumption	Net imports (mtoe)	% of UK consumption
Coal	19.0	49%	19.7	79%
Petroleum (oil)	-61.6	-80%	17.1	26%
Natural Gas	-12.5	-13%	28.3	42%
Bioenergy and waste	0.0	0%	3.4	25%
Primary electricity	1.2	6%	1.8	8%
Overall	-53.9	-23%	70.2	36%

NB: Negative sign denotes net exports

11) As Table 1 shows, in volume terms, in 2000, the UK was a net *exporter* of 54 million tonnes of oil equivalent (mtoe) of primary fuels and primary electricity. By 2015, the UK was a net *importer* of 70 mtoe. This represents a change of 124 mtoe

Large falls in UK energy production

12) As Table 2 shows², declines in coal, oil, gas and nuclear production (total fall of 176 mtoe from 1995 to 2015) were not offset by increases in bioenergy, waste, wind, solar and hydro production (total rise of 12 mtoe), nor by a fall in consumption (40 mtoe lower). **The key problem is that the UK no longer produces enough primary fuels to meet its energy demands.**

Mtoe	UK production, 2000	UK production, 2015	Change, 2000-2015	% change, 2000-2015
Coal	19.6	5.4	-14.2	-72%
Petroleum (oil)	138.3	49.5	-88.8	-64%
Natural Gas	108.4	39.6	-68.8	-63%
Nuclear	19.6	15.5	-4.1	-21%
Bioenergy and waste	2.3	9.9	+7.6	+330%
Wind, solar and hydro	0.5	4.7	+4.2	+840%
Total UK production	288.7	124.6	-164.1	-57%
<i>Total UK inland consumption</i>	<i>234.8</i>	<i>194.8</i>	<i>-40.0</i>	<i>-17%</i>

Negative impacts of relying on imported energy

- 13) Relying on imports for an increasing share of the UK's energy consumption has a number of detrimental effects. First, it **increases the risk of supply disruption**, if, for example, there is an interconnector failure or a disruption to LNG shipments:
- In November 2015, half the 2GW capacity of the electricity interconnector between the UK and France was lost following a storm. This capacity will stay offline until the end of February.³
 - While Russia is frequently cited as a source of insecurity when it comes to energy, much less discussed is the physical security of LNG supplies. It is of course true that the sources of LNG supplies, including from the US, are growing. At the same time, however, Qatar currently accounts for almost a third of global LNG supply, and over 90% of the UK's LNG imports.⁴ If the Straits of Hormuz were closed, for example due to renewed US-Iran tensions, it would not only represent a catastrophe for global oil supplies, but also a major threat to UK and global LNG supplies.
- 14) Second, it could lead to **increased price volatility**, with electricity and gas prices spiking during cold weather periods, when there is less gas and electricity available from the continent. It also exposes the UK to **international currency fluctuations**, with imported LNG, for example, priced in dollars. The post-Brexit fall in Sterling has therefore had a direct knock-on impact on the price of gas imports.
- 15) Third, it harms the UK's balance of trade, tax revenues and jobs. In 2015, the **UK spent over £14 billion on net primary fuel/energy imports** – crude oil, oil products, natural gas, coal and electricity – and the figure was over £20 billion in 2012 and 2013, when prices were much higher.⁵ We estimate that by 2030 imports of gas and oil alone could cost the UK economy £20 billion per year.⁶ This is money that could be generating jobs and tax revenue in the UK.
- 16) It should therefore be a priority, alongside efforts to decarbonise in a cost-effective manner, to reverse the UK's recent decline in energy production. This should be achieved through a balanced mix of **higher renewables, nuclear and gas and oil production** in the UK.

D. The importance of the UK's gas infrastructure

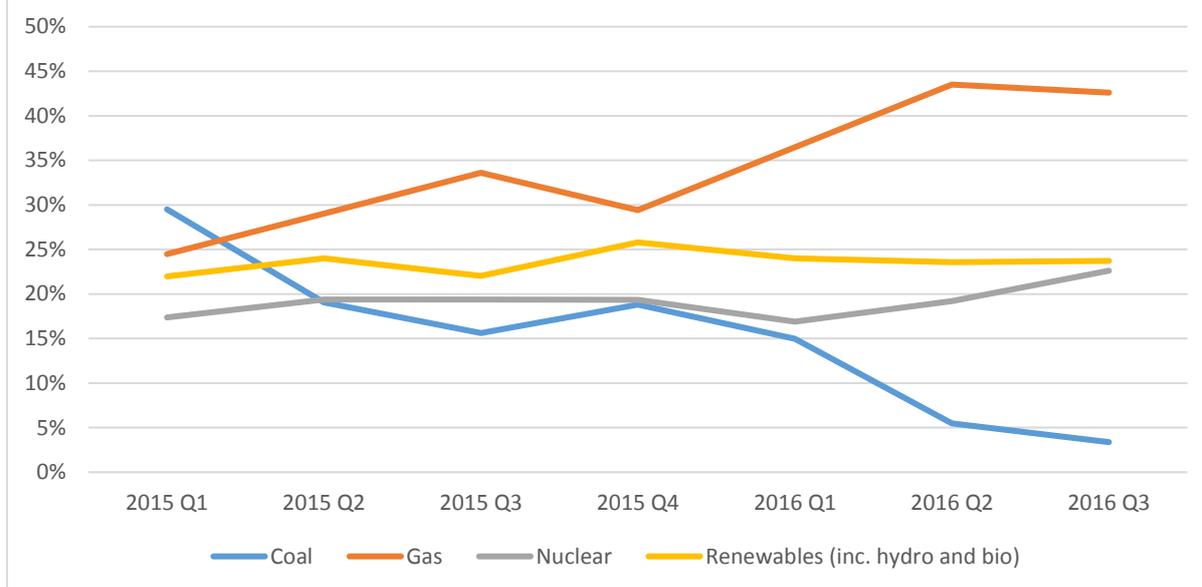
17) **Gas plays a crucial role** in the UK's **energy** system, as well as its **manufacturing** and **agriculture**. The gas network transports and stores more energy, especially in winter, than the electricity network. Gas use will remain high for some time to come, as the UK decarbonises, and therefore **indigenous production of gas** should be supported, including onshore shale gas.

The importance of gas

18) Gas is a vitally important source of **energy** for the UK:

- **Domestic heat:** 84% of homes are heated by gas⁷ and 61% of homes use gas for cooking⁸. Overall, gas meets 77% of domestic heating needs once space heating, water heating and cooking are combined.⁹ A typical household will use 12,500 KWh of gas annually, compared with 3,100 KWh of electricity.¹⁰ Looking at the whole economy, gas accounts for around 80% of domestic, commercial and industrial heating.¹¹
- **Industrial heat:** Heat accounts for around 80% of industrial energy use and can represent 20-40% of final product costs.¹² Sectors such as food and drink, chemicals and pulp and paper often require low temperature process heat of around 300-500°C. Energy intensive industry sectors, including the use of kilns or furnaces to produce glass, cement, iron, steel and chemicals, often require high temperature process heat of above 1,000°C. Gas is the most important industrial heating source, and in many industrial processes cannot be replaced by electricity – this is because for some high temperature processes, the burn characteristics of the fuel (namely calorific value, flame stability and cleanliness) are critical. In Scotland, 43% of all gas consumed is by industry.¹³
- **Electricity:** As Chart 2 shows, gas has become the UK's largest source of electricity, accounting for around 45% of electricity generation and allowing the share of coal-fired generation to fall to record lows.¹⁴ Gas-fired power stations can run continuously or as flexible back-up for intermittent wind and solar. In the absence of large-scale electricity storage, wind and solar cannot be successful without gas, and hence the Government's welcome policy to close coal-fired power stations by 2025 would not be possible without gas.

Chart 2: UK quarterly electricity generation 2015 and 2016 - main sources



- **Transport:** Compared with Euro VI diesel, natural gas-fuelled HGVs emit 41% less harmful NOx and 74% less NO₂.¹⁵ Compared with older diesel standards, the savings would be even greater. Natural gas trucks and buses could therefore help to reduce high levels of air pollution in cities. Companies such as Waitrose are already starting to use HGVs fuelled by compressed natural gas,¹⁶ while Reading has a fleet of natural gas buses.¹⁷

19) Gas is vital for the UK's **manufacturing** industries:

- Gas, together with natural gas liquids such as ethane and propane, is a **building block for everyday goods** such as food packaging, textiles, mobile phones, medicines, cosmetics and paints. It is also a raw material used in the construction of **green goods**, including loft insulation and solar panels.¹⁸ The UK's chemical and pharmaceutical industries, which rely on natural gas as a raw material, support **500,000 jobs**.¹⁹

20) Gas is also essential for **agriculture**:

- Natural gas is one of the main components of ammonia (the hydrogen (H) in ammonia (NH₃) comes primarily from natural gas). Ammonia is widely used in nitrogen-based fertilisers that are needed for food production.²⁰ **Nitrogen fertiliser** was applied to **75% of all farmland** (both crops and grass) in Great Britain in 2015.²¹

21) Improvements in **sustainability** also require the support of gas:

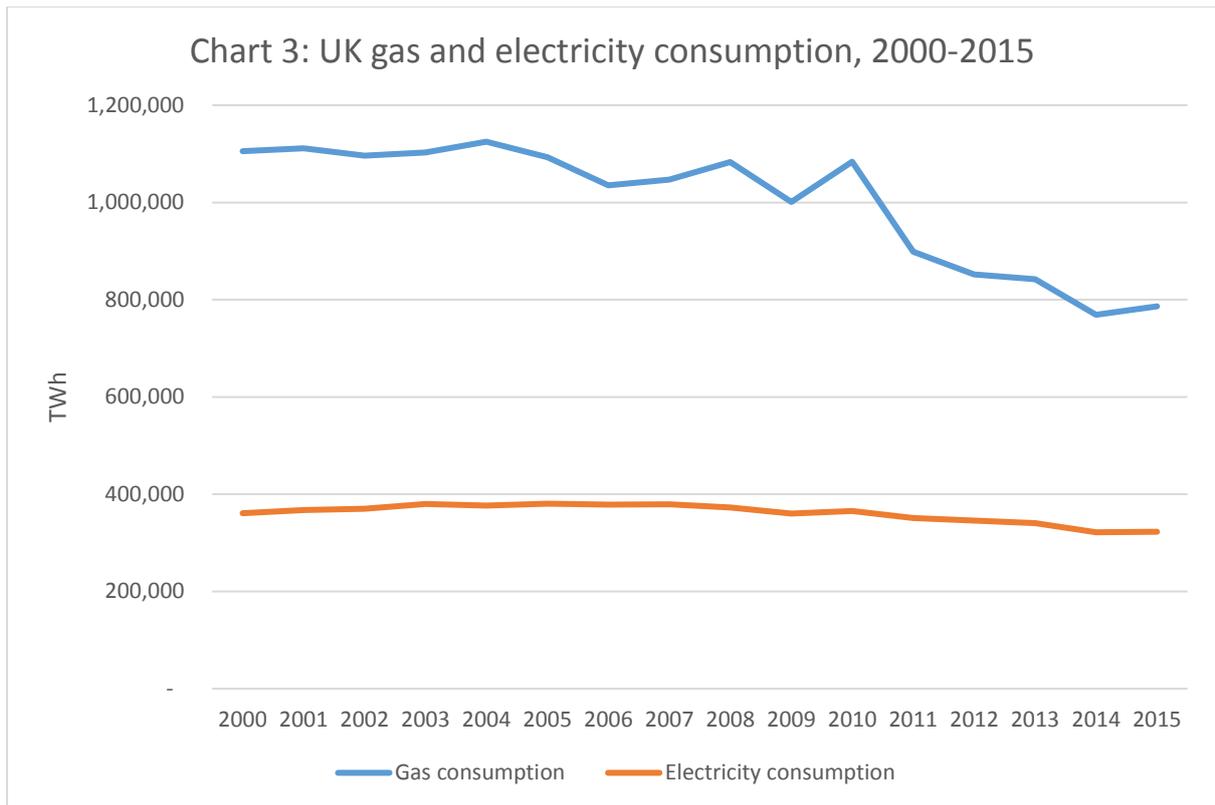
- As noted above, gas provides electricity when the wind doesn't blow and the sun doesn't shine, and is used as a raw material in the manufacture of items such as insulation material and solar panels. Gas is also a vital heat source in **recycling** – glass recycling furnaces in the UK use 1 million cubic metres of gas per day.²²

The UK's gas network infrastructure

- 22) The UK's gas network infrastructure consists of nearly **300,000 km of pipelines** of various dimensions, capacities and pressures, which transport the gas to over 20 million homes and businesses as well as the UK's gas-fired power stations.²³ It has been built up over 200 years, with local pipeline networks originally transporting gas derived from coal ('town gas').
- 23) In the 1960s and 1970s, the National Transmission System (NTS) – the very high capacity and pressure gas pipelines (the motorway network is a useful analogy) – was built to transport natural gas newly-produced from the North Sea across the country. At the same time, local gas networks switched from transporting town gas to natural gas, and conversions to the appliances in millions of homes were carried out systematically to enable natural gas to be used.
- 24) Overall, the UK's gas system remains a very high capacity, extremely reliable means of **transporting and storing energy**. As Table 3 shows, it has a far higher level of capacity and storage than the UK's electricity network, and at the same time is cheaper and lower carbon when used for heat.

	Gas network (for heat)	Electricity network
Peak demand (GW)	300	60
Storage duration (hours)	900	9
Storable energy (TWh)	50	0.027
Retail energy cost (£/MWh)	48	154
Carbon intensity (gCO ₂ /KWh)	185	375

- 25) The price differential between gas and electricity is significant. **Electricity costs consumers at least three times more per KWh than gas**, and this is true for domestic, commercial and industrial consumers.²⁵
- 26) As Chart 3 shows, although gas consumption has fallen in recent years, the **gas network** can carry **1,100 TWh** of energy a year, including gas used for electricity generation. By contrast, the **electricity network** carries up to around **400 TWh** a year.²⁶ And, as Table 3 shows, at peak times the gas network is meeting demand that is around five times higher than electricity.



27) Making best use of the UK's extensive gas infrastructure to support decarbonisation will be essential to avoid the costs of increasing the size of the electricity network several times over.

Projections for UK gas consumption and production

28) Over the next two decades, the UK is projected to continue to need a **considerable amount of gas**, including in scenarios where the carbon budgets are achieved:

- The **Committee on Climate Change's Fifth Carbon Budget** report, for the period 2028-32, expects that natural gas demand will fall slightly, from 810 TWh in 2014 to 700 TWh in 2030, in a scenario consistent with meeting the fifth carbon budget.²⁷
- In **National Grid's 'Gone Green' scenario**, natural gas demand (excluding 'green gas') falls from 78 billion cubic metres (bcm) in 2015 to 55 bcm in 2040.²⁸

29) At the same time, the UK's **production of natural gas offshore** is expected to continue to fall, leading to ever **greater import dependency**.²⁹

- Currently (2015), the UK produces around 400 TWh of gas, with an **import dependency of roughly 50%**.
- In 2030, the Oil and Gas Authority (OGA) expects UK offshore production to fall to 200 TWh, meaning an **import dependency of over 70%**, assuming demand is at the 700 TWh level projected in the Committee on Climate Change's Fifth Carbon Budget report (see above).
- In 2035, the OGA expects offshore production to fall further, to 155 TWh, or 14 bcm. This would mean **import dependency of 75%**, assuming gas demand (excluding

green gas) in line with National Grid's 'Gone Green' scenario of around 55 bcm by 2040. The 'Gone Green' scenario itself expects offshore production to fall faster than the OGA, meaning that **import dependency would rise to 89%** by 2040.

The benefits of indigenous onshore shale gas production

30) In order to address the negative effects of import dependency described earlier, and take advantage of a number of substantial opportunities, **indigenous onshore shale gas production should be permitted**. This should take place alongside the development of the UK's renewable and nuclear capacity. There are three key benefits:

- **Energy security:** As described above, without indigenous onshore production, gas imports will continue to rise to very high levels. By contrast, National Grid projects that shale gas production could reduce gas imports to around 25% of consumption by 2030.³⁰
- **Economy:** In 2014, UKOOG and the then Department for Business, Innovation and Skills commissioned EY to assess the level of materials, equipment and skills that a shale gas production phase would need. The report concluded that shale gas production could see £33 billion of spending in the supply chain over the next 20 years, creating 64,500 jobs.³¹ If the UK's onshore gas resources are not developed, these jobs and investment will go overseas.
- **Environment:** As Professors McKay and Stone have concluded, lifecycle greenhouse gas emissions from UK-produced shale are around 10% lower than for gas imported by LNG or long-distance pipeline.³² And this conclusion isn't surprising. Imported gas can come from parts of the world that lack the environmental safeguards we have in the UK, and it takes a lot of energy to freeze gas, transport it on a ship and then re-gasify it at a British terminal.

31) The UK has the **industry experience** to make a success of shale gas production. Over 2,000 wells have been drilled onshore, with around 200 having been hydraulically fractured to enhance recovery.³³ The Wytch Farm oilfield – western Europe's largest onshore – is located in an Area of Outstanding Natural Beauty, on a World Heritage Coastline, and amongst the highest property prices in the country, and produced 100,000 barrels of oil a day at peak production. Today, the industry has **230 operating oil and gas wells onshore** on 120 sites, producing about 8 million barrels of oil equivalent per year – this is enough to fuel the equivalent of around **1 million cars** or heat nearly **1 million homes**.³⁴

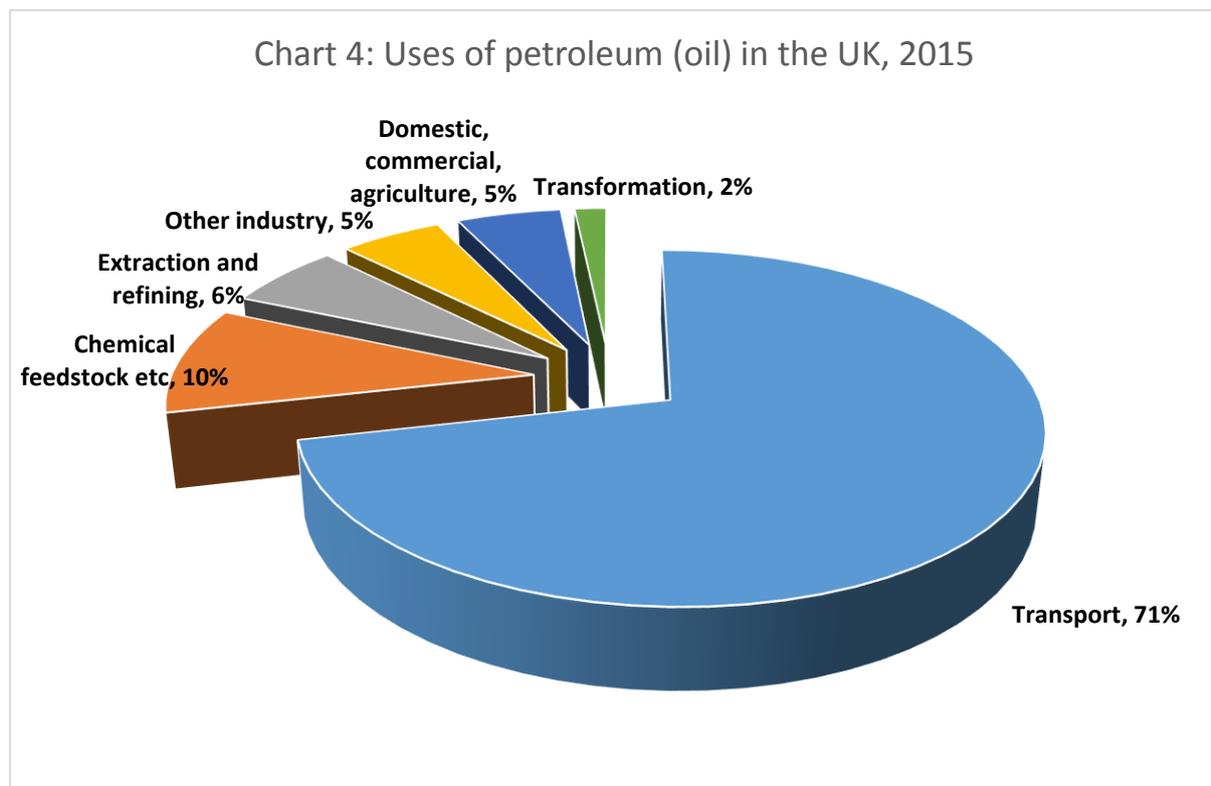
32) The UK also has **very large shale gas resources**, which make the aim of reducing gas imports a realistic prospect. An estimated 1,300 trillion cubic feet of shale gas lies in the Bowland Shale in the North of England³⁵ – if only 10% could be extracted, it would be equivalent to 40-50 years of UK gas consumption (the UK consumes around 2.75 trillion cubic feet of gas a year).

E. The importance of oil

33) Oil plays a vital role in the UK's energy system, providing **fuel for transport and vital chemical feedstocks**. Oil will continue to be needed in large quantities for some time to come, and like gas, the UK should prioritise **indigenous production**, including from onshore.

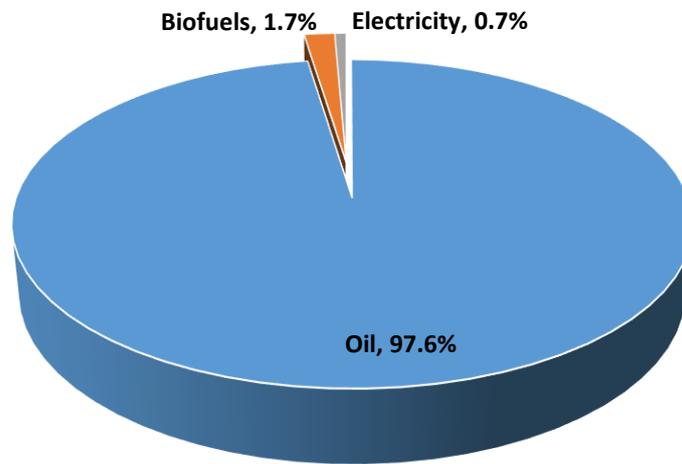
How oil is used in the UK

34) Chart 4 provides a breakdown of the UK's consumption of petroleum products (oil) in 2015. **Transport accounts for over 70% of oil demand**, while industrial and chemical feedstock use account for much of the rest.³⁶



35) Examining transport specifically, as Chart 5 shows, **oil accounted for 97.6% of all transport energy demand** in 2015, with 1.7% coming from biofuels and just 0.7% from electricity (mainly for trains).³⁷

Chart 5: UK transport energy use, 2015

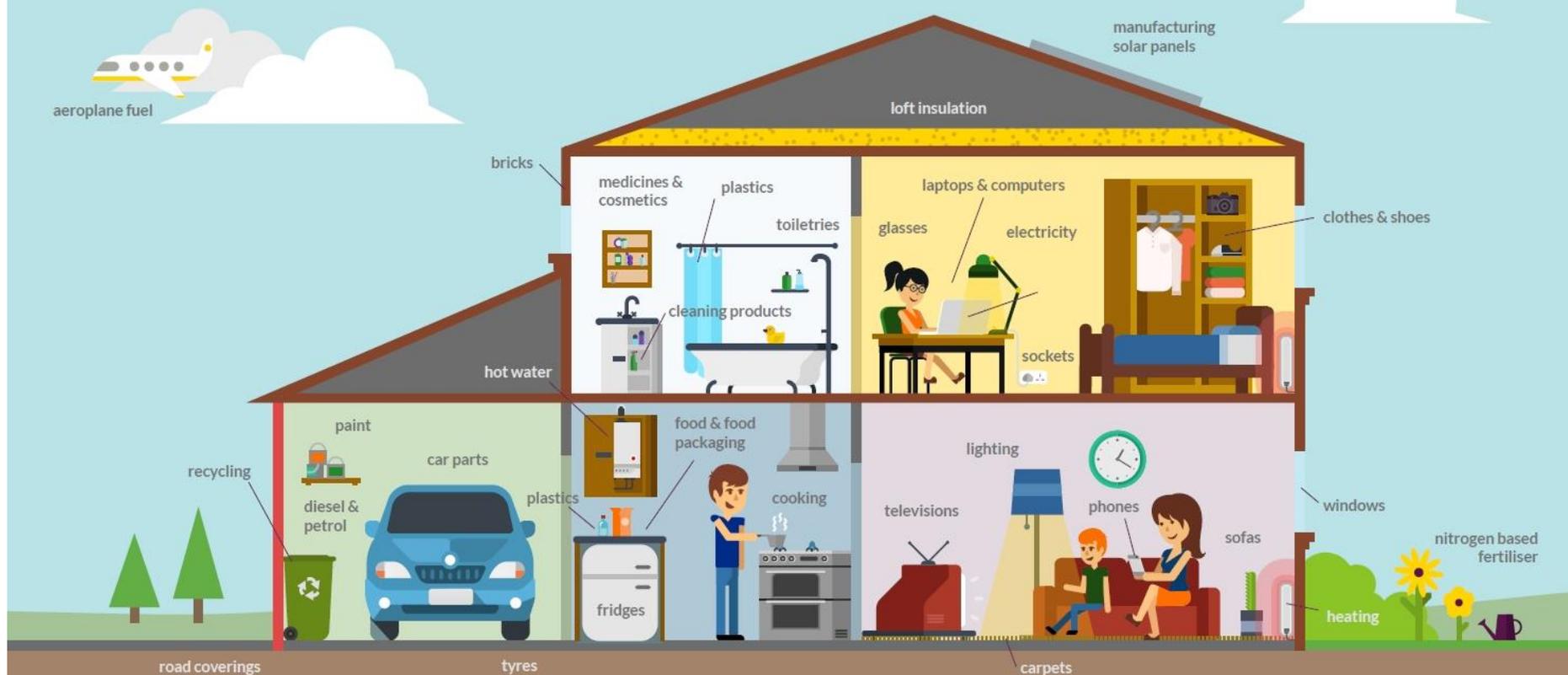


36) Oil, however, is not just vital as a transportation fuel. Alongside gas, it provides the **raw material** for a wide range of everyday products. The diagram on the next page provides examples of how oil and gas support so many of the products we use and the things we do at home. Further examples of products partly made with oil are listed below:

- **At school:** rulers, crayons, ink and cartridges, glue, coverings on books, binders.
- **For your health:** coatings for pills, binding agent for creams, disposable syringes.
- **In the home:** contact lenses, cosmetics, clothing, fabrics, nail polish, deodorants, shampoo, paint, upholstery and carpets, detergents for washing up and laundry, dry-cleaning fluid.
- **Out shopping:** shopping bags, credit cards, egg cartons, plastic milk bottles.
- **While cooking:** non-stick pans, cling film, storage containers.
- **For building:** roofing tiles, pipes, insulating material, paint.
- **On the move:** petrol, diesel and tyres for cars and lorries, emergency services and trains, marine and aviation fuel, asphalt road surfaces.
- **In the office:** computer hardware, phones and faxes, diskettes, pens, chairs, printing ink.
- **At your leisure:** CDs, videos, cassette tapes, camera film, artists' paint, bicycle handlebar grips, tyres, crash helmets, football boots, trainers, shin pads, windsurfers, roller blades, tents.
- **Garden:** fertilisers, pesticides, garden furniture.

Thanks to oil and gas...

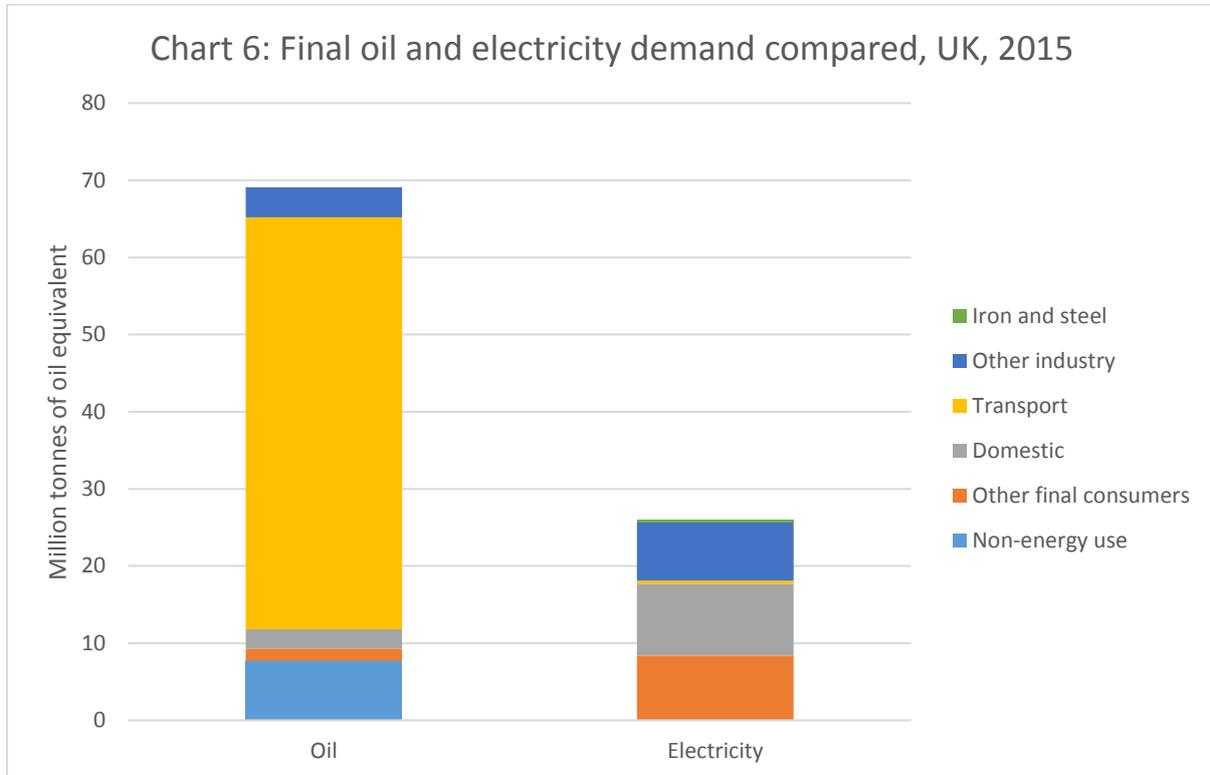
So many of the products we use and the things we do at home would not be possible without oil and gas and the compounds and materials produced from them. Oil and gas are used in all of the following:



The Natural Gas Coalition

What would you do without them?
Let's look under our feet

37) Oil is no longer a major generator of electricity, with less than 1% of the UK's oil demand being used in this way.³⁸ But like gas, **oil provides far more energy than the electricity system**. As Chart 6 shows, final oil demand was nearly 70 million tonnes of oil equivalent (mtoe) in 2015, compared with final electricity consumption of 26 mtoe in the same year.³⁹



Projections for UK oil consumption and production

38) Similar to gas, over the next two decades, the UK will continue to need a **considerable amount of oil and petroleum products**, including in scenarios where the carbon budgets are achieved:

- The **Committee on Climate Change's Fifth Carbon Budget** report, for the period 2028-32, expects that petroleum product demand will fall by 29%, from 890 TWh in 2014 to 635 TWh in 2030, in a scenario consistent with meeting the fifth carbon budget.⁴⁰
- The most recent projections from the Oil and Gas Authority envisage oil product demand falling more slowly, from 77 million tonnes of oil equivalent (mtoe) in 2015 to 71 mtoe in 2035.⁴¹

39) At the same time, the UK's **production of oil** is expected to continue to fall, leading to ever **greater import dependency**.⁴²

- Currently (2015), the UK produces just under 50 mtoe of crude oil and natural gas liquids, with an **import dependency of 36%**.
- In the **Committee on Climate Change's** fifth carbon budget scenario, petroleum product import dependency rises to 65% in 2030.

- In 2035, the Oil and Gas Authority (OGA) expects UK production to fall to 23 mtoe, meaning an **import dependency of 68%**.

The benefits of indigenous onshore oil production

40) The UK has **large onshore oil resources**:

- The **Weald Basin** in the South of England has been estimated to hold 124 billion barrels of oil in place (P50, best estimate), including 19.5 billion barrels (P50, best estimate) in the Kimmeridge Limestones,⁴³ which have seen successful initial flow-tests at Horse Hill in 2016.⁴⁴ Longer term Kimmeridge Limestones flow-tests and further drilling are planned in 2017-18.
- The British Geological Survey has estimated that the **Midland Valley of Scotland** holds 6 billion barrels of oil in place in the Carboniferous shales.⁴⁵

41) It also has a **long history of safe and sustainable production** onshore:

- The first oil was produced onshore in Scotland in **1851**.
- In the **second world war**, over 100 oil wells were drilled in Sherwood Forest, producing 3.5 million barrels of oil to support the war effort.⁴⁶
- As noted previously, the **Wytch Farm oilfield** – western Europe’s largest onshore – produced 100,000 barrels of oil a day at peak in the late 1990s, with minimal impact on the sensitive surrounding countryside and residential housing. Similarly, the industry today maintains 120 producing sites without negative impacts on communities or the environment.

42) There are a number of **economic advantages** of indigenous onshore oil production:⁴⁷

- A recent report by EY projected that Kimmeridge Limestones oil production in the South of England could reach up to 330,000 barrels a day at peak production in the High scenario. This is approximately 27% of current UK consumption and would represent oil that would no longer need to be imported. At an oil price of \$50 a barrel (£40 a barrel), this would **boost the UK’s balance of payments** by \$16.5 million (£13.2 million) each day, or over \$6 billion (£4.8 billion) a year.
- Over several decades, the EY report found that Kimmeridge Limestones oil production could **contribute between £7.1 billion to GVA in the Low scenario and £52.6 billion to GVA in the High scenario**, generating a peak of 8,000-49,000 jobs.
- **Lifetime tax revenues** from the development of Kimmeridge Limestones oil are estimated to be between £2.1 billion in the Low scenario and £18.1 billion in the High scenario.

43) The key **environmental benefit** is that production in the UK is strictly regulated by the Health and Safety Executive, Environment Agency, Oil and Gas Authority and local Mineral Planning Authorities to protect the health and safety of workers and the environment. UK production reduces the need for imports from parts of the world that may lack the UK’s stringent environmental safeguards and health and safety regime, and avoids the need for significant energy used in the transportation of oil across large distances.

F. Decarbonising the gas system in the longer term

44) The gas system not only provides important benefits in the next two decades, but has the potential to contribute directly to deeper decarbonisation. A **decarbonised natural gas infrastructure**, using hydrogen and other low carbon gases, could complement the development of renewable and nuclear electricity.

The great potential of hydrogen to help decarbonise heating and transport

45) **Hydrogen emits no CO₂ at the point of use** and has great potential to help decarbonise heating and transport – which currently account for around 50% of UK greenhouse gas emissions⁴⁸ – supporting the vital roles that renewables, nuclear and energy efficiency will play in meeting our carbon reduction commitments:

- Hydrogen could **directly replace natural gas use** for heating homes and businesses;
- Hydrogen could be distributed to customers using the **existing gas distribution network**, which is one of the most extensive in the world. Through the current Iron Mains Replacement Programme, older metal gas pipes are being replaced with polyethylene, which will allow hydrogen to be transported;
- Hydrogen therefore repurposes existing gas networks, **avoiding both expensive stranded assets and significant additional electrical network expenditure**;
- Hydrogen could **power cars, buses and HGVs**, with a similar driving range to diesel and petrol, with no carbon dioxide and no air pollutants – improving city air quality.

46) Modelling for the Committee on Climate Change carried out by E4tech, University College London Energy Institute and Kiwa Gastec showed that hydrogen could become the main source of energy for heating and transport by 2050, enabling dramatic reductions in emissions.⁴⁹ On more modest assumptions, Energy Research Partnership calculations suggest that **80 million tonnes a year of CO₂ could be saved** from domestic and commercial heat and from transport by 2050 – based on 9 million homes heated by hydrogen and 16 million fuel cell cars, with some additional commercial buildings, HGVs and buses also using hydrogen.⁵⁰

Hydrogen and electric heating are complementary, avoiding the major costs and challenges from relying solely on electricity

47) A fully decarbonised heating system will need a mix of solutions:

- **Hydrogen-based central heating**, using the current infrastructure for the delivery of gas;
- **Better insulation and technologies** such as more efficient boilers, gas-driven heat pumps and gas-fired micro CHP units, which can reduce the carbon intensity of the current gas-based heating system;
- **District heating and electric heat pumps** will have a role to play in some areas, and can complement the widespread use of hydrogen.

48) An electric-only UK-wide heating system would be very difficult and costly. Conversely, a grid of gaseous energy has proved its ability to meet the very high and time-varying

heat demands of the UK's buildings, and therefore the development of a low-carbon gas grid is fundamentally logical:

- **Meeting the UK's winter heating needs:** As noted earlier, peak electricity demand is up to 60 GW, but peak winter heat demand, (currently 80% gas-based) is over 350 GW – six times as high.⁵¹ A recent report by Policy Exchange found that installing electric heat pumps in 80% of homes would require an additional 105 GW of electricity generating capacity,⁵² more than double the current level and equivalent to more than 30 Hinkley Point C nuclear power stations. Much of this new electricity infrastructure would lie idle in the summer when heating is not needed.
- **Minimising cost to consumers:** For large parts of the UK heat system hydrogen has cost advantages over electricity. As it can be stored at scale (in similar facilities to those used for natural gas) and can make use of existing distribution infrastructure (to which 84% of homes in the UK are connected), hydrogen has much lower seasonal storage and distribution costs than wholesale electrification or district heating. Installing electric heat pumps in 80% of homes would be hugely expensive, costing an estimated £200 billion to install (nearly £10,000 to change the central heating system in each home) and an additional £100 billion to expand and upgrade the power system.⁵³ Overall, an electric-only solution could cost an additional £274-318 billion by 2050, compared with a predominantly gas-to-hydrogen route costing £104-122 billion – both scenarios would meet the 80% carbon reduction target in 2050.⁵⁴
- **Avoiding major infrastructure and storage impacts:** There would be significant landscape impacts from a large number of new electricity generating facilities and electricity pylons criss-crossing the country, or large additional costs from burying electricity cables. These landscape impacts can be avoided by displacing additional electricity generation facilities and networks with repurposed existing underground gas networks. At the same time, as noted earlier, the electricity system can currently only store 0.027 TWh⁵⁵ – a tiny fraction of electricity use – and so a major investment in inter-seasonal storage can be avoided by harnessing the value of the existing gas system.

Carbon capture is key to producing low-carbon hydrogen at scale

49) Hydrogen can be created in several ways:

- First, **fossil fuel reforming** is the most common way to produce hydrogen, accounting for more than 95% of the world's hydrogen production. The most common method is **steam methane reforming**, which produces hydrogen from natural gas. This process alone accounts for almost half of the world's hydrogen production.⁵⁶ With carbon capture, emissions from this process fall to just 33-39 gCO₂/KWh, at an estimated cost of around £2 per kg of hydrogen produced.⁵⁷
- Second, **electrolysis** of water produces hydrogen and oxygen using electricity. Once the UK's renewable electricity infrastructure is fully developed, the process could be powered with excess renewable generation at times of low demand – excess energy levels are predicted to rise considerably due to the rapid growth in intermittent renewables. It is currently estimated to cost around £4-6 per kg of hydrogen produced.⁵⁸
- Third, **biomass gasification** uses a controlled process involving heat, steam, and oxygen to convert biomass to hydrogen and other products, without combustion.

Combined with carbon capture, it offers the potential for negative emissions – up to minus 500 gCO₂/KWh. It is currently estimated to cost £4-5 per kg of hydrogen produced.⁵⁹

50) All these methods of hydrogen production will be needed, but the key to producing hydrogen in a low-carbon way at scale is to add carbon capture onto steam methane reforming:

- Excess renewable electricity could produce between 10 TWh and 32 TWh of hydrogen a year, providing up to around 10% of the UK's domestic heating needs.⁶⁰ **Meeting the UK's entire domestic heating needs from hydrogen produced by electrolysis, however, would require about 150 GW of wind power, a ten-fold increase on today's level of 15 GW.**⁶¹
- The ultimate contribution of biomass gasification could be limited by the amount of indigenous biomass available in the UK, depending on the sustainability criteria attached to imported biomass.

There is a major opportunity for low-carbon hydrogen production in the UK

51) **Hydrogen production from natural gas with carbon capture** is already proven:

- Two steam methane reforming plants in Port Arthur, Texas, have been retrofitted with carbon capture technology, and 1 million tonnes a year of CO₂ is now being captured and used;⁶²
- The Quest CCS project in Canada has been operating since November 2015,⁶³ and has stored over 1 million tonnes of CO₂ to date.⁶⁴

52) Overseas projects, however, will not help the UK to produce low-carbon hydrogen at scale – the carbon needs to be captured and stored or used here in Britain.

53) CCS is often thought about as capturing emissions from power stations post-combustion, but it can also be used to create low-carbon hydrogen before distribution to customers and therefore support decarbonisation of homes and industry. As specialist bodies have recommended, a **carbon capture strategy is urgently needed:**

- **Committee on Climate Change:** *“CCS is of critical importance to meet the UK's climate targets at least cost, and requires a strategic approach to its development ... There is no strategy for the development of CCS following the cancellation of the Commercialisation Programme in November 2015. Lessons learnt in that process enable a more strategic approach to be adopted, which can support commercialisation of CCS at a lower overall cost to the consumer and taxpayers. The new approach should ... be based around shared infrastructure for CCS ‘clusters’ in areas of industrial activity and requires a new funding mechanism for industrial CCS, to operate alongside contracts for difference for power plants.”*⁶⁵
- **Imperial College:** *“The most important precondition for using hydrogen would be the development of large scale, low cost production facilities. This could be by electrolysis of water, although this is currently very expensive and not yet suited to large scale production, or through conversion of natural gas by steam methane reformation (SMR) ... SMR produces carbon dioxide as a by-product and its use would therefore be very dependent on the availability of CCS.”*⁶⁶

54) The UK has **solid foundations** to build a carbon capture industry:

- Carbon capture infrastructure could be built around a number of **existing industrial clusters**, including Grangemouth, Teesside, the Humber, South Wales and North West England – including the Atlantic Gateway corridor;
- The **North Sea has ample CO₂ storage opportunities**, estimated to be around 78 billion tonnes. Simply utilising the top 15% of this storage capacity would be enough to meet UK needs for 100 years;⁶⁷
- The UK has a **world class oil and gas industry** with the expertise needed to deliver a CCS industry;
- As a recent government report highlighted, there is also great potential in Carbon Capture and Utilisation (CCU), whereby the captured **CO₂ is used to make chemical products and solid materials**, including more advanced building materials, putting UK companies at the forefront of new markets.⁶⁸

55) It takes many years to construct a CCS infrastructure and to develop CCU technologies to commercial readiness. It is imperative that progress is made now so that a large source of low carbon hydrogen can be provided to support the UK's decarbonisation in line with statutory targets. As the recent Lord Oxburgh review of CCS concluded: *"Carbon capture and storage is an essential component in delivering lowest cost decarbonisation across the whole UK economy. Current CCS technology and its supply chain are fit for purpose. There is no reason to wait for international projects or for technological progress in either the components or overall system of CCS ... UK action on CCS now will deliver lowest cost to the consumer ... Ample, safe and secure CO₂ storage capacity is available offshore in the rocks deep beneath UK territorial waters."*⁶⁹

56) The Committee on Climate Change has also drawn a similar conclusion: *"Hydrogen pilots can also begin and must be of sufficient scale and diversity to allow us to understand whether this can be a genuine option at large scale. As large-scale hydrogen deployment would require use of carbon capture and storage (CCS), a strategy for CCS deployment remains an urgent priority."*⁷⁰

G. Recommendations

57) We have two key **recommendations**:

- i. Allow **onshore oil and gas production** to reduce import dependency, generate significant tax revenues and support jobs, the balance of payments and UK industry, while reducing global greenhouse gas emissions by producing more of our energy needs ourselves.
- ii. Support the progressive **decarbonisation of the gas system**, including through hydrogen and CCS

-
- ¹ Department for Business, Energy and Industrial Strategy, Energy Trends, Total Energy, Tables ET 1.1 and ET 1.2, October 2016 <https://www.gov.uk/government/statistics/total-energy-section-1-energy-trends>
- ² Department for Business, Energy and Industrial Strategy, Energy Trends, Total Energy, Tables ET 1.1 and ET 1.2, October 2016 <https://www.gov.uk/government/statistics/total-energy-section-1-energy-trends>
- ³ See <https://www.ft.com/content/52e957a6-b64a-11e6-ba85-95d1533d9a62>
- ⁴ BP, Statistical Review of World Energy, 2016 (data for 2015) <http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html>
- ⁵ Office for National Statistics, BQNE and BQNH data series
- ⁶ Based on OGA projections for imports of gas and oil products in 2030, multiplied by 50 pence per therm for gas and £40 per barrel of oil equivalent. Oil and Gas Authority, UKCS Oil and Gas Production Projections <https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/>
- ⁷ Department of Energy and Climate Change, United Kingdom housing energy fact file 2013, Tables 6a, 6b and 6d – data for 2011 (most recent year available) <https://www.gov.uk/government/publications/united-kingdom-housing-energy-fact-file-2013>
- ⁸ Energy Follow-Up Survey 2011, Report 9: Domestic appliances, cooking and cooling equipment, Prepared by BRE on behalf of the Department of Energy and Climate Change, December 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/274778/9_Domestic_appliances_cooking_and_cooling_equipment.pdf
- ⁹ Policy Exchange, Too hot to handle? How to decarbonise domestic heating, August 2016 <http://www.policyexchange.org.uk/images/publications/too%20hot%20to%20handle%20-%20sept%2016.pdf>
- ¹⁰ Ofgem, Typical Domestic Consumption Values 2015 <https://www.ofgem.gov.uk/gas/retail-market/monitoring-data-and-statistics/typical-domestic-consumption-values>
- ¹¹ Department of Energy and Climate Change, The Future of Heating: A strategic framework for low carbon heat in the UK, March 2012 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48574/4805-future-heating-strategic-framework.pdf
- ¹² Department of Energy and Climate Change, The Future of Heating: A strategic framework for low carbon heat in the UK, March 2012, pp.77-79 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48574/4805-future-heating-strategic-framework.pdf
- ¹³ Energy in Scotland 2016 <http://www.gov.scot/Resource/0050/00501041.pdf>
- ¹⁴ Department for Business, Energy and Industrial Strategy, Energy Trends, December 2016, Table 5.1 <https://www.gov.uk/government/statistics/electricity-section-5-energy-trends>
- ¹⁵ Department for Transport, Emissions Testing of Gas-Powered Commercial Vehicles, Prepared by Low Carbon Vehicle Partnership, January 2017 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/581859/emissions-testing-of-gas-powered-commercial-vehicles.pdf
- ¹⁶ See <https://www.greengas.org.uk/news/cng-fuels-and-national-grid-unveil-first-high-pressure-grid-connected-cng-filling-station>
- ¹⁷ See <http://www.reading-buses.co.uk/cng-faqs/>
- ¹⁸ For further details on the use of gas (and oil) in products, see <http://www.ukoog.org.uk/the-natural-gas-coalition/gas-use-in-the-home>
- ¹⁹ Chemical Industries Association http://www.cia.org.uk/Portals/0/Documents/Manifesto%202015_1_9.pdf
- ²⁰ The main forms of inorganic nitrogen fertilisers are ammonium nitrate, urea, ammonium phosphates and ammonium sulphate. Department for Environment, Food and Rural Affairs, The British Survey of Fertiliser Practice: Fertiliser Use on Farm Crops for Crop Year 2015, p.9 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516111/fertiliseruse-report2015-14apr16.pdf
- ²¹ Department for Environment, Food and Rural Affairs, The British Survey of Fertiliser Practice: Fertiliser Use on Farm Crops for Crop Year 2015, Table ES1 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516111/fertiliseruse-report2015-14apr16.pdf
- ²² Remsol, Powering the circular economy: why the right energy policy is vital to success, 2014 <http://www.mrw.co.uk/Journals/2014/10/10/h/f/y/20141009-Powering-the-circular-economy.pdf>
- ²³ Energy Networks Association <http://www.energynetworks.org/gas/>
- ²⁴ Imperial College London, Centre for Energy Policy and Technology, Managing Heat System Decarbonisation: Comparing the impacts and costs of transitions in heat infrastructure, April 2016, Table 1 <http://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Heat-infrastructure-paper.pdf>
- ²⁵ BEIS, Quarterly Energy Prices, December 2016, Tables 2.2.4, 2.3.4 and 3.1.3 <https://www.gov.uk/government/statistics/quarterly-energy-prices-december-2016>
- ²⁶ Department for Business, Energy and Industrial Strategy, DUKES 2016, Tables 4.1.1 and 5.1.3 <https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes>

-
- ²⁷ Committee on Climate Change, The Fifth Carbon Budget: The next step towards a low-carbon economy, November 2015, pp.89-90 <https://www.theccc.org.uk/wp-content/uploads/2015/11/Committee-on-Climate-Change-Fifth-Carbon-Budget-Report.pdf>
- ²⁸ National Grid, Future Energy Scenarios 2016, 'Gone Green' scenario <http://fes.nationalgrid.com/>
- ²⁹ Oil and Gas Authority, UKCS Oil and Gas Production Projections <https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/>
- ³⁰ National Grid, Future Energy Scenarios 2016, 'Consumer Power' scenario <http://fes.nationalgrid.com/>
- ³¹ EY, Getting ready for UK shale gas: Supply chain and skills requirements and opportunities, April 2014 http://www.ey.com/Publication/vwLUAssets/Getting_ready_for_UK_shale_gas/%24FILE/EY-Getting-ready-for-UK-shale-gas-April-2014.pdf
- ³² Comparison of midpoint of ranges. Professor David MacKay and Dr Timothy Stone, Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use, Department of Energy and Climate Change, September 2013, pp.3-4 <https://www.gov.uk/government/publications/potential-greenhouse-gas-emissions-associated-with-shale-gas-production-and-use>
- ³³ Royal Society and Royal Academy of Engineering, Shale gas extraction in the UK: a review of hydraulic fracturing, June 2012, p.17 <https://royalsociety.org/~media/policy/projects/shale-gas-extraction/2012-06-28-shale-gas.pdf>
- ³⁴ See UKOOG Annual Report 2014 for more detail http://www.ukoog.org.uk/images/ukoog/pdfs/UKOOG_Annual_Report_2014.pdf
- ³⁵ British Geological Survey, The Carboniferous Bowland Shale gas study: geology and resource estimation, 2013 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/226874/BGS_DECC_BowlandShaleGasReport_MAIN_REPORT.pdf
- ³⁶ The 10% of oil demand in the "chemical feedstocks etc" section include: feedstock for petroleum chemical plants, white spirit and specific boiling point (SBP) spirits, lubricating oils, bitumen, petroleum wax, petroleum cokes. Department for Business, Energy and Industrial Strategy, DUKES 2016, July 2016, Table 3.2 and Paragraph 3.71 <https://www.gov.uk/government/statistics/petroleum-chapter-3-digest-of-united-kingdom-energy-statistics-dukes>
- ³⁷ Department for Transport, Table ENV0102: Energy consumption by transport mode and source of energy, December 2016 <https://www.gov.uk/government/statistical-data-sets/env01-fuel-consumption>
- ³⁸ Department for Business, Energy and Industrial Strategy, DUKES 2016, July 2016, Table 3.2 <https://www.gov.uk/government/statistics/petroleum-chapter-3-digest-of-united-kingdom-energy-statistics-dukes>
- ³⁹ Department for Business, Energy and Industrial Strategy, Energy Flow Chart 2015 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/539637/Energy_Flow_Chart.pdf
- ⁴⁰ Committee on Climate Change, The Fifth Carbon Budget: The next step towards a low-carbon economy, November 2015, p.90 <https://www.theccc.org.uk/wp-content/uploads/2015/11/Committee-on-Climate-Change-Fifth-Carbon-Budget-Report.pdf>
- ⁴¹ Oil and Gas Authority, UKCS Oil and Gas Production and Demand Projections <https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/>
- ⁴² Oil and Gas Authority, UKCS Oil and Gas Production Projections <https://www.ogauthority.co.uk/data-centre/data-downloads-and-publications/production-projections/>
- ⁴³ See <http://www.ukogplc.com/ul/Nutech%20OIP%20Exec%20Summary%20Final%20201015.pdf>
- ⁴⁴ See UKOG, 21 March 2016 http://irpages2.equitystory.com/websites/rns_news/English/1100/news-tool---rns---eqs-group.html?article=24146677&company=ukog
- ⁴⁵ British Geological Survey, The Carboniferous shales of the Midland Valley of Scotland: geology and resource estimation, 2014 https://www.ogauthority.co.uk/media/2765/bgs_decc_mvs_2014_main_report.pdf
- ⁴⁶ See <http://www.ogj.com/articles/print/volume-111/issue-12b/regular-features/journally-speaking/roughnecks-of-sherwood-forest.html>
- ⁴⁷ EY, Kimmeridge Limestone Oil: The UK opportunity, April 2016 <http://www.ukogplc.com/ul/Kimmeridge%20Limestone%20Oil%20-%20The%20UK%20opportunity%20-%20Final%20Approved%20-%202015%20April%202016.pdf>
- ⁴⁸ NB: GHG emissions broken down by final user - Transport and Residential Combustion. Department of Energy and Climate Change, 2014 UK greenhouse gas emissions – final figures, March 2016 <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2014>
- ⁴⁹ E4tech, UCL Energy Institute, University College London, Kiwa Gastec, Scenarios for deployment of hydrogen in contributing to meeting carbon budgets and the 2050 target, Report to the Committee on Climate Change, October 2015 <https://documents.theccc.org.uk/wp-content/uploads/2015/11/E4tech-for-CCC-Scenarios-for-deployment-of-hydrogen-in-contributing-to-meeting-carbon-budgets.pdf>
- ⁵⁰ Energy Research Partnership calculations based on scenarios in the following references: LowCVP, Element Energy, Transport Energy Infrastructure Roadmap to 2050: Hydrogen Roadmap Low Carbon Vehicle Partnership, June 2015 http://www.lowcvc.org.uk/news/lowcvc-2050-transport-energy-infrastructure-roadmaps-show-the-way-to-transport-decarbonisation_3263.htm; Northern Gas Networks, H21 Leeds City Gate, July 2016 <http://www.northerngasnetworks.co.uk/document/h21-leeds-city-gate/>
- ⁵¹ Data for 2010 – half-hourly heat demand; actual electricity demand. Robert Sansom, Decarbonising Low Grade Heat for a Low Carbon Future, Doctoral thesis submitted to Imperial College London, October 2014, Figure 20 <https://spiral.imperial.ac.uk:8443/handle/10044/1/25503>

-
- ⁵² Richard Howard and Zoe Bengherbi, Too hot to handle? How to decarbonise domestic heating, Policy Exchange, August 2016 <http://www.policyexchange.org.uk/images/publications/too%20hot%20to%20handle%20-%20sept%2016.pdf>
- ⁵³ Richard Howard and Zoe Bengherbi, Too hot to handle? How to decarbonise domestic heating, Policy Exchange, August 2016 <http://www.policyexchange.org.uk/images/publications/too%20hot%20to%20handle%20-%20sept%2016.pdf>
- ⁵⁴ KPMG, The UK Gas Networks role in a 2050 whole energy system, July 2016 <http://www.energynetworks.org/assets/files/gas/futures/KPMG%20Future%20of%20Gas%20Main%20report%20plus%20appendices%20FINAL.pdf>
- ⁵⁵ Imperial College London, Centre for Energy Policy and Technology, Managing Heat System Decarbonisation: Comparing the impacts and costs of transitions in heat infrastructure, April 2016 <http://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Heat-infrastructure-paper.pdf>
- ⁵⁶ Arup, Five minute guide: Hydrogen http://publications.arup.com/publications/five_minute_guide_hydrogen
- ⁵⁷ E4tech and Element Energy, Hydrogen and Fuel Cells: Opportunities for Growth – A Roadmap for the UK, August 2016 <http://www.e4tech.com/reports/hydrogen-and-fuel-cells-opportunities-for-growth-a-roadmap-for-the-uk/>
- ⁵⁸ E4tech and Element Energy, Hydrogen and Fuel Cells: Opportunities for Growth – A Roadmap for the UK, August 2016 <http://www.e4tech.com/reports/hydrogen-and-fuel-cells-opportunities-for-growth-a-roadmap-for-the-uk/>
- ⁵⁹ E4tech and Element Energy, Hydrogen and Fuel Cells: Opportunities for Growth – A Roadmap for the UK, August 2016 <http://www.e4tech.com/reports/hydrogen-and-fuel-cells-opportunities-for-growth-a-roadmap-for-the-uk/>
- ⁶⁰ Energy Research Partnership, The Potential Role of Hydrogen in the UK Energy System, October 2016 <http://erpuk.org/project/hydrogen/>
- ⁶¹ 150 GW calculation based on 35% load factor, 80% electrolyser efficiency, 7% electricity transmission and distribution losses, and domestic heat demand of 350 TWh.
- ⁶² See <http://www.globalccsinstitute.com/projects/air-products-steam-methane-reformer-eor-project>
- ⁶³ See <http://www.globalccsinstitute.com/projects/quest>
- ⁶⁴ See <https://www.gasworld.com/global-ccs-institute-applauds-shell-quest-ccs-milestone/2011423.article>
- ⁶⁵ Committee on Climate Change, Meeting Carbon Budgets: 2016 Progress Report to Parliament, June 2016 <https://documents.theccc.org.uk/wp-content/uploads/2016/06/2016-CCC-Progress-Report.pdf>
- ⁶⁶ Imperial College London, Centre for Energy Policy and Technology, Managing Heat System Decarbonisation: Comparing the impacts and costs of transitions in heat infrastructure, April 2016 <http://www.imperial.ac.uk/media/imperial-college/research-centres-and-groups/icept/Heat-infrastructure-paper.pdf>
- ⁶⁷ Energy Technologies Institute, Pale Blue Dot, Costain and Axis, Progressing Development of the UK's Strategic Carbon Dioxide Storage Reserve: A Summary of Results from the Strategic UK CO₂ Storage Appraisal Project, April 2016 <http://www.eti.co.uk/project/strategic-uk-ccs-storage-appraisal/>
- ⁶⁸ The Knowledge Transfer Network, From Shale Gas to Biomass: The Future of Chemical Feedstocks, August 2016 https://connect.innovateuk.org/documents/15494238/0/Shale+Gas+to+Biomass+2016+Web+020816.pdf/e4211721-5da2-4743-ae28-666409706c40?_ga=1.183436070.1648127770.1472212002
- ⁶⁹ Lowest cost decarbonisation for the UK: The critical role of CCS, Report to the Secretary of State for Business, Energy and Industrial Strategy from the Parliamentary Advisory Group on Carbon Capture and Storage (CCS), September 2016 <http://www.ccsassociation.org/news-and-events/reports-and-publications/parliamentary-advisory-group-on-ccs-report/>
- ⁷⁰ Committee on Climate Change, Next steps for UK heat policy, October 2016 <https://www.theccc.org.uk/publication/next-steps-for-uk-heat-policy/>

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
LONDON
EC3M 8UD

By email to: NIAEvidence@nic.gsi.gov.uk

10 February 2017

Dear Sir

National Infrastructure Assessment Call for Evidence

Thank you for the opportunity to respond to the Commission's call for evidence to provide input into the development of its National Infrastructure Assessment. This letter should be regarded as a consolidated response on behalf of UK Power Networks' three distribution licence holding companies: Eastern Power Networks plc, London Power Networks plc, and South Eastern Power Networks plc.

We have responded to three questions in the call for evidence that are relevant to our activities as a distribution network operator. Our comments are set out in the appendix to this letter.

We would also draw your attention to our response to the call for evidence on A Smart, Flexible Energy System by Ofgem and the Department of Business Energy And Industrial Strategy, which we attach separately.

I hope that you will find our comments helpful. If you have any questions, please do not hesitate to contact me.

Yours faithfully

[signature redacted]

[name redacted]
[job title redacted]
UK Power Networks

Copy: [name redacted], [job title redacted], UK Power Networks

Appendix: UK Power Networks' response to selected questions in the Commission's call for evidence (October 2016)

Cross-cutting issues:

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

There are key interdependencies between transport, heat and electricity demands. As the solutions to decarbonising these systems develop, through low carbon electricity and other low carbon energy sources such as hydrogen, it will be important to consider the interactions and resilience implications, as is already the case between the gas and electricity sectors.

The future energy system will also be reliant on the resilience and security of information systems that allow the control of smart demands (e.g. smart domestic appliances and electric vehicle (EV) charging). A risk based, proportionate and flexible approach to cyber security will be required.

Energy:

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.

A zero carbon system will need to have flexibility at the core of its operation, including flexible demand and energy storage technology (comprising of grid scale, behind the meter domestic and commercial and vehicle to grid technologies).

We believe that the transition of distribution network operators to active distribution system operators will be key to this transition. In this respect, we would highlight our attached response to the call for evidence on A Smart, Flexible Energy System by Ofgem and the Department of Business Energy And Industrial Strategy.

The approach to decarbonisation of heat will be a key issue for electricity systems in the period beyond 2030, given the 300GW of heat demand compared to the current 60-70GW of electricity demand.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

The anticipated uptake of low carbon technologies such as EVs, storage and distributed generation means that, by the mid-2020s, we could see over two million active devices providing flexibility on our three distribution networks.

Current forecasts indicate that by 2030, EVs could introduce as much as 3GW of additional demand to the peak demand in UK. Recent analysis showed that electrification of taxis and buses in London could see the connection of approximately 1.5GW of charge points by 2030. This can be compared to the current peak demand on the London network of 4.8GW.

The need for additional generation, transmission and distribution resources will depend on how the energy demand coincides with existing demands or can make use of periods of lower demand. A key priority for government, which we have highlighted in our response to a Smart, Flexible Energy System, should therefore be the development of a smart vehicle charging framework. This needs to encourage cross-sector cooperation to develop the technology (both vehicle and charging control), infrastructure, markets and incentives that encourage customers to adopt EVs in a way that allows the transport and supporting energy infrastructure to develop efficiently. For example, low cost energy is currently available during the daytime when demand is lower and solar generation output is at its peak, so it would seem sensible, from an energy system perspective, to provide the infrastructure and incentives to encourage charging of EVs at this time, rather than in the evening when demand is higher. This may require a framework where users are encouraged to charge vehicles away from home.

Improving visibility of the location, characteristics and use of charge points will be vital to realising the benefits of smart charging for customers and electricity networks, and to enabling the efficient development of the supporting energy system. We would welcome government support in this respect.

Finally, fast charging infrastructure (with output up to 350kW) may require significant infrastructure investment to support; therefore, understanding the likely development will be a key input into future planning. We are already working with Transport for London on the implications for the electrification of the London bus fleet and how best to connect the additional demand (potentially 800MVA). Attention is also turning to planning for the provision of charging infrastructure to support the electrification of the London taxi fleet.

UK Power Networks response to A smart, flexible energy system

January 2017



ukpowernetworks.co.uk



WINNER
Utility of the Year



**INVESTORS
IN PEOPLE** | Gold

**UK
Power
Networks** 
Delivering your electricity

Contents

Executive summary	5
1. Removing policy and regulatory barriers	14
Enabling storage	14
Question 1: Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by industry?	14
Question 2: Have we identified and correctly assessed the issues regarding network connections for storage? Have we identified the correct areas where more progress is required?	17
Question 3a): Have we identified and correctly assessed the issues regarding storage and network charging?	20
Question 3b): Do you agree that flexible connection agreements could help to address issues regarding storage and network charging?	22
Question 4a): Do you agree with our assessment that network operators could use storage to support their networks?	22
Question 4b): Are there sufficient safeguards to enable the development of a competitive market for storage?	23
Question 4c): Are there any circumstances in which network companies should own storage?	23
Question 5: Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage?	25
Question 6: Do you agree with any of the proposed definitions of storage?	25
Aggregators	26
Question 7: What are the impacts of the perceived barriers for aggregators and other market participants? Please provide your views on:	26
Question 8: What are your views on these different approaches to dealing with the barriers set out above?	27
Question 9: What are your views on the pros and cons of the options outlined in Table 5? Please provide evidence for your answers.	27
Question 10: Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure? Do you have views on the tools outlined to mitigate this risk?	27
2. Providing price signals for flexibility	29
System value pricing	29
Question 11: What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future?	29
Question 12: If you are a potential or existing provider of flexibility could you provide evidence on the extent to which you are currently able to access and combine different revenue streams? Where do you see the most attractive opportunities for combining revenues and what do you see as the main barriers preventing you from doing so?	31
Question 13: If you are a potential or existing provider of flexibility are there benefits of your technology which are not currently remunerated or are undervalued? What is preventing you from capturing the full value of these benefits?	31
Question 14: Can you provide evidence to support changes to market and regulatory arrangements that would allow the efficient use of flexibility and what might be the Government's, Ofgem's, and System Operator's role in making these changes?	31
Smart tariffs	32
Question 15: To what extent do you believe Government and Ofgem should play a role in promoting smart tariffs or enabling new business models in this area? Please provide a rationale for your answer, and, if you feel Government and Ofgem should play a role, examples of the sort of interventions which might be helpful.	32
Question 16: If deemed appropriate, when would it be most sensible for Government/Ofgem to take any further action to drive the market (i.e. what are the relevant trigger points for determining whether to take action)? Please provide a rationale for your answer.	34

Question 17: What relevant evidence is there from other countries that we should take into account when considering how to encourage the development of smart tariffs?	34
Question 18: Do you recognise the reasons we have identified for why suppliers may not offer or why larger non-domestic consumers may not take up, smart tariffs? If so, please provide details, especially if you have experienced them. Have we missed any?	35
Smart Distribution tariffs: Incremental change	35
Question 19: Are distribution charges currently acting as a barrier to the development of a more flexible system? Please provide details, including experiences/case studies where relevant.	35
Question 20: What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility?	35
Question 21: How problematic and urgent are any disparities between the treatment of different types of distribution connected users? An example could be that that in the Common Distribution Charging Methodology generators are paid 'charges' which would suggest they add no network cost and only net demand.	36
Smart Distribution tariffs: Fundamental change	36
Question 22: Do you anticipate that underlying network cost drivers are likely to substantively change as the use of the distribution network changes? If so, in what way and how should DUoS charges change as a result?	36
Question 23: Network charges can send both short term signals to support efficient operation and flexibility needs in close to real time as well as longer term signals relating to new investments, and connections to, the distribution network. Can DUoS charges send both short term and long term signals at the same time effectively? Should they do so? And if so, how?	37
Question 24: In the context of the DSO transition and the models set out in Chapter 5 we would be interested to understand your views of the interaction between potential distribution charges and this thinking.	37
Other Government policies	38
Question 25: Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future?	38
Question 26: What changes to CM application/verification processes could reduce barriers to flexibility in the near term, and what longer term evolutions within/alongside the CM might be needed to enable newer forms of flexibility (such as storage and DSR) to contribute in light of future smart system developments?	38
Question 27: Do you have any evidence to support measures that would best incentivise renewable generation, but fully account for the costs and benefits of distributed generation on a smart system?	38
3. A system for the consumer	40
Smart appliances	40
Question 28: Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)? Yes or No (please explain)	40
Question 29: What evidence do you have in favour of or against any of the options set out to incentivise/ensure that these principles are followed? Please select below which options you would like to submit evidence for, specify if these relate to a particular sector(s), and use the text box/attachments to provide your evidence.	40
Question 30: Do you have any evidence to support actions focused on any particular category of appliance? Please select below which category or categories of appliances you would like to submit evidence for, and use the text box/attachments to provide your evidence:	41
Question 31: Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified?	41
Question 32: Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers?	41
Ultra-low emissions vehicles	41
Question 33: How might Government and industry best engage electric vehicle users to promote smart charging for system benefit?	41

Question 34: What barriers are there for vehicle and electricity system participants (e.g. vehicle manufacturers, aggregators, energy suppliers, networks and system operators) to develop consumer propositions for the:	43
Question 35: What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium?	45
Consumer engagement with demand side response	45
Question 36: Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services?	45
Question 37: Do you recognise the barriers we have identified to large non-domestic customers providing DSR? Can you provide evidence of additional barriers that we have not identified?	46
Question 38: Do you think that existing initiatives are the best way to engage large non-domestic consumers with DSR? If not, what else do you think we should be doing?	46
Question 39: When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (i.e. in terms of trigger points)?	47
Consumer protection and cyber security	47
Question 40: Please provide views on what interventions might be necessary to ensure consumer protection in the following areas:	47
Question 41: Can you provide evidence demonstrating how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely this is?	50
Question 42: What risks would you highlight in the context of securing the energy system? Please provide evidence on the current likelihood and impact.	51
4. The roles of different parties in system and network operation	52
Roles and responsibilities	52
Question 43: Do you agree with the emerging system requirements we have identified)? Are any missing?	52
Question 44: Do you have any data which illustrates:	53
Question 45a): With regard to the need for immediate action, do you agree with the proposed roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wide use of resources?	58
Question 45 b): With regard to the need for immediate action, how could industry best carry these activities forward? Do you agree the further progress we describe is both necessary and possible over the coming year?	61
Question 45 c): With regard to the need for immediate action, are there any legal or regulatory barriers (e.g. including appropriate incentives), to the immediate actions we identify as necessary? If so, please state and prioritise them.	62
Question 46a): With regard to further future changes to arrangements, do you consider that further changes to roles and arrangements are likely to be necessary? Please provide reasons. If so, when do you consider they would be needed? Why?	63
Question 46 b): With regard to further future changes to arrangements, what are your views on the different models, including:	68
5. Innovation	72
Question 47: Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas?	72
Question 48: Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer.	72
Annex 1: Stakeholder engagement	73
Annex 2: Bibliography	74

Executive summary

The priorities for Government and Ofgem in 2017

Distribution networks have already responded to the challenge of the changing energy market, connecting 27GW of distributed generation (DG), of which 8.5GW has connected across UK Power Networks' service area (with a further 2.4GW contracted to connect). We have already begun the roll-out of active network management of DG allowing 330MW of generation to connect saving over £100m to DG customers. Current forecasts for the development of low carbon technologies indicate that the capability to use flexibility extensively will be needed from the mid-2020s.

Research undertaken by Imperial College for our Low Carbon London project¹, The Carbon Trust² and E3G³ clearly demonstrate the benefits from a smart, flexible energy system which will be enabled by the transition of Distribution Network Operators (DNOs) to Distribution System Operators (DSOs).

In developing our response, we have actively engaged with stakeholders, including renewable generators, storage providers, aggregators, suppliers and new IT platform providers. Our engagement has provided us with first-hand experience of the issues which these stakeholders face, both in their interaction with us as a network operator and also the wider market place. We have used this experience to inform this response.

We consider that Ofgem and BEIS's should:

- Start the work needed to build on the RIIO regulatory framework to develop aligned incentives for transmission and distribution in time for RIIO-T2 and RIIO-ED2, to deliver whole system flexibility benefits and cost effective decarbonisation;
- Engage with DNOs and the System Operator (SO) to understand the additional costs of developing the advanced monitoring and control systems and enhanced organisational capabilities which will be critical to ensure an efficient flexible energy system, and the additional costs that will need to be incurred developing and deploying these capabilities;
- Clarify the regulatory framework to ensure DSOs can build storage as the least cost technical solution to provide security of supply if specific local circumstances inhibit those services being provided by third parties;
- Support the development of the commercial frameworks and platforms that will allow markets and DSOs to support the complex interactions of a smart, flexible energy system including the visibility of actions to all parties; and
- Support the development of standards to ensure the visibility and control of smart EV charging in conjunction with the Department for Transport and their work on the Modern Transport Bill.

The role of different parties in system and network operation: DNOs must become DSOs and lead the transition to a smart, flexible energy system

The benefits of smart, flexible systems are estimated to be up to £8bn a year by 2050⁴ and rely on the optimisation of distribution connected resources. Since 2010 we have invested heavily in innovation to understand how to deliver these benefits and our highly successful innovation projects are helping us to develop DSO capabilities across our business. Our response draws on the learning from successful projects including:

¹ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/)

² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf

³ <https://www.e3g.org/library/plugging-the-energy-gap>

⁴ Imperial College & The Carbon Trust 'An analysis of electricity system flexibility in GB':

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf November 2016

- The Low Carbon London (UK Power Networks) and Customer Led Network Revolution (Northern PowerGrid) trials on many of the elements of flexible networks needed for a DSO, testing smart tariffs, EV charging, and demand-side response (DSR);
- The Flexible Plug and Play (UK Power Networks) project which pioneered flexible connections using active network management to allow customers to connect more quickly and at a lower cost;
- The Smarter Network Storage (UK Power Networks) project which demonstrated the value of grid scale storage and highlighted many of the issues raised in the call for evidence;
- The Kent Active System Management (UK Power Networks) and Equilibrium (Western Power Distribution) projects are developing the tools DSOs will need to optimise the use of distribution networks to increase the output of distributed energy;
- The My Electric Avenue (SSE Power Distribution) project which was the first project to look at smart domestic EV charging;
- The Flexible Approaches to Low Carbon Optimised Networks (FALCON) (Western Power Distribution) and Flexible Networks for a Low Carbon Future (Scottish Power Energy Networks) projects which demonstrated tools and techniques including dynamic ratings and network modelling and monitoring to optimise the use of networks;
- The Customer Load Active System Services (CLASS) (Electricity North West) project which has proven that distribution network management can provide cost effective solutions to wider system management;
- The energywise (UK Power Networks) project which is looking at how to engage fuel poor and vulnerable customers in the smart energy transition; and
- The TDI 2.0 (National Grid and UK Power Networks) project which will pioneer the integration of systems and commercial arrangements between SO and DSO to optimise the whole system benefits of flexibility.

In the past few years, our networks have been at the forefront of the low carbon transition. We have issued connection offers to 54GW of storage and generation since 2012, requiring us to change the way we operate as a business to meet the associated challenges. This has involved deploying the DSO capability from innovation trials into our business, particularly in our Eastern and South Eastern regions. This has been successful in helping to reduce the cost of connecting for generation customers by over £100m. UK Power Networks will continue to develop our work on flexible generation connections, using the pioneering tools being developed in our Kent Active System Management project and our other innovation projects to see how we can minimise system constraints and optimise the use of the generation connected to our networks.

The anticipated uptake of low carbon technologies such as electric vehicles, storage and distributed generation means that, by the mid-2020s, we could see over two million active devices providing flexibility on our three distribution networks. To deliver the scale of benefits cited in the Call for Evidence, DSO capabilities will need to be focussed on optimising the resources on our distribution network, not only to avoid distribution reinforcement but to deliver whole system solutions that support cost effective decarbonisation. We are actively working with National Grid, including through the joint TDI 2.0 innovation project, to further develop our capabilities in this area.

The transition to DSO represents a paradigm shift in the complexity of system operation and the smart control systems needed to support it. Network operators should be empowered to develop and deploy the supporting DSO infrastructure so that flexibility can develop efficiently in response to local and whole system needs. The regulatory framework should fully recognise the risks and costs associated with the development and deployment of new technologies, and clear incentives are needed to facilitate a timely evolution towards a smart DSO future. Clearly, enhancing the present commercial and regulatory framework.

Incentive regulation in Great Britain has been successful in promoting innovation to deliver efficiency and service improvements within the individual parts of the energy system. Indeed, regulators in

many parts of the world are looking at the totex incentives used in the RIIO framework as a good foundation for developing flexible energy systems. We believe that the current RIIO model can be adapted to support DNOs to complete the transition to DSOs and optimally manage the resources on their networks. We would like to see Ofgem and BEIS build on this Call for Evidence by establishing a work programme with industry to develop the regulatory incentive frameworks to incentivise transmission and distribution network investments to reduce whole system costs in time for the start of RIIO-ED2 and RIIO-T2. We believe that our track record in delivering safe, reliable networks with excellent customer service puts DNOs in a good position to develop into effective DSOs.

The DSO model will need to be supported by appropriate commercial frameworks that provide a level playing field for all technologies. We believe that contractual frameworks for flexibility services can best provide the conditions to support investment needed to develop new flexible resources (including storage and demand side flexibility), particularly where these are being used as alternatives to traditional solutions to provide security of supply. As the number of flexible distributed energy resources grow, more complex market platform arrangements for flexibility may be required. We are therefore supporting and learning from a number of novel commercial platforms that are being proposed and trialled, for example Centrica's Cornwall Local Energy Market, and a recent bid for EEF funding by Open Utility, looking at both marginal price platforms and peer to peer markets. We believe DNOs, Ofgem and BEIS should support these to explore the different information needs and interfaces they will require from the DSO.

Removing policy and regulatory barriers: Enabling storage

Our Smarter Network Storage (SNS) project has demonstrated that clear benefits to network customers are deliverable by DNOs using storage to manage the network. SNS first highlighted many of the issues which are raised in the Call for Evidence.

Storage is a key technology in ensuring security of supply at an efficient cost as it provides:

- An alternative customer for generation output that is local to the point of production, and able to relieve export constraints;
- An option that allows DSOs to balance supply and demand local to needs;
- An alternative to traditional network reinforcement, or allowing it to be deferred thereby creating option value where there is uncertainty in load forecasts;
- A fast response to address frequency control for the whole system and address power quality issues in distribution networks where there are many variable loads; and
- A source of voltage control to manage issues such as high voltages at times of low demand and high generation.

We are fully supportive of the development of a competitive market in this fast moving sector, so that storage can provide services to the whole value chain. Over the last 15 months we have witnessed a buoyant storage market. We have received over 600 applications for the connection of 12GW of storage.

Many DSO services needs are likely to be very specific and highly locational. When procuring flexibility services for specific constraints it will be important for DSOs to have the least cost technical option, including storage, available to ensure customers get the most efficient outcome. Where storage is developed by the networks, the enduring framework that we are putting in place for SNS should be considered as the template for arrangements to maximise the value of the investment to the benefit of customers.

The typical size of a storage application we have seen to date is 20MW (the equivalent to a small town of 9,000 domestic homes) often with complex and specific technical requirements which we need to assess and accommodate. It is therefore not surprising that connections costs can be high where there is not the capacity to accommodate such large demands without reinforcement. The scale of applications for storage connections has represented a significant challenge for us as a

business. We have responded by undertaking substantial engagement with storage providers to understand their needs and improve the service we provide to them and have taken the following steps:

- Introduced a connections guide specifically for storage providers which provides clarity to new entrants on how their application will be treated from a network design perspective. This guidance is now becoming industry best practice;
- Introduced a simple and clear common connections application template for storage which has since been adopted as industry best practice through the Energy Networks Association (ENA);
- Introduced demand heat maps (alongside our existing generation ones) to provide a transparent picture of where there is available capacity on our networks;
- Run customer surgeries to improve our understanding of the needs of stakeholders and collect feedback on the processes we have introduced to improve our service; and
- Offered flexible connections to storage providers whose connection request triggers reinforcement. The availability requirements of the first Enhanced Frequency Response (EFR) tender from National Grid did not favour flexible connections but we strongly believe that future service requirements should be developed to facilitate these.

Whilst these initiatives have been successful to a large degree, we are identifying further improvements through our ongoing engagement with customers. For example: we are considering whether allowing developers to specify a range of capacities on their application could allow a more effective and efficient discussion with planning engineers. Equally, developers still find they need access to planners with knowledge of the system and status of existing connection applications, which we could better support if we were able to charge assessment and design fees to cover the costs. The industry has also started the work to clarify how storage is treated under planning standards and look at the differences between transmission and distribution.

We have been supportive through our SNS project of clarifying the status of storage in the regulatory framework. We support the definitions proposed in the Call for Evidence, and are of the opinion that these make a distinction between systems developed for the purpose of storing electricity and devices such as capacitors in use on the distribution networks to maintain technical compliance.

The work to codify the distinct needs of storage in the industry codes and as a category of generation needs to be undertaken whatever enduring legal arrangements are put in place. Ofgem and BEIS should consider creating a separate licence category when the opportunity arises to amend legislation.

However, we think there are some key policy aspects which Ofgem and BEIS should examine at to help the development of the storage market:

- Support the industry in the development of a whole system framework which allows storage (and other providers) to stack the value of services they can provide to different industry parties;
- Progress the introduction of assessment and design fees to recover the costs of providing better services to flexibility developers whilst providing an incentive against excessive speculative applications;
- Address the issue of undue levies on imports to energy storage systems; and
- Provide clarity on the regulatory treatment of storage to ensure that distribution networks can provide bespoke cost reflective charges to storage and own storage assets where the market does not deliver.

Pricing for flexibility

The development of the resources to enable flexibility needs a framework that supports investment. Current contracts for flexibility such as National Grid's Enhanced Frequency Response Contracts and

DNO demand side response services are trying to provide this. We currently see contracts as key to allow resources to be procured as an alternative to traditional assets. Contracts for flexibility help ensure that they are available when needed, and can provide an appropriate fixed term income against which flexibility providers can invest in new services. Price based flexibility has not provided sufficient certainty to avoid the need for the Capacity Mechanism in the wholesale market and we are concerned that, on its own, it would not support a flexibility market either. However as the volume of flexible resources increases, price flexibility may become a more valuable tool in dispatch of resources and we would expect the market arrangements to evolve to support this.⁵

Price signals and the development of smart tariffs

Existing network tariffs already exhibit some smart characteristics. Existing DUoS tariffs provide time of day signals (CDCM) for all half hourly metered customers (including an option for domestic smart meter customers) and locational and seasonal signals (EDCM). They also have to fulfil two key objectives to provide:

- Stable forward price signals and ensure fair recovery of fixed and sunk costs; and
- Signals to promote the efficient development of the network.

Our experience gained in Low Carbon London indicates that consumers are receptive to smart tariffs but that the differentials between peak and off peak charges required to incentivise changes in behaviour need to be significant (between 2 and 6 times normal tariffs)⁶. One of the key challenges with smart tariffs will be the balance between the fair recovery of fixed and sunk costs against the need to send price signals most customers respond to as highlighted by CEPA in on the following page.

The needs of the tariffs and service contracts that emerge will be driven by the framework under which flexibility is ultimately procured or scheduled. Experience in existing markets indicates that a structure of markets and price signals is needed that:

- Incentivises or procures sufficient flexible capacity at the location required (provides predictable investable signals);
- Schedules or allocates the systems' available resources efficiently (in near real time); and
- Recovers the fixed and sunk costs of the system in a fair manner.

Industry experience is that significant tariff changes can take several years to design and implement.⁷

⁵ See Berkley Labs Future Electric Utility Regulation 'Distribution Systems in a high distributed energy resource future', October 2015:

https://emp.lbl.gov/sites/all/files/FEUR_2%20distribution%20systems%2020151023.pdf and also Scottish Power Energy Network's DSO paper:

<http://www.spenergynetworks.co.uk/userfiles/file/SPEN%20DSO%20Vision%20210116.pdf>

MIT Energy Initiative: Utility of the future: <http://energy.mit.edu/research/utility-future-study/> December 2016

⁶ Low Carbon London report A3 Sept 2014 'Residential consumer responsiveness to time of use pricing':

[http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A3%20-%20Residential%20consumer%20responsiveness%20to%20time%20varying%20pricing.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A3%20-%20Residential%20consumer%20responsiveness%20to%20time%20varying%20pricing.pdf)

Department of Energy and Climate Change July 2014: Electricity Price Signals and Demand Response.

<https://www.gov.uk/government/publications/electricity-price-signals-and-demand-response>

Customer Led Network Revolution Jan 2015: High Level Summary of Learning: Domestic Smart Meter

Customers on Time of Use Tariffs <http://www.networkrevolution.co.uk/wp-content/uploads/2015/01/CLNR-L243-High-Level-Summary-of-Learning-Domestic-Smart-Meter-Customers-on-Time-of-Use-Tariffs.pdf>

⁷ The distribution structure of charges projects started in 2000 and did not fully conclude until 2012.

Objectives and principles for network charging in a more flexible electricity system

Electricity network charges have two primary objectives: (i) the **recovery of electricity allowed revenues**; and (ii) the **provision of price signals** to beneficially influence system user (consumer and producer) behaviour. Changes may be required in future to GB network charging methodologies to address the challenges of a more flexible electricity system and to capture the opportunities such a system creates. As is the case today, however, the underlying charging issue will be how these two primary objectives are reconciled.

To achieve this, the general principles that underlie network charging decisions today should continue to apply in a more flexible electricity system. Those principles include:

- **Cost reflectivity** – as is the case today cost reflective network access charging is important to help convey the costs market participants create at the time they make their operational or investment decisions to use the network;
- **Transparency and predictability** – in the context of practically shaping network user behaviour, the quality of price signals is also relevant, making transparency and predictability relevant principles for charging; and
- **Non-discrimination** – charges for electricity network access should be non-discriminatory, dependent on how the network is used rather than based on the particular activities that it is used for.

With the increasing uptake of distributed energy resources (DERs), charging structures will increasingly need to balance the following in the practical application of these principles:

- The expected or necessary spatial and temporal granularity of network charge signals to encourage the **efficient use of and investment in resources** to deliver the services the electricity system needs;
- Transparency and predictability are generally achieved through simple tariffs, but this may create some tension with the principle of cost-reflectivity as truly **cost-reflective network tariffs should capture network costs that are specific to (i) capacity; (ii) volume; (iii) location; and (iv) time**;
- Competition between different resources and solutions to system needs based **on a level playing field**;
- Tariff structures that create a **fair and sustainable basis** for cost allocation and recovery between network user groups; and
- A future basis for cost recovery that distorts price signals and decisions of potential flexibility providers as little as possible from cost reflective levels, while remaining non-discriminatory.

Reconciling the primary objectives of network charging (recovering allowed revenue and providing price signals to beneficially influence system user behaviour) may as a consequence not be easy to achieve in a more flexible electricity system.

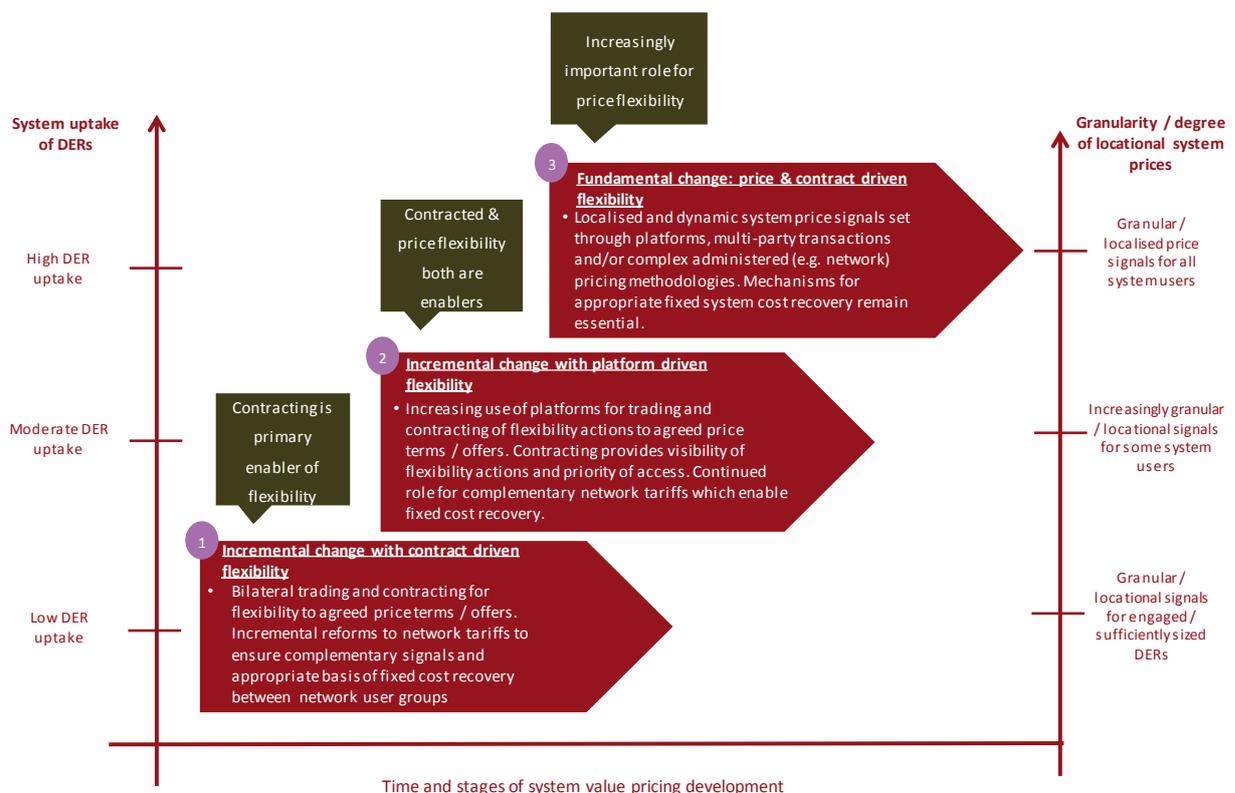
The emphasis which is placed on the different principles may need to adapt as the system and other aspects of the electricity market architecture evolve.

CEPA 2017

We believe that a practical way forward as illustrated in Figure 1 will be to:

- Use contracted flexibility routes to provide the price signals and incentives for flexibility actions and stimulate the development of flexibility resources in the market in the near term;
- Make incremental changes to current (e.g. network) charging methodologies when issues are identified to ensure that: price signals complement the value signals for flexibility from contracted system services; and there continues to be appropriate contributions to fixed system cost recovery between system user groups; and
- In the longer term, as the number of DER and system user price responsiveness increases, price driven flexibility can increasingly enable response through localised, granular, marginal energy and network price signals.

Figure 1 Role and complexity of system value pricing in different stages of future distribution flexibility system development – CEPA adapted from Berkley Labs⁸



In the longer term, there needs to be further thought about the contributions different network users make to DNO cost recovery through tariffs. We see the potential for prosumers and local community energy groups start to be more self-sufficient for their energy needs but they will still rely and benefit from network infrastructure for security of supply, and therefore need to contribute to networks' capacity in a fair manner. This issue (of fixed and sunk cost recovery) must be a key focus of any future review of tariffs, along with what is needed to support the development of flexibility markets. There are a number of charging approaches (a good summary is provided in the NARUC rate design

⁸ CEPA : Adapted from Berkley Labs Future Energy October 2015

https://emp.lbl.gov/sites/all/files/FEUR_2%20distribution%20systems%2020151023.pdf

manual⁹) which all have strengths and weaknesses, which we summarise in our main response. As flexibility develops, a combination of approaches over time will likely be needed.

The pricing approach used will have to support suppliers' tariffs and the commercial processes used to manage flexibility in the system. A number of novel approaches are being explored or proposed through innovation projects (including those by Centrica, Open Utility, Electron, InnovateUK and the National Grid / UK Power Networks TDI2.0 project) which we are actively engaged with, and believe this is an area which should be explored further. Our experience from our innovation projects shows that trials are the ideal way to develop the best approach for the GB system. Ofgem and BEIS should be promoting innovation in this area with a view to a common approach will being developed when active DER volumes increase.

A system for the Consumer: Ultra Low Emission Vehicles, Smart Appliances and Cyber Security

One of the most significant flexible future demands on distribution networks will come from electric vehicles (EVs). EVs will be a key enabler in achieving improvements in air quality and meeting carbon reduction targets for transport.

Optimising the use of existing networks to keep network reinforcement costs low will be key, especially given the needs of fast and high capacity charging. To facilitate the cost effective decarbonisation of transport, we believe that we will require:

- Visibility of where chargers are installed, their usage and future planned installations in order that we can plan and manage our network effectively;
- Smart tariffs to customers to incentivise charging outside network peak demand; and
- An ability to control charging to ensure network infrastructure operates within its technical capabilities and ensure efficient development of the network infrastructure required to accommodate charging points.

To support this, BEIS and Ofgem should work with vehicle manufacturers, network operators, suppliers and aggregators to:

- Develop technology and commercial standards to enable visibility and control smart charging of vehicles; and
- Develop and trial smart tariffs to support smart charging.

EV charging is a specific area where smarter charging structures may have a role. EV customers are more likely to be more engaged with and accepting of smart tariffs. The charging infrastructure or the vehicles themselves could also have in-built enabling technology to deal with complex price signals, simplifying user interactions and providing certainty of response.

As with all consumer devices, it will be important for government to support standards that enable interoperability, and provide confidence for consumers and security for the power system. The government should support the development of smart home systems with appropriate risk based cyber security controls.

Innovation: supporting the transition

Our successful innovation projects have demonstrated that using trials to develop and demonstrate solutions to the needs of a smart flexible energy system will be essential to its successful delivery. The key areas for ongoing innovation we have identified include:

- Supporting innovation that delivers value across the whole system, beyond individual network or system operator business scope, as is being trialled in TDI2.0;

⁹ NARUC Distributed Energy Resources Rate Design Manual November 2016

<http://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0>

- Supporting trialling of emerging commercial and market models and platforms, not just technology to be embedded into network/system operator operations;
- Facilitating cross energy vector projects (e.g. Hydrogen or heat projects) and not just electricity in NIA/NIC;
- Supporting local energy (including community energy schemes) to ensure approaches exist to allow those least able to adopt smart flexibility technologies;
- Supporting the development of smart EV charging technologies and commercial frameworks to facilitate the development of interoperable standards and visibility of EV charging to network operators; and
- Supporting the development of vehicle to grid technologies with the UK automotive technology sector.

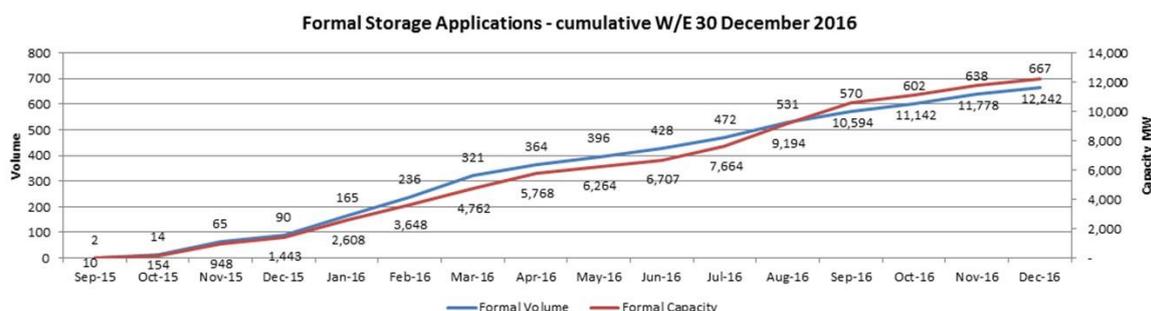
The subsequent sections of this document provided detailed responses to the questions raised in the Call for Evidence.

1. Removing policy and regulatory barriers

Enabling storage

We have practical experience of the issues highlighted in the Call for Evidence, having successfully delivered and operated the largest battery storage project in the UK (smarter network storage – SNS). We worked closely with National Grid and aggregators to use battery storage as an alternative to £6m of traditional reinforcement in Leighton Buzzard. We have also processed 12GW of applications from over 600 storage providers (as shown by Figure 2 below).

Figure 2: Storage application requests to UK Power Networks September 15 – December 16



As the first project in the country to go through the full design and implementation process, our SNS project has outlined many of the barriers mentioned in the Call for Evidence¹⁰. Our learning from the SNS project is that an effective market for storage providers has the potential to allow us to procure lower cost services and help to deliver network outputs at a lower cost to our customers.

Question 1: Have we identified and correctly assessed the main policy and regulatory barriers to the development of storage? Are there any additional barriers faced by industry?

The feedback we have received from storage providers mostly aligns with the regulatory barriers set out in the Call for Evidence. We draw attention below to some of the additional barriers in facilitating the whole system value of storage which, if addressed, could better facilitate the storage market.

The Call for Evidence outlines six main barriers, which we cover in turn below. We also list the additional barriers where support from Ofgem/BEIS would be welcomed.

a) New connections

We have covered new connections for storage in detail in our response to question 2. In summary, the one element missing from the Call for Evidence is an acknowledgement that the high cost for new storage connections is largely driven by their size (typically 20MW, equivalent to a small town). The current 'shallowish' connections charging boundary has been successful in incentivising customers to connect where there is existing spare capacity. However, the size of typical storage plant and its need to ramp between import and export, means that there are a limited number of areas on the network with the capacity to connect them without reinforcement.

We have trialled a number of approaches with developers to help inform where capacity is available, including heat maps. However, customer feedback continues to support access to an informed planner who can advise them and provide information on the current position on connections activity, which we support with regular customer surgeries where prospective applicants can discuss options with planners. There are clearly issues for DNOs who have limited resources with the skills and

¹⁰ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/Project-Documents/Report+9.5+19Oct_v2.1_%28Final+Photos%29.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/Report+9.5+19Oct_v2.1_%28Final+Photos%29.pdf)

experience to advise on complex storage applications in providing a balance between supporting pre-application advice and meeting obligations relating to quotation timescales. However, our experience (which our discussions with developers supports) is that we need:

- Regulatory support for the introduction of reasonable assessment and design fees to support the delivery of a higher level of service and deter highly speculative enquiries; and
- To adapt our processes to allow developers to specify a range of capacity (e.g. a minimum and maximum) that they would consider in an application for a connection quote; this could improve the dialogue with the DSO as it would allow the DSO to indicate the capacity that could be taken up without reinforcement.

We have been proactive in finding solutions for our customers, including offering flexible connections through active network management. However, our experience shows that storage providers have not yet taken up our offers because they did not align with the service requirements for National Grid's first Enhanced Frequency Response (EFR) tender. We are actively working with National Grid and other DNOs to understand how better alignment can be achieved in the terms for future services to enable faster and cheaper connections to take place.

b) Network charging

The Call for Evidence raises the issue of whether storage should be treated as intermittent or non-intermittent within the charging methodologies. We treat storage as non-intermittent for the purposes of network charging because most storage customers would tend to have quite predictable import and export patterns. This is beneficial for storage providers as it allows them to claim greater credits for exports under the charging methodologies.

As fully explained in our response to question 3, analysis from our SNS project has demonstrated that the charging methodologies provide appropriate cost signals for the various impacts storage can have on the network.

One of the challenges of smarter locational price signals (such as the EDCM charges) is that it is not possible for developers to calculate these for themselves, making it difficult to predict their future costs when assessing their business case for investment. This is part of the trade-off which must be considered between flexible pricing and complexity.

c) Consumption levies

The issue highlighted in the Call for Evidence was outlined in our SNS findings; storage devices currently pay the same levies as demand customers when energy is imported. Demand customers pay these levies again when the energy is released from the storage system and consumed. The levies are therefore charged twice, making the energy derived from storage more expensive than necessary. We agree that this is a challenge government needs to address. Defining storage as a separate activity would be a clear step towards being able to create specific charging arrangements for storage that avoid discrimination issues with demand and generation.

d) Planning

As a purchaser of services from storage providers, we want to ensure that these services are low cost and available in a timely manner. Storage facilities such as SNS are not comparable to traditional generation stations in terms of the impact on the local environment (be that visual or emissions based) but are currently subject to the same process and requirement. The construction costs of the building for SNS were shown to be a significant factor in the business case assessment¹¹ and could be a significant issue in the development of storage to support local network issues. Therefore, we

¹¹ SNS The business case of storage October 2016

[http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/Project-Documents/The+business+case+of+Storage.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/The+business+case+of+Storage.pdf)

are supportive of the development of planning rules and guidelines more suitable for storage than those in place for generation. Our experience from our SNS project is that planning changes could reduce the construction costs of storage and help to make storage a more financially viable alternative to reinforcement.

e) Use of storage for network operation

Through our SNS project, we have proved that storage is a valuable source of flexibility. Contracts for services from storage are providing an effective signal for investment in storage, as we have seen from the EFR and Capacity Markets.

We agree that the competitive provision of storage is most likely to deliver low cost solutions for customers, as has been evidenced by the prices seen in the EFR procurement. However, DSO services needs are likely to be very specific and highly locational. We believe that DSOs should always have the least cost technical solution available to them to meet network constraints, including the use of storage. When procuring flexible solutions to address network needs, the least cost network solution provides a key control on the costs customers will pay for the network service, and limiting this to traditional solutions for DSOs may be counter to delivering an efficient outcome for customers. We respond to this matter in detail on question 4.

f) Regulatory clarity

We agree with the need for greater regulatory clarity as without this there is uncertainty for investors. We believe that only by defining and creating specific rules for storage will we be able to maximise the benefits that it can deliver. We have supported the development of a separate licensed activity for storage, and this should be considered when the opportunity arises. We provide further thoughts in this area in our response to question 5.

Additional barriers faced by industry

Overall, we agree with the barriers mentioned above and in the Call for Evidence. However, we recommend that Ofgem and BEIS provide a clear policy steer to industry to help develop:

- **A whole system framework for flexibility services.** We consider that a commercial and regulatory framework that sets out the guidance to minimise exclusivity in service specifications and enables providers to stack whole system benefits is crucial. The development of network for services supporting supply security will need appropriate governance arrangements to ensure that such services are reliable, which could include licensing where appropriate. We can play our role in helping to develop this framework but it requires coordination of different industry parties with separate (and sometimes competing) commercial drivers. Consequently, we welcome Ofgem's participation in the ENA's TSO-DSO Project. We can see a role for Ofgem/BEIS in developing the correct regulatory incentives which empower industry to implement the roles and commercial framework to deliver these benefits. At present, regulatory incentives and commercial drivers are not well aligned across transmission and distribution which makes delivery of this framework difficult. We expand on this in our response to questions 45 and 46; and
- **A regulatory framework that permits limited network ownership of storage.** The regulatory and legal framework for storage should not deny network operators the ability to own storage where this is the least cost network solution. We expand on this further in our response to question 4.

Question 2: Have we identified and correctly assessed the issues regarding network connections for storage? Have we identified the correct areas where more progress is required?

We broadly agree with the issues identified in the Call for Evidence. We undertake extensive work with stakeholders to improve the process as part of our Incentive on Connections Engagement (ICE) plans including:

- Running two DG Fora each year, attracting around 70 participants;
- Establishing an Industry Panel of 12 invited industry experts (from the customer base) which meets regularly to review our plans and initiatives for each market sector;
- Issuing consultations on new policies and processes to ensure stakeholder input; and
- Holding over 40 surgeries with stakeholders.

Despite having customer satisfaction scores for DG customers reaching 86% in our Eastern area, there are still some areas where more progress can be made. However, we think we have put in place a range of new policies and processes in the wake of the unprecedented number of storage applications we have received:

Network Connections

a) Clarity on connections process – how to connect and where to connect

Based on extensive market engagement with our customers, we do not entirely agree with the presentation, within the Call for Evidence, of where further progress is required. Our stakeholder engagement has helped to shape our process and service offerings to storage customers. Specific improvements we have made include:

i) Clear storage process guidance

In August 2016, we issued clear guidance to help our customers understand how we will treat storage applications from a planning and design perspective¹². This provides clarity to customers on both the network planning and technical requirements associated with their application. We acknowledged that at a domestic level there is some uncertainty on how the installation of energy storage when combined with existing generation will be treated. With this in mind we are developing a separate guidance document, through consultation with the industry, to provide clarity on the application process and costs attributable to different types of installations.

In addition, we are working within the current Electricity Safety, Quality and Continuity Regulations (ESQCR) requirements to develop a 'fast track' process for the majority of domestic schemes, allowing for quicker and cheaper connections. To further inform this process, we are now running an NIA project Domestic Energy Storage and Control (DESC)¹³ where we are working closely with a small scale storage developer (Powervault) to install storage units at premises with solar generation.

The outcome of this project is threefold:

- Determine the impact of these units on the distribution network by defining the load profile changes of these households;
- Understand the potential network benefits by having control of the storage units; and

¹²http://library.ukpowernetworks.co.uk/library/en/g81/Design_and_Planning/Planning_and_Design/Documents/EDS+08-5010+Energy+Storage.pdf

¹³ <http://www.smarternetworks.org/Project.aspx?ProjectID=1967>

- Understand how the connection process can be improved and specifically understand what information should be required from customers and how best to ensure the information and visibility is given to the network operator when these units are connected.

ii) Storage specific application form

We led the development of a specific application form for storage providers which has since become industry best practice after being adopted by the ENA¹⁴. The form allows storage applicants to provide specific details of how they plan to operate allowing our network design team to provide a more bespoke connection quote based on this information. This means that we do not make 'worse case' assumptions when assessing the connection assets needed to connect the storage device. We have found that the application form can stimulate a useful dialogue with storage providers on how their planned operation can be adapted to help reduce the network investment (and connection charge to the customer). Our ongoing engagement with developers continue to seek ways to improve the information gathered. For example, we are considering whether to ask developers for an indication of the range of capacities acceptable to them as part of the application process in order to allow us to explore alternative connection designs as part of a standard application.

iii) Clarification of Engineering Recommendation P2/6

There are two aspects of P2/6 which require clarification which are being taken forward in 2017 by the ENA's P2/6 working group:

- Currently P2/6 does not recognise the contribution which storage can make (when exporting) to the network, in the same way that generation does. We agree that this needs to be amended and we are working with other DNOs, through the ENA, to make the necessary changes to P2/6. Through our SNS project, we have worked with Imperial College to develop a methodology outlining how the contribution of storage can be taken into account in network planning.¹⁵ We will be using this as an input to the ENA work on P2/6; and
- There also needs to be clarity on the treatment of storage demand under P2/6, assessing whether it is treated as a firm demand in reinforcement assessments associated with connection applications.

iv) Clarity on treatment of changes to existing applications

We have taken a lead on this issue and have been clear that the addition of storage to an existing application is a 'material change' to that connection. The addition of storage is a considerable technical change to an existing connection of application in progress, which requires a reassessment and potential redesign of the scheme. Our stance has been driven from feedback from our stakeholders, who want fair, non-discriminatory treatment.

Stakeholders have indicated that they do not think that allowing such a change while maintaining the position in the queue is fair or provides a good process. These issues have also been debated through the ENA and the consultation it produced in conjunction with stakeholders reflects the stance

¹⁴ http://www.ukpowernetworks.co.uk/internet/en/our-services/documents/2016_Energy_Storage_System_-_Futher_Information_Request_V1-5.docx

¹⁵ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/Project-Documents/SNS_P2_6_SDR9.6v1.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/SNS_P2_6_SDR9.6v1.pdf)

we have taken¹⁶. We will continue to work through the ENA to ensure a consistent approach on this issue across all DNOs.

v) UK Power Networks' range of tools to inform providers where to connect

We have provided heat maps for generation applications since 2013 with over 700 customers now signed up to use them. To further assist our storage customers, we have recently developed additional functionality to this mapping tool to provide demand data from our networks. This has resulted in another 50 customers signing up to use the application. Our customers have told us that the addition of load data to our heat maps has been helpful in their pre-application assessment of storage schemes. However, our customers still value direct engagement with network planners on the current state of connection applications. To assist this engagement, we have conducted over 40 developer surgeries in the last year to allow customers to discuss possible storage project locations to our network infrastructure planners and identify the most accessible locations.

To support the efficient development of a more interactive service for developers, the introduction of assessment and design (A&D) fees should be expedited to allow the additional costs to be appropriately recovered and encourage developers to make best use of the freely available information published such as our Long Term Development Statements. The introduction of A&D fees would also act as a strong deterrent against speculative enquiries and allow us to provide a higher quality of service to genuine connection applications.

b) Cost and time of connecting

The Call for Evidence highlights the high cost of connection for storage. While we recognise the ongoing work highlighted by Ofgem/BEIS on releasing unused capacity, the current legal provisions to reclaim unused capacity can only be applied retrospectively by agreement with the customer. In addition, we have been offering flexible connections to storage providers but the majority have found it difficult to accept these as it impacted their ability to meet the availability criteria set out by National Grid for services such as the first enhanced frequency response tender. We have set out the issues as we see them below:

i) High cost of connecting

We do not fully agree with the way that this barrier has been presented in the Call for Evidence. The high cost of connecting storage is a feature of the typical size of storage plant (20MW, or the equivalent of 9,000 domestic homes) and the shallowish charging boundary in place. There are very few places on the network which can support this size of connection without reinforcement and the charging rules mean that the connecting customer pays a proportion of these reinforcement costs up front in a connection charge. It is important to recognise that this shallowish boundary is a vital element in keeping distribution costs down for customers, since it incentivises connection where there is existing spare capacity. It has incentivised a large volume of generation to connect to the distribution networks where there is spare capacity, avoiding the need for reinforcement.

As unconstrained capacity on our networks is becoming increasingly limited, we are looking to be innovative in how we can provide better information to our customers on the extent of constraints and likelihood they will occur. Our customers want to be able to sign up to a flexible connection agreement but still retain the ability to provide services to the SO. Ultimately this will require better co-ordination between the SO and DNO in providing contracts that optimise existing assets and get the most out of energy storage within ANM areas. We are already starting the required work with National Grid, through our TDI 2.0 project.

¹⁶ <http://www.energynetworks.org/assets/files/news/consultation-responses/Consultation%20responses%202016/Fair%20and%20Effective%20Management%20of%20DNO%20Connection%20Queues%20Treating%20Changes%20within%20Applications.pdf>

- ii) Storage may need to queue for a long time behind generation for a connection even if it can relieve constraints.

We agree that that this is an issue and one where the commercial relationships are as important as the physical network. Removing a generation constraint using storage requires that the storage device imports energy at the times needed to relieve the constraint. An agreement to arbitrage energy in this manner would logically be handled today by a supplier/aggregator providing a service to the generators rather than by the DSO. At present, it is not clear to the DSO if promoting the storage provider might commercially disadvantage a generator that was ahead of it in the queue. Therefore, the DSO should not make such a decision unilaterally. We believe that this can be addressed through our contracted queue process below, but we are also looking at other approaches as part of our development work on flexible connections.

The connection queue process can be considered in two parts:

- Applications Queue: All enquiries are dealt with in application date order. This is in line with the Common Connection Charging Methodology Statement (CCCMS) and the application of our interactivity methodology. Prior to making a formal application customers are encouraged to attend a developer surgery. This allows customers to discuss their potential project with our network planners and assess the viability of connection to our network, including timescales and likely costs.
- Contracted Queue: Post offer, where slow moving projects are otherwise preventing the connection of a scheme until reinforcement is completed, we will assess the possibility of expediting those customers adversely positioned in the contracted queue but ready to connect. This assessment is carried out on a case by case basis where certain criteria can be met and agreement made between parties to ensure that system security is maintained.

Question 3a): Have we identified and correctly assessed the issues regarding storage and network charging?

The Call for Evidence highlights three issues regarding storage and network charging. We broadly agree with these and provide views on each below:

- i) Treated as non-intermittent or intermittent

We are currently treating storage as non-intermittent for the purposes of DUoS charging. We think this is appropriate in that it allows storage providers to access the same credits (i.e. payments for exports that are set against charges for imports) available under the use of system charging methodologies as non-intermittent generators. However, we would stress that this principle does not necessarily translate as counting as non-intermittent generation for contributions to network security within Engineering Recommendation P2/6. Any contribution to security of supply depends on exactly how storage is being used. For example, where a storage device is providing a service to the network such as peak lopping and has a contract to export at local demand peak, this is effectively non-intermittent. However, where a storage device is providing services such as frequency response, we have no guarantee that it will export and not import at local demand peak; therefore, it cannot be treated in the same way under P2/6.

- ii) Cost reflective import and export charges

Our experience from operating a battery on the GB system suggests that existing tariffs do not present an undue barrier. Existing tariffs provide payments to generators for export at peak times and provide a cost signal to storage not to import energy at peak times.

In terms of the connection charge levied, if a storage provider enters into a flexible connection arrangement whereby they guarantee to export at peak load, then we can account for this in the

connection design and subsequent costs. Without the contract in place it would be wrong to make the assumption that the storage device will export at peak. The storage provider may be contracted for a service which means it imports at peak and had we assumed that it only ever exports at peak, then it would threaten system security.

We agree that network charges should represent the fair recovery of network costs and should offer a level playing field. Based on the evidence from our SNS trial, we believe that distribution charges do not prohibit the business case for storage. We consider that the current EDCM charging methodology provides cost reflective import and export charges for storage. As part of our SNS project, we modelled the DUoS charges paid by the storage device. These are shown in Figure 3 below:

Figure 3: DUoS charges paid under SNS project (E=Export, I=Import)

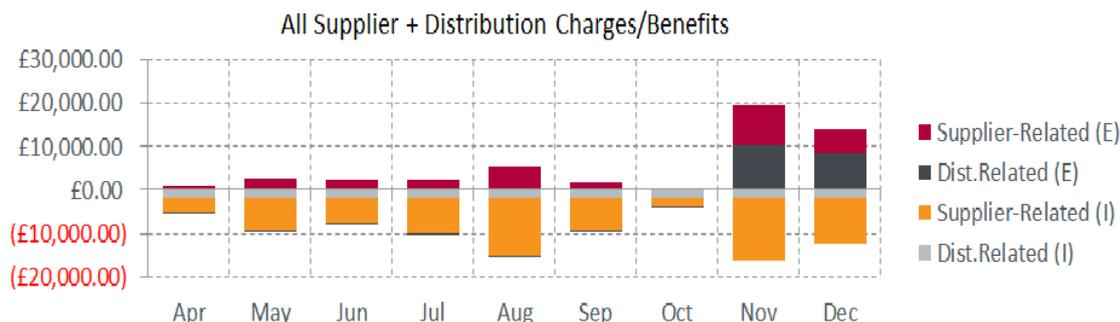


Figure 3 illustrates that DUoS charges were a very small part of the costs incurred by the battery. Due to the fact that the battery was exporting at peak demand to defer reinforcement, it received a credit under the EDCM and the net DUoS bill was a credit of £3,700 for the year. This seems appropriate since the storage device was actively supporting the network during winter months.

If the storage device was not supporting the network by exporting at network peak, we accept that there would be a different picture than that presented above. However, this would also be appropriate since the storage device would be contributing to peak and imposing costs on the network.

iii) Transparency of network charges

The Call for Evidence correctly highlights the difficulty for storage developers when estimating their network charges. We have engaged a number of our customers to understand their perspective. They have highlighted that under the EDCM, it is difficult for them to understand what DUoS charges they will be liable for once connected. Consequently, we have put in place a policy whereby we engage with customers on the likely EDCM distribution charges once they have an acceptable connection offer.

Within our Use of System Charging Statement, published in April 2015¹⁷, we address demand-side management (DSM) and the ability for customers to have interruptible import capacity in order to benefit from a reduced Use of System charge. Specifically, we outline:

¹⁷ <https://www.ukpowernetworks.co.uk/internet/en/about-us/documents/EPN-LC14-Statement-Effective-1st-April-2015-V2-Final.pdf>

5.8. New or existing Designated EHV Property Customers may wish to offer part of their Maximum Import Capacity (MIC) to be interruptible by us (for active network management purposes other than normal planned or unplanned outages) in order to benefit from any reduced UoS charges calculated using the EDCM. Several options exist in which we may agree for some or the entire MIC to be interruptible. Under the EDCM the applicable demand capacity costs would be based on the MIC minus the capacity subject to interruption.

5.10. If you are interested in making part or all of your MIC interruptible as an integral irrevocable feature of a new connection or modification to an existing connection you should in the first instance contact our connections function

In line with this statement, we have made it clear to storage providers and other customers that we are open for discussions on how to create flexible contracts and manage the application of import charges. We encourage all customers to approach us to discuss these possible arrangements.

It is important to highlight that this is an example of the trade-off between specific locational tariffs that reflect specific customer impact on the network and broader, more predictable tariffs.

Question 3b): Do you agree that flexible connection agreements could help to address issues regarding storage and network charging?

As stated above, flexible connections can help to address any issues around connection charging through providing the network operator with certainty on how the storage device will be operated. This allows our network design teams to take account of this when assessing the connection assets required.

As highlighted in our response to questions 1 and 2, our experience to date has been that despite making flexible connection offers to storage applicants, developers have not been keen to take these up. We have engaged with these providers to understand why and the feedback is that they are not compatible with the terms of National Grid's current services, particularly the EFR service. As stated elsewhere in this section and in our responses to chapter 5, this highlights the need to develop a process which allows for efficient allocation of flexible resources across the whole system.

Question 4a: Do you agree with our assessment that network operators could use storage to support their networks?

We fully agree that network operators can use storage to support their network. Our SNS project has proven that storage can be used as an alternative to network reinforcement, where our 6MW/10MWh/7.5MVAR battery has provided an alternative to £6m of conventional reinforcement at Leighton Buzzard.

The benefits of storage to networks are comprised of:

- A potentially lower cost alternative to reinforcement to meet demand needs;
- Using reactive power capabilities for:
 - Losses/power factor improvement, (the benefits passes to the customers); and
 - Voltage control.
- Allowing more generation customers to connect or reducing constraints on existing generation, therefore enabling more renewable energy; and
- Extensive adoption of domestic storage could offset the impact of increased LCT demands and reduce high voltage problems resulting for example from solar output at times of low demand.

The RIIO framework provides equalised incentives for network companies to develop the most efficient network solutions. As flexibility develops, we will increasingly contract for demand side services as a lower cost alternative to traditional reinforcement. Our SNS project demonstrated a positive NPV outcome but costs still need to fall and it requires the stacking of different services from other parties within the energy system. One of the key issues for battery storage supporting the network is the need for longer duration export capability than a similar level of frequency response capability alone requires, thus requiring a more expensive battery system. As and when the technology costs of storage fall and it is the least cost solution to meet the network needs alone, it should be available as an option to ensure that any process to procure flexibility does not result in a higher cost for consumers than is necessary (the least cost solution available to the DNO, as signalled in any long term development statements would set the benchmark for the value of any services offered).

Question 4b): Are there sufficient safeguards to enable the development of a competitive market for storage?

We would like to see active markets of all forms of flexibility including storage, as this would limit the possibility of one type of flexibility or provider from gaining excessive market power. This is particularly important for us given the highly localised nature of our constraints. It may be necessary for DSOs to procure flexibility capacity in a similar manner to the Capacity Market to ensure sufficient capability exists to defer traditional investment to secure the system or address emerging issues caused by the growth of low carbon technologies such as EVs.

Our experience is that the current framework has enabled competition. For example, the EFR tender successfully allocated 201MW to provide frequency capabilities to National Grid. However, the projects allocated will only be providing value to National Grid and will not be used, at least in the first four years of operation, to support local distribution network constraints. The wider question is how to ensure competition and enable the whole system benefits that storage can provide.

To extract maximum value from a storage asset, commercial capabilities are required across a number of services, interfacing with the system operator, network operator, suppliers and generators. Establishing commercial relationships with aggregators and suppliers will enable DNOs to interface with the commercial markets for further revenues, which at this point are critical for the business case of storage to add up.

Question 4c): Are there any circumstances in which network companies should own storage?

We have demonstrated in our SNS project that storage has the potential to provide benefits to the network. To deliver these benefits, the storage must be at a specific location on the network and available when needed. At the Leighton Buzzard site, we successfully used a 6MW battery for peak demand shaving instead of a £6m traditional network reinforcement¹⁸. Demand side services, including storage, potentially create option value compared to incremental investment in traditional assets and may be highly valuable given current unpredictable demand and generation patterns.

Wherever possible we agree these services should be provided through an active market. This should allow network companies to highlight where they need a service from storage or other demand side service and tender to see if providers can meet the requirements at a cost lower than other alternatives. Storage providers should be able to optimise the use of the storage asset by selling services to others when the DSO does not require it, thereby reducing the cost to the DSO. To ensure that these services offer the lowest cost solution for customers, the DSO must have the least cost network option available to it, and this should include storage assets (even if limited to network use only).

¹⁸[http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/)

For a highly specific constraint service there may be some circumstances where the market cannot deliver the precise service at the specific location which meets network companies' needs. Any system operator needs confidence that a service will be available at the location it is needed where it is providing security of supply. This is an important consideration in allowing ownership.

Ideal markets should provide the lowest cost services to the DSO. However, this relies on there being sufficient numbers of providers to ensure a competitive process. We note there are examples in the connections market where competition has not developed despite efforts to promote it and demand side markets that have not provided the required response to calls¹⁹. We have set out scenarios where the market may not deliver the least cost solutions for customers without the ability of DSOs to develop storage:

i) Incremental storage required

Network operators may already be managing constraints through flexibility and need a small amount of available storage to supplement current contracts. The storage would have a high option value to the network company in avoiding investment. The local market may be constrained on locations and participants (e.g. in a residential area where some domestic storage exists). If economical, yet not provided by the market, it seems unfair to prevent network companies building the limited storage asset themselves to provide this option value and save the reinforcement.

ii) Driving lowest cost solution from the market

Allowing network companies to own storage for network purposes can help extract the lowest cost solution from markets. For example, take the following hypothetical cost scenario:

- Standard DNO reinforcement costs – £15m
- Costs to DNO of procuring and operating storage to alleviate constraint (no other use) – £10m
- Cost of DNO service for market storage provider allowing for other revenue streams – £7m

Without the option of DNO owned storage, a market provider will know from the DNO's long term development statement that the baseline costs for a traditional network solution would be £15m. In a perfect market the costs for a storage operator to provide an equivalent solution to meet the DNO's needs, taking into account other revenue streams would be £7m. However, the DNO's minimum intervention is likely to be known to bidders which would encourage bids as close to this value as possible, say £12m to win the contract. If the DNO is allowed to own storage to resolve constraints, and could do this for say £10m then bidders would be encouraged to bid closer to the true cost to them of £7m, ensuring that the market provides an efficient outcome for consumers.

Keeping the door open on network ownership

As the storage and wider flexibility market develops, there may be other circumstances where the market cannot deliver. At this stage, we do not think Ofgem and BEIS should rule out network ownership of storage in specific circumstances where it can provide benefits to customers.

We fully recognise the competition issues surrounding selling services from a storage asset funded by regulated allowances. We believe that the enduring model for SNS provides a solution to these issues. Under SNS, all market transactions were undertaken through a supplier or aggregator. This allows for the stacking of benefits required to make storage viable but without direct DNO involvement in the market. This demonstrates that network ownership of storage does not need to equate to participating in the market and therefore any competition issues can be avoided.

¹⁹ WPD did not secure the service it sought in the 2016 demand turn up service
<http://www2.nationalgrid.com/WorkArea/DownloadAsset.aspx?id=8589938135>

We note that other regulators and the European Commission are recognising that in specific circumstances network ownership of storage can be permitted. The recent 'Winter Package' released by the European Commission outlines that unbundled DNOs should be able to own storage where the market has not delivered in order to deliver efficient and secure network operation. Other regulators in Europe and Australia²⁰ are also supportive of limited network ownership of storage. We think our SNS model is broadly consistent with this approach. Consequently, we would urge Ofgem and BEIS to develop a regulatory framework for storage which outlines the specific circumstances where network companies can own storage.

Question 5: Do you agree with our assessment of the regulatory approaches available to provide greater clarity for storage?

The Call for Evidence adequately captures the range of regulatory approaches available to provide clarity for storage. As a network operator, there are two key things which the regulatory approach for storage needs to deliver:

- i) Ability to provide cost reflective charges

In the future, we may need to develop commercial arrangements which are specific to storage. We have some concerns that our ability to do this may be restricted if storage remains defined as generation. We have a licence requirement not to restrict, prevent or distort competition in the generation of electricity²¹. If the legal and regulatory definition of storage is as generation, we may be limited in our ability to treat the two differently (i.e. not able to discriminate between types of generation), even where there are legitimate reasons to do so.

- ii) Allowing network ownership where the market cannot deliver

As outlined in our response to question 4c) above, we think it is essential that network companies are not denied the ability to own storage in specific circumstances where the market has not been able to deliver the service needed. Our preference is that specific circumstances for network ownership and safeguards (such as no participation in the market) are outlined as part of the regulatory approach.

Given the above, we do not think it is ideal to continue treating storage as generation for licensing purposes (option a in the Call for Evidence). We think that options b, c and d could deliver our two objectives. We would highlight that if BEIS goes to the time and effort of defining storage in primary legislation (option c) then it will be worthwhile going the extra step of creating the new licensable activity (option d).

Question 6: Do you agree with any of the proposed definitions of storage?

We support the definition proposed by the Electricity Storage Network which is outlined in the Call for Evidence. This is on the basis that it is specific to electricity storage and it covers the conversion of electrical energy, not its generation. We consider that both of these elements are important in order to distinguish electricity storage from other network systems such as capacitors.

²⁰ <http://www.aemc.gov.au/Major-Pages/Technology-impacts/Documents/AEMC-Integration-of-energy-storage-final-report.aspx>

²¹ Standard licence condition 4 of the Electricity Distribution Licence.

Our view is supported through our discussions at the BEIS/Ofgem storage working group, which has been debating these issues, and the specific work we undertook on a proposed storage licence as part of the SNS project.²²

Aggregators

Question 7: What are the impacts of the perceived barriers for aggregators and other market participants? Please provide your views on:

- **balancing services;**
- **extracting value from the balancing mechanism and wholesale market;**
- **other market barriers; and**
- **consumer protection.**

Do you have evidence of the benefits that could accrue to consumers from removing or reducing them?

Ofgem and BEIS have identified a number of barriers which we recognise. Removing these barriers requires a clear framework for flexibility in wholesale and balancing services.

Product design and procurement

If the SO procures services to support the system and aims to be technology agnostic, then it must set out its requirements for these services. The challenge for the SO is to set out its requirements in a manner that allows new technologies to contribute, while maintaining security of supply. It is relatively straightforward to specify services that replicate existing system requirements (e.g. for frequency response) and this might allow existing providers to deliver these services but seem to exclude new entrants.

Real time services are certain to have more stringent requirements than those aimed at supplier balancing positions (half hourly flexibility). For demand-side services there is more work to be undertaken to ensure that actions taken by DSR providers are clearly visible to the procurer of the service. This is particularly the case for real time services (where half hourly metering is inadequate). It may be important to ensure that new service providers have a framework through which they can demonstrate capability ahead of contracting for system security services (critical constraint management, reserve or frequency services).

Cross party impacts

We agree that actions taken by aggregators should have the impact reflected on related parties. The points raised in the Call for Evidence identify a number of issues with regards to the design and operation of markets supporting the operation of the system.

The impact depends on the relationship of the aggregator to the other parties:

- The aggregator is providing flexibility to a supplier within the wholesale markets: the aggregator should be responsible for the costs of any transaction costs between suppliers where it is contracting services from DERs; and
- The aggregator is providing services to the system through balancing services: we would agree that suppliers' imbalance positions should be mitigated.

As a DSO we believe that there is a need for transparency of DER contracted to respond to any participant in the operation of the system. This transparency is needed to ensure that:

²² [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/Project-Documents/Report+9.5+19Oct_v2.1_%28Final+Photos%29.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/Report+9.5+19Oct_v2.1_%28Final+Photos%29.pdf)

- The extent of flexibility being used and the net-demand position is understood for planning, developing and operating an efficient system; and
- Resources are not called upon that are already in use and are unable to respond (there is a linkage here to the value of services provided – flexibility providers should see fair value for the services provided).

There is a need to have clear roles for the different market functions in the operation of the system so that parties understand where the value is derived and managed. There is also a need to identify means to assess whether behind the meter actions have had the contracted effect. Actions taken that reduce demand that are offset by other uncontrolled increases within the same metered demand are not possible to determine.

Suppliers, aggregators and customers will all seek value through flexibility services, so consideration should be given as to whether there should be separate licensing for:

- Retail services to customers (and associated customer protection); and
- Flexibility services (to suppliers and system services) with conditions associated with inter market actions.

Question 8: What are your views on these different approaches to dealing with the barriers set out above?

Ofgem should develop a range of approaches to the barriers described. It may be appropriate that there are different entry requirements for different flexibility services. For example, it may be appropriate to have lower entry requirements for services that are provided to suppliers for commercial positions in the wholesale markets than it is for providers of Balancing Market services or constraint management services where system security or the maintenance of customer supplies is at risk. It is important to start developing these entry requirements now so that they are in place before the volumes of aggregated services increase dramatically.

Question 9: What are your views on the pros and cons of the options outlined in Table 5? Please provide evidence for your answers.

Ofgem should keep a watching brief to see if providers of flexibility and system operators can find suitable service offerings for flexibility to access all markets. We are observing a number of aggregators and suppliers offering converging capabilities, particularly demand-side frequency response.

We support a clear regulatory framework for all participants in delivering system services. Contracts for services can mandate obligations on to providers, but there may be merit in licensing to avoid duplication or inconsistencies. In our response to question 10 below we highlight that licensing for those wishing to participate in system critical services may be appropriate to ensure the security of the system, as many of those services are now procured from licence exempt flexible resources not operating under a licence framework.

Question 10: Do you agree with our assessment of the risks to system stability if aggregators' systems are not robust and secure? Do you have views on the tools outlined to mitigate this risk?

It is inevitable that loads behind the meter will be controlled through bypassing smart meters, and this creates a risk that large amounts of load could be switched simultaneously. These devices will almost certainly be controlled through internet technologies with the inherent risk of cyber-attack or communications failure. It is therefore important that those systems be made as reliable and secure as possible.

We agree that this will require cross system thinking including those manufacturing and selling smart devices, but it is likely that different services would require different specifications. For example, a demand-side service providing frequency services (should this be possible) would be likely to require much faster ramp rates than normal balancing services. As such it should be for the system operator to set the required service standards.

As with a number of services supporting system security, the merits of licensing need to be considered. It is unclear whether purely contractual terms for non-delivery or failure to meet underpinning standards (e.g. for IT security) are sufficient. This is because commercial contracts require penalty mechanisms that are linked to damages and it might be difficult to make these appropriate for managing system security risks. Any associated provisions could be seen as excessive risks producing barriers to entry. For example, it is conceivable that a service provider could establish individual corporate entities, to deliver individual services. This could leave the SO unable to enforce any penalties wider than for that service or discriminate against the operator in other services. However, a licensing regime could place responsibilities on the controlling shareholders, while minimising barriers to entry.

Ofgem should consider the merits of licensing participants in such services in order to underpin 'good behaviour' and essential service rules.

General Authorisation Regimes similar to those used in IT may be appropriate to ensure transparency in services to wholesale markets but it is not clear that they provide sufficient powers to support system critical services, therefore licensing for such services may have some merit.

2. Providing price signals for flexibility

System value pricing

Question 11: What types of enablers do you think could make accessing flexibility, and seeing a benefit from offering it, easier in future?

Our view is that the enablers that could make accessing flexibility, and seeing a benefit from offering it, easier in the future will include:

- i) Development of half hourly settlement as a minimum;

The development of half hourly settlement (as a minimum, as shorter time periods are being considered) will be essential in ensuring value signals to domestic customers (or intermediaries offering energy management services). Existing DUoS tariffs' design has been developed to provide price signals that should encourage the usage 'off peak'. However, DUoS tariffs are only one component of the charges to customers and it will be up to suppliers to provide them with smart tariffs or other incentives.

- ii) Sufficient flexibility in licence arrangements to allow us to set charges or procure services to promote efficient use of the network;

In theory, price flexibility could indicate full system cost variations, locationally and over time, and this could then provide the right amount of flexibility. Price flexibility already drives many large customers' flexibility to avoid high peak energy charges and triad costs, but this is to some degree allowing users to avoid fixed and sunk costs. There are practical challenges to price flexibility. For example, for EV users it would require producing different price signals, in real time, in several thousand locations across our network. Highly local constraints affecting small numbers of users also may not result in effective flexibility markets. Complexity can be a disincentive for customers but this is likely to be moderated for end users by smart intermediaries and technology.

There are other charging considerations, including stability, transparency and non-discrimination, which need to be addressed. Network charges are strongly defined by the need to recover allowed revenue in a non-discriminatory manner. Highly locational charges, where customers pay different prices in adjacent streets, may not be seen to be fair. DNOs' revenue recovery licence compliance should not be a barrier to the use of seasonal time period charges. Consequently, licence charge restrictions should have sufficient flexibility so that they do not penalise DNOs who are targeting their charges to provide minimum long term cost to consumers by incentivising efficient use of their network.

The final charges consumers responding to price signals see are a composite of fixed and variable costs, generation costs (which combine fixed charges from investment and mechanisms such as FiT and CfD with variable production costs), network charges (which could be considered to be fixed), and suppliers' operating costs. Network charges (including transmission) currently represent approximately 25% of the final costs, so reliance on price flexibility to secure demand response to meet local constraints may not be sufficient, as it is only a proportion of the energy bill²³.

- iii) Visibility of resources that exhibit flexibility (and their use);

Visibility of resources that exhibit flexibility (and their likely use) will be critical to enabling system operators to forecast demand, plan and develop the network to provide the most efficient outcome for consumers (whether they provide contracted services or not). The current market arrangements do

²³ <https://www.ofgem.gov.uk/consumers/household-gas-and-electricity-guide/understand-your-gas-and-electricity-bills>

not promote the visibility of which customers are providing flexibility (for example, to suppliers to manage triad positions).

We are actively engaging with projects looking at how these challenges might be addressed, such as Centrica's Cornwall Local Energy Market that uses learning from California, Open Utility's proposals for a flexibility trial under EEF using learning from their peer to peer Piclo project, and Electron's ideas for block chain driven systems.

We intend to start recruiting and procuring flexibility in 2017, using the engagement experiences under LCL and relationships with aggregators and directly with industrial and commercial consumers. As a SO, using contracted or market procured flexibility as is the case of balancing services, is more likely to provide the certainty required for services vital to ensuring continuity of supply. Transparent market places that allow visibility of available resources and service requirements could assist this.

- iv) the development of commercial and market models for flexibility, where procurers of flexibility share costs according to the priority of access required.

We support the development of commercial and market models for flexibility to complement the existing industry systems and in doing so develop a more adaptable future system that can adapt to the widespread flexibility that domestic storage and smart appliances may provide. A key issue in making use of and remunerating demand side services is visibility of the actions occurring amongst other variables on the system. As noted above, we are aware and supportive of the initiatives being developed by Centrica, Electron, Open Utility and InnovateUK and would encourage support for these as the industry determines its future needs. Block chain technology, distributed settlement platforms, and smart contracts that implement merit orders in procuring flexibility all need to be explored and developed in parallel with existing improvements to settlement systems to improve current markets.

There are two ways of stacking the value of flexibility:

- Providers of flexibility buy into multiple revenue streams, with the ability to extract value providing the incentive to act flexibly; or
- Flexibility providers offer their services at a price which the procurers of flexibility then share according to the priority of access required (which could change over time).

It is probable that the first option will drive the initial development of flexibility but future flexibility platforms could enable the second and permit greater optimisation of the system.

We are already seeing examples of the potential challenges from the first option:

- Price sensitive flexible demand will be responsive to the largest price risk it faces, e.g. flexibility will be used to manage exposure to high half hourly imbalance costs rather than provide lower value demand side response services;
- Service offerings have to be designed to be complementary, not exclusive, but avoid paying twice for the value provided to the system; and
- Customers/providers of flexibility have to navigate a complex array of services.

As we have seen with the generation capacity, marginal price driven markets may not provide capability ahead of need and establishing markets for future flexibility equivalent to the Capacity Market may be necessary to drive the business case for the incremental costs of investing in flexibility.

Question 12: If you are a potential or existing provider of flexibility could you provide evidence on the extent to which you are currently able to access and combine different revenue streams? Where do you see the most attractive opportunities for combining revenues and what do you see as the main barriers preventing you from doing so?

Our experience from SNS as a provider of flexibility to National Grid is that a key barrier to combining revenues can be the definition of the services themselves, e.g. STOR and EFR. We note that flexibility is procured through individual contracts: for example, National Grid has 12 frequency and reserve services and distribution services are currently procured through specific contracts to address specific network issues. The development of effective market places for the forward procurement and real time despatch of flexibility resources may reduce the barriers created by this complexity.

Question 13: If you are a potential or existing provider of flexibility are there benefits of your technology which are not currently remunerated or are undervalued? What is preventing you from capturing the full value of these benefits?

As a DSO we are incentivised to procure demand-side flexibility where we are certain of the requirement in order to minimise costs to our customers. Demand growth has been low and uncertain over recent years and this has created only a limited need for flexibility. This uncertainty 'limits' our ability to create a wider market for demand-side flexibility services to our system and may be seen by some to be limiting their ability to enter the market.

We intend to start recruiting and procuring flexibility in 2017, using the engagement experiences under Low Carbon London and relationships forged with aggregators and directly with industrial and commercial consumers. As the use of flexible connections expands and more storage looks to connect, demand-side flexibility will need to be facilitated through the connections process and agreement, which we are well positioned to enable.

Given that we are a procurer of flexibility we will leave it to providers to comment on technologies which are not currently remunerated or are undervalued.

Question 14: Can you provide evidence to support changes to market and regulatory arrangements that would allow the efficient use of flexibility and what might be the Government's, Ofgem's, and System Operator's role in making these changes?

Flexibility is already used both in the balancing system and by customers and suppliers to mitigate high peak charges and triads. We are also using it from export customers in order to connect them without the need for reinforcement. In developing efficient markets for flexibility, procurers of flexibility need to understand the resources that are acting in the system and therefore forecast the additional resources that need to be procured. In designing an overall framework, we need to understand the relative opportunity value of different services and how resources will respond.

It should also be clear for providers of flexibility where services would be remunerated, for example.

- Price driven flexibility provided to the wholesale market to match supply and demand is remunerated through those markets and use of system charges; and
- System operators procure additional flexibility to meet the needs of the system and remunerate this through contractual payments, or through flexibility markets.

Inherent price driven flexibility is not directly visible to system operators. As we have stated above, future markets should have visibility of all flexibility in order to allow system operators to efficiently develop the network and extend future services.

Government and Ofgem have a role in developing a regulatory framework that supports flexibility. Ofgem should look at where incremental changes to the existing systems and codes will not suffice and drive the development of systems which will support future markets, much as it did with previous market reforms.

Ofgem must also enable industry to collaborate across the value chain – for example, on flexibility platforms – to develop the solutions needed in collaboration with new entrants. Ofgem's role should be to ensure that these are developed in an open manner that does not create barriers to entry and supports a market for flexibility, but should encourage innovation. System operators (SO and particularly DSOs) should be incentivised to lead these developments for two reasons:

- They have a critical role in optimising use of resources, including networks, to ensure the best outcome for customers; and
- They can be incentivised to have no interest in excluding providers of services as their incomes are regulated (i.e. they have no incentive to limit competition in services in order to extract value from providing flexibility).

As explained in our response to question 46, Government and Ofgem have a role in ensuring there is a clear regulatory framework to promote flexibility, recognising the risks, costs and benefits that the shift to a smart, flexible network represents. If this framework can be put in place then it allows industry to develop the commercial incentives and tariffs for customers to provide flexibility.

Smart tariffs

Question 15: To what extent do you believe Government and Ofgem should play a role in promoting smart tariffs or enabling new business models in this area? Please provide a rationale for your answer, and, if you feel Government and Ofgem should play a role, examples of the sort of interventions which might be helpful.

We believe the industry should be allowed to develop products and services to meet customers' needs, consistent with the recent findings from the CMA markets review. Ofgem and Government's role should be to encourage the industry to develop the right frameworks to meet customers' needs. There are many approaches to developing smart tariffs (the NARUC rate design manual is a good summary of the approaches²⁴), as highlighted in Table 1 below. There are competing needs between long term signals and short term optimisation.

We can develop smart network tariffs but are reliant on suppliers to reflect these on to our customers. Different suppliers have different appetites, simpler distribution tariffs can be easier to administer, but complex pricing and optimisation can offer a competitive advantage for suppliers.

²⁴NARUC Distributed Energy Resources Rate Design Manual November 2016
<http://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0>

Table 1: Strengths and weaknesses of different charging approaches

Charging approach	Strengths	Weaknesses
Fixed capacity charges	Equitable charges for access to capacity and standby services; revenue certainty	No price signals to promote efficient utilisation of the networks
Demand charges (kW)	Reflect drivers of costs if largely fixed; revenue certainty	Difficult to respond to Penalises low demand low load factor customers No overall efficiency signal Drive cost avoidance (e.g. Triads)
Unit based volumetric (kWh)	Half hourly unit rates reflect demand and efficiency	Can drive fixed cost avoidance High peak charges can be difficult for some customers to avoid
Locational Marginal Pricing	Strong costs signals to optimise variable costs on the system	Complex pricing signals (day, hour, 5 minute) Variable Requires separate mechanism to recover fixed cost Certainty to promote investment needs longer term prices Advanced Metering infrastructure
Standby and Back Up	Option for recovering costs from customers who want grid availability for when they do not have enough capacity to meet their own needs	Can be seen to affect business case for DER
Flat rates	Ensure predictability	No efficiency signals
Block rates	Increasing charges in each consumption can drive efficiency	Need for consumer to understand ongoing consumption Can drive under recovery of fixed costs Decreasing block charges (fixed cost recovered up front can damage efficiency incentive)
Time Variant rates	Drives efficient use of resources	Require all customers to have time of use metering (e.g. half hourly)
Value Resources	Target value specific types of resources create	Ensure values only accounted for once (e.g. in FiTs or tariffs but not both)
Value Services	Value provided to the grid Technology neutral	Requires technology to implement
Transactive Energy Charges	Supportive of peer to peer interactions (SO earns revenue from promoting interactions) Value based on services provided	Requires technology and communications platforms Advanced Metering infrastructure

Through our Low Carbon London project, we conducted an extensive, first of its kind, dynamic time of use tariff with over 1,100 customers in our London area. We also conducted extensive analyses of both the quantified effectiveness of the tariff to flex customers' demand and domestic customers' attitudes towards flexibility²⁵. We observed clear and strong support for flexibility-oriented tariffs with customers responding to surveys showing as evidence of customer attitudes:

- 91% of participants reported that the tariff should be offered to everyone and 81% even reported that the tariff should be a default or standard tariff. This was an impressively clear finding of support for more cost-reflective pricing, which was viewed as fairer and actually promoting efficiency for customers;
- 79% of participants reported that a dynamic, three rate time of use tariff was not experienced as complex in the course of living day-to-day with the tariff. This finding suggested that more consumers accept, or even have an appetite for some types of complexity; and
- The trial showed a clear response from customers, delivering up to an 8% reduction in their average peak consumption during high price periods.

As discussed earlier, smart tariffs may come from a combination of price signals and services. Further research may be helpful in understanding the incentives consumers react to – for example, whether negative cost avoidance incentives have the same power as positive payments for flexibility through contracts.

There are areas where Government or Ofgem could have a role in mandating smart tariffs, particularly in areas such as EV charging or electrification of heat, which will have a significant impact on the supporting network infrastructure and which could be reduced through smart tariffs. As previously mentioned, ensuring consistent approaches such as full half hourly settlement will play an important role in driving benefit from changing consumer behaviour.

Question 16: If deemed appropriate, when would it be most sensible for Government/Ofgem to take any further action to drive the market (i.e. what are the relevant trigger points for determining whether to take action)? Please provide a rationale for your answer.

We consider that action from Government/Ofgem should focus on setting firm objectives and a timetable for implementing future change linked to the forecast uptake of DER. This approach ensures that all parties understand the priorities and their regulatory obligations. Ofgem/Government should maintain an oversight of delivery against these objectives but only intervene where necessary; for example, to prevent barriers to competition developing, or to arbitrate where industry consensus is needed but cannot be achieved.

This timetable must recognise the needs of the price control frameworks of RIIO-T2 and RIIO-ED2 that will set the incentives, obligations and funding for the network operators during the 2020s.

Question 17: What relevant evidence is there from other countries that we should take into account when considering how to encourage the development of smart tariffs?

There are many options for smart charging approached that should be monitored. In the USA, nodal marginal pricing is being used more widely for day ahead and real time markets (e.g. PJM have a system of approximately 10,000 nodes, equivalent to pricing at the level of larger distribution primary substations (11kV))²⁶.

²⁵ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A2%20-%20Residential%20consumer%20attitudes%20to%20time%20varying%20pricing.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A2%20-%20Residential%20consumer%20attitudes%20to%20time%20varying%20pricing.pdf)

²⁶ <http://www.pjm.com/about-pjm.aspx>

Question 18: Do you recognise the reasons we have identified for why suppliers may not offer or why larger non-domestic consumers may not take up, smart tariffs? If so, please provide details, especially if you have experienced them. Have we missed any?

Our experience in Low Carbon London echoes the Call for Evidence in terms of consumers' appetite for smart tariffs but also identified that significant price signals were required to invoke any behavioural change.

Larger non-domestic consumers may be indifferent to smart tariffs simply because understanding energy use is not part of their core business or immediate priorities. They may also feel that there is no scope for changing consumption patterns due to their business needs, or it may simply be that the business cost disturbance of a meter change is an unnecessary event. There may also be inertia due to expectation that energy costs may increase and that consumers do not expect decreasing costs as change happens.

We believe that half hourly tariffs will see lower cost consumers 'cherry picked' by innovative suppliers who offer appropriate products. These products will make use of seasonal time-banded tariffs which will benefit those consumers who are currently paying a 'penalty' on single unit rate average tariffs due to the consumer's actual lower cost usage. Over time the consumers who remain on tariffs that are not cost-reflective will face increases to reflect their higher than average costs as the low cost consumers migrate to the seasonal tariffs.

Smart Distribution tariffs: Incremental change

Question 19: Are distribution charges currently acting as a barrier to the development of a more flexible system? Please provide details, including experiences/case studies where relevant.

We do not think that distribution tariffs are acting as a barrier to a more flexible system. Distribution charges are designed, within limitations, to reflect the time when the system is most congested and therefore promote flexible use of the system. They are limited in that CDCM charges are not locational within the distribution service area. However, for larger customers, the EDCM produces a 'bespoke' charge that recognises their location in the system and the impact their actions have on the network.

We consider that the distribution charges provide a basis on which to layer other flexible products, such as contractual flexibility. As highlighted earlier in this response, contractual flexibility can provide the certainty of response which we need as well as the certainty of income required by providers of flexibility. We consider that trying to deliver flexibility solely through tariffs will make those tariffs too complex. DNOs have already been challenged about the differential in prices between service areas by suppliers desiring to reduce their costs, which illustrates one of the challenges that will emerge between smart tariffs and the opposing desire for simplicity/predictability.

Question 20: What are the incremental changes that could be made to distribution charges to overcome any barriers you have identified, and to better enable flexibility?

Since the introduction of the CDCM in 2010 and EDCM in 2012, many types of incremental change have been implemented. Some of the changes implemented have been to improve the stability of prices so that a consistent or predictable cost signal is provided and the risk of volatility is removed. Having a consistent cost message has been promoted as a way to reduce supply costs by removing unnecessary risk premiums applied by suppliers.

Feedback from our stakeholder engagement with suppliers and aggregators has revealed that incremental changes to the DUoS charging mechanism, through change modifications, can be seen to drive uncertainty and affect the business case for investment.

It is likely that changes to enable flexibility will have an effect of removing consistency and predictability. With this in mind it would be better to enact flexibility with 'active' flexible network participants such as demand aggregators (e.g. through contracts or market places), who will be best placed to manage the volatility of the charges. A separate charging regime for electric vehicles may also be an opportunity for 'incremental' change using smarter tariffs.

A clear path forward needs to be signalled to allow a flexible system to be developed and business cases made for users to participate.

Question 21: How problematic and urgent are any disparities between the treatment of different types of distribution connected users? An example could be that that in the Common Distribution Charging Methodology generators are paid 'charges' which would suggest they add no network cost and only net demand.

Given the average principles of the CDCM we feel that the current array of charges for demand and credits for generators are appropriately applied for the different types of users. One of the main underpinning concepts of the charging methodologies is that demand consumers are the ones who will ultimately pay for any charges applied to generators. With this in mind there should be no arbitrary charging of generators unless there is a real time cost driver for that generator.

However, there are issues relating to the interaction of the generation connection arrangements and the need to reinforce or constrain generation which may interact with generation use of system charges. Connection charges are currently used to signal where it is efficient to connect generation, but as constraints become more remote from the location of a generator, these signals are weakened by the connections charging framework (in particular the voltage rule which limits charges to one voltage above the point of connection). This may require DSOs to begin constraining generation off or to require a flexible connection, because of the high costs of addressing constraints. As constraints that are addressed by flexible connections are removed there will also be a need to ensure that the costs are appropriately assigned to those who benefit from their removal. This may require consideration of generation use of system charges in conjunction with the connections framework to ensure fair recovery of costs.

Smart Distribution tariffs: Fundamental change

Question 22: Do you anticipate that underlying network cost drivers are likely to substantively change as the use of the distribution network changes? If so, in what way and how should DUoS charges change as a result?

Potentially, the main way that the underlying network cost drivers will change is in the way that the costs of system operation (e.g. for services from DER) will vary from the costs of network asset provision. System operation will change as network operators become more innovative in seeking alternative solutions to traditional network problems. This will drive dynamic approaches that will be designed to reduce long term cost and improve system reliability. The costs of traditional network provision are likely to change over time as localised generation replaces the need for upstream reinforcement and the consequential maintenance of those assets.

With the advent of new low carbon technologies such as EVs, heat pumps and domestic storage, it is possible that some customers' demands will increase and others' will decrease or become more intermittent, and there will be a need to ensure that costs are recovered fairly from all users. It will be important to monitor the balance between fixed charges to recover the provision of standby capacity and variable charges that promote flexible response.

The other area of interaction is that between connection charges and flexibility, noted in question 21 above. Our current flexible connections provide the benefits of flexibility to the generators through lower upfront charges, with the DSO not incurring costs to curtail for the relevant constraints.

Question 23: Network charges can send both short term signals to support efficient operation and flexibility needs in close to real time as well as longer term signals relating to new investments, and connections to, the distribution network. Can DUoS charges send both short term and long term signals at the same time effectively? Should they do so? And if so, how?

While prices can in theory send long term signals, many market mechanisms seem to require longer term signals in addition to network charges (e.g. capacity payments) to provide sufficient certainty to enable investments in flexibility. The complexity of using DUoS for short term price signals may make transparency and predictability difficult as the system changes to support growing low carbon technologies. It may therefore be better to allow DUoS to provide long term signals and use separate flexibility charges/services to manage short term system requirements, initially through contracts, but eventually through flexibility markets.

Short term pricing signals are best placed with those who can contribute to active network management. We feel that those that will be able to contribute most will be active network participants such as aggregators. The costs and benefits of active network management will need to be split from longer term cost signals and should be reflective of specific network problems and reinforcement alternatives.

Longer term pricing signals are best placed to recover the DNOs' longer term or sunk costs that form the majority of the current allowed revenue. While these costs will only change over the longer term, it is still important that appropriate cost signals are synchronised so that consumers avoid behaviour which would drive the need to reinforce.

Question 24: In the context of the DSO transition and the models set out in Chapter 5 we would be interested to understand your views of the interaction between potential distribution charges and this thinking.

Our view is that in the short to medium term i.e. the next 10 years, the DSO will continue to evolve around purchasing contractual flexibility. This can provide the certainty needed for both DNOs (in knowing resources are available) and for providers of flexibility (in terms of certainty of revenue). In the longer term, it may become possible and potentially more practical to use pricing as a way to procure flexibility once there is an abundance of active distributed energy resources connected.

For example, as the demand and resources served by the networks develop greater flexibility, both the DSO model and the energy markets will evolve and charging structures will need to evolve to support them. There are also challenges in flexible systems in determining rights to capacity (currently a connections issue), particularly as the system evolves. Charges may therefore need to reflect users' rights to capacity as well as their actual use of it. We will use our TDI 2.0 project to look at how flexible capacity rights can be assigned using more market based mechanisms.

We are already seeing local and peer to peer services emerge where local trading reduces some users' reliance on upstream infrastructure. These customers will still need to contribute fairly to the maintenance of upstream capacity (physical or flexible) if they want to retain rights to secure capacity in all circumstances, in which instance an element of fixed capacity charges may also be appropriate.

Other Government policies

Question 25: Can you provide evidence to show how existing Government policies can help or hinder the transition to a smart energy future?

One example of where Government policy impacts the transition to a smart energy future is around connection charging. The current connection charging regime at distribution levels reflects, in part, the deep connection costs (one voltage level above the point of connection) and encourages generation to connect where there is capacity or to make best use of capacity. Transmission connected generators have a different regime where the charges are shallow and use of system and constraint payments are used to manage access (connect and manage). This can impact decisions generators make over whether to connect at distribution or transmission level.

If DNOs were to trigger transmission reinforcement because of generation connections at lower voltages, then these costs can only be recovered by being passed through to the generators. These costs are typically significant such that the generators cannot fund them and thus they limit the capacity available, prohibiting our ability to make further connections. Our TDI 2.0 project will look at interfacing active network management across the T&D boundary to enable more connections without the need for reinforcement. A consistent commercial framework is needed across this boundary.

In addition, we would support changes to renewable incentives that support the co-location of storage with generation where this supports the networks through reduced intermittency. At a system level, intermittency can be addressed by storage located remotely from generation, but this does not have the same overall benefit as energy has to be transported between the two locations.

Question 26: What changes to CM application/verification processes could reduce barriers to flexibility in the near term, and what longer term evolutions within/alongside the CM might be needed to enable newer forms of flexibility (such as storage and DSR) to contribute in light of future smart system developments?

A suitable framework is needed to promote investment in flexibility ahead of need, both storage and demand flexibility, but there should be a debate as to whether a single mechanism can procure the underlying capacity needs and the flexibility needs. Flexibility will have different values in different localities, and to the system as a whole, and it is not evident that the current capacity market is designed to deliver local needs.

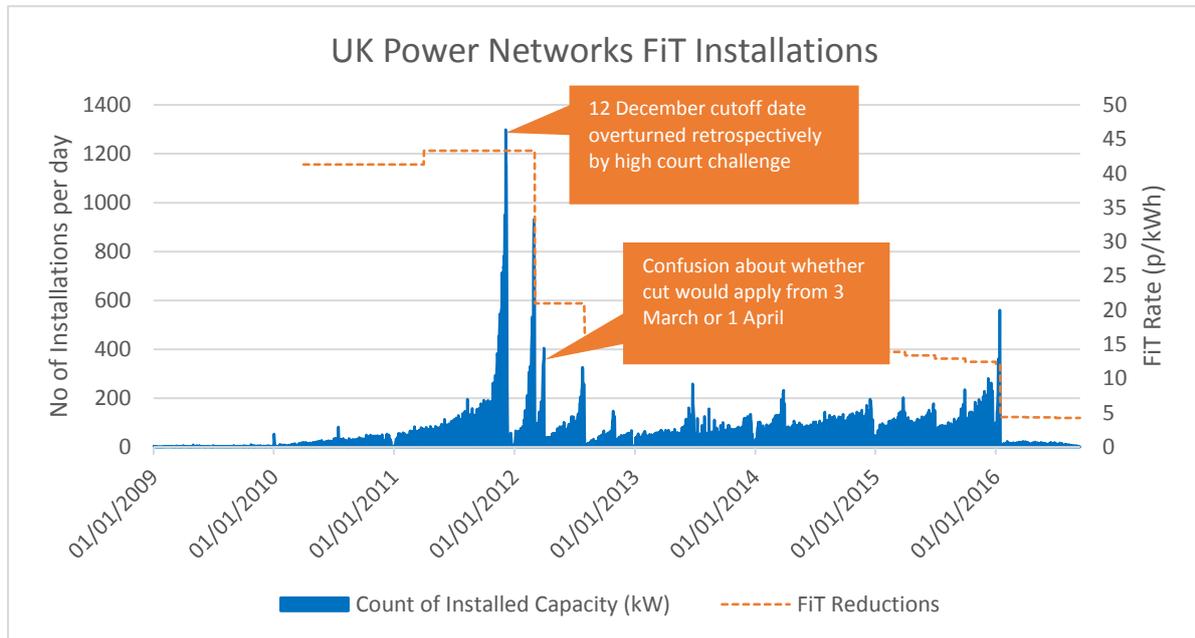
Question 27: Do you have any evidence to support measures that would best incentivise renewable generation, but fully account for the costs and benefits of distributed generation on a smart system?

The American NARUC Distributed Energy Resources Rate Design Manual (November 2016) considers approaches to valuing resources. This discusses designing the tariffs or rates to value the many aspects of renewable energy value. A clear and enduring framework will both promote investment and allow the SO and DSO to plan to integrate renewables, sending clear cost signals about the costs/value they can bring. An enduring framework would also ensure clarity on where benefits provided are credited and costs are met. For example, if carbon benefits are credited to generators through mechanisms such as renewable obligations, then any mechanism should make clear where the costs should fall for addressing constraints justified by reduced carbon emissions from increased exports.

We have clear evidence that Government support measures (and their level) can have a significant impact on the take-up of renewables in a way that can affect network operation and our business investment needs. Changes to renewable subsidies can create bursts of activity, shown in Figure 4

below, as investors seek to access the incentives. It is therefore important for Government to set out a long term, clear plan on where it will provide support and to what extent.

Figure 4: Number of FIT installation in UK Power Networks



3. A system for the consumer

Smart appliances

Question 28: Do you agree with the 4 principles for smart appliances set out above (interoperability, data privacy, grid security, energy consumption)? Yes or No (please explain)

We broadly agree. In order to maximise the benefits that smart appliances offer to customers, networks would require visibility of where these devices are acting in order to coordinate with demands for the network. Standards would also be crucial to allow scalability with networks interacting with smart appliances from various manufacturers. This would also mitigate 'consumer lock in'.

In our Low Carbon London Learning Laboratory, we utilised data from over 2,800 detailed customer appliance surveys to complete an analysis of the flexibility available from smart appliances. This survey data was used to populate a device-level household model developed by Imperial College London that used real network data. This work showed a peak reduction opportunity of between 8.8% and 12.9% for those customers on the trial, when industry coordination of appliance demand is assumed. However, this model also showed that uncoordinated smart appliances create a clear possibility of significant new network peaks as a consequence of loss of demand diversity and widespread (i.e. coordinated) price incentives. We take this to be clear evidence that both visibility and the ability to maintain or promote diversity in the use of smart appliances is essential.

Question 29: What evidence do you have in favour of or against any of the options set out to incentivise/ensure that these principles are followed? Please select below which options you would like to submit evidence for, specify if these relate to a particular sector(s), and use the text box/attachments to provide your evidence.

- **Option A: Smart appliance labelling**
- **Option B: Regulate smart appliances**
- **Option C: Require appliances to be smart**
- **Other/none of the above (please explain why)**

We view consumer trust, understanding and therefore informed and confident adoption as essential success factors to allowing smart appliances and services to drive the flexible energy system of the future. The requirements are likely to be dependent on the technologies in question.

Product labelling and British Standards (option A) can promote or advertise equipment meeting minimum standards. This might be an appropriate approach for consumer goods where British standards will have to align with international standards.

Technologies that provide key flexibility or have a very significant impact on system demand (e.g. EVs and heat pumps) may require more stringent regulation (option B) and potentially have to have minimum levels of functionality mandated (e.g. public EV charging infrastructure).

Robust, agile and scalable approaches to cyber security will be critical in developing and maintaining consumer trust, understanding and adoption. Smart appliances that are vulnerable to disruption are unlikely to be accepted or made use of.

Question 30: Do you have any evidence to support actions focused on any particular category of appliance? Please select below which category or categories of appliances you would like to submit evidence for, and use the text box/attachments to provide your evidence:

- **Wet appliances (dishwashers, washing machines, washer-dryers, tumble dryers)**
- **Cold appliances (refrigeration units, freezers)**
- **Heating, ventilation and air conditioning**
- **Battery storage systems**
- **Others (please specify)**

We do not have any specific evidence to submit.

Question 31: Are there any other barriers or risks to the uptake of smart appliances in addition to those already identified?

The perceived value of enabling the smart functionality over user convenience may be a barrier. Many non-smart devices such as dishwashers and washer/dryers offer users flexibility (e.g. deferred operation) and additional functionality may not be perceived to have sufficient added value, in a similar manner to Industrial and Commercial customers, who do not engage in flexibility.

Internet of Things (IoT) devices have already been used in internet denial of service events. Public perception of the risk to their own data security from such devices could limit their uptake.

We have highlighted our experience and observations about cyber security in our response to question 41.

Question 32: Are there any other options that we should be considering with regards to mitigating potential risks, in particular with relation to vulnerable consumers?

The fuel poor may be the biggest beneficiaries of flexibility but least able to access it through smart devices. Our energywise project has used a flexible approach to engagement that can be tailored for different groups. The energywise recruitment strategy was based on:

- Contact from a local trusted organisation with an excellent understanding of the local area and languages;
- An engagement strategy and materials tailored to the target population; and
- Face-to-face communication and support.

We would recommend that Ofgem and BEIS consider further engagement with community groups and support for community energy schemes as worthwhile initiatives to help engagement with fuel poor customers.

Ultra-low emissions vehicles

Question 33: How might Government and industry best engage electric vehicle users to promote smart charging for system benefit?

We believe that there are three key elements that will require a coordinated effort from Government, the transport industry and the energy industry:

- i) Information and education at the time of purchase

Informed and engaged customers will improve the user acceptance of smart charging. EV users already tend to be more engaged as the technology requires a change in behaviour. At the early stage, where EV purchase is being considered, the consumers can/should be engaged to promote the value/benefits of smart charging. Better informed customers can be empowered to take control over when and where their vehicle receives a charge.

ii) Ensuring the smart option is simple and easy to choose

Our Low Carbon London project demonstrated the value of smart charging to shift electricity consumption during vehicle charging and release capacity on constrained networks²⁷. This would enable increased demand on the network at a lower cost to customers. The EV trials in the Low Carbon London project highlighted that there are two interventions that can be applied in relation to smart charging of EVs:

- Behavioural interventions: such as time-of-use tariffs which require the customer to take action. This could be supported by offerings from energy suppliers, vehicle manufacturers and suppliers, which could minimise the costs of charging to customers; and
- Technical interventions: which automate the process for customers. In order to maintain safe and secure supplies to customers, technical interventions offer more scalable, reliable and sustained responses.

To ensure the smart option is simple and easy to choose, it clearly requires vehicle manufacturers, Government and the energy industry to develop a technical and commercial framework that supports smart charging being the default choice for customers. This will require standards for smart charging infrastructure, development of supporting energy products and infrastructure to allow the vehicles to be used as smart devices by the energy system.

iii) Ensuring smart tariffs are available and benefit smart users

While it must be easy to choose the smart option, smart tariffs that support both technical coordination of smart charging and can be used to indicate the benefits of smart charging to customers will be a necessary innovation.

We are already thinking about these areas as part of developing a strategy to manage EV take-up across our networks. To achieve the three outcomes above we propose the following:

1. The EV Network Group²⁸ is used to promote wider engagement and knowledge dissemination between vehicle manufacturers, aggregators, energy suppliers, networks and system operators to promote the understanding of the benefits of smart charging and kindle the development of smart charging solutions;
2. There are further Innovation trials building on the work of Low Carbon London and My Electric Avenue²⁹ to develop smart charging standards; and
3. The Modern Transport Bill is used to ensure the development of the technical standards and interoperable systems needed to underpin smart charging.

²⁷ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A10%20-%20Smart%20appliances%20for%20residential%20demand%20response.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A10%20-%20Smart%20appliances%20for%20residential%20demand%20response.pdf)

²⁸ <http://www.lowcvp.org.uk/projects/fuels-working-group/EVNetworkGroup.htm>

²⁹ <http://myelectricavenue.info/>

Question 34: What barriers are there for vehicle and electricity system participants (e.g. vehicle manufacturers, aggregators, energy suppliers, networks and system operators) to develop consumer propositions for the:

- **control or shift of electricity consumption during vehicle charging; or**
- **utilisation of an electric vehicle battery for putting electricity back into homes, businesses or the network?**

There is clearly a need for the electricity system participants to work with the vehicle and transport providers to develop products that enable the system to work for consumers. We have identified two key barriers, discussed below.

i) Visibility of Information

The visibility of the location, characteristics and use of chargepoints will be vital to enabling smart charging to support the efficient development of the supporting electricity networks. We would welcome mandating this visibility.

Maximising the benefits to customers from smart charging is inextricably linked to the location of the chargepoints on the network. Demands on the network are by their nature typically limited to specific locations as a result of the local load and generation. Therefore, in order to maximise the benefit to customers from the smart functionality in chargepoints and vehicles, it is vital that DSOs have access to static data such as the geographical location and dynamic data such as the availability and usage of chargepoints. This would provide the minimum information required for the DNO to value and request a smart intervention for that network. The case for visibility is a key recommendation from our Low Carbon London report on smart charging³⁰. We do recognise that there will be data privacy concerns, as there have been with smart meter data, but we believe that these can and must be addressed to enable smart charging that enables network operators to deliver a service that will meet customers' expectations.

DNOs currently capture public chargepoints through their connections processes. The ENA has established a notification process³¹ to capture data on the location and rating of behind the meter chargepoints through the EV chargepoint installation notification process. This is recommended in the IET Code of Practice on chargepoint installations. This is a voluntary recommendation which there is no means of currently enforcing. We therefore welcome and support initiatives that set out clear requirements on chargepoint installers to notify the DNO in order to facilitate the benefits of smart charging to customers. We are also proactively engaging with local authorities and EV chargepoint manufacturers to understand where larger scale roll-outs of EVs are planned.

Considering evidence from a similar example of the notification requirement that DG installers have to inform a DNO when a small-scale generator (e.g. G83 classified) is commissioned: When we gained access to the feed in tariff (FIT) register of G83 connected devices in our networks, we discovered that we had only been notified of around 40% of devices through the voluntary mechanism. We would propose this evidence as justification for a more formal or enforceable position on DNO notification of electric vehicle connection. For example, enabling vehicle registration data to be shared with DNOs, and/or a data sharing agreement between charging infrastructure providers facilitated by OLEV or another body.

Visibility would entail the following data fields being provided, as a minimum, to inform the DNO on the suitability of smart enabled EV chargepoints to mitigate a local network constraint:

³⁰ LCL report [B5 'Opportunities for smart optimisation of new heat and transport loads'](#)

³¹ <http://www.energynetworks.org/electricity/futures/electric-vehicle-infrastructure.html>

- Static data: location of chargepoint, number of sockets, rated power (kW) per socket, mode of charge (AC/DC), smart functionality e.g. stop charge, vary charge rate; and
- Dynamic data: charge rate, charging status.

We have established views, which have been presented in papers³² such as the IET Hybrid Electric Vehicle Conference on the importance of dynamic data to facilitate the benefits of smart charging. The 'availability' of an EV charging load which is described as the volume of EV chargepoints in use, and their associated load, at the time of constraint on the network is an important metric informing the value of smart charging. With the right level of availability, a given volume of EV chargepoints will be able to provide a suitable level of response to mitigate the network constraint. Dynamic data is particularly vital to the management of the network in response to the live load and generation on the network – this is described as active management of the network.

The visibility of this data coupled with smart charging options will provide the opportunity for EVs to provide network services, such as constraint management. This has the potential to ensure the costs of facilitating the low carbon transition are minimised, which will also result in lower customer costs.

ii) Standards

Standards allow for safe, secure and interoperable smart charging to be realised. Standards also enable smart functionality to be scaled and applied consistently to ensure the realisation of the benefits to customers.

Standards are particularly important to ensure that customers have safe and secure smart functionality designed into a system that is also open, interoperable and scalable. Standards can be designed to allow consistent interaction and information exchange between the smart chargepoint and grid management systems as well as protection from cyber-attack. An additional benefit of standards is the opportunity to maintain consumer confidence without hindering the competitive development of chargepoints. These open standards can be developed akin to 3G/4G/5G in the telecoms industry, which have allowed the market for smart phones to thrive and grow with various offerings.

We are aware that similar work is underway in the Netherlands by ElaadNL. ElaadNL is the knowledge and innovation centre in the field of smart charging infrastructure in the Netherlands. Their work to develop smart charging standards could provide valuable learning for the UK. ElaadNL's 'Living Lab Smart Charging' demonstrator has involved a sizeable upgrade operation across the country to ensure the existing charging stations will be able to technically facilitate smart charging and all new installed chargepoints are smart charging ready³³. The proposals under this consultation present an opportunity for the UK to take the lead as the international frontrunner for smart charging.

Standards can also be designed to accommodate varying degrees of energy supply balancing including:

- Simple On/Off instruction; This could be established as the minimum requirements or standard for smart functionality in chargepoints;
- Instruction to vary the rate of charge;
- Varying the rate and duration of charge disruption relative to the EV battery state of charge; and
- Bi-directional power transfer through 'Vehicle-to-Grid' (V2G) applications. Demonstrators such as the V2G project³⁴ have investigated the potential of battery-powered vehicles to use their

³² Regulating EV demand: Distribution Network Operator perspective on Electric Vehicles.' HEVC 2016 conference publication

³³ <https://www.elaad.nl/nieuws/nederland-als-living-lab-voor-het-slim-opladen-van-elektrische-autos/>

³⁴ <http://www.smarternetworks.org/Project.aspx?ProjectID=1291>

excess rechargeable battery capacity to provide power to the grid in response to peak load demands. This project involved retro-fitting an EV to allow bi-directional power flows from the EV as well as the development of a bespoke V2G chargepoint. The project successfully demonstrated this but concluded that in the long term the vehicle and chargepoint manufacturers would need to see the value of V2G to develop the technology at a scale that would allow benefits to the customers and grid. With V2G applications, utilisation of an electric vehicle battery for putting electricity back into homes, businesses or the network is possible. There are currently very few vehicles and chargepoints which allow for bi-directional power transfer to facilitate this. Nissan and ENEL are most notable for trialling this technology currently with the Nissan Leaf and a suitable V2G chargepoint respectively.

Visibility and standards go hand in hand towards realising the value of smart charging and we would welcome initiatives from manufacturers, aggregators, energy suppliers, network and system operators to develop these standards. We have developed a strategy to help facilitate electric vehicles on our network and this includes the continual development of innovative solutions, using learning from innovation projects such as 'My Electric Avenue'³⁵.

Question 35: What barriers (regulatory or otherwise) are there to the use of hydrogen water electrolysis as a renewable energy storage medium?

As a DNO we would be agnostic to the storage technology used and cannot comment on the barriers to this technology. We encourage early engagement from customers seeking to utilise this technology in order to adequately meet their needs and support the adoption of the technology. Clearly the impacts on the system will depend largely on where the storage occurs. Co-located with generation (and using its output) is likely to have a much lower impact than if it presents an additional demand like any other storage system.

Consumer engagement with demand side response

Question 36: Can you provide any evidence demonstrating how large non-domestic consumers currently find out about and provide DSR services?

Since the completion of our Low Carbon London project in 2014 there has been an increase in activities from established buyers. This includes National Grid's Power Responsive campaign and the new Enhanced Frequency Response (EFR) service. Changes in imbalance pricing have also created new supplier-specific products/service offerings such as DONG Energy's Renewable Balancing Reserve (RBR), as new aggregators are entering the market³⁶. DNOs will also become increasingly active in the market for flexibility and will be raising awareness of the DNO DSR requirements. We see the bigger challenge in converting awareness into participation.

Our four-year Low Carbon London project investigated the impact of a wide range of low carbon technologies on London's electricity distribution network, including DSR. A key learning from the Low Carbon London trial was that the industrial and commercial sector are largely familiar with established DSR services such as peak demand avoidance and short term operating reserve (STOR) marketed through suppliers and National Grid, as well as aggregators.

In the Low Carbon London project, we marketed a new service offering, requiring significant up-front and continuous engagement with providers and aggregator partners played a significant role in recruitment. There were trial-specific challenges, such as some reluctance to sign up to a trial of short duration and an unclear business case (the purpose of the trial). However more generally, the

³⁵ <http://myelectricavenue.info/about-project>

³⁶ <http://www.dongenergy.co.uk/news/press-releases/articles/dong-energy-launches-flexibility-service-to-balance-renewable-portfolio>

challenges and approaches taken in the project gave us good insight into how non-domestic consumers engage with DSR³⁷. This learning will inform our approach when we go out to tender for further demand side services later this year.

Question 37: Do you recognise the barriers we have identified to large non-domestic customers providing DSR? Can you provide evidence of additional barriers that we have not identified?

We completed a detailed survey and analysis of larger, non-domestic customer's attitudes towards participation in DSR schemes on the Low Carbon London programme in 2012. This analysis identified that the most significant barriers related to:

- Negative perceptions of potential risks to comfort if building services are turned down; and
- Effects on service levels to customers and building residents, costs, time, equipment and other resources.

These negative perceptions were found to outweigh technical and financial barriers to participation. An additional, important point that we noted during the Low Carbon London programme is that the different layers of owners, operators, and users of flexible assets which all need to be involved to support participation in DSR. For example, a CHP generator may be owned (e.g. a property owner), operated (e.g. a facilities company), and utilised (the business tenant) by three different companies who would all need to approve participation in flexibility programmes.

These findings are consistent with that of Ofgem's survey that identified that the most commonly quoted risk was "risk to business from providing (further) DSR, including third party control of processes"³⁸.

Question 38: Do you think that existing initiatives are the best way to engage large non-domestic consumers with DSR? If not, what else do you think we should be doing?

The current engagement initiatives have raised awareness of DSR amongst non-domestic consumers. However, it is important that these initiatives try to address the barriers, otherwise increased awareness will not necessarily lead to greater up-take.

We launched the first of our ED1 DSR schemes in our Eastern area in 2016. We intend to start recruiting and procuring further flexibility in 2017. These programmes benefit from the engagement experiences under Low Carbon London, relationships with aggregators, and relationships with direct with industrial and commercial consumers. We will continue to share our experiences with Ofgem and BEIS as we embark on this programme.

We would urge Ofgem and BEIS to clarify the market structure and the role and responsibilities within it to facilitate the development of DSR. We expand on this comment in our response to questions 45 and 46.

³⁷ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A4%20-%20Industrial%20and%20Commercial%20Demand%20Side%20Response%20for%20outage%20management%20and%20as%20an%20alternative%20to%20network%20reinforcement.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A4%20-%20Industrial%20and%20Commercial%20Demand%20Side%20Response%20for%20outage%20management%20and%20as%20an%20alternative%20to%20network%20reinforcement.pdf)

³⁸ <https://www.ofgem.gov.uk/publications-and-updates/electricity-system-flexibility-demand-side-response-survey>

Question 39: When does engaging/informing domestic and smaller non-domestic consumers about the transition to a smarter energy system become a top priority and why (i.e. in terms of trigger points)?

We believe that the need to engage with smaller customers has already arisen. Customers are starting to be exposed to low carbon technologies, such as smart meters, electric vehicles, neighbours installing solar panels in their rooftops. As this rapidly changing world evolves it is really important that all consumers start to understand the future impacts and opportunities that, for example, energy efficiency and demand response measures, could provide them.

Consumer engagement will occur through many channels, suppliers and the roll-out of smart metering, home automation technology and service providers, smart appliance providers and vehicle and transport providers.

Our LCNF funded projects have consistently engaged with smaller customers and communicated the challenges and opportunities the transition represents. These projects are providing useful learning on how to engage and revealing the issues that will need to be overcome to get smaller customer to engage.

- Our Low Carbon London project installed 5,815 smart meters in domestic homes with a number participating in trials of dynamic time-of-use tariffs. The trial participants were also invited to complete detailed energy behaviour surveys. We found enthusiasm to participate but behavioural change required significant price signals; and
- Our energywise project is using community agencies to engage with vulnerable customers in the London Borough of Tower Hamlets (one of the most deprived areas in London) to address the best ways to engage with fuel poor customers to deliver energy efficiency (including smart meters) and DSR opportunities.

The learning from these projects is that the engagement will need to be enduring and the importance of engagement will grow as the number of controllable devices increases to the point where they have a notable impact on the system. Key developments which will need enhanced engagement include the electrification of transport and heat. Smart charging of vehicles will be one of the major opportunities to engage with customers on smart energy behaviours.

Consumer protection and cyber security

Question 40: Please provide views on what interventions might be necessary to ensure consumer protection in the following areas:

- **Social impacts**
- **Data and privacy**
- **Informed consumers**
- **Preventing abuses**
- **Other**

As the first DNO-led innovation project specifically addressing fuel poverty, energywise is seeking to understand how the industry can better engage with traditionally hard to reach groups on energy initiatives and how we can work in collaboration with energy suppliers and local trusted organisations to support them to access the benefits associated to smart technologies and new tariff structures. While the project is still running, we have already gathered key learning on what are the potential barriers in delivering smart benefits for hard to reach customers and tested a locally-based approach to overcome some of these barriers.

The consultation outlines four main areas where customer protection issues may arise within the context of a smart, more flexible system:

Social impacts

Time of Use tariffs are facilitated by the national roll-out of smart meters. The take-up of smart meters and smart tariffs is voluntary; customers have to willingly opt-in to have a smart meter installed and to switch to a new tariff. Some consumer groups are expected to be less likely to accept a smart meter and therefore will be unable to receive some of the new tariff offers. This includes those aged over 75 years, those who cannot speak English well or those who have a disability, such as being partially sighted or blind³⁹. Our Low Carbon London project has also shown that the Inner City Adversity social group (in the widely used ACORN classification system for social groups, the Inner City Adversity group are low income, high unemployment groups typically earning less than £10,000 per annum) was the most prevalent to refuse to have a smart meter, owing to it being too technical or confusing. In order for the transition to a smart energy system to be successful and that the benefits are accessible to all, it is vital that it reaches all customers, including those who are vulnerable or low income.

energywise has proposed a flexible approach to engagement that can be tailored for different groups. The energywise recruitment strategy was based on:

- Contact from a local trusted organisation with an excellent understanding of the local area and languages;
- An engagement strategy and materials tailored to the target population; and
- Face-to-face communication and support.

This approach proved to be very successful in achieving the impressive 40% sign-up rate while ensuring inclusive recruitment of consumers that are considered hard to reach, including elderly households, and black or minority ethnic households which lack English as a first language. Based on our experience we recommend the following considerations in order to make sure the transition to a smart system is inclusive to those that are hard to reach:

- Consider a tailored approach for those that are most difficult to engage;
- A local approach may be preferable to target ethnic minorities living in specific areas or hard to reach communities;
- It is important to identify who are the organisations or individuals trusted by specific demographic segments and what are the messages that resonate with them;
- Work in partnership with trusted intermediaries or with champions with local intelligence and language skills;
- Consider face-to-face engagement to communicate to consumers the benefits they may realise if they opt in to smart interventions and respond to smart tariff; and
- Local champions have to be trained up professionally to identify vulnerability and to deliver key messages such as energy efficiency advice.

energywise is currently setting up the second phase of the project that will test the ability of fuel poor consumers to respond to DSR opportunities. Early considerations on how to increase the response to smart tariffs include:

- Tariff structures for those that are most vulnerable and hard to reach should be easy to communicate and understand;
- While energy efficiency advice is now very common and delivered through a multitude of channels, educational materials on how best to shift the energy consumption away from peak hours and access the benefits of different pricing signals should be made available to consumers on smart tariffs; and
- It is important to put in place a series of measures that will ensure that the change of behaviour is sustained over time, otherwise consumers may be worse off in the long term.

³⁹ Smart Energy GB, 2015, "Smart energy for all; identifying audience characteristics that may act as additional barriers to realising the benefits of a smart meter".

Data and privacy

We agree that the move to a smart energy system requires a careful consideration of data protection matters due to the expected increase of the amount of data that will be available to energy suppliers, network operators and other parties. We believe that this is a critical area for consumer protection.

We also agree that appropriate privacy safeguards need to be in place for handling personal data and that personal data needs to be managed in accordance to the Data Protection Act. Transparent processes should be in place to regulate how data is used only as intended for the purposes of a specific organisation. Data privacy should not be a barrier to develop new smart tariffs, new business models, or using the data to efficiently manage the system. As networks and the loads connected to them become more active then visibility, forecasting of customer behaviour will become more important for the system operator and this may require more disaggregated customer data to be available to network operators.

However, consumers' privacy should be central when defining new procedures to process their data. We already have robust processes in place to manage the customers' data which we receive, particularly for managing outages. Our innovation project energywise set up a Data Privacy Strategy to define the approach taken by the project partners in handling and processing personal data (as defined in the Data Protection Act 1998).

Informed consumers

In order to ensure that all consumers are taking part in the transition to a smart energy system by making informed decisions on how they wish to participate, we recommend that information is accessible and transparent to all community groups. These should include ethnic minorities, consumers living in areas of financial deprivation or in disadvantaged areas and households that may experience language and communication barriers.

Many customer groups are hard to reach or have vulnerabilities that limit their chances to access information. Through our engagement with vulnerable customers we have gathered invaluable learnings on best ways to engage with these groups and support them to understand the benefits available to them when accessing smart technologies and smart tariffs.

The following measures should be taken into consideration when informing consumers about the opportunities in a smart energy system:

- Develop key messages and identify trusted messengers that resonate with different consumers' groups and vulnerable people;
- When targeting hard to reach customers, tailor the communication strategy and materials to the specific demographic group; face to face engagement also works best;
- Make partnerships with trusted intermediaries that can support customers in breaking the barriers in understanding how to operate smart technologies and the benefits associated to smart interventions and smart tariffs;
- Consider using multiple languages, different media and communication channels and include as much visual content as possible; and
- Ensure that the consumers receiving the information, signing up to a smart tariff or attending the demonstration of smart technologies, are briefing others living in the household, otherwise the benefits from smart energy systems and smart tariffs will be limited.

Through our project energywise targeting households who may be struggling with their energy bills, we have learned that low income customers are likely to be primarily motivated to opt in for smart meters and DSR by the prospect of saving money on their bills. In the case of smart meters, better visibility of energy costs and easier top up methods for prepay customers are also key features that

make them attractive. This demonstrates the importance of providing clear information on what are the benefits associated to smart interventions to allow consumers to take informed decisions on the extent they wish to participate.

Preventing abuses

As a licenced operator we believe that there are robust controls in place on the network/system operators.

Question 41: Can you provide evidence demonstrating how smart technologies (domestic or industrial/commercial) could compromise the energy system and how likely this is?

A key system issue is rapid increases and decreases in demand. The system already addresses increases related to consumer behaviour before or after major events (e.g. people turning kettles on) which are predictable. Smart technologies theoretically create the risk of wider co-ordinated events that are difficult/impossible to predict. National Grid has indicated that ramp rates will continue to increase, meaning that fast, reliable actions are needed to be able to respond and maintain system stability. Robust cyber security of key smart technologies (e.g. EVs) and improvements to IoT devices should be encouraged to mitigate such risks.

Focusing on the perspective of the DSO, we recognise there's an increasing need to adapt and evolve cyber security measures to effectively manage the increased risks and attack surfaces provided by the pervasive deployment of smart technologies within our distribution networks. We consider the following scenarios as key areas of risk:

- The local IP connectivity of distributed generator owned and maintained SCADA equipment directly into the DNO's substations LAN or electrical apparatus;
- Either domestic or industrial smart devices being directly controlled and managed from the internet without sufficiently robust user access controls;
- A significant quantity of smart devices being remotely compromised by a threat actor, maybe due to a common vulnerability or management system, and these being maliciously operated to significantly adjust DSR within our distribution networks; and
- The tampering and malicious adjustment of critical messages between operators, consumers, aggregators or other participants resulting in modified generation and/or consumption patterns which cause a disruptive effect on electrical networks or market stability, operation and trust.

There are many factors, some of which are complex and interrelated in nature, that we feel will influence the likelihood of the above risks becoming of material concern such as:

- The critical mass of deployed smart technologies within our networks and the DSR capabilities and levels being supported;
- The cyber security maturity of the system design and development practices undertaken by smart solution providers, integrators and operators and their adherence to good practice cyber security measures and frameworks;
- The inherent resilience within the design of distribution networks and the diversity smart technologies deployed; and
- The sophistication and motivation of threat actors.

Designing, implementing and maintaining effective and proportionate levels of cyber security within smart appliances, data exchanges between the varied system participants and the resilience of critical supporting IT networks and systems are key to realising system security in a technology driven flexible energy system.

In these regards we consider the following approaches worthy of consideration by Ofgem and Government:

- Smart appliances and services will ultimately need to be intuitive to use and therefore have effective cyber security capabilities largely embedded into their construction and operation. Where consumers have settings and features at their control which could impact theirs or another energy system participant's cyber security, clear advice and effective agreements need to be in place to cover technical, procedural and contractual aspects to set acceptable tolerances of operation;
- Minimum cyber security standards through close collaboration between industry and government are to be established in relation to the build and operation of smart appliances supporting DSR;
- Above such minimum standards, energy system participants, including operators, aggregators and consumers, are given flexibility to use common good practice cyber security frameworks to take appropriate and proportionate 'risk' based cyber security measures;
- As the smart grid evolves with a flexible energy system playing a pivotal role in a secure, sustainable and low carbon energy supply, the need to understand and test the technology and data interdependencies between smart energy system participants is ever more vital. Again government and industry collaboration, driven through entities like the National Cyber Security Centre, can be used to undertake system level cyber assessments and attack simulation exercises to test system resilience and to drive a cycle of continuous cyber improvement in keeping with technology evolutions and cyber threats; and
- In order to effectively balance the needs of consumer flexibility and system reliability in the context of a smart energy system, further research and development of solutions to provide advanced cyber-attack detection capabilities (including unusual behaviours in IT systems and the devices or demands on the electricity system) are essential to support the adaptive management of electrical distribution networks and their supporting critical IT infrastructure and smart management components.

We believe that the cyber security risks arising from the transition to an increasingly flexible energy system are inherently manageable through the application of industry recognised good security practices, the development of minimum standards with all stakeholders where required and the continued healthy industry and government collaboration on cyber security.

To this end, in the last year we have:

- Undertaken a full review of our cyber security operating model against recognised global best practice to inform ongoing continuous improvements;
- Increased our level of investment in cyber security by 32%;
- Contributed extensively at industry and government information groups exchanges in support of Critical National Infrastructure Protection; and
- Taken on the chair of the ENA Cyber Security Forum to lead the future development of security standards and good practices as relevant to DNOs.

Question 42: What risks would you highlight in the context of securing the energy system? Please provide evidence on the current likelihood and impact.

We have set out the risks in our answers to the earlier questions on cyber security. There is current evidence that IoT devices have been co-opted to support internet denial of service actions and therefore are clearly vulnerable to cyber risks.

As IoT devices become more numerous a risk based approach to establishing the necessary system contingencies will be necessary.

4. The roles of different parties in system and network operation

This is a crucial section of the Call for Evidence and we are already utilising our portfolio of cutting-edge innovation projects to understand how our role is changing and are feeding this learning directly into our business. We are already displaying many aspects of the DSO role which is described in the Call for Evidence. We would like Ofgem to expand the current regulatory framework, in time for ED2, to provide the correct incentives across network companies to invest and deliver whole system benefits in the most efficient way. We also want to ensure that in meeting the immediate actions outlined in the Call for Evidence, we retain the flexibility to make changes to roles and arrangements in the future.

In response to the specific questions posed in the Call for Evidence we have set out the current situation on our networks, how this is likely to evolve in the future and where new roles and arrangements can help us maintain security of supply and deliver substantial whole system benefits.

Roles and responsibilities

Question 43: Do you agree with the emerging system requirements we have identified)? Are any missing?

We broadly agree with the emerging system requirements presented in the Call for Evidence and have provided examples in our response to question 44 of where we are already seeing evidence of the drivers for change on our networks.

The key priority for us will be to have visibility of the actions which others will be taking on our network and ensuring other parties have visibility of the actions we take. For example, we will need visibility of services provided from DERs, the SO and aggregators. Limited visibility may impact our ability to optimally manage the network and maintain system security in the future, as well as limiting the ability of the SO, generators and suppliers to operate efficiently. Again, we expand on this in our response to question 44.

Many of the aspects listed in the emerging requirements are already being implemented as business as usual. We have experienced rapid change in a number of our network areas, particularly with the high volume of DG and storage applications mentioned previously in this response. In addition, to ensure a resilient network we have undertaken bi-lateral work with National Grid to ensure that our connection contracts allow for emergency disconnection of DG when National Grid require it. We have also revised our process and procedures to manage a black start scenario.

In addition, we believe there are three important aspects which should be included in the emerging requirements.

- Forecasting of load and generation growth across the transmission and distribution networks. Accurate forecasting is a critical first step of network planning and important in enabling efficient system operation;
- The importance of providing transparent information to stakeholders. This includes where there is spare capacity available (through our heat maps) and also helping customers understand their potential DUoS charges under the EDCM and how they may vary depending on where they connect; and
- The need to start developing, advanced real time system-wide control. This will be a critical enabler of allowing the optimal operation of the networks (across transmission and distribution) to deliver whole system benefits. We are already embarking on the trajectory towards greater real time control through the TDI 2.0 project and we expand on this theme in our response to question 44.

Question 44: Do you have any data which illustrates:

- a) the current scale and cost of the system impacts described in table 7, and how these might change in the future?**
- b) the potential efficiency savings which could be achieved, now and in the future, through a more co-ordinated approach to managing these impacts?**

- a) the current scale and cost of the system impacts described in table 7, and how these might change in the future?

Table 7 in your consultation outlines three separate (if intrinsically linked) network impacts. We have looked at each of these in turn and where possible set out the costs and impacts in a qualitative and quantitative way.

Growth of Distributed Generation (DG)

The last few years have seen a rapid increase in not just the volume of DG connected but in the number of connection requests. We also have a substantial volume of DG which has accepted offers and are waiting to connect. We have set this out in Table 2 below:

Table 2: DG offers, contracted and connected

Category	Eastern Power Networks plc	South Eastern Power Networks plc	London Power Networks plc	Total
Offers issued (GW)⁴⁰	36	17	1	54
Contracted and waiting to connect (GW)	1.6	0.73	0.04	2.41
Connected⁴¹ (GW)	5.39	2.41	0.66	8.46

As a result of the above, our networks are becoming increasingly constrained. For example, in our Eastern region, a fifth of our GSPs could not accommodate a 25MW generator at EHV without reinforcement and over a tenth could not accommodate a 5MW generator at HV without reinforcement. As a consequence of these constraints we are offering flexible connections to customers, with ambitious plan to roll-out active network management across our Eastern and South Eastern networks by 2021.

As outlined earlier in our response, in addition to the DG connections, we have also received close to 12GW of applications from over 600 storage providers. This adds further complexity to assessing new connections as storage providers can be import and export. While we wait to see if storage providers accept a connection offer, we need to treat new connection requests on the basis that the storage providers accepts the offer. Therefore, new connection offers become interactive with those already issued. This is a difficult position to explain to customers and to keep an orderly interactive connection queue, particularly with 2.4GW of accepted offers to manage.

We have had to adapt our business and change the way we operate to deal with these connection volumes and the increasingly constrained nature of our networks. Specifically, we have:

- Increased the size of our network design teams to ensure a responsive service whilst experiencing a doubling in application volumes in the between 2012 and 2015;
- Introduced new policy guidance to support new market entrants such as storage providers and community energy groups understand the connection process;

⁴⁰ From January 2012 to November 2016.

⁴¹ To date

- Developed new processes to provide fair and equitable management of the interactive connection queues which have developed in the last three years;
- Increased our engagement and level of ongoing communication with connection applicants to ensure that they each understand explain the complex background to their connection request and received a bespoke service; and
- Deployed active network management across areas of our network to facilitate new connections in constrained areas without costly and time consuming reinforcement.

Exporting GSPs and whole system investment

We currently have several exporting GSPs across our networks. The impact of this is that all DG and storage connections above 1MW needs to be assessed by National Grid to understand what impact (if any) it will have on the transmission network. This is known as the statement of works process. It has resulted in considerable uncertainty for our customers in terms of the costs and timescales of connecting. In many cases where transmission network reinforcement is required, it makes the DG or storage project commercially unviable and the customer does not proceed with the connection.

We have been working with National Grid, both bi-laterally and through the ENA to try and improve the statement of works process. The aim is for National Grid to produce planning limits for each GSP which we can then use to provide better information up front to connecting customers on the time and cost of connecting. To date, it has proved very difficult for National Grid to produce these planning limits, given the complexity of the network and the constantly changing picture of DNO connection requests.

Co-ordinating local network management and system frequency requirements

The Call for Evidence correctly highlights the issues around co-ordinating local management of DG and storage with balancing actions taken by National Grid as the SO. We are currently rolling out active network management across large areas of our Eastern network. As stated above, we plan to have fully rolled out active network management across our entire Eastern and South Eastern networks (as well as where needed in London) by 2021. Therefore, co-ordinating the use of distributed resources for local and system wide benefits will become even more important in the future.

The scale of DNO active network management schemes, while ramping up, is currently low meaning that we have little evidence of actual conflicts with other services and their associated costs. However, we do have relevant evidence from the impact of National Grid's EFR tender. It was apparent that connecting customers who wished to bid for this tender were generally not interested in flexible connections for local network management. The feedback from these customers indicated that this was because the terms of the EFR tender did not lend themselves to being actively managed by the DNO.

We have been exploring these co-ordination issues through the ENA's Active Network Management group. This group has a specific work stream looking at where conflicts are likely to arise between local ANM and system wide balancing and how best to manage these conflicts. It is looking at the ownership of the ANM equipment where that equipment is used to resolve transmission and distribution constraints. The group are also looking at the process for managing the ANM scheme and the operational interface between SO, TO and DNO. As part of the strategic work stream, the ANM group is looking at whether the distribution network needs to leave some headroom for balancing actions or whether balancing and local constraints can be more optimally managed. The learning from our TDI 2.0 project will be important in informing future approaches.

Changes to cost in the future

We think there are two ways in which to look at how our costs may change in the future:

i) Network operation costs

Our forecasts (transposed from National Grid's Future Energy Scenarios) and set out in Table 3 below, are that under a high take-up scenario, we could have over two million active devices (such as EVs, DG and storage) connected to our networks by the mid-2020s⁴². These devices will not have regular consumption or export patterns and may be providing flexibility services elsewhere to the SO, suppliers or aggregators. To provide some context, the current number of active devices is in the low thousands and the flexibility markets to access these devices are only just developing. This will significantly increase the complexity of operating the system and the level of co-ordination needed between DSOs and National Grid.

Table 3: Take-up of low carbon technologies within UK Power Networks regions by 2030 based on National Grid Future Energy Scenarios⁴³ applied to UK Power Networks

Scenario	PV	Electric Vehicles
Now	2.6GW	0.016m
High	12.9GW	1.9m
Low	6GW	1.2m

To deliver decarbonisation at lowest cost, a paradigm shift is required in system operation. This will require investment in new IT and communications systems, along with the data and analytical processing to drive advance distribution management with strong co-ordination with National Grid. If we do not have the tools and remit to manage these devices, we will not be able to maintain the current levels of security of supply to our customers and it is also likely that the cost of decarbonisation will increase as we will be unable to optimise the use of resources on our network. As we outline in our response to question 45, it would be helpful if there was clarity of how the regulatory regime will treat the costs of investment in these areas and how transmission and distribution incentives will be aligned to ensure efficient delivery.

ii) Network infrastructure costs

We are already looking at the potential reinforcement costs associated with the Government's scenarios for the take-up of low carbon technologies in ED2. As part of our ED1 business plan we ran the Transform model⁴⁴ using our network data to provide a high level indication of potential reinforcement costs out to 2030. We ran the model across a range of scenarios based on the incremental use of the smart grid solutions. The model produced a range of potential reinforcement costs in ED2 of between £1.5bn (based on the core scenario we used in ED1) and £3.2bn (based on a 'high' take-up of heat pumps and EVs). We should emphasise that these figures are highly indicative but they are the best approximation available to us at present.

The figures emerging from the Transform model are supported to some extent by the work the ENA has undertaken for OLEV on the potential reinforcement costs for EVs. The ENA has estimated that the GB reinforcement costs of accommodating the anticipated eight million Electric Vehicles by 2030 and provided these to OLEV. We have assumed, based on the size of our network that around a third of these costs would fall to us between now and 2030.

⁴² This is based on the number of EVs, active DG and storage customers on our network, according to the figures in Table 3.

⁴³ <http://fes.nationalgrid.com/fes-document/>

⁴⁴ <https://www.eatechnology.com/global/middle-east-english/products-and-services/create-smarter-grids/transform-model>

The evidence above suggests we could need up to a four-fold increase in reinforcement allowances for ED2 (approximately £800m for the ED1 period), should the high take up low carbon scenarios emerge.

- b) the potential efficiency savings which could be achieved, now and in the future, through a more co-ordinated approach to managing these impacts?

We have split our response between savings available now and potential savings available in the future:

Savings available now

We have responded to the volume of DG connections through early deployment of our highly successful Flexible Plug & Play project, into the business as usual. We have expanded the trial zone and enabled 330MW of DG without the need for reinforcement. This has saved over £100m of reinforcement costs which would have otherwise made most of the DG schemes unviable. As outlined above, we are now planning an ambitious roll-out of the active network management infrastructure across our Eastern and South Eastern regions by 2021. Extrapolating the benefits against the current growth rate for Flexible Distributed Generation (FDG), we believe that this will allow in excess of 1GW of FDG generation/storage connect, saving customers up to £500m.

In addition, we are targeting the delivery of £43m of reinforcement savings (which are reflected in our ED1 business plan) through use of smart grid solutions, including flexibility.

Savings available in the future

It is difficult to estimate the level of potential savings with any certainty, particularly since the take-up of low carbon technologies is uncertain, along with the commercial and operational model for a more co-ordinated approach. We have looked at the evidence available to illustrate the wider system benefits as well as those which would accrue directly to our customers.

- i) Wider system benefits

The Call for Evidence cites the work undertaken by Imperial College for the Carbon Trust, which estimates the benefits of co-ordinated flexibility of £17-£40bn by 2050. We have engaged with Imperial College to help understand the assumptions made on the DSOs' role in delivering these benefits. Imperial College have been clear that a DSO role is crucial in delivering the vast majority of these benefits, given that the flexible resources will be connected to the distribution networks.

It is useful to look at where the savings delivered by a DSO can accrue across the system as shown in Figure 5 below:

Avoided generation plant: Imperial College's research shows that optimising the system operation at distribution level allows more generation to connect to the distribution network and avoids the need for more expensive, larger, generating plant to be built. This is a substantial proportion of the overall benefits (generation capex).

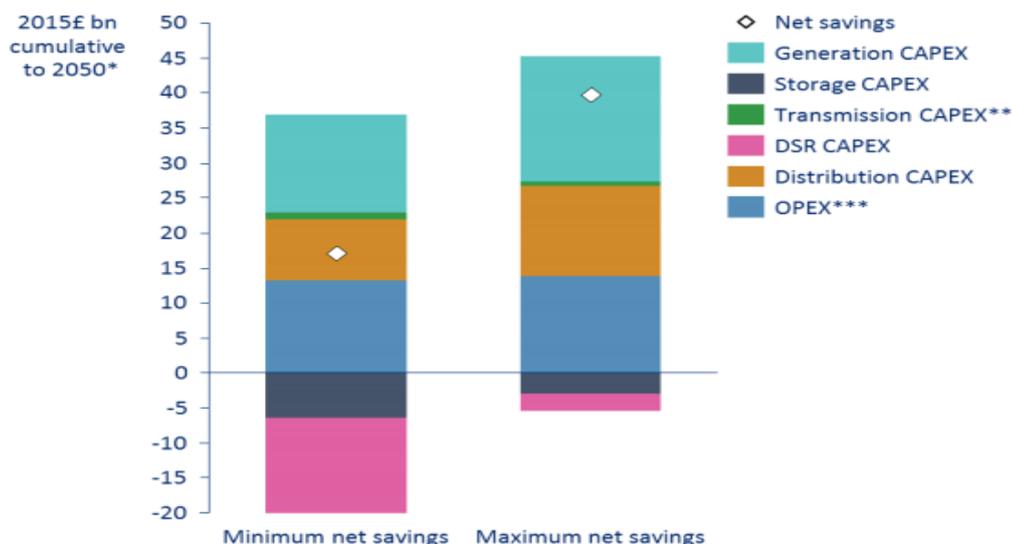
Avoided Transmission investment: Management of local distribution resources can avoid the need for transmission reinforcement. This is highlighted in the Imperial College work. We are actively trialling the delivery of these benefits through the TDI 2.0 project. National Grid has estimated that the benefits of the increased co-ordination being trialled will enable an additional 3.7GW of generation to connect to the system. National Grid go on to estimate that the total GB savings achieved through successful roll-out of the trial could be over £400m by 2050⁴⁵.

⁴⁵ https://www.ofgem.gov.uk/system/files/docs/2016/11/final_submission_tdi_2.0.pdf

More efficient balancing services: Access to DER for system balancing could displace the need for more expensive balancing options such as peaking plant. Again, this features in the work undertaken by Imperial College and Carbon Trust

Figure 5: Summary of flexibility benefits: An analysis of electricity system flexibility for Great Britain by the Carbon Trust (p5)⁴⁶

Chart 1 A breakdown of the minimum and maximum cost differences in scenarios with and without flexibility, cumulative to 2050



*Discounted back to 2015 using HM Treasury's Green Book social discount rate.

**Includes interconnector and onshore transmission CAPEX.

***Refers to variable OPEX (fuel and carbon costs). Fixed OPEX is included in CAPEX figures.

It is worth stressing that the regulatory framework does not currently allow any of the benefits to flow back to DNOs, despite our investment being needed to facilitate delivery of those benefits. Therefore, new incentives are needed to allow us to share in these benefits in order to fund the increased investment needed. We expand on this in our response to question 46 b).

ii) Distribution capex savings

Greater flexibility (and co-ordination of that flexibility by the DSO) can allow new connections to be accommodated without spending as much on reinforcing the distribution network. This can provide savings to the connecting customer, who avoid the need to pay for reinforcement and savings to wider customers who contribute to reinforcement costs through DUoS. Given projections of the take-up of low carbon technologies, these savings could be significant and account for around £8bn-£10bn of the savings cited by Imperial College. Many of the avoided connection costs will accrue to connecting customers under the shallowish connection charging policy.⁴⁷

We are already delivering some of these benefits today. We have £43m of reinforcement savings to deliver in our ED1 reinforcement budgets from use of DSR, as part of the wider smart grid benefits we are delivering. As highlighted above, we have ambitions plans to roll-out ANM across our EPN and SPN regions. Extrapolating the benefits against the current growth rate for FDG, we believe that this will allow in excess of 1GW of FDG generation/storage to connect saving the customers close to £500m.

⁴⁶https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf

⁴⁷ This requires customers to pay a proportion of reinforcement costs up front, with the remainder funded by DUoS customer. DNOs only receive these benefits

It is important to highlight that achieving the scale of benefits highlighted by Imperial College requires investment in IT and communications systems to provide real time visibility and network operation across transmission and distribution. As discussed further in our response to question 45, we are starting to trial this in areas (particularly through our TDI 2.0 project) but wider roll-out requires investment. We need a regulatory framework with aligned incentives across transmission and distribution to provide the certainty required to help attract this investment.

Question 45a): With regard to the need for immediate action, do you agree with the proposed roles of DSOs and the need for increased coordination between DSOs, the SO and TOs in delivering efficient network planning and local/system-wide use of resources?

We agree with the proposed roles of DSOs set out in the Call for Evidence and are already displaying many of these roles in our business operations. To fully respond to this question, we have set out the approach we have taken to developing our DSO capability, explained how this covers many of the roles outline in the Call for Evidence and highlight where further joint work is required by network operators to implement those immediate actions asking for greater co-ordination between parties.

Our approach to the development of DSO

We have been developing DSO capability since 2010 when we launched our Low Carbon London project⁴⁸. Our ED1 business plan included ambitious smart grid and innovation strategies aimed at ramping up our DSO capability⁴⁹. We have the largest and most successful portfolio of innovation projects across DNOs, which has helped us to trial and implement the foundation capabilities underpinning a DSO. We have also been active in following the innovation projects run by other DNOs to leverage the learning from them into our business.

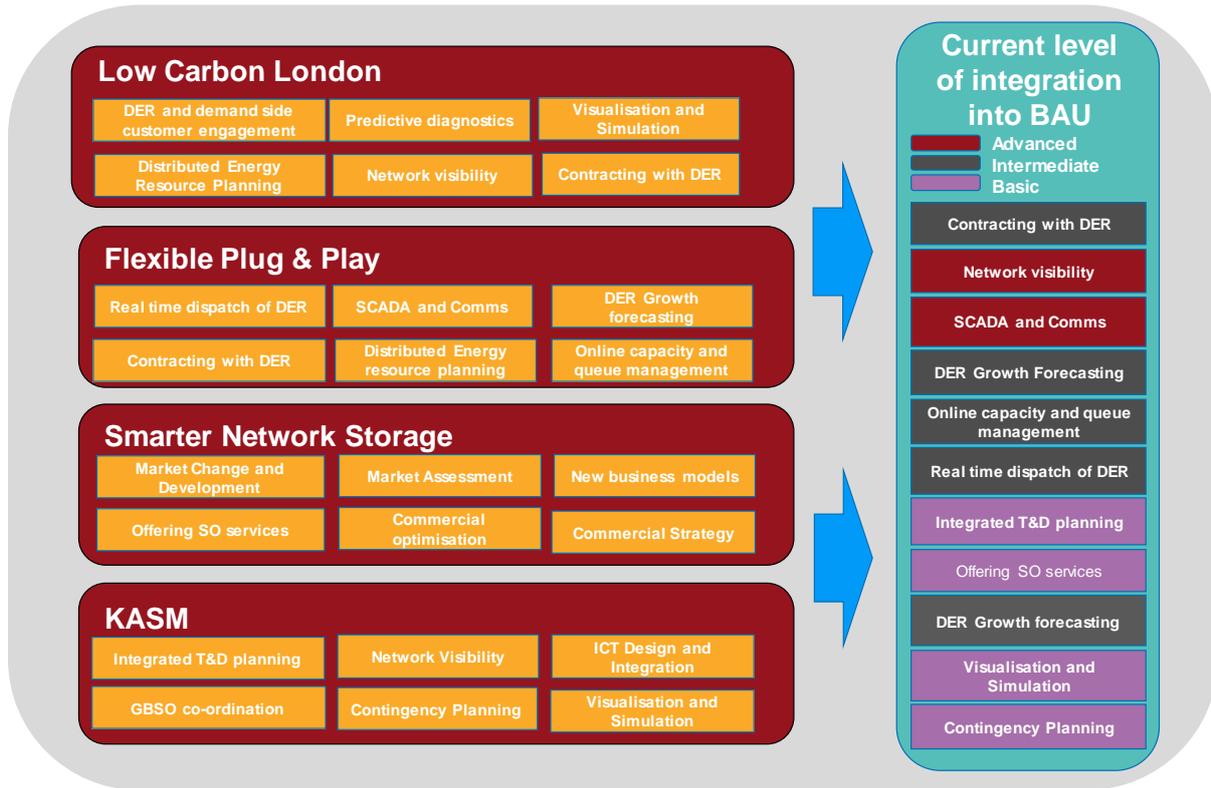
In response to the challenges we have seen on our network, we have started to deploy DSO capabilities as part of business as usual and are actively delivering over £200m of smart grid benefits within our ED1 business plan. We are actively developing other capabilities for deployment by the start of ED2.

Figure 6 shows how our innovation portfolio has defined and tested the building blocks of the DSO infrastructure. To ensure that these are deployed to provide benefits to our customers, we have restructured our business to support the delivery of the DSO capability in terms of technology, skills, data and systems that is required.

⁴⁸ [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/)

⁴⁹ http://library.ukpowernetworks.co.uk/library/en/RIIO/Main_Business_Plan_Documents_and_Annexes/UKPN_Smart_Grid_Strategy.pdf and https://library.ukpowernetworks.co.uk/library/en/RIIO/Main_Business_Plan_Documents_and_Annexes/UKPN_Innovation_Strategy.pdf

Figure 6: DSO capability developed through some key innovation projects:



We are moving towards a new model of delivering system security which is less reliant on replacing and upgrading assets to maintain a certain level of redundancy, and more reliant on smart, real time operation of network assets. We believe that this is the most cost effective and efficient way to accommodate low carbon technologies to our network in order to deliver the Government's carbon reduction plans.

A full description of the work we have undertaken and that currently underway is set out below in Table 4:

We believe that we are actively meeting many of the immediate actions set out in the Call for Evidence and are incorporating them into our new DSO operating model. This looks to understand in depth the capabilities needed, their priority and the necessarily business change to build these capabilities. Consequently, we consider that we are advanced in terms of integrating the ability to run the network more flexibly into our central operations models, rather than have it running as a separate innovative trial which only works in some areas.

We acknowledge there is more work to be done in terms of implementing the joint industry processes around this co-ordination. This will involve learning the lessons from various innovation projects and trials and agreeing with other DNOs and National Grid how best to deliver a co-ordinated framework for planning and use of resources. We are committed to doing this but highlight some of the risks and challenges around these specific actions in our response to part b) below.

Table 4: Detailed description our integration of DSO capabilities into our business

Component	Examples
<p>1. Prioritising the DSO foundation capabilities, focusing on no-regret actions, that deliver customer and market needs.</p>	<ul style="list-style-type: none"> • We are prioritising investment in skills, particularly energy forecasting, power systems planning and ICT, energy markets and commercial analysis • We are creating a DSO function within our Information System department, focussed on delivering the software platforms, security and data architecture and DER management systems required for DSO transition • Network technologies that enable increased visibility and controllability of the network such as monitoring and automation at all voltage levels • We are actively developing cyber defence monitoring in order to ensure our more complex IT and communications systems remain secure
<p>2. Embedding successful innovation as business as usual to deliver customer benefits</p>	<ul style="list-style-type: none"> • We have created a 15 person strong dedicated team to enable the DSO transition for UK Power Networks. The team comprises of experts in programme management and change, power systems, ICT and commercial arrangements • We have the most network under active network control in mainland UK. Covering north Norfolk, we have enabled 330MW of DG capacity that may not have been viable saving over £100m for connecting customers • We have rollout plans to enable active network management across our Eastern and South Eastern networks by 2021 • We are planning to act as purchaser of flexibility through tendering for flexibility services to help avoid reinforcement and provide support during network outages • We have developed connections policy for large scale storage and domestic LV storage in response to market demand. We have published heat maps for demand and generation constraints • We are developing a comprehensive standard for the connection of EVs
<p>3. Working closely with the System Operator to improve co-ordination of network planning and operation</p>	<ul style="list-style-type: none"> • Working with National Grid to unlock capacity for further DG and Storage in our South Eastern region. This is examining how we can refine modelling assumptions, how the regional UK Power Networks Flexible DG scheme can coordinate with the transmission operator, how storage can be integrated and how distribution networks could offer solutions to transmission constraints • Our TDI 2.0 NIC project has been designed to develop and test practical co-ordination between T&D in order to resolve real constraints across both networks in the most efficient manner • Along with National Grid, we are co-developing the Regional Development Programme for the South Eastern region which focus on ANM, storage and network planning
<p>4. Developing Commercial Arrangements that inform future changes</p>	<ul style="list-style-type: none"> • We are developing market based development of more efficient curtailment mechanisms under NIA project⁵⁰ • Developing a commercial framework for joint SO/DSO procurement of flexibility under the TDI 2.0 project. The project is a world first DSO trial and tests the local balancing unit future model described in the Ofgem/BEIS Call for Evidence

⁵⁰ This is a potential NIA project which builds on the success of our LCNF project Flexible Plug and Play

Question 45 b): With regard to the need for immediate action, how could industry best carry these activities forward? Do you agree the further progress we describe is both necessary and possible over the coming year?

Further progress is necessary and possible over the coming year

If the projections on the future growth of DER are correct then it will be vital that we make further progress on the immediate actions and longer term models. These longer term models can not only reduce the cost of accommodating that DER but co-ordinate that DER in a way that maintains the security of our network. We expand on this concept in our response to question 46 a).

Some of the aspects listed in the immediate actions such as the formalised framework for whole system network planning and co-ordinating the use of resources require co-operation and clear allocation of tasks responsibilities between network operators. The premise in the Call for Evidence is that all the immediate actions can be delivered through current roles and arrangements. We agree but are concerned that this could 'lock in' current arrangements without a full debate and assessment of more fundamental changes. In this sense, we see delivery of these aspects of the immediate actions as intrinsically linked to the consideration of the future models outlined in question 46.

As an example, we are starting to see the SO co-operate with DNOs on its latest demand turn up service.⁵¹ Under the proposals trialled last year between National Grid and Western Power Distribution (and planned for roll-out in 2017), DNOs can access the distribution resources contracted for the demand turn up service through making a request to National Grid. National Grid then use the terms of their contract with the customer to procure the response required by the DNO. This is helpful in terms of sharing resources across SO and DNO. It starts to meet aspects of the immediate actions around co-ordinated use of resources. However, this is just one potential way of managing co-ordination and may not be the most efficient in the longer term (see Figure 7 in our response to question 46 a). We do not want to see systems and processes put in place to address the immediate actions which make changes to roles and arrangements more difficult as we move forward.

Best way to carry these actions forward

It is important that the immediate actions are implemented in a consistent way across network operators in order to provide a common set of processes and policies for our stakeholders. As such, we believe that the ENA provides the vital platform through which to share learning on how companies are addressing the immediate actions and agree how best to continue the co-ordination required. In addition, there will be some areas where it is helpful for individual network operators to work bi-laterally with National Grid to explore different options to help inform the policy debate. We are active in doing both of these to help address the immediate actions:

i) ENA work streams

We are using the knowledge gained from our innovation portfolio and practical experience of managing flexible connections to play a key role in the ENA's Transmission and Distribution Interface (TDI) work stream⁵². We chair the High Volts working group and have played a key role in developing the work programme for the Active Network Management and Statement of Works working groups. We recognise that progress across the TDI work streams have been mixed and we have supported plans to re-focus the work plan and accelerate delivery. It remains crucial to develop a common understanding of the issues and the mechanism to generate new common processes and procedures which can then be codified. Consequently, we believe that the ENA TDI work on TSO-DSO interface will develop a common roadmap which will provide a cohesive framework for DSO transition.

⁵¹ <http://www2.nationalgrid.com/UK/Services/Balancing-services/Reserve-services/Demand-Turn-Up/>

⁵² [http://www.energynetworks.org/electricity/regulation/transmission-distribution-interface-\(tdi\)-steering-group/transmission-distribution-interface-\(tdi\)-steering-group-deliverables.html](http://www.energynetworks.org/electricity/regulation/transmission-distribution-interface-(tdi)-steering-group/transmission-distribution-interface-(tdi)-steering-group-deliverables.html)

ii) Bi-lateral work with National Grid

To supplement the work through the ENA, we are working closely with National Grid to address whole system challenges. The close collaboration has been developing over the last three years with particular focus on the complex network of our South Eastern region. We have developed a joint work stream with National Grid on overcoming the whole system challenges in the South Eastern region with the following focus:

- Data exchange at interface and revision of T&D planning assumptions;
- Optimised ANM deployment;
- Integration of storage;
- T&D planning process; and
- Impact of ROCOF protection issues.

The outputs of this work will deliver additional capacity for connections at lowest whole system cost. The collaboration will be further accelerated through the TDI 2.0 project which will be starting with National Grid shortly. This will provide practical experience of how to share flexible resources between us and optimise their use for network operation and planning. It is also worth highlighting our KASM (Kent Active System Management) project. KASM will be delivering its final trials in 2017, demonstrating how the use of contingency analysis and increased visibility of the transmission and distribution network can reduce constraints for distributed resources⁵³.

Question 45 c): With regard to the need for immediate action, are there any legal or regulatory barriers (e.g. including appropriate incentives), to the immediate actions we identify as necessary? If so, please state and prioritise them.

The immediate actions identified around greater co-ordination in system planning and efficient use of flexible resources are both about extracting whole system benefits. As set out in our response to question 45 b), we are conscious that the actions needed to deliver them may need to be mindful of the longer term system operation models set out in question 46.

Our view is that alongside the work industry is taking forward on the immediate actions, there needs to be work undertaken on the supporting regulatory framework through which whole system benefits can be delivered. The current regulatory framework has been hugely successful in delivering safe, reliable networks which respond to customers' needs at an efficient cost. However, the framework was not designed with the delivery of whole system benefits in mind. We provide two examples below where this is the case:

i) Incentive for DSOs to invest for whole system benefits

As highlighted by research undertaken by Imperial College and the Carbon Trust, there could be £17-£40bn of benefits from optimal system operation by 2050⁵⁴. The vast majority of these benefits are obtained through optimising the use of resources at distribution level and therefore delivered by the DSO. Under ED1, the totex incentive mechanism encourages us to make investments where they reduce costs on our network but not where investments deliver cost savings elsewhere on the system. Equally, there is no current mechanism for us to share in the wider benefits which we could use to fund the necessary capability. We expand on these arguments in our response to question 46.

⁵³ <http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/kent-active-system-management/>

⁵⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf

ii) Alignment of Transmission and Distribution price controls

A whole system planning framework requires a more joined up approach to assessing the costs (and associated benefits) across transmission and distribution. DNOs can provide some services directly to National Grid to alleviate constraints, as proven in Electricity North West's CLASS project.⁵⁵ However, some of the actions DNOs can take to provide lower cost solutions to transmission can impact on distribution network performance, for example, losses or customer interruptions.

The ED1 and T1 price controls were not set with delivery of whole system solutions in mind. We are uncertain if National Grid is funded to procure these types of solutions. We were not funded to do so and it is not clear how our provision of such services relates to the rest of the balancing market. In addition, our ED1 outputs do not take account of the impact of providing such services. Our performance is measured against our network outputs and not on the wider system benefits we facilitate. Therefore, even when it could be the most economic action, our regulatory framework does not provide us sufficient clarity over funding or the incentives to provide the services required.

Adapting the regulatory framework

We believe that the strengths of the current regulatory framework (totex benchmarking; outputs led with strong incentives) can evolve to encourage DSOs to enable the successful delivery of whole system benefits and achieve decarbonisation at least cost. We consider that there would also be merits in setting out a timetable for this work to provide the certainty that these issues will be looked at. This timetable could include a commitment from Ofgem to align the T2 and ED2 price control incentives.

As outlined in our response to question 46 below, evolving the current regulatory framework can place the correct incentives for industry to develop the commercial arrangements and specific roles needed to deliver whole system benefits.

Question 46a): With regard to further future changes to arrangements, do you consider that further changes to roles and arrangements are likely to be necessary? Please provide reasons. If so, when do you consider they would be needed? Why?

As and when more flexible resources (DER) connect to the distribution network, we believe that changes will be required to roles and arrangements in order to maintain current network reliability and to provide a framework through which to deliver whole system benefits. We also consider that DSOs need to play a central role in managing the resources on their network to maximise these benefits. Our knowledge of our networks and track record of delivery under a strong regulatory framework make us an obvious choice to take on a new role.

Why changes to roles and arrangements are likely to be needed

We consider there are two key reasons why we may need changes to current roles and arrangements.

i) Maintaining system security

We have highlighted earlier in this response how the anticipated increase in DER connecting to the network will vastly complicate the operation of the network. By the mid-2020s there could be up to two million DERs on our network which do not have regular consumption or generation patterns⁵⁶. The effective management of these devices, at lowest cost, will require DSOs to undertake a paradigm shift in system operation (enabled by advanced IT and distribution management systems). This will add significant complexity to system operation which will require co-ordination (and resolution of conflicts)

⁵⁵ <http://www.enwl.co.uk/class>

⁵⁶ See Table 3 under our response to Q44 a).

between DSOs and National Grid and potentially with other procurers of flexibility such as suppliers and aggregators.

Current roles and arrangements do not give us visibility of the actions of DER or the tools to manage potential conflicts over the use of DER by the DSO, SO, aggregators or suppliers. It is the inability to manage these conflicts, in a world where we will have vastly more complex system operation at distribution level which puts system security at risk. New roles and responsibilities and underpinning market frameworks will be needed to resolve this issue.

We are already concerned about this, hence our support to take forward greater visibility on the immediate actions. DNOs are the only party who are highly sensitive to the location of customers providing services. Consequently, given the more complex nature of system operation and the likely conflicts which will arise between parties on the use of DER, DNOs need to assume a new role as a neutral market facilitator of services from customers connected to their networks, in order to maintain system security. We are in a unique position to act as this facilitator, with a mandate to optimise the use of those resources for whole system benefits while maintaining the security of our network.

It is worth highlighting how co-ordination on use of DER based on current roles and responsibilities has the potential to be inefficient and compromise reliability. As briefly mentioned in our response to question 45b), the latest National Grid tender for demand turn up goes down to 1MW and generators of 0.1MW can contract with aggregators for the service⁵⁷. Therefore, it clearly reaches down into the distribution network. National Grid is trying to co-ordinate with DNOs, however, the only option available to DNOs is to contract for a response through National Grid when required. This has been trialled with Western Power Distribution and while it is a step forward in looking to co-ordinate efficient use of resources we do not consider it provides the most efficient medium or longer term option. This is an example of where we need to be careful in putting in place processes to address the immediate actions outlined which lock industry into a specific model.

Figure 7 below depicts how this co-ordination will work based on current roles and responsibilities. Figure 8 shows how co-ordination on use of DER could be more efficient with the DNO acting as a neutral market facilitator and procuring services from DER for the SO. Under option 1, the SO is contracting for all services on DNO networks without the visibility of how the DNO network is operating. It can lead to efficient procurement decisions and reliability issues. Figure 8 below shows option 2 where a DSO procures the services needed from its customers to the SO. It is a simpler process and avoids the reliability issues.

⁵⁷ <http://www2.nationalgrid.com/UK/Services/Balancing-services/Reserve-services/Demand-Turn-Up/>

Figure 7: Current roles and responsibilities with SO contracting party with DER

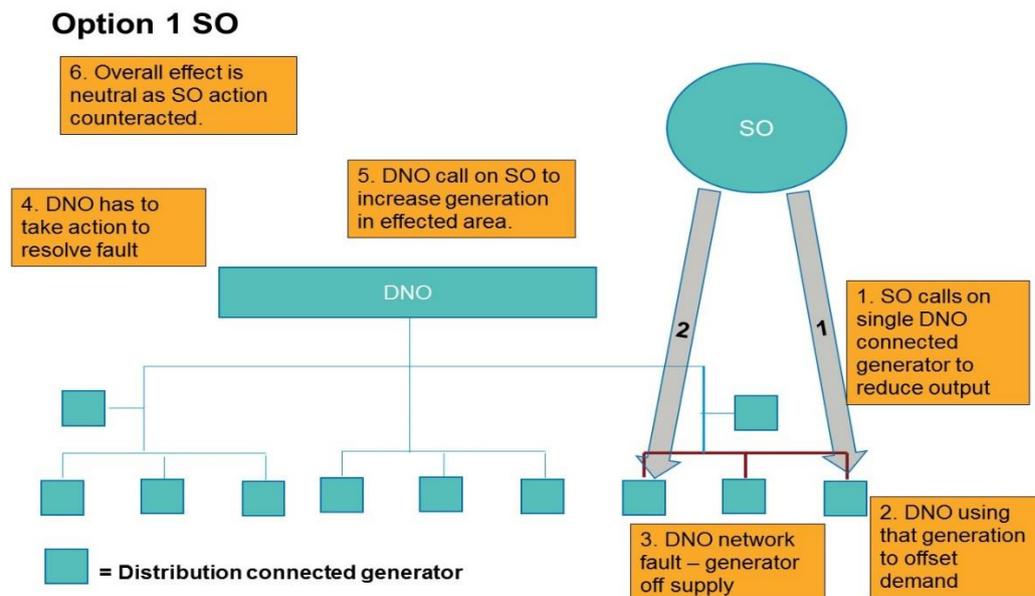
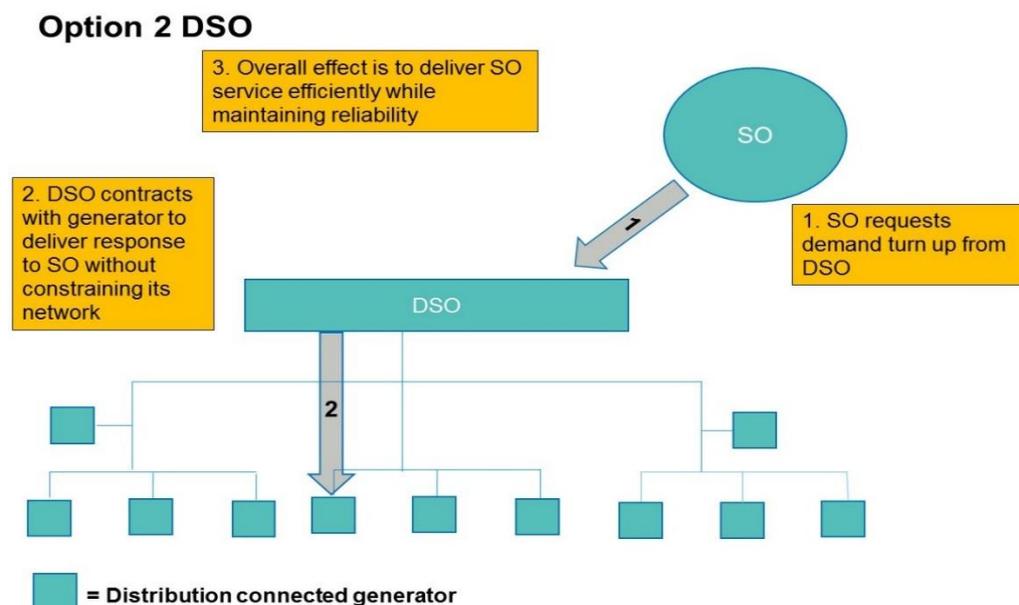


Figure 8: DSO co-ordination



ii) Delivering greatest whole system benefits

Analysis carried out in our Low Carbon London project demonstrated that the historical approach to designing distribution networks maybe suboptimal in the context of low carbon agenda⁵⁸. The analysis stated that what was required was a whole-systems approach – joining energy, emissions, ancillary services with infrastructure design covering local and national geographies. Again, DNOs are best

⁵⁸ Low Carbon London, “Novel commercial arrangements for smart distribution networks”, Report D5, Dec 2014, [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20D5%20-%20Novel%20commercial%20arrangements%20for%20smart%20distribution%20networks.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20D5%20-%20Novel%20commercial%20arrangements%20for%20smart%20distribution%20networks.pdf)

placed to take a new role to deliver these benefits. The vast majority of flexible resources will be connected to DNO networks. DNOs can use the detailed knowledge they have from years of operating and developing their networks efficiently and safely to optimise the use of these resources, in a way that the transmission system operator cannot. As the number of DER increased dramatically (as predicted) we can use this knowledge to manage those resources to provide the following benefits;

- Optimise the revenue which DER can receive for providing services;
- Provide more efficient procurement of services for other parties (like the SO);
- Reduce the need for distribution reinforcement; and
- Maintain the high quality of system security.

The industry needs to be open to changes to current roles and arrangements, as well as have certainty over the regulatory treatment of the investment required in IT, communications and data processing, to deliver these benefits.

Why we are best placed to assume these new roles

In addition to our knowledge of the networks, we believe that we are well placed to take on a greater role in managing the flexible resources to our networks:

i) Strength of the current regulatory regime

The current regulatory regime has been hugely successful in delivering efficient, customer focussed networks. We think this could be adapted around an expanded DSO role to deliver whole system benefits. Such an expansion would incentivise network companies to work together to adapt roles and commercial arrangements at the pace and level needed to optimise the delivery of whole system benefits. The regulatory framework could also adapt over time as we learn more about fulfilling this role and the challenges involved.

ii) Our track record of delivering for customers

We have consistently delivered on our price control commitments and indeed gone above those to deliver for our customers. For example, we would highlight our track record of:

- Improving reliability, where we have reduced CMLs by 50% since 2010/1;
- Delivering improved customer service as demonstrated by our customer service scores which are now averaging 8.6 out of 10;
- Accepting and promoting competition in service provision in connections markets; and
- Delivering efficient totex outcomes for customers.

This demonstrates that we can be trusted to take on new responsibilities and deliver them for customers.

iii) Neutral market facilitators

We are completely unbundled from retail, generation or any other interest in the value chain. This means we are well placed to act as a neutral market facilitator for the flexible resources connected to our network. In addition, the totex approach under which we operate, means we are neutral to whether we choose a build or non-build option to meet our outputs. Consequently, we can be trusted to manage the flexible resources on our network in a way which optimises the wider system benefits they can provide to lower costs for customers.

Timing of changes to roles and arrangements

The timing on when changes are needed will be driven by the number of DER which connect to our networks⁵⁹. We have seen significant increases in DER in the last few years, particularly in our Eastern area. Experience to date shows that the volumes of connections are not uniform across GB and that changes to roles in some DNO areas may be needed before others. It remains to be seen if the pace of change will continue at its current rate, accelerate or decrease. This is largely dependent on factors outside of our control such as technological developments, market prices, consumer behaviour and Government policy, particularly around any incentives for EVs.

Our objective is to ensure that we are ready when changes are required and this is why we have invested heavily in our innovation programme. Our best view developed from our stakeholder engagement and experience on our networks is that we need to be ready to integrate the remaining DSO capabilities into our business for the start of ED2 to be in a position to manage the expected increase in DER at the lowest possible cost to our customers. We have a plan for how we continue to ramp up our capability to be in this position outlined in Figure 9 below:

Figure 9: Timeline for our ramp-up of DSO capability

DER take-up 		
2017-2019	2019-2023	ED2
<ul style="list-style-type: none"> • Flexible DG connections capacity exceeds 600MW • Initial flexibility tenders for reinforcement deferral/outage management completed • Commercial framework for DSO to SO services completed as part of TDI • Distributed Energy Resource Management Energy Software live as part of TDI • System monitoring enhancements underway 	<ul style="list-style-type: none"> • DSO trials underway in our South Eastern region (specifically on the South Coast) • DSO incentives development as part of ED2 consultation • Network support services contracts are widely used to defer reinforcement or minimise constraints • Revised framework for T&D planning at the interface • Introduction of market arrangements for constraint management • EHV ANM Capability fully enabled across our Eastern and South Eastern regions • Availability of smart metering data • IT DSO system implementation 	<ul style="list-style-type: none"> • Formalised DSO framework in operation • Distributed Energy Resource planning • Eastern and South Eastern regions operating as regional DSOs • LV visibility and automation • DSO commercial operations becoming core business capability • LV DER Dispatch • Extensive use data analytics • Creation of distribution level markets

We are conscious that it will take time to evaluate the options and implement new arrangements. Clarity on the regulatory framework for delivering whole system benefits will be crucial in empowering network operators to adapt current roles and develop the new commercial arrangements which are likely to be required.

⁵⁹ The Future Electricity Regulation paper provides an excellent overview of the evolutionary changes and different models required to respond to the stages of evolution:

https://emp.bl.gov/sites/all/files/FEUR_2%20distribution%20systems%2020151023_1.pdf

Question 46 b): With regard to further future changes to arrangements, what are your views on the different models, including:

- i) whether the models presented illustrate the right range of potential arrangements to act as a basis for further thinking and analysis? Are there any other models/trials we should be aware of?**

We have split our answer to this question into three sections to pick up each individual question separately:

Right range of models

The models presented represent the right range but it is important that the detail underpinning them is clear in order to properly evaluate them. We would also stress that in practice, there may need to be a hybrid of different models. Therefore, policy development should not be fixed on the three models presented in the Call for Evidence but consider aspects under each model.

Other models or trials

We think it is crucial to utilise the output of past and ongoing trials to develop the detail of the models set out in the Call for Evidence. We are already playing our role in this through the TDI 2.0 project which we are running in conjunction with National Grid. It will deliver the following outputs which can feed into policy design for the models needed:

- Commercial arrangements required to deliver a functioning local market platform for reactive and active power which can be used to resolve local constraints and transmission constraints;
- A full assessment of the costs and benefits of the local market platform and net benefit of extending the trial; and
- An assessment of the incentive framework used to make the market platform work and recommendations on an enduring incentive framework for an active DSO.

We are keen to work with Ofgem and BEIS to use learnings from the TDI 2.0 project as they emerge, to feed into the policy debate around the models and develop an evaluation framework through which to assess them.

There is substantial other work ongoing across GB, Europe and the USA as many countries wrestle with the same issue of how to coordinate the integration of DER triggered by a low carbon transition. Some of the studies worth highlighting include:

- Work by Elexon and Baringa on potential DSO models for GB in 2014/5⁶⁰;
- Centrica's Cornwall study on local energy market⁶¹;
- The European SmartNet project which is assessing the various models for TSO/DSO interaction⁶²;
- The European TSO/DSO platform work on data models⁶³; and
- The Californian ISO local margin pricing⁶⁴.

We have reviewed these models to help inform this response.

⁶⁰ https://www.elexon.co.uk/wp-content/uploads/2015/03/Active-Management-of-Distributed-Generation_March2015.pdf

⁶¹ <https://www.centrica.com/news/centrica-build-pioneering-local-energy-market-cornwall-0>

⁶² <http://smartnet-project.eu/consultations/basic-schemes-for-tso-dso-coordination/>

⁶³ http://www.eurelectric.org/media/285585/tso-dso_dm_rep-2016-030-0382-01-e.pdf

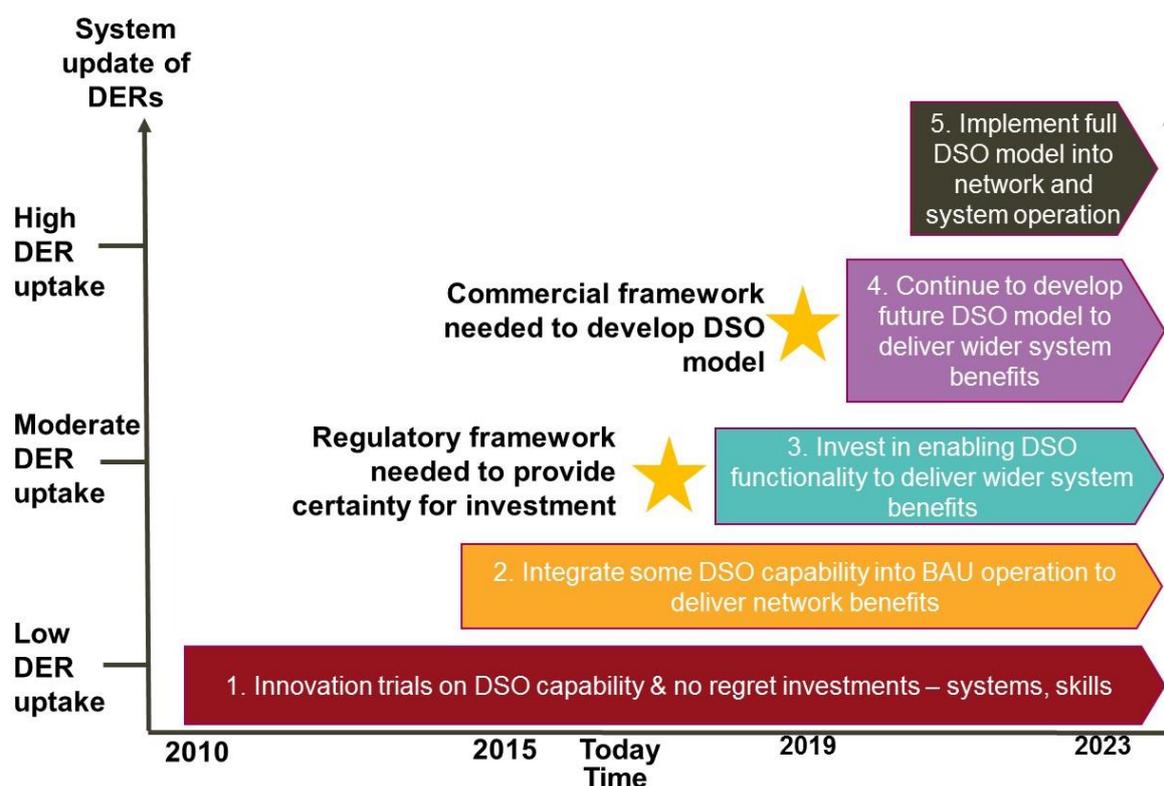
⁶⁴ <http://www.caiso.com/pages/pricemaps.aspx>

ii) which other changes or arrangements might be needed to support the adoption of different models?

The key change to support any of the different models will be the development of the underpinning regulatory regime. The current regulatory framework does not provide the funding or incentives for us to make investments which deliver savings, where those savings do not flow back to us. As highlighted in our response to questions 45 c) we think that the development of the regulatory framework needs to be a key priority as it will also help with the delivery of some of the immediate actions. Figure 10 (see below), highlights how we think the evolution of DSOs to deliver wider system benefits can be hindered by the lack of a clear regulatory framework, along with the detailed design of the commercial model.

Our experience is that we are currently at stage 2 within Figure 10 in our Eastern and South Eastern regions. In these regions we are integrating DSO capability into our operating model to connect new customers through actively managing them. The focus for our deployment is on the network benefits which can be delivered as this is what we have the commercial tools to do and the incentives under ED1 to implement. Our innovation programme is starting to develop functionality for stages 4 and 5 – particularly through the TDI 2.0 project which will develop greater co-ordination between ourselves and National Grid on the use of flexibility resources on our network.

Figure 10: Potential evolutionary stages of DSO



To encourage development beyond stage 2 in the diagram, it would help to have a regulatory framework which provided the incentives for us to invest to deliver whole system benefits. The certainty such a regulatory framework could deliver would help to attract the investment required for the roll-out of the enabling technology. An amended regulatory framework can also place the correct incentives on network operators to develop the commercial framework to deliver DSO. At present, the misalignment of incentives and different commercial drivers between DNOs, TO and SO make this difficult.

Based on the predicted take-up of low carbon technologies (see our response to question 44) we think that a commercial model and associated regulatory framework need to be in place by the start of ED2. Given typical lead times to implementation, this means that clarity of the regulatory framework is needed in the next few years. This will allow industry to deliver the commercial framework in time for ED2 and provide a clear policy basis on which to start developing ED2 business plans in the early 2020s.

iii) do you have any initial thoughts on the potential benefits, costs and risks of the models?

As highlighted in our response to question 46 a), on the basis of the expected take-up of low carbon technologies, we will need visibility and an element of control of the flexible resources on our network in order to maintain system security. Based on the detail of the models presented (and we acknowledge they are high level) we think that the 'DSO/SO procurement mechanism' and 'Total DSO' models would best meet these needs. However, it is important not to think of the models presented in isolation – there may well need to be aspects of different models which need to come together. For example, based on our experience, we can see merit in contractual procurement of flexibility through a DSO model. If and when the number of flexible resources becomes so large, it makes management of these contracts too complex, it may be worth moving to a platform that is more based around marginal pricing. This should be seen as a potential future evolution and the focus in the next few years should be around the establishing arrangements for the efficient co-ordination of contractually procured flexibility.

We have used our experience to date to undertake a high level review of the costs and benefits of each of the models set out in the Call for Evidence. These are outlined in Table 5 below. We would be keen to develop the next level of detail around these models and use experience from trials to help undertake further assessment. Our TDI 2.0 project with National Grid will provide particularly useful insights into the DSO/SO procurement model and in particular the detailed interfaces required between ourselves and National Grid.

The main risks around the models are the level of complexity they could entail and how that is simplified to market propositions which are clear and transparent for our customers. We also need to be mindful of the considerable investment they could require in IT, communications and operational systems.

Evaluation of the models

We think it is important that, as an industry we start to develop an evaluation framework for these types of models (or aspects of the models). For instance, we feel that it would be important to consider the following:

- The simplicity of design and lead times to implement and have the flexibility to evolve over time;
- How the models will interface with other procurers of flexibility, such as suppliers and aggregators and take account of bi-lateral arrangements between DER to aggregate their output;
- Understand how the models will work alongside settlement processes, ensuring that suppliers are not out of balance as a result of flexibility actions taken by others;
- How the models can provide a framework for the coordination of planning and operation between TSO and DSO; and
- How the models interact with the connection process to give stronger signals to customers on where they can provide value for the local network.

Table 5: Costs and benefits of DSO models in the Call for Evidence

	DSO/SO procurement mechanism	Market signals and arrangements	Responsibilities in system operation	
			"Total TSO"	"Total DSO"
Costs	<ul style="list-style-type: none"> Requires effective DSO-SO coordination Potential conflicts between DSO and SO which will require a mechanism to resolve 	<ul style="list-style-type: none"> High levels of complexity Significant implementation overhead Requires fundamental change to charging arrangements which are typically slow May not provide certainty of income to service providers May not provide certainty of response required for network security 	<ul style="list-style-type: none"> SO will not necessarily have the right information and experience to make planning decisions at D level Adds significant complexity for SO to manage decisions at D level May not provide DNO with tools needed to maintain reliability 	<ul style="list-style-type: none"> Requires significant expansion of DNOs' current capabilities, over and above those for DSO/SO procurement model
Benefits	<ul style="list-style-type: none"> Allows party with best information to plan and operate own networks Should allow effective deployment of flexible resources Potentially supports most rapid connections process Provides DNO will a large degree of visibility and control over the flexible resources on its network 	<ul style="list-style-type: none"> Expansion of market signals Maximising competition Reduced requirement for monopsony residual balancers 	<ul style="list-style-type: none"> Reduces requirement for coordination between multiple entities 	<ul style="list-style-type: none"> Better ability to coordinate local solutions Provides for benchmarking and potentially competition between multiple DSOs Provides DNO will a large degree of visibility and control over the flexible resources on its network

5. Innovation

Question 47: Can you give specific examples of types of support that would be most effective in bringing forward innovation in these areas?

As we have set out in the Executive Summary, NIA and NIC funding has been successful in promoting investment in innovation, is broadly fit for purpose and continues to be required. Government could consider how NIA and NIC funding can be made compatible with other matched funding opportunities in areas such as smart vehicle charging and the development of flexibility platforms. We have encountered the need for clarity in our discussions with Open Utility in their application to the Energy Entrepreneurs Fund, which we supported.

We also support innovation projects having sufficient time to demonstrate value, and the framework should be developed to avoid NIC, NIA and price controls limiting energy sector involvement in longer term projects.

Question 48: Do you think these are the right areas for innovation funding support? Please state reasons or, if possible, provide evidence to support your answer.

We would generally support the areas identified. The key areas for ongoing innovation we have identified along with our ENA partners include:

- Supporting innovation that delivers value across the whole system and beyond individual network or system operator business scope as is being trialled in TD12.0;
- Supporting trialling of emerging commercial and market models and platforms, not just technology to be embedded into network/system operator operations;
- Facilitating cross-energy vector projects (e.g. Hydrogen or heat projects) and not just electricity in NIA/NIC;
- Supporting local energy (including community energy schemes) to ensure approaches exist to allow those least able to adopt smart flexibility technologies;
- Supporting the development of smart EV charging technologies and commercial frameworks to facilitate the development of interoperable standards and visibility of EV charging to network operators; and
- Supporting the development of vehicle to grid technologies with the UK automotive technology sector.

Annex 1: Stakeholder engagement

To help inform our response and to test that our messages help to deliver our stakeholders needs, we have engaged with a number of parties. We have listed these below for transparency:

- Two roundtable sessions with storage providers, to test our views on network charging and regulatory framework for storage;
- Cornwall LMP (local marginal pricing) to understand the project being run with Centrica;
- Goran Strbac from Imperial College to understand his work on the potential benefits of flexibility and the role of the DSO in delivering these benefits;
- Open Utility to understand its work on market platforms and peer to peer trading;
- Electron to understand its work on open source platforms and apps and how this technology can be used in energy sector;
- Lime Jump to understand their business model as a virtual power plant and how this relates to current market structures; and
- Innovate UK to understand the innovation funding landscape in the UK.

Annex 2: Bibliography

Berkley Labs Future Electric Utility Regulation 'Distribution Systems in a high distributed energy resource future', October 2015:

https://emp.lbl.gov/sites/all/files/FEUR_2%20distribution%20systems%2020151023.pdf

Californian ISO price maps: <http://www.caiso.com/pages/pricemaps.aspx>

Centrica Cornwall local energy market: <https://www.centrica.com/news/centrica-build-pioneering-local-energy-market-cornwall-0>

Customer led Network Revolution (Northern Powergrid): <http://www.networkrevolution.co.uk/>

ELAAD Smart Living Lab: <https://www.elaad.nl/nieuws/nederland-als-living-lab-voor-het-slim-opladen-van-elektrische-autos/>

Elexon & Baringa 'Active Management of DG', March 2015: https://www.elexon.co.uk/wp-content/uploads/2015/03/Active-Management-of-Distributed-Generation_March2015.pdf

Energy Networks Association 'Fair and effective queue management of connection queues: Changes to applications' May 2016: <http://www.energynetworks.org/assets/files/news/consultation-responses/Consultation%20responses%202016/Fair%20and%20Effective%20Management%20of%20DNO%20Connection%20Queues%20Treating%20Changes%20within%20Applications.pdf>

ENWL 'Customer Load active system services – CLASS': <http://www.enwl.co.uk/class>
European TSO DSO data management report, May 2016:

http://www.eurelectric.org/media/285585/tso-dso_dm_rep-2016-030-0382-01-e.pdf

FALCON (Flexible Approaches to Low Carbon Optimised Networks) – Western Power Distribution: <https://www.westernpowerinnovation.co.uk/Projects/Falcon.aspx>

Flexible Networks for a low carbon future (Scottish Power Energy Networks): http://www.spenergynetworks.co.uk/pages/flexible_networks_for_a_low_carbon_future.asp

Imperial College & Carbon Trust: 'An analysis of electricity system flexibility for GB', November 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568982/An_analysis_of_electricity_flexibility_for_Great_Britain.pdf

MIT Energy Initiative: Utility of the future: <http://energy.mit.edu/research/utility-future-study/>
December 2016

My Electric Avenue Innovation project (Scottish & Southern Electricity Networks): <http://myelectricavenue.info/about-project>

National Association of Regulatory Utility Commissioners (US) 'Manual on distributed energy resources rate design and compensation', 2016: <http://pubs.naruc.org/pub/19FDF48B-AA57-5160-DBA1-BE2E9C2F7EA0>

Network Equilibrium (Western Power Distribution): <https://www.westernpowerinnovation.co.uk/Projects/Network-Equilibrium.aspx>

Regulating EV demand: Distribution Network Operator perspective on Electric Vehicles.' HEVC 2016 conference publication

UK Power Networks' response to 'A smart, flexible energy system'

12 January 2017

Smart Energy GB, 2015, 'Smart energy for all; identifying audience characteristics that may act as additional barriers to realising the benefits of a smart meter': <http://studylib.net/doc/18339617/smart-energy-for-all>

Smartnet consultation on basic schemes for TSO DSO co-ordination and ancillary service provision: <http://smartnet-project.eu/consultations/basic-schemes-for-tso-dso-coordination/>

UKPN Low Carbon London report A1 'Residential demand side response as an alternative to network reinforcement', September 2014: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A1%20-%20Residential%20Demand%20Side%20Response%20for%20outage%20management%20and%20as%20an%20alternative%20to%20network%20reinforcement.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A1%20-%20Residential%20Demand%20Side%20Response%20for%20outage%20management%20and%20as%20an%20alternative%20to%20network%20reinforcement.pdf)

UKPN Low Carbon London report A2 'Residential consumer attitudes to time varying pricing', September 2014: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A2%20-%20Residential%20consumer%20attitudes%20to%20time%20varying%20pricing.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A2%20-%20Residential%20consumer%20attitudes%20to%20time%20varying%20pricing.pdf)

UKPN Low Carbon London report A3 'Residential consumer responsiveness to time of use pricing', September 2014: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A3%20-%20Residential%20consumer%20responsiveness%20to%20time%20varying%20pricing.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A3%20-%20Residential%20consumer%20responsiveness%20to%20time%20varying%20pricing.pdf)

UKPN Low Carbon London report A10 'Smart Appliances for residential demand response', September 2014: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A10%20-%20Smart%20appliances%20for%20residential%20demand%20response.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A10%20-%20Smart%20appliances%20for%20residential%20demand%20response.pdf)

UKPN Low Carbon London report B1 'Impact and opportunities of wide-scale electric vehicle deployment', September 2014: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20A1%20-%20Residential%20Demand%20Side%20Response%20for%20outage%20management%20and%20as%20an%20alternative%20to%20network%20reinforcement.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20A1%20-%20Residential%20Demand%20Side%20Response%20for%20outage%20management%20and%20as%20an%20alternative%20to%20network%20reinforcement.pdf)

UKPN Low Carbon London report B5 'Opportunities for smart optimisation of new heat and transport loads', September 2014: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20B5%20-%20Opportunities%20for%20smart%20optimisation%20of%20new%20heat%20and%20transport%20loads.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20B5%20-%20Opportunities%20for%20smart%20optimisation%20of%20new%20heat%20and%20transport%20loads.pdf)

UKPN Low Carbon London report D5 'Novel commercial arrangements for smart distribution networks', December 2014: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-\(LCL\)/Project-Documents/LCL%20Learning%20Report%20-%20D5%20-%20Novel%20commercial%20arrangements%20for%20smart%20distribution%20networks.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Low-Carbon-London-(LCL)/Project-Documents/LCL%20Learning%20Report%20-%20D5%20-%20Novel%20commercial%20arrangements%20for%20smart%20distribution%20networks.pdf)

UKPN Smarter Network Storage 'Electricity Storage in GB: SNS 4.7 recommendations for regulatory and legal framework', September 2015: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/Project-Documents/Report+9.5+19Oct_v2.1_%28Final+Photos%29.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/Report+9.5+19Oct_v2.1_%28Final+Photos%29.pdf)

UK Power Networks' response to 'A smart, flexible energy system'

12 January 2017

UKPN Smarter Network Storage 'Analysis of integrated energy storage contribution to security of supply', January 2016: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/Project-Documents/SNS_P2_6_SDRC9.6v1.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/SNS_P2_6_SDRC9.6v1.pdf)

UKPN Smarter Network Storage 'Successful demonstration of storage value streams', March 2016: [http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-\(SNS\)/Project-Documents/SDRC+9.7+Successful+Demonstrations+of+Storage+Value+Streams+LoRes+v1.pdf](http://innovation.ukpowernetworks.co.uk/innovation/en/Projects/tier-2-projects/Smarter-Network-Storage-(SNS)/Project-Documents/SDRC+9.7+Successful+Demonstrations+of+Storage+Value+Streams+LoRes+v1.pdf)

National Infrastructure Assessment - Call for evidence (October 2016)



Response by United Utilities

General Comments

United Utilities is the statutory water and wastewater service provider for the North West of England, responsible for planning, delivering, operating and maintaining vital water and wastewater infrastructure as well as providing water and wastewater services to more than 3 million households and businesses.

We welcome the proposals for an on-going collaborative, long term, cross sector and holistic assessment of the country's infrastructure needs and the development of coherent recommendations for addressing them. We welcome the focus on transparency so that all stakeholders can understand the impact of investment decisions on customers' bills, and the recognition of the role that the private sector plays in financing and delivering most of this investment.

Of particular interest to us is the requirement to ensure that water and wastewater services for customers in the North West remain resilient to hazards and trends including a changing climate and population growth. Management of our infrastructure to ensure that sites are protected, or can be recovered quickly in the event of impacts, must be at the heart of our business planning processes. The level of protection and acceptable risk to services should be aligned to national requirements or policy guidance and we see the formation of the National Infrastructure Commission as an opportunity to provide clarity around this at a national level. In addition, it should provide a mechanism whereby risk management authorities, regulators and other utility and service providers can ensure they undertake joined up resilience planning within a defined geographical area. In our view, there is still more to do to ensure that water issues are managed in an integrated way to get the best overall outcome for water quality, water resources and flood mitigation.

There are a number of common themes that come across in our responses to the questions, we would particularly welcome National Infrastructure Commission engagement in the following areas:

- **Flooding** - Like many parts of the country, the North West has experienced very significant flooding events over the last few years, driven by both long periods of exceptional rainfall and short intense storms in urban areas. Planning effectively for holistic flood management can be hampered by the disparate responsibilities that organisations have and the interaction of the different assets in their control. We believe that significant improvements can be driven in the planning and management of flooding by improving the planning system and through a systems thinking driven approach which integrates the use of assets, leverages data intelligence and employs new technology and work. In addition, the split in responsibilities and the focus on short term priorities is leaving the UK lagging behind other developed nations in the embedment in the use of more sustainable drainage systems (SuDS).
- **Catchment Management** - Linked to flooding, we have strong views that all water planning should be managed holistically at a catchment level. Planning for water quality improvements and management of water quantity (resources and flooding) will only be effective when considered together. Indeed, many of the natural measures now being promoted, such as upland restoration, slowing the flow and tree planting all have significant water quality and biodiversity benefits as well as reducing flood peaks. By thinking holistically costs can be reduced for customers. We are promoting the proliferation of natural solutions to achieve water quality improvements more cost effectively and sustainably.
- **Water Trading** - Long term climatic change is also forecast to bring longer periods of warm dry weather. This, coupled with increasing growth and housing development, means that we need to think about the management of our water resources nationally in a different way. At the moment all companies are working on their long term water resources management plans, which will be submitted to Defra in 2018. The

NIA Call for evidence: Response by United Utilities

assessment of long term water supply and demand will inevitably mean that consideration will be given around the country to the provision of new water sources in certain areas. We believe that water trading, a transfer of available resources from the North and West to the South and East, should be a fundamental part of these plans. This should be facilitated at a national level to enable successful implementation and to ensure that regulators and planners take a joined-up approach.

- **Resilience of our cities** - Over the last 12 months we have undertaken a comprehensive review of the resilience of our water and wastewater service, taking a structured approach and looking at likely hazards and the risk and consequence of failure of our systems. We have identified a number of areas where we are planning to invest over the next 10 years to reduce the number of potential single points of failure. Due to the nature of our water supply system many of our cities are supplied by water from the Lake District, Pennines and Wales many miles away from the point of use. We would welcome the opportunity to discuss our approach to ensuring the long term resilience of our city's supplies with you.

The governance and regulation of water issues can be improved to enable better decision making and a more sustainable outcome. We look forward to supporting the National Infrastructure Commission on these topics as they develop the first National Infrastructure Assessment.

Cross-cutting issues

Q1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

We have made a considerable investment in supporting the long-term sustainable growth of the North West of England since privatisation. A recent example is the completion of the West East Link in 2013 to enhance our ability to move water around our region to increase flexibility in droughts, enable us to take large trunk mains out of service for maintenance and make us more resistant to climate change in the longer term. We are also in the process of building a link from our Thirlmere reservoir to West Cumbria to replace local, environmentally sensitive water sources, increase the resilience of West Cumbria to short term droughts and provide additional capacity to support long term population growth. Over the last five years we have made considerable investment in wastewater infrastructure too including at Manchester Wastewater Treatment Works to achieve new environmental standards and to cope with the rapid and continuing growth in population. We are in the process of delivering substantial rebuilds of our wastewater treatment works at Blackburn and Oldham to meet new environmental standards and ensure our works are sustainable in terms of environmental performance but also in cost to customers.

As part of our business planning we are using new and even more sophisticated approaches to explore the resilience of our water supply systems to a range of hazards, from extreme drought to asset failure. To facilitate expected future economic and population growth, in particular with the potential for a Northern Powerhouse growth scenario in the North West, it is critical that there is enough supply to meet demand, and our systems have enough capacity and resilience both to meet the needs of society now and in the future. We expect that with higher expectations on the resilience of water supplies we will be promoting future investment to ensure that some of our major cities are less vulnerable to events that have a low probability of occurrence but the potential to have a significant consequence. Given the criticality of water to economic growth, this process could realise high value infrastructure investment. We are also examining the potential to undertake water trading (this could be imports, as well as exports) which would facilitate additional infrastructure activity in the North West, benefitting the regional economy (see our response to question 22).

Q2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

We have no evidence to offer to this question.

NIA Call for evidence: Response by United Utilities

Q3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

We have split our response to this question into two parts, the first covering wastewater disposal and particularly the management of surface water drainage and the second covering water efficiency and the importance of managing demand for water.

Surface water management

We would advocate a move towards more detailed, coordinated catchment level planning for surface water drainage. Whilst drainage is a matter considered in local plans and we welcome the commitments to sustainable drainage in the recently published draft Greater Manchester Spatial Strategy¹, we feel the current plans² are not sufficiently detailed in how surface water will be managed on a catchment by catchment, site by site basis to ensure that flood risk is sustainably managed in the face of the increasing trends from development and climate change as described in our 2015 Climate Change Adaptation report³. There is a focus on the flood risk to the development site but not whether that development will increase flood risk elsewhere. Responsibility for surface water management infrastructure is split between sewerage companies, local authorities, private land owners and the Environment Agency. This leads to a lack of leadership in making decisions about where investment is required to ensure that flood risk is managed in the most sustainable and cost effective manner for current and future generations. This split in responsibilities means that UK cities lag behind many of our European⁴ and international partners⁵ in the implementation of sustainable drainage systems despite being a relatively wet and densely populated country that has amongst the most to gain from more effective management of surface water in urban areas.

If done well, sustainable drainage systems are no more expensive than conventional systems to construct and operate (albeit some of the costs may fall on different agencies which is one of the issues blocking change). Some systems have the potential to reduce flood risk boost the aesthetic appeal of development (contributing to mental wellbeing), increase the potential for biodiversity and dampen heat island effects that will become more acute with climate change. Research has also evidenced the health and financial benefits of nearby nature and health⁶. Sustainable drainage systems like dry detention ponds can be integrated into developments and perform multiple tasks, not only are they a welcome open space but there are plenty of examples internationally of detention ponds that function as playgrounds⁷ or parking areas when dry. If implemented as part of an urban regeneration initiative, sustainable drainage can greatly increase the appeal of former industrial sites. The blue green infrastructure pilot in Newcastle⁸ is a great example of this, that we would like to see replicated in many of the former industrial areas of the North West.

In order to respond to the need to deliver additional housing in accordance with national government priorities, the UK planning system is increasingly identifying large sites for development. For example, the Draft Greater Manchester Spatial Plan⁹ proposes the release of a number of sites from the green belt. It has 37 sites which are capable of delivering more than 500 dwelling units and of these 37 sites, at least 20 are capable of delivering more than 1,000 units. Such large sites are often in multiple ownership and developed by a range of developers over a number of years and sometimes through the uncertainty of changing economic conditions. The delivery of infrastructure on these sites lacks the co-ordination that can be more easily delivered on sites in one ownership. We would welcome consideration of enhanced powers which are better able to ensure infrastructure is delivered in

¹ Greater Manchester draft Spatial Strategy (p86/87) - https://www.greatermanchester-ca.gov.uk/info/20081/draft_plan

² Greater Manchester Flood Risk and Water Management evidence paper - <http://gmsf-consult.objective.co.uk/file/4227103>

³ UU Climate Change Adaptation Report – 2nd round - <https://www.gov.uk/government/publications/climate-adaptation-reporting-second-round-united-utilities>

⁴ Copenhagen Climate Resilient City - http://www.klimakvarter.dk/wp-content/2013/03/klimakvarter_ENG_low.pdf

⁵ Philadelphia Green City, Clean Waters - http://www.phillywatersheds.org/doc/GCCW_AmendedJune2011_LOWRES-web.pdf

⁶ The Health and Financial Benefits of Nearby Nature and health -

http://www.naturewithin.info/New/2016.11.Economic_Benefits_of_Nature_in_Cities.KWolf.pdf

⁷ Copenhagen Citiscope - <http://citiscope.org/story/2016/why-copenhagen-building-parks-can-turn-ponds>

⁸ Blue-green cities - <http://www.bluegreencities.ac.uk/research/newcastle-as-demonstration-city.aspx>

⁹ Greater Manchester draft Spatial Strategy (p86/87) - https://www.greatermanchester-ca.gov.uk/info/20081/draft_plan

NIA Call for evidence: Response by United Utilities

a co-ordinated manner and as part of site wide infrastructure strategies rather than the piecemeal approach dictated by differing land ownership boundaries.

Water efficiency

The Water Efficiency Strategy for the UK¹⁰, recently published by Waterwise for consultation, suggests introducing variable infrastructure charges for new developments to encourage water efficiency measures. The proposal is to use market incentives to reward developers for environmental improvements (e.g. using water labelled appliances and water efficient fittings) in order to enable them to improve environmental standards at no cost and with almost no administrative burden. Householders get higher quality fittings and lower running costs and there are benefits to the aquatic environment and improved water security. The offset is to be funded by the water company, but the idea is that all costs should be compensated by the generated water efficiency savings. This approach is currently being tested by Southern Water and if proved successful it could bring substantial reductions in both consumption and carbon emissions if rolled out across the UK, providing it is supported by appropriate promotion of water labeling in stores, on websites and linking it to building/procurement standards. This would significantly increase the market for water efficient appliances and fittings and would make these a more attractive purchase for all customers, not only developers.

Both the Water Efficiency Strategy and the Water Resources Long Term Planning Framework¹¹ recognise that although water efficiency in new developments has been improving, there are still opportunities to reduce water use further. This could be achieved by for example review of current policies for water efficiency and requirement for new dwellings to meet tighter Building Regulations (studies would have to be carried out to assess the achievable level of per capita consumption) and encouraging water neutrality partnerships i.e. homes, businesses, schools and hospitals in the area receiving a water efficiency retrofit to avoid an increase in overall demand as a result of new local development.

National standards

We will continue to work with developers to encourage the take up of sustainable drainage systems and the building of water efficient homes. However, we have limited powers to enforce any change in behaviour. Our customer research¹² shows that communities are concerned about the impact of development on their flood risk and environment. In our view developers stand to gain from developing water efficient houses and sustainable drainage to reduce local opposition and demonstrate their environmental and societal credentials and many recognise this and act accordingly. Unfortunately some developers see only an additional cost and are not willing to engage and as they can build, sell and walk away with no retrospective control, others (such as water bill payers) are left to deal with the long term consequences.

The government is understandably reluctant to maintain or strengthen standards on water efficiency and sustainable drainage as it is concerned about imposing any additional costs on developers in the light of the need for more housing nationally. But this is a short term view that doesn't take into account the wider societal and long term costs of high water consumption as well as surface water discharged to sewer and the consequences for flood and pollution risk downstream. An example of working differently towards wider societal benefits is from Business in The Community working with partners from The Water Taskforce¹³ and testing the concept that implementing SuDS on a school site could generate savings for a school, by reducing their hard-standing area and taking them down a charging band with their water supplier.

¹⁰ Waterwise 2016 <http://www.waterwise.org.uk/news.php/85/consultation-on-a-water-efficiency-strategy-for-the-uk>

¹¹ Water UK, Water resources long term planning framework (2015-2065) [Report] / auth. Atkins Mott MacDonald, Nera, HR Wallingford, Oxford University. - July 2016.

¹² UU customer research, available to the NIC on request.

¹³ The Water Taskforce <http://www.bitc.org.uk/blog/post/surface-water-money-down-drain>

NIA Call for evidence: Response by United Utilities

We would support the National Infrastructure Commission in encouraging national standards for water efficiency and sustainable drainage systems that deliver a more sustainable and level playing field in the sharing of the cost of consequences in line with the polluter pays principle.

Q4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

We recognise the important contribution of demand management in achieving and maintaining an adequate water supply-demand balance in the North West. Demand management is an integral component of our strategy to balance supply and demand. Since privatisation of the sector in 1996, we have significantly reduced leakage helping to achieve and maintain a high standard of water supply reliability. Water efficiency promotion has been significantly enhanced since 2010 and overall water demand is at its lowest level for at least the last 20 years.¹⁴

Demand forecasts are complex and require many assumptions. The recently published water resources long-term planning framework¹⁵ models three scenarios, business as usual, extended and enhanced. The enhanced scenario considers the most ambitious savings that are feasible technically and economically over the next 50 years, but would come at considerable expense and/or require a significant change in legislation or regulation to enable their development. This scenario assumes extensive water efficiency activities (including greywater re-use and rain harvesting), high level of leakage management (including pressure management, active leakage control and maximum mains renewal) and most importantly a significant increase in customer metering. The relationship between demand management and cost savings is highly non-linear and is driven by the high costs of retrofitting for some measures (e.g. grey water re-use), leakage (e.g. mains renewals), and metering (incorporating difficult property installations).

We believe that increased smart metering is the way to maximise the potential for demand management. Better insight into customer consumption patterns will enable smarter, more appropriate targeting of water efficiency campaigns. It would allow for better quantification of the savings achieved and more robust cost-benefit analyses. Having more metered data would enable the development of new, more attractive tariffs financially benefiting customers from being more conscious and careful of their water usage. Increase in customer meter penetration will help in leakage management activities. As leakage is not directly measured, its accuracy depends on the accuracy of the components used in the leakage calculation, of which consumption is key.

The framework¹⁶ states that: “UK may achieve Per Capita Consumption (PCC) levels in line with the most efficient European countries over the next 50 years, through preferred metering programmes, sustainable house building and macroeconomic factors, though this is by no means assured”. In the extensive comparison carried by Ofwat¹⁷ the UK’s PCC is the highest (UK PCC 150 l/head/day, highest – Denmark 131 l/head/day, lowest – Belgium 107 l/head/day). By no means is the UK less developed or with significantly poorer infrastructure than any of these countries. The main difference is that in each of these countries’ meter penetration exceeds 90%, whereas in the UK fewer than 50% of domestic customers are metered.

Q5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

As our asset base has expanded both in size and complexity, maintenance and repair costs have increased. The increase in our asset base has been driven by:

- ever tightening industry permit standards due to the ongoing delivery of the Water Framework Directive and preceding environmental legislation in the UK;
- increases in population; and the

¹⁴ UU’s Water Resources Management Plan 2015 <http://corporate.unitedutilities.com/documents/WRMPMainReport.pdf>

¹⁵ Water UK, Water resources long term planning framework (2015-2065) [Report] / auth. Atkins Mott MacDonald, Nera, HR Wallingford, Oxford University. - July 2016.

¹⁶ Water UK, Water resources long term planning framework (2015-2065) [Report] / auth. Atkins Mott MacDonald, Nera, HR Wallingford, Oxford University. - July 2016.

¹⁷ [International comparison of water and sewerage service : 2007 report \[Report\] / auth. OFWAT. - 2007.](#)

NIA Call for evidence: Response by United Utilities

- increase in service level expectations from customers, businesses and regulators resulting in an even greater focus on the reliability of services.

The maintenance and repair of existing assets should be prioritised over the construction of new assets. A planned maintenance approach combined with repair when required is generally a lower cost approach through the lifecycle of the asset than construction of new assets. This is due to the tangible and intangible costs associated with construction such as planning, permissions, surveys and land acquisition before a new asset even starts to be built. Furthermore, a more systematic approach to maintenance focused on the criticality of that asset to the service system inevitably provides a greater level of service to customers.

The maintenance versus construction balance should be most effectively thought of as the decision to maintain and optimise the existing asset base, delivering reduced customer and environmental costs. However, the need to invest in the construction of new assets should be based firmly on the absolute necessity to construct new assets to meet future demands that existing assets cannot meet even with a well maintained baseline in place. In order to de-risk decisions around balancing maintenance and constructions to both utility providers and customers, being certain of the anticipated future demands on an asset or the regulatory requirement upfront is key.

Q6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

There is a significant opportunity for competition and collaboration within infrastructure services. Firstly, in terms of competition in the water industry, the potential for competition in retail services, water resources provision and sewerage sludge treatment and disposal, is being actively explored by the regulator. Ofwat is promoting this through the Open Water 2020 programme, opening up new markets across the sector and developing price controls. The purpose is to ensure the best deal for customers by promoting competition and innovation in the sector. The role of competition within the water industry is currently focusing on less tangible elements of infrastructure such as market testing of costs to serve customers, expanding on the element currently in place for project costs greater than £100m. As the industry progresses there may be further opportunities for competition in sub-services provision within infrastructure services.

Although collaboration in delivery of infrastructure projects is generally good, further opportunities lie in terms of feeding into regional strategic plans for developments; for example there could be further opportunity for delivering infrastructure needs in a collaborative way such as joint laying of water or sewers with fibre optical cables. There is the potential for collaborative working on resilience requirements for communities such as the re-use of decommissioned water industry assets for storage in the event of flooding.

Q7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

The water industry is financed on a regional, five-yearly basis. It is funded by customers within each region who benefit from the infrastructure built within their area. To encourage the construction of inter-regional infrastructure, there is an opportunity to explore how companies could build infrastructure which doesn't directly, or solely, serve their customers. As many large inter-regional projects would take longer than 5 years to deliver and therefore impact more than one regulatory cycle, we would also need to examine a funding mechanism for water companies that would help to facilitate the delivery of large cross-boundary infrastructure where costs may be incurred in one region and most, if not all, the benefits in another.

United Utilities' region as a whole has sufficient water resources; this is in contrast to other areas of England which can be described as "water-stressed". Owing to how our industry is financially regulated (regional, five-yearly) there is currently no mechanism to encourage us to build infrastructure to transport this water to another, more water-stressed region. An example is the Thirlmere pipeline that we are building to link one area in our region with another which is more water stressed. Other options were considered (a pipeline from Northumbria Water's Kielder

NIA Call for evidence: Response by United Utilities

reservoir)¹⁸, which may have had a positive impact on national water resilience and infrastructure. However, national resilience was not a relevant driver when considering the options available in this project.

Q8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

In the regulated water industry there should only be an issue with financing if the project undertaken is non-appointed (i.e. the remit falls outside the regulated licence). It would therefore not attract funding through Ofwat's price review mechanism. In these circumstances we could not raise funding for the project from customers and would have to fund the project separately, finding the finance from someone other than through customer water bill receipts. An example of this would be building the infrastructure to enable water trading with another region. This would be a non-appointed activity because it would not directly provide water for customers in our region, but those in another region, under another licence. We would therefore not be funded through customer bills for such a project and would have to find the financing elsewhere, such as a national infrastructure funding pot or a third party fund.

Such infrastructure could typically take 10 years to be commissioned. The beneficiary of the infrastructure would usually pay in stages or in advance for this project. Alternatively, a third party could pay for this infrastructure to be built, later recouping the costs from the beneficiary water company once it is commissioned. This is unlikely to be the most cost effective option. Rather, should a funding mechanism be created to support such national infrastructure projects, the financing costs should be reduced and the obstacles to such projects diminished.

Q9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Regional and national forums for sharing resilience risk assessments should be developed to ensure the collaboration and sharing of best practice in managing resilience risks. ResilienceDirect is an online private 'network' which enables civil protection practitioners to work together – across geographical and organisational boundaries – during the preparation, response and recovery phases of an event or emergency¹⁹. This is a step in the right direction, however, the remit of ResilienceDirect and the associated existing regional and national groups for civil contingency response and management should be extended to accommodate the infrastructure investment capabilities within the various organisations responsible for delivering, managing, maintaining and operating key infrastructure. Clear responsibilities for each organisation to deliver and maintain resilience to defined levels for its infrastructure should become statutory requirements subject to cost benefit analysis to ensure efficient and affordable investment and maintenance.

Collaborative contingency planning should be actively encouraged with sharing of investment in mobile and temporary equipment across multiple parties; however this would need to include a clear protocol for access to the equipment in the event of an incident.

Q10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Water and wastewater infrastructure is critical for supporting population growth and economic development. However, the water and sewerage undertaker is wholly reliant on the planning system to ensure that the interests of existing bill payers are protected and that new development does not impose an unreasonable cost burden on current and future generations. The automatic right to connect water, foul sewage and surface water to the public sewer was established by the Water Industry Act 1991 (amended)²⁰. Whilst the right to connect for water supply and foul sewage is a public health issue and we fully support its retention, we believe the automatic right to connect surface water to the public sewer is outdated and offers no public benefit and indeed can be detrimental to the public if it results in an increase in flood and pollution risk elsewhere.

¹⁸ UU's Water Resources Management Plan p9 - <http://corporate.unitedutilities.com/documents/WRMPMainReport.pdf>

¹⁹ Cabinet Office, Resilient Communications - <https://www.gov.uk/guidance/resilient-communications>

²⁰ Water Industry Act 1991 - <http://www.legislation.gov.uk/ukpga/1991/56/contents>

NIA Call for evidence: Response by United Utilities

Our reliance on the planning system is insufficient given that drainage is only one of a number of factors that planning authorities have to take into account. Local planning authorities often have limited drainage expertise and certainly have limited resources to undertake the assessments required to determine the most sustainable approach to drainage. Lord Phillips' judgement in a landmark case (*Barratt Homes Limited v Welsh Water*) at the Supreme Court in 2009 stated that "more thought may need to be given to the interaction of planning and water regulation systems under the modern law to ensure that the different interests are adequately protected"²¹. We support this view and would welcome the opportunity to explore this further with the National Infrastructure Commission.

Rates of Surface Water Discharge

Since March 2015, the mechanism for determining the rate of surface water discharge from development sites has rested with the planning system. Prior to this there was an intention to create a separate approval process for determining the approach to surface water discharge. This was outlined in the Flood and Water Management Act 2010. The intention was to create sustainable drainage approving bodies, however, this approving process has never been enacted amidst fears that a separate approval body would lead to delays and increased costs for developers. We consider the current approach places an unnecessary burden on the planning process. We do not believe the planning system is the most appropriate arena for determining the rates of discharge to the receiving conduit for surface water discharge.

We recommend that the decision on rates of discharge should be part of a separate governance process directly determined by those organisations responsible for the receiving conduit/s, i.e. sewerage companies for sewers and lead local flood authorities for watercourses. On this basis, where there is a proposal to discharge directly to the public sewer, we believe it is important that powers are vested in a sewerage company to control the rate of discharge to the public sewer, especially the public combined sewer, as part of the normal technical drainage approval processes within the Water Industry Act 1991. We believe a change is required if we are to respond to the challenges of climate change and housing delivery whilst also reducing the burden on local planning authorities.

Point of Connection to Public Sewer

We believe there is merit in ensuring sewerage companies are able to exert more control over the point of connection to the public sewer directly under the Water Industry Act 1991. We acknowledge this would need to be reasonable and governed by a fair framework.

Right to Discharge to Waterbodies

We are concerned there is no predictable, transparent and fair framework for securing the right to discharge surface water to watercourses and canals even though these may be the natural receiving drainage catchment for the land in question. Currently, developers of land have to negotiate with the riparian owners of watercourses and canals to acquire the right to discharge. This introduces delay and uncertainty to costs in the development process. The automatic right to connect surface water to public sewers means that developers often prefer the certainty of discharging to public sewer rather than incurring the uncertainty of a connection to watercourse even if this is clearly the most sustainable solution. We believe the current uncertain framework for acquiring the right to discharge drives the wrong behaviours in the context of the delivery of sustainable drainage and the surface water hierarchy and results in delays to the delivery of development.

Q11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The growing awareness of the planet's vulnerability to human driven changes provides an opportunity to re-emphasize the multiple values of natural environment and the services that it provides. Protected areas, when integrated into land use plans as part of larger and connected conservation networks, offer practical, tangible solutions to the problems of both species loss and adaptation to climate change. Natural habitats make a significant contribution to mitigation by storing and sequestering carbon in vegetation and soils, and to adaptation by

²¹ Supreme Court judgement 2009, para. 58 - <https://www.supremecourt.uk/cases/docs/uksc-2009-0038-judgment.pdf>

NIA Call for evidence: Response by United Utilities

maintaining essential ecosystem services which help societies to respond to, and cope with, climate change and other environmental challenges. Many protected areas could be justified on socioeconomic grounds alone yet their multiple goods and services are largely unrecognized in traditional Cost Benefit Accounting (CBA) type approaches. The emergence of the concept of natural capital reflects the recognition that environmental systems play a fundamental role in determining economic output and human well-being. They can provide resources and services, and recycle emissions and wastes. It is for this reason that Natural Capital Accounting (NCA) or Ecosystem tools need to be used to better understand the various solutions that are available to any problem to determine the best long term societal approach.

Strategic decisions concerning infrastructure services are likely to be influenced by public authorities and policy makers in order to achieve their wider objectives, such as eliminating regional price disparities or cross-subsidising of other public services. Regulation is often also put in place to try and meet these aims, as well as to mitigate environmental impacts and to consider more cost effective approaches to infrastructure development.

Infrastructure should contribute, enhance and protect the natural environment by protecting and enhancing valued landscapes, geological conservation interests and soils and recognising the wider benefits of ecosystem services. Through minimising impacts on biodiversity (and providing net gains in biodiversity where possible) infrastructure could contribute to the Government's commitment to halt the overall decline in biodiversity or if this is not readily achievable, it may lead to the development of ecological networks that are more resilient to current and future pressures. To minimise impacts on biodiversity and the natural environment, infrastructure plans should consider biodiversity and promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations.

Consideration of more natural approaches to infrastructure development should aim to conserve and enhance biodiversity by applying the following principles:

- if significant harm resulting from a development/infrastructure scheme cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then consideration for alternative approaches must be considered;
- proposed development on land within or outside a Site of Special Scientific Interest likely to have an adverse effect on it (either individually or in combination with other developments) should normally be limited;
- opportunities to incorporate biodiversity in and around infrastructure developments should be encouraged;
- planning permission should be refused for any development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss.

Q12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

CBA techniques need a more open approach with easily accessible information, particularly related to values used to measure costs and benefits. This could include a simplified manual or library explaining the theories behind the methodologies and how the CBA process is conducted. If easily accessible and open to the public, this could help increase transparency. Ensuring that CBA methods follow consistent principle-led frameworks such as the Natural Capital Protocol would add consistency and enable decisions to be made using consistent, trusted and credible information.

A major improvement would be standardised tools which are easy to follow and replicate. These would require consistent and clear baseline assumptions and some guidance to encourage all parties to use these standardised tools to develop consistent cost benefit assessments. If these are not in place, evidence gathering to improve assumptions (including peer-reviewed studies) should be explored. Provisions of a single set of data sources for key assumptions would be of great benefit, particularly for non-monetary qualitative values.

There is potential to make better use of statistical and probabilistic analyses to understand the robustness and of CBA scores and implication of results. Additionally, the evaluation of a broad range of alternatives or scenarios to support decision-making, exploring where possible, alternatives to new policies and regulations.

NIA Call for evidence: Response by United Utilities

CBA techniques are often tailored to a particular benefit for the sector driving it e.g. drinking water, flooding. There needs to be a more joined up approach to wider benefits, including consultation with key stakeholders, local residents and businesses to understand what benefits already exist and what is lacking. This has started to be demonstrated via a few Defra pilots of local action toolkits and Natural Capital, including an evidence review for Manchester²². Our infrastructure assets are located and interact with other systems such as the natural environment, other infrastructure and private assets. Understanding the costs and benefits of new infrastructure should consider how similar interactions might be affected.

Transport

As customers rather than providers of transport infrastructure, we have no evidence to provide in response to question 13 to 16. However, the resilience of the North West transport system is critical to the daily operational effectiveness of water and wastewater provision, particularly during incidents. The flooding and damage to road links in Cumbria and Lancashire in December 2015 had a detrimental impact on our ability to recover services quickly. We would welcome an improvement to the resilience of local transport systems and would highlight the need to prioritise links that benefit the recovery of critical services that flood affected communities are reliant upon, such as potable water supply.

Digital communications

Q17. What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?

We have no evidence to offer to this question.

Q18. Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?

The ever continuing development of technology creates a challenge to the expansion of digital connectivity with much of this focusing on 'Smart' technology with some level of artificial intelligence, the Internet of Things (IoT) and the link to big data and data analytics. All of these technological advances are prevalent and continually expanding.

Due to the highly contrasting nature of infrastructure coverage from densely populated urban areas to dispersed rural settlements, the level of digital connectivity differs vastly across our region. The poor coverage of broadband capacity in Cumbria is a major barrier to our ability to improve the remote monitoring and control of our assets in that area and puts us at a disadvantage in delivering efficient water and wastewater services compared to our peers in areas that are better served by digital technology.

There have been discussions about the potential to use our sewers as conduits to aid a more cost effective delivery route for new communications infrastructure. We are open to the concept but there are issues remaining around ownership and liability should the activities of one service have a detrimental impact on the other.

Energy

Q19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

Decarbonising heat could be achieved through decarbonising the natural gas grid by replacing natural gas with a low carbon/renewable fuel, and/or utilising technology such as ground, air or water source heat pumps, or solar thermal, for space heating. Larger scale district heating networks could provide a means of decarbonising heat.

A future with relatively plentiful, cheap shale gas (wherever this comes from) will mean that decarbonisation technologies would need to be incentivised and/or natural gas needs to be heavily taxed, to provide an incentive to decarbonise. Sunk infrastructure costs in the existing gas grid, suggests decarbonisation of the existing gas network

²² DEFRA Pilot – Manchester http://urbanwater-eco.services/resources/Manchester_LAP_Evidence_Review_Final.pdf

NIA Call for evidence: Response by United Utilities

as perhaps being the most effective way to decarbonise heat. Where alternative private networks can be made commercially viable, these should be incentivised, but this isn't likely to be a solution for all heating requirements. Finding low carbon alternatives to natural gas and incentivising their use as a replacement to natural gas should be prioritised. The Renewable Heat Incentive (RHI) goes some way towards this, but this initiative could be made more secure for investors.

The water industry has significant potential to offer value in these spaces.

The production of biogas from sewage sludge provides a renewable and reliable source of gas. There are several uses of the biogas, it is widely used to produce heat and electricity for wastewater treatment processes. It may be possible that this approach could be extended to become part of district heating networks.

Recent developments in technology combined with financial incentives through the RHI has enabled the development of biogas clean up and injection to the national gas grid. These schemes decarbonise the existing natural gas grid. There is potential to significantly increase the quantity of biogas to grid if there is the right financial incentive for the market. Innovation in the water industry is at a very early stage in considering producing hydrogen that could be injected into the national grid network.

Heating (and cooling) requirements could be provided by using water source heat pumps alongside sewer flows. The opportunity for water companies to enter this space is perhaps difficult due to the financial risk around the loss of long term revenues from heat provision to a customer (i.e. will the customer be around for long enough for the initial capital outlay to be recovered). Developing the market and removing potential regulatory and financial barriers to this approach would be required to see this opportunity realised.

Q20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Energy efficiency will always be the first priority to reduce demand. An effective zero carbon power sector will need to be flexible, distributed and secure.

Flexible – We recognise that renewable generation will provide local and intermittent power and that energy storage technology will be needed to better match supply to demand. The power system will need to have inbuilt intelligence to respond quickly to price and balancing services signals. When there is a surplus, excess power can be put to productive use and when there is a deficit, non-essential power use can be curtailed. Incentives in the market to use energy when zero carbon sources are producing energy would support the right user behaviours.

Distributed – from households to businesses, more of the power required is generated and used locally. The transition to distributed and local systems means fewer people are paying for transmission and distribution networks.

Secure – a zero carbon power system must still provide secure supplies to critical national infrastructure, such as water and wastewater treatment plants. Back up supplies and local storage can play a part in this.

Q21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Low carbon vehicles could operate on electricity or hydrogen in the future. Low carbon electric vehicles present an opportunity to utilise excess electricity generation and store it for use at a later time in a productive manner. There is a need to develop a co-ordinated and organised grid of fast chargers across the country to enable the proliferation of this type of vehicle. Current charging opportunities are often linked to the motorway system and there is a risk this isn't developed in more rural or dispersed communities.

Hydrogen fuelled vehicles may become the preferred low carbon vehicle technology. However, this requires the development of infrastructure to provide the supply and distribution of hydrogen to the market. The water industry already has water infrastructure that could be used to supply the raw material for the production of hydrogen.

Water and wastewater (drainage and sewerage)

NIA Call for evidence: Response by United Utilities

Q22. What are the most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

There are long term water resources supply demand challenges, particularly surrounding climate change and population growth. In particular, it is widely known that the South and East of England face future acute shortages of water without intervention. There is no single most effective intervention to these problems, recognising in particular that demand side solutions are politically seen as preferential. Instead, the most effective intervention to ensure future demand needs can be met is likely to be a combination of a number of supply and demand solutions, and within the former category, the transfer of water between companies and regions has a key role to play. This view is consistent with latest 2019 Water Resources Management Plan guidelines and associated new methods, which strongly advocate exploring all options within an equitable and robust appraisal framework that takes account of future uncertainty in defining the optimal solution.

We have recently been involved in a collaborative Water UK led project entitled “Water resources long-term planning framework”²³ exploring the national water resources resilience outlook over a 50 year horizon, and examining the role of different option types to address those challenges. This was initiated in September 2015 in agreement with the Water Minister. The project complements the water companies’ own plans, but takes a higher more strategic view given the national scale. It used many of the techniques that a number of water companies are looking to apply in the next Water Resources Management Plan round. This concluded that most of the South East currently faces a 12% chance over a 25 year period of a drought severe enough to require standpipes for circa three months. The economic consequences of such an event are very high (£40-£120 per day per household) and provides a strong case to improve resilience at a cost of around £4 per customer per year. The current risk is lower in the north and west of England. This shows it is cost-beneficial to implement interventions to address this need, and that this is therefore in the economic interests of the country.

It was clear from this project, in line with our own views, that the most effective interventions would be a blend, termed a ‘triple-track approach’ of supply, demand and water transfer solutions. At a national level, resilience would be enhanced through greater national connectivity (such as from the River Severn to the Thames Water area, e.g. from Lake Vyrnwy). Further work is required to analyse the potential inter-regional transfers and consider the potable water quality and environmental risks implications on donor region resilience, and to ensure the regulatory, financial and operational arrangements can facilitate such transfers.

Other areas of the country face severe water resources challenges, and recognising the national importance we are keen to explore water trading in our plans. However, it should be recognised that there are long-term challenges in our own region such as climate change, and whilst the supply-demand options or interventions available to us are currently significantly greater than in other areas of the country, to facilitate transfers of water in our region requires additional interventions in our own region. We need to ensure that any proposals fully consider the effects on our own customers, stakeholders and the local environment. This is being completed as part of our next Water Resources Management Plan, with a focus on decision-making under future uncertainty (to define the best long-term solutions), resilience and ‘pathways’ in our plan where appropriate; this approach is in line with the recommendations from the Water UK project.

We are exploring water trading as a core part of our plan, and investigating all possible options (including those from third-parties) to define the best way to achieve a robust supply-demand balance for our own region, whether for our own needs or to facilitate the export of water. Our customers and stakeholders have strongly emphasised to us that they want water quality, resilience and the environment to be protected or enhanced from the activity, and/or that they would like to see financial benefits from any water exports. Recognising this, we advocate that further strategic level reviews and studies are completed after the next round of Water Resources Management Plans are developed, to further mature proposals that are generated as part of those strategic plans. Under such proposals, the need for a

²³ Water UK, Water Resources Long Term Planning Framework, <http://www.water.org.uk/water-resources-long-term-planning-framework>

NIA Call for evidence: Response by United Utilities

collaborative approach between government, regulators, companies and stakeholders is needed if the interventions are to be implemented and benefits achieved.

Q23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Demand growth from a sewerage perspective can be driven by:

- housing development and population growth
- changes in demand by existing households
- new commercial development
- increasing demand from existing commercial sites (led by expansion of the site or diversion of discharges from water course to sewer)
- infiltration (groundwater seeping into sewers through joints and cracks)
- urban creep (the increasing building over of permeable areas with impermeable, particularly in urban areas)
- climate change (increasing storm intensity and frequency)

Of these, the last two (urban creep and climate change) are by some margin the most significant medium to long term risks to sewerage and drainage capacity in North West England. The areas of demand growth have to some extent been mitigated by water efficiency activity including increasing numbers of metered households and the transition from a manufacturing (discharging trade effluent) to service sector (reduced volume and volatility of load) although the benefit from these trends is declining. Avoiding additional surface water being discharged to combined sewer is a priority to avoid future cost of collection and treatment and an increased environmental impact.

Surface water removal or detention during peak flows can be implemented at source or at other locations on the sewer network. This can be achieved through the prioritisation of surface water disposal to watercourse, increased take up of sustainable drainage solutions or more traditional storage solutions such as detention tanks. Retrofit SuDS into existing areas can be costly but should be explored when redeveloping previously industrialised areas and could reduce the impact in combination with other interventions. Installation of SuDS as standard at new developments (where surface water removal is unachievable) would also contribute to a reduction in peak flows maintaining the resilience of the receiving sewer network.

We have inherited a legacy of watercourses culverted into sewers with complex interactive upstream catchments of ditches, highways and land drainage. These were typically tapped into the sewer for a specific local reason at the time, when management of sewers and watercourses fell under the same local authority and environmental impacts of overflow discharges were not a high priority. The impacts and flows vary across our region but can produce significant peak flows that reduce capacity of the sewer network. A joined-up approach to returning flows back to their natural paths wherever feasible should be explored further.

The increase in demand from growth in population can usually be managed effectively, provided it is a foul only flow as these flows are an order of magnitude smaller than the surface water contribution. Whilst the growth in population in the North West is not projected to be as significant as in the South East, there are pockets that are significant particularly around Manchester and its associated commuter belt and the Mersey gateway. We actively engage with local authorities in developing their local plans particularly in relation to the management of surface water from new and re-development sites. The spatial location of development is more difficult to influence as our concerns are just one of many that planners need to take into account. We try to encourage development in areas where there is existing drainage and sewerage capacity and away from areas where environmental capacity for wastewater discharges are constrained and cannot be achieved without incurring considerable cost. In practice, such is the constraint on planning sites, we are rarely able to have a significant impact. Population growth means an increase in the load received at our wastewater treatment works and with the focus on maximising the benefit from this load through energy production and fertiliser products, demand growth does not just represent a downside risk but also a potential opportunity to increase output in these areas, increasing income and reducing costs for customers. This is another reason why our supply demand emphasis is on removal of surface water flows from sewers. We believe surface water is best managed on the surface and sewerage assets should preferentially focus on the collection and disposal of foul flows.

NIA Call for evidence: Response by United Utilities

Q24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Alongside the Environment Agency, Greater Manchester Combined Authority, the Rivers Trust and Natural England, we are a partner in “Natural Course”, a 10 year LIFE Integrated Project (IP)²⁴. The project strongly supports a whole catchment approach and is working towards better implementation of plans under the Water Framework Directive by working in a more integrated way with project beneficiaries and stakeholders to address the barriers, gaps and shortcomings preventing Good Ecological Status being achieved by 2027. Two of Defra’s Pioneer projects to test various aspects of their 25 year environment plan are located in our region, an urban focus in Manchester and a catchment focus in Cumbria. We will play our part in delivering these projects as our operations make a significant contribution to the environment in both areas, we are also one of the largest owners of catchment land in Cumbria (and the largest commercial land owner in the UK). Working in partnership is fundamental to effectively delivering a whole catchment approach to manage water, wastewater and flood risk.

A whole catchment approach allows us to develop joined-up thinking and strategic planning across our water supply, wastewater and flood risk management systems. We have been advocating for some time that there needs to be a more joined-up approach to water quality, water resources and flooding planning at all levels of governance and regulation on a catchment by catchment basis. Within government departments and regulators, responsibility for these different topics tends to sit with different teams and there is often a lack of joined up thinking in plans and initiatives. We welcome recent steps to get greater alignment between river basin management plans and flood risk management plans but there is some way still to go to get to a truly integrated catchment approach.

We created an Integrated Catchment Strategy team in March 2015 to take a look at how environmental and service targets could be more cost effectively delivered through a catchment approach. Our strategy has switched the focus from our assets to the river itself and we are aiming to achieve targets through the most efficient approach which may not be through investment on our own assets. We have been testing this approach with local stakeholders on the River Ellen in West Cumbria and are planning a more detailed catchment pilot on the River Petteril in North Cumbria. The River Petteril is a good test catchment as it not only has issues with phosphates from both point and diffuse pollution sources but the river was also a contributor to the flooding experienced in Carlisle in December 2015. We think that by working with farmers and landowners in the catchment we can deliver water quality objectives at lower cost to water bill payers and potential deliver a benefit to flood risk too as the objective of reducing or slowing run off from farmland has benefits for water quality and flood risk reduction.

In summary, taking a catchment approach would enable water resources, water quality and flooding to be managed in a more sustainable, resilient and cost-effective manner, giving us the opportunity to:

- Take a holistic, risk based approach by addressing the wider drainage issues, as well as surface water flooding and water quality issues in the catchment;
- Involve key stakeholders and work in collaboration with other organisations, such as local authorities, highways agencies, the Environment Agency and housing developers;
- Target and develop integrated solutions to: reduce flood risk, protect local communities, improve water availability and quality, improve our assets, and enhance the natural environment and urban areas;
- Deliver more for less: aligning resources and efforts through a partnership can deliver interventions which may not be achievable or affordable if individually tackled. Combined resources also means that more benefits and savings can potentially be achieved by the partners; and
- Deliver multiple benefits: integrated solutions can reduce localised risk as well as influence and impact on other issues in the catchment. For example, sustainable drainage solutions which combine water management and green infrastructure, can deliver a multitude of benefits such as: reducing water runoffs from urban developments, but also improve water quality by intercepting pollution from runoffs, mitigate flood risks, increase biodiversity and amenity value.

Through the LIFE IP project and other engagement with stakeholders we are endeavouring to bring about a change towards more integrated planning. Defra’s introduction of the Catchment Based Approach (CaBA) aims to embed

²⁴ Natural Course (LIFE IP) – <http://www.naturalcourse.co.uk>

NIA Call for evidence: Response by United Utilities

collaborative working at a river catchment scale to deliver cross cutting improvements to our water environments²⁵. Defra's view is that over time collaborative catchment working will become self-funding, unfortunately the reduction in government financial support in this area has in our view come too soon, before this point was reached. As a result, most CaBA hosts are underfunded and insufficiently empowered to bring about such a fundamental change in approach. We believe a reinvigoration (with appropriate funding) of the CaBA framework is the best vehicle to achieve a more effective whole catchment approach rather than creating a new structure, new bureaucracy or new initiatives.

Flood risk management

Q25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

It would be helpful for there to be a defined national minimum standard for flood resilience. This would help infrastructure providers to plan to meet at least a certain level of protection which could then be enhanced subject to local conditions, customer support and willingness to pay. Flooding is understandably an emotive issue and a horrific experience for those who suffer flooding of their homes. After flood events there is often an expressed desire to ensure "this can never happen again" or an expectation that we will protect assets to ever higher standards without any consideration of the cost or the relative risk of flooding compared to other hazards to service. When developing investment plans that includes assets with long lives, knee jerk changes to expectations on risk exposure lead to inefficient investment and unnecessary costs to water bill payers.

The Pitt Review 2008 considered that "for the purpose of building resilience in the critical infrastructure a minimum standard of 1 in 200 annual probability would be a proportionate starting point" but this was never incorporated into any official guidance.²⁶ The National Flood Resilience Review²⁷ led by Defra asked infrastructure providers to consider risk to sites serving more than 10,000 people from flood based on the "Extreme Flood Outline" and to procure temporary flood barriers to protect vulnerable sites in the short term with the aim of providing more permanent protection in the longer term. It is not clear to what extent these requirements now constitute official standards or what the basis for setting standards at this level was.

Building upon the National Flood Resilience Review, it would be appropriate for there to be different levels of resilience requirements for different levels of criticality of infrastructure assets, coupled with a suitable and affordable timeframe for their implementation. It would be sensible to align the requirement to the Environment Agency's currently published flood risk zones, although it would be beneficial for additional modelling to be undertaken to assess the impact of climate change on those return periods and flood extents. This would require agreement on appropriate climate change scenarios to be used for such assessments to avoid excessive cost through adoption of an extreme condition.

Flood resilience is not just about protecting sites from flooding with barriers, we need to ensure that other approaches to the provision of flood resilience get equal consideration including the decision to allow sites to flood and interrupt service but to have robust response and recovery plans to get sites back on line as quickly as possible once the flood subsides. This aligns with the principle of the 4 R's of resilience planning: resistance, reliability, redundancy and response/recovery as advocated by the Cabinet Office "Keeping the Country Running".²⁸ We would

²⁵ Defra, Catchment Based Approach, 2013 -

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/204231/pb13934-water-environment-catchment-based-approach.pdf

²⁶ Pitt Review – Lessons from the 2007 floods, 2008, paragraph 15.39

http://webarchive.nationalarchives.gov.uk/20100807034701/http://archive.cabinetoffice.gov.uk/pittreview/_/media/assets/www.cabinetoffice.gov.uk/flooding_review/pitt_review_full%20pdf.pdf

²⁷ National Flood Resilience Review 2015 - <https://www.gov.uk/government/publications/national-flood-resilience-review>

²⁸ Defra, Keeping the Country Running, 2011 <https://www.gov.uk/government/publications/keeping-the-country-running-natural-hazards-and-infrastructure>

NIA Call for evidence: Response by United Utilities

be happy to work with the National Infrastructure Commission to assess how appropriate national flooding standards could be set in the context of finding the appropriate balance between risk and cost.

As well as being an infrastructure provider, we are also a customer of other infrastructure providers on which our service relies, particularly electricity, telecommunications, transport and flood protection. Any standards should apply equally to other infrastructure sectors (albeit adjusted based on criticality) as a failure in service standards in any one of these sectors could adversely impact on our service levels. Resilience to flooding is necessary for all infrastructure irrespective of whether it is provided through general taxation or private infrastructure providers.

We are impacted by flooding but others are also potentially impacted by flooding from our assets, particularly sewers. We have reduced the number of sewer flooding incidents considerably in recent years but there is still more to do to reduce the risk even further. Sewer flooding can be caused by a lack of hydraulic capacity or due to a blockage in the pipe. Most hydraulic capacity issues have already been addressed and those that remain are extremely costly to resolve on a cost per property basis. There is a debate to be had as to how much it is reasonable to invest to prevent flooding to an individual property. Our focus in recent years has been to address the most common cause of sewer flooding, blockages. It is considerably more cost effective to tackle this problem through operational activity and through customer education to prevent the misuse of sewers, for example, the disposal of wipes, fats, oils and greases down the drain. The industry is currently engaged with trading standards about the use of the word “flushable” on products that cause problems with sewer blockages and lead to flooding and environmental pollution.

Q26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Natural flood risk management (NFRM) covers a wide range of actions and land use types. Whilst NFRM can only be part of the solution to flood risk we believe it can make a good contribution and offers many wider benefits than traditional hard engineering. Many different measures can act as NFRM, encouraging the retention of water within a catchment and, through that, enhancing the natural functioning of the catchment. They contribute to a reduction in flood risk through regulating the flow and transport of water so as to smooth peaks and moderate extreme events. Measures can include riparian planting, reinstating flood plains and restoring meanders. They can support biodiversity conservation and restoration and they are more resilient to climate change as they are not generally designed to cope with a flood of a fixed severity but provide a benefit in all conditions.

As the largest commercial land owner in the UK with 57,000 hectares of land including large upland areas supplying our key reservoirs in Cumbria and the Pennines, we are well placed to support the proliferation of natural flood management schemes. Our Sustainable Catchment Programme (SCaMP) has been operating since 2005 restoring damaged peatland on our catchments primarily to provide a water quality and biodiversity benefit. We also expect our programme to provide a benefit to carbon sequestration by leading to an increase in the rate of peat development and a flood benefit by slowing the rate of flow off the uplands. This has been achieved by controlling stock levels, blocking grips and re-seeding bare peat that has been damaged by air pollution, overgrazing and historic drainage to increase agricultural output. Alongside this we have been undertaking an extensive monitoring programme and we believe this monitoring data is the longest continuous record of the benefits of a re-naturalisation of uplands in the UK. We are starting to see a slowing down in the deterioration of colour in the water draining from SCaMP catchments and the consultants undertaking the monitoring programme are undertaking a review of the impact on peak river flows downstream, early indications are that there is a considerable impact on peak flows during storm events.

We are involved in river restoration work with the Environment Agency and other partners. A project to restore a historically straightened section of Swindale Beck immediately upstream of our intake at Truss Gap was completed in September 2016. The project has resulted in a new sinuous channel measuring 891m in length, replacing a straightened reach 750m long. The new channel is better connected to the flood plain with a wider and more gently sloping profile, helping to slow the flow of water through the valley. The sinuosity of the channel has meant that natural in-river features (gravel bars, riffles and pools) have all formed rapidly after connection, resulting in much greater habitat diversity than in the straightened route. The old channel was in-filled and reseeded using brush

NIA Call for evidence: Response by United Utilities

harvested seed from the surrounding SSSI hay meadow, resulting in an increased area of species rich hay meadow. The project was funded by the Environment Agency, Natural England, United Utilities, Cumbria Waste Management Environment Trust and RSPB and was project managed by RSPB. The work took six months to complete and cost £205,000.

There are difficulties with the implementation of NFRM including those around the need to align with multiple stakeholders and legal issues around the liability from less certainty around the level of protection provided. However, better computer models are enabling us to process the many strands needed to design and create a built environment with water at its heart particularly within ungauged catchments where we have no historic flow data. The implementation of NFRM and evidence gathering around its effectiveness takes time. There is still a high level of uncertainty and there is difficulty in monitoring dynamic catchments, there is potential for new approaches e.g. use of time-lapse cameras and drones to aid our understanding and communication technologies are enabling us to introduce computer activated controls into our water management systems.

In winter 2015-16, flooding caused widespread disruption and damage in several areas of the north of England. As a consequence, Defra is investigating a range of flood alleviation options. One of these options is to consider case studies of impounding reservoirs used for water supply purposes operating in a way that may assist with the alleviation of downstream flooding: this is not a new concept as several examples exist already where arrangements are in place for this purpose. Yorkshire Water, United Utilities, Environment Agency, Ofwat and Defra are working together to understand the potential benefits and risks and identify the potential for wider application. Reservoirs within Yorkshire Water's and United Utilities' areas are currently being screened to identify suitable case studies. It is anticipated that agreements may be reached to test further reservoirs to determine whether flood alleviation benefits can be realised without adverse consequential impacts and without compromising the reservoirs' principal purpose of the long-term provision of reliable drinking water supplies.

Solid waste

Q27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

Our wide ranging business activities lead to a variety of waste streams, each requiring different approaches and business processes to optimise the management of wastes. In total, we produced 730,313 tonnes of waste in 2015/16, which was made up of the following waste streams:

- Construction waste 43.6%;
- Treated wastewater sludge 35.1%;
- Network excavated material 8.4%;
- Water sludge 6.2%;
- Grit and screenings 3%;
- Ash 2.2%;
- Office waste 0.6%;
- Hazardous waste 0.6%; and
- Operational site waste 0.3%.

Of this waste, 94.5% was diverted from landfill and we have set ourselves a target to divert 95% of waste to beneficial use. Our high level of waste diversion demonstrates that current financial and regulatory incentives are sufficient in driving us to manage the sustainable disposal of our waste and contribute to UK recycling targets.

In 2015/16, we diverted 100% of ash produced from landfill, compared to 0% diverted from landfill in the previous financial year. Ash is now blended with other end of use wastes for further use as aggregates and in concrete block manufacture. To support better ways of managing our ash waste, we have formed an internal working group with

NIA Call for evidence: Response by United Utilities

the aim to provide alternative long term sustainable solutions for the disposal and application of ash. Options considered include use by civil engineering suppliers and/or use within our supply chain. Alongside this we frequently provide samples of ash to businesses and researchers to explore the recovery of phosphorus and/or precious metals. Regulations to amend Annex III of the Waste Framework Directive (2008/98/EC) as regards the hazardous property HP 14 ('Ecotoxic'), could potentially cause the reclassification of ash from non-hazardous to hazardous. For United Utilities, this would result in a reduction in diversion from landfill and could significantly increase disposal costs if ash is classified as hazardous and is subject to a higher rate of tax under the proposed landfill tax changes.

Wastewater sludge is a large contributor to our total waste volume and a key feature of our sludge strategy is to maximise the beneficial reuse of sludge, by recycling to agricultural land as the Best Practicable Environmental Option in line with EU and UK Government requirements and policy. In order to sustain this recycling outlet, we will seek to maximise farmer uptake rates and reduce the exposure to changes in supply-chain sentiment by improving sludge digestate quality and engaging agricultural and food industry stakeholders. We participate in research, both independently and collaboratively, to promote the beneficial use of sludge in agriculture and technologies that will help secure the long term sustainability of our recycling activities. We are supporting the development of the Biosolids Assurance Scheme, which is a quality protocol for sludge treatment and disposal, to reassure stakeholders that the use of treated sewage sludge is safe and beneficial. Maintaining an outlet for sludge disposal to land is crucial. Therefore, any legislation that inhibits this would be detrimental and have a financial impact on our customers due to the high costs associated with disposing of sludge by incineration.

Q28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?

Waste regulation is complex and differentiated by waste types entering the treatment process. Current regulations often specifically exclude the reuse of wastewater and sewage sludge from the circular economy and this must change to enable the water industry to support national circular economy goals. Recovery from wastewater and sewage sludge has the potential to play a significant part in a circular economy, providing a wide spectrum of opportunities including water, nutrients (notably phosphorus), plastics, as well as generating renewable electricity and gas. We recommend that circular economy regulations should set out criteria that describe the quality of the final product, without limiting the input material from which it originates.

The circular economy regulations must support the recovery of phosphorus from wastewater and sewage sludge. Phosphorus is one of the essential nutrients for plants, animals and humans and is therefore crucial for all life on the planet. The limited availability of phosphate rock as well as Europe's high dependency on imports made it part of the revised list of Critical Raw Materials in May 2014. There is enough phosphorus in wastewater that if recovered, could provide a significant sustainable contribution to agriculture and food security, whilst also delivering environmental benefits to the natural environment through cleaner watercourses.

Currently, phosphorus recovery from wastewater or sewage sludge is not economically feasible. Market opportunities for recycled phosphates are essential for closing the cycle and should be broader than the fertilizers industry only. Legislative frameworks could better support the development of cost-efficient and optimal solutions. Incentives for phosphorus recovery would focus actions to the most promising and cost effective solutions. However, at the moment it is not clear what raw materials or processes are the best for phosphorus recovery and more research is needed.

National Infrastructure Assessment Call for Evidence

Submitted by [name redacted] and [name redacted], School for Social and Community Medicine, University of Bristol

Cross-cutting issues:

1. Investment in walking infrastructure is the best value for money of all road infrastructure types.

Walking infrastructure has potential to reduce the large national health burdens of physical inactivity and air pollution while also increasing transport network capacity, strengthening community cohesion, local spend in high streets, and equitable access to jobs.

Physical inactivity and air pollution are two of the great health challenges of our times - both are clearly linked to leading causes of premature death including cancers, heart disease and dementia¹. Physical inactivity is estimated to cause 17% of deaths in the UK² and costs the nation £20 billion per year³. The mortality burden of outdoor air pollution is estimated at 40,000 deaths per year, with social-economic costs of £20 billion per year⁴. Walking is known to be the single most equitable form of physical activity across gender, age, ethnicity and categories of deprivation⁵. As such, walking is a unique form of transport which can reduce both health and job access inequalities.

3. Walking infrastructure needs to be safe, enjoyable and convenient for everybody.

Walking is currently not safe in the UK, but is poor in both absolute and relative terms of traffic risk. The rate of killed or seriously injured (KSI) per billion miles is almost 20 times higher for pedestrians than car occupants (484 vs. 25 respectively)⁶. These rates are 3 to 10 times higher than absolute traffic injury rates of European counterparts such as Sweden, Denmark and the Netherlands, and up to 19 times higher when comparing rates for children⁷. Even allowing for the methodological limitations of traffic injury rates per distance travelled, this international data clearly suggests that our national traffic safety ambitions can be improved. The need for improved road safety is consistently identified across scientific literature as a key determinant of children's travel by walking or cycling to school⁸, meaning there is a double negative impact in the resulting low levels of active travel to school. Countries and cities across the world are adopting zero KSI targets for pedestrians⁹.

Evidence from the UK indicates that walking infrastructure should be enjoyable, pleasant and convenient, with connections to public transport to facilitate walking uptake and maintenance¹⁰.

A previous National Infrastructure Commission report identified that population projections show that we have a growing and ageing population¹¹. It is essential to recognise that we spend a large part of later life in poor health¹², and that this is related to the accumulation of non-communicable disease across the life course¹³ and unsustainable treatment costs¹⁴. Older adults gain some of the greatest health and wellbeing benefits from walking. There is a strong cost rationale to ensuring that walking infrastructure is safe, enjoyable and convenient for older adults for it to achieve full health and economic potential at scale.

Transport:

13. Daily walking needs to be built-in.

Walking needs to be built in to travel patterns to ensure that the Chief Medical Officer's recommendation of 150 minutes of moderate-to-vigorous physical activity per week are met on a population scale. Research from the UK shows that a daily 15 min walk at 3mph to work or local public transport interchange would achieve this¹⁵ – a spatial radius of 0.75 miles. Up to 1.5 miles (30 mins) radius would be ideal from a public health point of view to counteract the effects of prevalent sedentary work patterns. Imagining scenarios of flexible home working, the importance of local density of housing with walking scaled spatial relationships to shops, schools and services has increased importance.

Flood risk management:

26. Blue-green infrastructure can help maximise flood protection and upgrade walking infrastructure.

An example of this is investment in walking and cycling infrastructure in Copenhagen co-financed through climate adaptation and flood protection measures.

The following statement was provided by Ramboll Denmark:

"In response to extreme urban flood events in 2011 and 2012, legislative changes were made to allow the municipality to upgrade service requirements to be delivered by water utility companies. This decision was based on allowing for both a 30% increase of precipitation over the next 100 years and management of larger storm events e.g. 1-in-100 storms based on cost-benefit risk analysis. Legislative changes further enabled water utility companies to take out loans and increase revenues through rate increases in order to invest in capital projects to deliver this

new level of flood and stormwater management. In addition, water utility companies were given the legal right to co-finance urban renewal projects which achieve these new urban hydraulic performance targets together with both municipalities and private investment companies.

The volume of expected investment is equivalent to over £2 billion (20-25 billion DKK) over the next 20-25 years. Based on initial project work, an estimated 50% of this will be spent on surface infrastructure systems – termed blue-green infrastructure - which improve hydraulic performance and flood capacity while upgrading for example pedestrian and cycling environments and recreational areas. From 2017, typically utility companies will finance 75% of investment and municipalities 25%.”

Biographies:

[biographies redacted]

REFERENCES

¹ Department of Health (2011) *Start active, stay active: a report on physical activity for health from the four home countries' Chief Medical Officers*. Available at: <https://www.gov.uk/government/publications/start-active-stay-active-a-report-on-physical-activity-from-the-four-home-countries-chief-medical-officers>; Royal College of Physicians (2016) *Every Breath We Take – the lifelong impact of air pollution*. Available at: <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>

² Global Physical Activity Observatory (2016) Country card England. Available at: <http://www.globalphysicalactivityobservatory.com/card/?country=EN> (Accessed: 5 January, 2016).

³ Cabinet Office (2014) *Moving More, Living More*.

⁴ Royal College of Physicians (2016) *Every Breath We Take – the lifelong impact of air pollution*. Available at: <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution>

⁵ Based on data from national physical activity surveys: Active People Survey 7/8 and 8, Health Survey for England 2012, National Travel Survey 2013, National Census 2011.

⁶ Department for Transport (2015) 'Relative risk of different forms of transport, Great Britain: 2014, Table RAS30070.

⁷ DTU Transport (2012) *Risiko i trafikken*; Official Statistics Sweden (2014) *Road Traffic Injuries*; Official Statistics Sweden (2014b) *The Swedish national travel survey 2012–2013*; SWOV (2013) *Fact sheet: risk in traffic*; Wiklund, M. (2015).

⁸ Audrey, S. and Batista-Ferrer, H. (2015) 'Healthy urban environments for children and young people: A systematic review of intervention studies', *Health & Place*, 36, pp. 97–117.

Christie, N. *et al.* (2011) 'Children aged 9–14 living in disadvantaged areas in England: Opportunities and barriers for cycling', *Journal of Transport Geography*, 19, pp. 943–949.

Mantjes, J. *et al.* (2012) 'School related factors and 1yr change in physical activity amongst 9–11 year old English schoolchildren', *International Journal of Behavioral Nutrition and Physical Activity*, 9(153).

Panter, J. *et al.* (2010) 'Attitudes, social support and environmental perceptions as predictors of active commuting behaviour in school children', *J Epidemiol Community Health*; 64, pp. 41–48. doi:10.1136/jech.2009.086918

⁹ [http://www.visionzeroinitiative.com/;](http://www.visionzeroinitiative.com/)
<http://www.visionzeroboston.org/actionplans>

¹⁰ Adams, E. and Cavill, N. (2015) 'Engaging communities in changing the environment to promote transport-related walking: Evaluation of route use in the 'Fitter for Walking' project', *Journal of Transport & Health*, 2, pp. 580–594.

Adams, E. *et al.* (2013) 'Correlates of walking and cycling for transport and recreation: factor structure, reliability and behavioural associations of the perceptions of the environment in the neighbourhood scale (PENS)', *International Journal of Behavioral Nutrition and Physical Activity*, 10(87).

Clayton, W. and Musselwhite, C. (2015) 'Exploring changes to cycle infrastructure to improve the experience of cycling for families', *Journal of Transport Geography*, 33, pp.54–61.

Goodman, A. *et al.* (2013) 'Who uses new walking and cycling infrastructure and how? Longitudinal results from the UK iConnect study', *Preventive Medicine*, 57, pp. 518–524

Guell, C., Panter, J., Jones, N.R., and Ogilvie, D. (2012) 'Towards a differentiated understanding of active travel behaviour: Using social theory to explore everyday commuting', *Soc Sci Med*, 75(1), 233-239.

Guell, C. *et al.* (2013) 'Walking and cycling to work despite reporting an unsupportive environment: insights from a mixed-method exploration of counterintuitive findings', *BMC Public Health*, 13(497).

Panter, J., and Jones, A. (2010) 'Attitudes and the Environment as Determinants of Active Travel in Adults: What Do and Don't We Know?', *Journal of Physical Activity and Health*, 7, pp.551-561.

Panter, J., Griffin, S., Dalton, A., Ogilvie, D. (2013) 'Patterns and predictors of changes in active commuting over 12 months', *Preventive Medicine*, 57(6), pp. 776-784.

Panter, J. *et al.* (2013) 'Incorporating walking or cycling into car journeys to and from work: The role of individual, workplace and environmental characteristics', *Preventive Medicine*, 56, pp. 211-217.

¹¹ National Infrastructure Commission (2016) *The impact of population change and demography on future infrastructure demand*.

¹² Office for National Statistics (2016) *Healthy life expectancy (HLE) and life expectancy (LE) at birth by region, England*. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthandlifeexpectancies/datasets/healthylifeexpectancyhleandlifeexpectancyhleatbirthbyregionengland>

¹³ Ibid 1.

¹⁴ Appleby, J. (2013) *Spending on health and social care over the next 50 years Why think long term?* Available at: <http://www.kingsfund.org.uk/time-to-think-differently/publications/spending-health-and-social-care-over-next-50-years>

¹⁵ Audrey S, Procter S, Cooper AR. The contribution of walking to work to adult physical activity levels: a cross sectional study. *Int J of Behavioral Nutrition and Physical Activity*, 2014, 11:37. doi:10.1186/1479-5868-11-37

LOCATION, LOCATION AND LOCATION

Getting best value from investment in infrastructure

This paper responds to question 3 in the consultation by the NIC on carrying out the National Infrastructure Assessment. It amplifies evidence sent in by the Royal Society of Arts' Sustainability Network. An attachment, originally prepared for the Call for Ideas, suggests testing out Multi-Criteria Analysis (MCA) and Land Value Capture in different types of situation where difficult choices have to be made. The aim of this particular paper is to show how housing and infrastructure should be linked together to get better value from public investment.

The real challenges

Achieving the NIC's aims, including fiscal responsibility, require the UK to adopt better methods for devising, assessing, and financing major infrastructure projects. The huge bill for updating our infrastructure systems set out in reports by McKinsey and Company and The Policy Exchange makes strategic phasing critical.¹ As infrastructure is a necessary, but not a sufficient condition for economic growth, it also needs to be located in the right places. Every surveyor learns that there only three things that matter in property: location, location and location. Yet government has been criticised for being 'spatially blind'; short-term political pressures make it hard to focus public investment where it will yield best long-term value.² This means producing not just simple short-term economic benefits, but also balancing social and environmental impacts.

The report of the Mayor of London's infrastructure plan provides some useful data on the expected capital expenditure in London alone over the next three decades.³ Leaving out health, still requires capital expenditure of £1.3 trillion. Significantly housing accounts for 41% closely followed by transport at 35%, while energy trails behind at 11%. Studies in both Milton Keynes and Cambridgeshire found similar orders of magnitude.⁴ So there is no escaping the realities that government objectives such as doubling housing output or raising

¹ Dieter Helm et al, Delivering a 21st Century Infrastructure for Britain, Policy Exchange 2009

² See for example case studies in Sir Ivor Crewe and Anthony King, The Blunders of our Governments

³ The Mayor of London, London Infrastructure Plan 2050

⁴ Nicholas Falk, The Steps to Quality Growth: towards a new business model for house-building, Cambridgeshire Horizons 2101

productivity depend on mobilising much greater levels of investment that we have achieved in past decades.

The task is made more complicated by five facts of life:

- Much of the opposition to development, especially house-building in the South, stems from concerns over impact on congestion (and related pollution)⁵
- Private developers and institutional investors will not fund major projects without assurances that infrastructure will be in place
- Utilities are reluctant to commit until spatial growth plans have been agreed
- Infrastructure projects in the UK take many years to plan and implement (Crossrail was initiated in the 1940s)
- There is little public appetite for raising taxes to fill the gaps, or trusting in Commissions of Inquiry.

How housing and infrastructure interact

Despite the obvious truism that economic growth and housing are inter-related, there is surprisingly little clear research on how far one shapes the other. Much of the work on ‘urban form’, while interesting, has been inconclusive.⁶

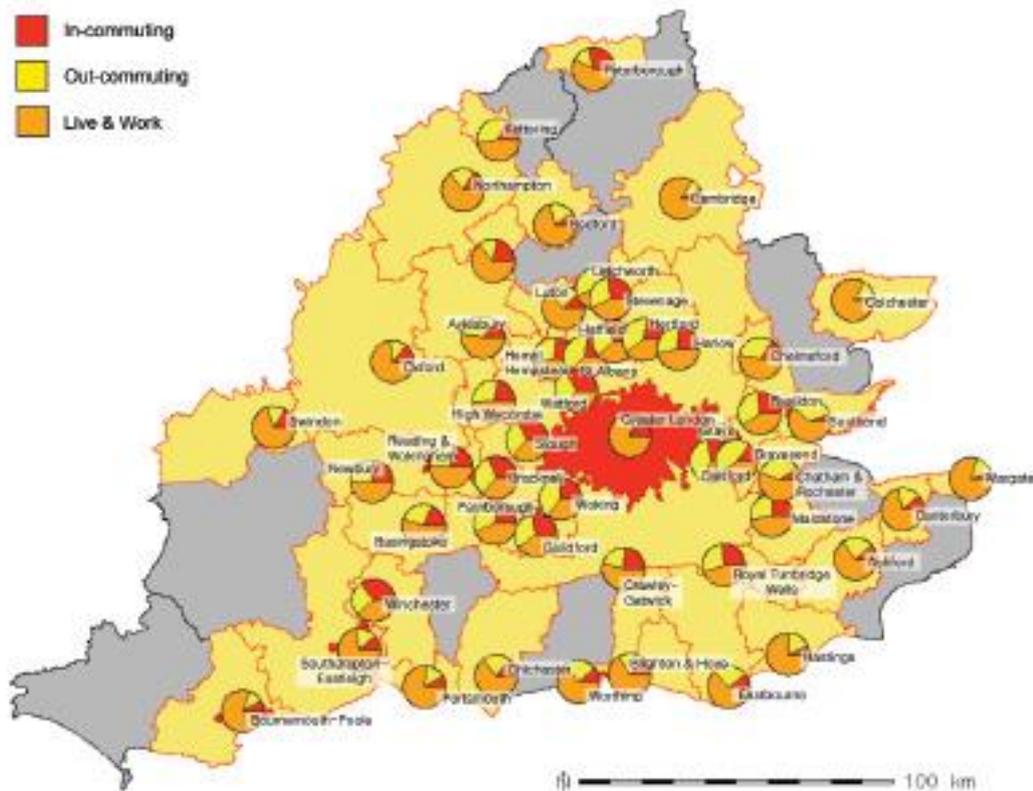
However there is evidence of significant differences between types of town:

- Much of the congestion on the roads and railways is caused by more people commuting ever further to work: paradoxically improved transport capacity tends to lead to people living further away from work.⁷
- Outside London and the South East, where most people take well over an hour to commute into Central London, commuting times are often quite short. The chart below from Peter Hall’s research shows that the smaller the town, the more people tend to commute outside to work, using cars for the most part. It is the larger university towns that are most self-contained.

⁵ URBED with MORI, Attitudes to Higher Density Development in the South East, South Eastern England Development Agency, 2007

⁶ Katie Williams on Shaping our Cities for the Future of Cities Foresight 2014

⁷ David Metz, Travel Fast or Smart? A Manifesto for an Intelligent Transport Policy, London Publishing Partnership 2016

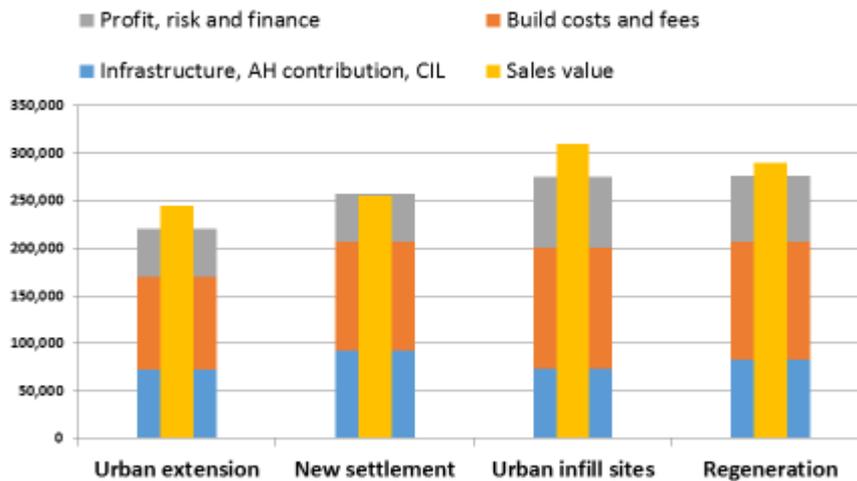


- House prices determine land values, with huge differences across the country; thus in Cambridgeshire, land in Cambridge City (which is 45 minutes from Kings Cross) is valued at £5.7 million an acre, compared with £1.0 million in East Cambridgeshire, and only £370,000 in Fenland.
- House prices are affected by travel times to work, with a clear gradient as distances from major sources of employment such as London increase.⁸ Much of the impact of improved transport is therefore lost in higher house (and land) values.
- Even within a relatively well-served conurbation, such as London, differences in accessibility can trap people in disadvantaged areas, and may explain why low-paid jobs are filled by immigrants. As the public transport system is largely radial, most use cars to make orbital journeys to get to work in many parts of Outer London, and clog up poorer town centres.
- Very different returns on investment are possible from urban infill or extending areas with infrastructure capacity compared with developing new communities from scratch (which require substantial subsidies).⁹ The

⁸ A useful web site from Anna Powell-Smith shows this graphically for 2,500 stations

⁹ The analysis for URBED's Wolfson submission was prepared by Pete Redman of Trade Risks, who calculated that land value uplift from development on the edge of Oxford was sufficient to build the first stage of a tram system

residual land value is the difference between the sale receipts and the cost of construction, including fees, and urban infill sites involve lower costs and risks.



Transport models such as SATURN, are typically used at great cost to evaluate single projects or options, and little seems to have been done to assess the interrelationship of alternative growth scenarios and transport systems. Local authorities no longer have the staff or budget to explore the options properly. Yet improvements in GIS and mapping techniques have revolutionised the possibilities.

- Transport for London has just upgraded its online planning tool WebCAT which shows how well connected locations are in terms of transport as well as journey times¹⁰
- The Centre for Advanced Spatial Analysis(CASA) at UCL has been backed by Innovate to develop better software which brings all the environmental constraints together, and allows development impacts to be assessed at a sub-national or city region level¹¹
- URBED’s work in Central Oxfordshire, following on from winning the 2014 Wolfson Economics Prize, has identified options for making better use of rail, and the need to change the way we plan for strategic growth if we are to realise the benefits and avoid waste.¹²
- Work on major national infrastructure projects such as High Speed 2, and also the Oxford/Milton Keynes/Cambridge links has highlighted

¹⁰ <https://tfl.gov.uk/info-for/urban-planning-and-construction/planning-with-webcat/webcat>

¹¹ An overview is available from Prospective, the company developing the software

¹² Nicholas Falk, Planning for Posterity, Town and Country Planning, September 2016

the importance of ensuring that local linkages are in place if the benefits of increased rail usage are to be secured.¹³

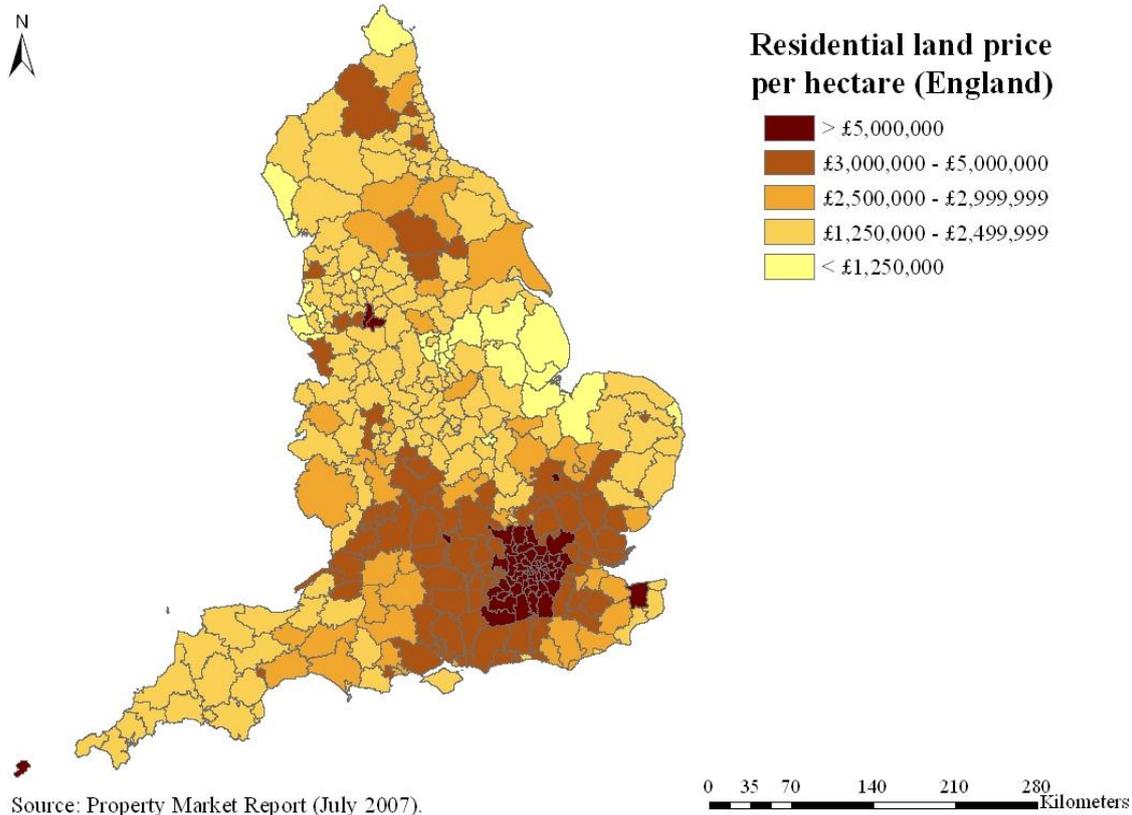
But cities are not the simple ‘engines’ or ‘drivers of growth’ that they are sometimes called. Comparisons between British and Continental cities show that while London is in a class of its own, as a ‘World City’, our provincial cities lag behind their Continental counterparts in many aspects.¹⁴ However most studies fail to take sufficient account of the wider Travel To Work or Functional Urban Area in which skilled staff and managers live: some of the most dynamic employers such as Dyson in Malmesbury or Renishaw in Stroud are now based far from the cities where they may have originated.

Not only is it important to compare like with like, but also to distinguish between different types of location. Crudely a distinction can be made between Growth and Regeneration Areas based on land values, where regeneration areas require public subsidy before development is viable, while growth areas have high enough land values to attract private investment not just in house building, but also providing enabling infrastructure. The map below sets out land values from a CLG report, and £3 million a hectare should provide enough land value uplift not just to build private houses for sale, but also to meet social and environmental obligations.

Pete Redman of TradeRisks, (who specialise in raising bonds and produced the calculations in our Wolfson Economics Essay,) is cautious about how much could be secured from capturing land value uplift. He thinks the UK government is already spending large amounts on infrastructure renewal and improvement; we need to spend about £88 billion a year, of which half should be private investment, whereas actual expenditure is a little over £60 billion. The private contribution is only about half of what it should be. He reckons we could squeeze another £2.5 billion a year, or double the current contribution from the private sector. As Ministers are keen to keep public expenditure down, something has to give.

¹³ See for example the reports of the Independent Transport Commission High Speed Rail and Connected Cities: Accessible Places for Growing Economies , 2016

¹⁴ EU State of the Nations 2016 , Centre for Cities Competing with the Continent: how UK cities compare with their Continental counterparts.



A further distinction also needs to be made according to the size or role of the city, with Metropolitan Cities or Junctions having quite different needs and potential. Thus it is the larger or Core Cities where metro or tram systems are viable, and cities such as Leeds should expect to be compared with cities such as Lille in France or Leipzig in Germany. It is these ‘Metro cities’ where the returns from upgrading local infrastructure should be greatest if the impact on social and environmental capital is properly assessed. Finally it is often helpful to distinguish between Central, Inner and Outer or Rural areas, and different types of urban form, such as Linear or Connected Cities, which lend themselves to quality public transit, such as Swift Rail. www.connectedcities.co.uk While this may not suit the way UK statistics are collected, when it comes to planning major transport and development projects it is essential.

Where we can learn from

As well as learning from the places that have failed to ‘join-up’ transport and development, the NIC should also be learning from cities that have used different approaches with greater success. In *Good Cities Better Lives*, Sir Peter Hall and I selected a range of Continental cities that could serve as models for

how the UK might achieve better growth.¹⁵ We picked French cities for the chapter on transport, but similar approaches are used throughout Europe as the following examples of ‘smarter urbanisation illustrate¹⁶. I have chosen examples below of what might be classed as ‘regeneration’ areas that have lost industrial jobs, and therefore which are most similar to typical British major towns and cities:

- The conurbation of **Lille** not only succeeded in attracting a station on the High Speed line from London to Paris, but also upgraded its local transport system at the same time. In what was known as the Metropolitan Compromise, implemented through a kind of ‘City Deal’, some 80 communes support the Mayor of Lille in return for upgrades to local transport.¹⁷ This included a driverless Metro linking up the old industrial towns of Roubaix and Tourcoing, an upgraded tram to Roubaix, and an integrated quality bus system that knitted the whole agglomeration together. This was helped through the Versement Transport, a charge on the payroll of those with more than ten employees. The French planning system of Aménagement de Territoire starts with the ‘bigger picture’.
- The ‘shrinking’ city of **Leipzig**, in East Germany, a former textile city which lost 90% of its manufacturing jobs after reunification, has reversed its decline in a relatively short period. Major transport projects have put a long-distance line under the central city, and upgraded the tram system to make it easier to use public transport. At the same time, the major employer of BMW was persuaded to open up its new manufacturing and research facility by the commitment to build a new motorway around the edge of the city, to ensure components get to the factory without congestion. The City planned its future by working closely with the universities and major employers, and is able to draw on finance from the state investment bank KfW and also local savings banks or Sparkasse, who fund business growth. As a result Leipzig has become known for its creative cluster of artists and businesses.
- In **Rotterdam**, the old port area of Kop Von Zuid has been transformed with stylish housing, connected up by the iconic Erasmus Bridge, and river taxis.¹⁸ The splendid new Central Station symbolises the city’

¹⁵ Peter Hall with Nicholas Falk, *Good Cities Better Lives: how Europe discovered the lost art of urbanism*, Routledge 2013

¹⁶ Nicholas Falk, *Smarter Urbanisation and Rapid Growth*, *The Planner* February 2017

¹⁷ Lille is also a case study in URBED’s report for Joseph Rowntree Foundation, *Regeneration in European Cities*, 2008i, and is compared with Bradford and Leeds

¹⁸ Rotterdam forms another case study in URBED’s report for the Joseph Rowntree Foundation, *Regeneration in European Cities: making connections*, and is compared with Southwark

renaissance as a cultural city to rival Amsterdam, and as well as local Metro and tram services, the whole Randstad area (equivalent to Greater London) is connected together with Swift Rail type services. Dutch planning is a model for how to integrate transport and development, with higher densities promoted around the most accessible locations. As an example, Rotterdam was not allowed to build a new business park by its airport until the one at Amsterdam's Schipol had been completed, while South Amsterdam provides one of the best models of how to integrate transport with mixed high density development.

Joining up investment plans

Difficult choices have to be made if the constraints on the growth of areas with real economic potential, such as Oxford and Cambridge or West London around Heathrow are to be relaxed. Similarly efforts to regenerate older industrial areas such as in Stoke or Bradford cannot be accomplished with major investment in transport. But making decisions by ranking all transport projects together and applying relatively crude Benefit Cost Analysis (BCA) is simply stupid, even if the WebTAG process has tried to take account of different factors. The studies for corridors like Oxford to Milton Keynes are a good start, but only effective if they grapple with the problems of Intra-City, as well as Inter-City transport, and succeed in linking development with infrastructure projects.

There is, alas, no simple answer, and politicians have a key role in weighting priorities or values. But this should come AFTER options have been sketched out or scoped, and in the light of broad estimates not just of likely costs and usage, but also of risks. As in the example of Cambridge Futures, some clear thinking early on, bringing the main stakeholders together, can produce a clear enough vision to allow major infrastructure investment decisions to be taken, and quality growth secured. It looks as if techniques such as Agent Based Modelling could offer a way forward, and certainly deserve consideration: https://en.wikipedia.org/wiki/Agent-based_model . So too does Policy-led Multi Criteria Analysis, as set out in UCL's Omega 3 report, which was explored in a seminar on Trams for Oxford.¹⁹

While it may be over-ambitious to think that the UK as a whole will adopt Land Value Rating, and start to hypothecate the uplift in land values from development towards local infrastructure, at least a start could be made by considering land values in making investment decisions, such as where to locate

¹⁹ See paper by Robin Hickman in the report Trams for Oxford, www.oxfordfuture.org.uk and paper by Fiona Ferbrache on the economic impacts of light rail, both of whom are linked to the Transport Studies Unit at the University of Oxford.

a new generation of Garden Cities or Sustainable Urban Extensions.²⁰ Indeed, there could even be support in some areas for going further and requiring major housing developments to contribute to the cost of upgrading local transit systems where that will relieve congestion for all and help support property values.²¹

The NIC, through its role in assessing major projects and infrastructure capacity, could hold the key. Thus Multi Criteria Analysis in a historic city like Oxford might consider not just at time savings, but the impact of different transport investments on the growth of private sector jobs and housing investment, and also on the employment prospects and earnings for people living in the poorer parts of East Oxford, and possibly on pollution and health more generally.

Conclusion

Tackling the challenges the UK faces in upgrading its worn-out infrastructure are technically and politically complex. They are also critical if the country is to respond to the likely loss of confidence and community wellbeing after Brexit. This requires more than just a few grand projects; instead it means enabling a range of small projects to go ahead that will release local constraints and support plans that mobilise private investment and community enterprise.

A separate report prepared with transport and planning experts for the NIC's Call for Ideas, suggests how 'smarter growth' might be achieved. The RSA's Inclusive Growth Commission, and bodies such as the New Economics Foundation, are also working on proposals for land value capture. The time could be ripe for a break-through in achieving the three E's by which all strategic planning should be judged²²:

- **Effectiveness:** does it work (and produce desired results)?
- **Efficiency:** is it being delivered economically (and minimise waste)?
- **Equity:** is it fair to all concerned (and does it help social inclusion?)

[Name redacted] , www.urbedtrust.org [phone number redacted]

²⁰ David Rudlin and Nicholas Falk, Uxcester Garden City, 2014 Wolfson Economics Prize, www.urbed.coop
Nicholas Falk, Garden Cities for the 21st Century, International Journal of Urban Design, 2017

²¹ Reg Harman and Nicholas Falk, Swift Rail- Funding local rail transit through Smarter Growth, Public Money and Management September 2016

²² Quoted in Hugh Barton's City of Wellbeing: a radical guide to planning, Routledge, 2016 and attributed to Archie Cochrane, these were also developed in Nicholas Falk's doctoral thesis on The Planning and Development of London's Docklands, LSE 1984.



**Viessmann response to
National Infrastructure Assessment Call for Evidence**

Response submitted by: [name redacted] [email redacted]

Executive summary

About Viessmann

*The **Viessmann Group** is one of the leading international manufacturers of heating, industrial and refrigeration systems. Founded in 1917, the family business maintains a staff of approximately 11,600 employees and generates 2.2 billion Euro in annual group turnover.*

With 22 production divisions in 11 countries, subsidiaries and representations in 74 countries and 120 sales offices around the world, Viessmann is an internationally orientated company. 56 percent of sales are generated outside Germany.

As a family-run company, Viessmann sets great store by responsible conduct with a long-term vision. Sustainability is already firmly embedded into the company's guiding principles. For Viessmann, the practice of sustainability means reconciling cost efficiency, ecology and social responsibility throughout the entire company to enable us to meet our current needs without compromising the ability of future generations to meet theirs.

As an environmental pioneer and technology leader in the heating industry, Viessmann has been supplying minimal emission, energy-efficient heating systems for oil and gas for decades as well as solar thermal systems, wood combustion systems and heat pumps. Many Viessmann developments are regarded as milestones in heating technology.

For further information please contact:

[name redacted]
[job title redacted]
E: [email redacted]

Answers to questions:

We have provided answers to questions 1, 4, 5, 6, 7, 12, 19, 20 and 21.

Cross Cutting Issues	
1.	What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?
As a general comment Viessmann would support the message being made by trade associations such as the Sustainable Energy Association that energy, including heat and power generation and demand reduction should be treated as an infrastructure priority. We welcome the recognition of energy as a workstream by the National Infrastructure Commission. Having buildings suitable for purpose for both domestic and commercial use can have wide-ranging benefits such as improved health of UK citizens from living in warmer homes and on the UK economy through more manageable fuel bills.	

<p>4.</p>	<p>What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?</p> <p><i>Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.</i></p>
<p>Viessmann is supportive of demand management in energy consumption as an effective way to reduce energy use; cutting carbon and lowering fuel bills. In particular, we support the approach ‘system plus’ which can apply to existing boilers and renewables in future. The approach ensures that boilers and heating systems are installed and operated optimally. This can be achieved through robust regulation in the heating sector applying many of the principles outlined in the ‘Each home counts’ review which targets renewables but the approach is applicable across the sector to ensure installation best practice and consumer protection.</p> <p>Alongside this, cost-effective technologies such as boiler controls, weather compensation and hydraulic balancing ensure a system is operating optimally. This ensures system efficiency with minimal human input but also no loss of comfort, which mitigates many behavioural constraints related to demand reduction. Payback periods are also relatively short for these technologies and intervention points such as a gradual strengthening of building regulations could increase their use. More details on hydraulic system balancing and system plus are provided below.</p> <p>In relation to rebound effects, most private end users adjust their heating in response to variations in their thermal comfort, driven by the typical start/stop performance of a boiler operating as heat generator for a high temperature heating system, coupled with room thermostats that traditionally have a high tolerance of +/- three to five degrees C. In our scenario of a balanced and weather compensated heating system, modulation of the flow temperature and integration of a digital thermostat ensures that heating comfort is improved and internal temperature delivery is stabilised to a much smaller thermal tolerance, therefore, it is anticipated that adjustment of heating circuits will in fact decrease and there will be very minimal rebound effect as the root cause has been marginalised.</p> <p><u>Hydraulic balancing and system plus in detail</u> <u>Hydraulic balancing</u></p> <ul style="list-style-type: none"> ▪ Hydraulic balancing of a heating system is necessary to ensure that all heat emitters in the system are supplied with the same level of heat at the same time. ▪ This requires the flow rates in the heating circuit piping, the output of the circulating pump and the heating curve of the heat generator to be adjusted very precisely. Subsequently, it is ensured that no room is under- or oversupplied with heat and that the energy is used in the most efficient way. 	

- Hydraulic balancing, as part of a package of measures such as advanced controls, has the potential to reduce energy consumption of a heating system by up to 15 percent – therefore hydraulic balancing can fundamentally maximise efficiency and reduce CO2 in the long term.
- However, unlike commercial installations, hydraulic balancing is often not done in domestic properties because it is perceived to be a complex procedure and requires a lot of time as well as expert knowledge. However, significant progress has taken place over the last few years with several developers, including Viessmann, developing automated or simplified hydraulic balancing processes that render it easier for installers to implement.
- An innovative solution is provided by these automatic hydraulic balancing systems which are already being used in the market. The Viessmann solution, Vitoflow, simplifies and accelerates the execution of hydraulic balancing and is a precise and reliable method of balancing the heating system. Other novel systems are also available developed by Grundfos, Danfoss and Schneider amongst others. Simpler manual options for hydraulic balancing are also available that do not require specialised equipment.
- Legislation should aim to incentivise hydraulic balancing in all interactions installers have with consumers including regular maintenance visits, spot checks, or radiator and pump replacement. The Energy Company Obligation (ECO) scheme also presents another intervention opportunity and including hydraulic balancing as a proposed and eligible measure helps support the aims of the scheme.
- In Germany, the benefits of hydraulic balancing are already recognised¹ and in August 2016 a scheme was launched to support hydraulic balancing².

Advanced system controls – weather compensation

- Weather compensation should be a necessary component of boiler installation. It is a proven, low cost, non-disruptive technology developed by all key market participants and mandated in other leading markets like Germany. Weather compensation is also necessary for regulatory changes to lead to real change in heating system operating efficiency by allowing boilers to operate in lower operating temperatures and condense fully.
- Weather compensation is delivered via a small temperature sensor located on the outside of the building, on a north facing wall. This is wired to the internal controls of the boiler and information about the outside temperature is sent to the boiler controller constantly. When the outside temperature changes the boiler responds to either increase or decrease the central heating water flow temperature to compensate.
- Modulating flow temperatures in this way means building inhabitants do not experience a change in temperature. The boiler output is sized to meet the coldest

¹ <http://www.deutschland-machts-effizient.de/KAENEF/Redaktion/DE/Standardartikel/Dossier/B-hydraulischer-abgleich-2.html>

² https://ec.europa.eu/energy/sites/ener/files/documents/DE%202016%20Energy%20Efficiency%20Annual%20Report_en.pdf (see page 4).

conditions, and therefore the boiler can reduce energy consumption for the majority of the year, increasing system efficiency and reducing wear and tear on the boiler. This results in lower fuel bills and also fewer breakdowns which is also of benefit to fuel poor customers.

- Weather compensation is one example of advanced system controls that can provide energy efficiency benefits. Viessmann has commissioned Salford University to undertake research to assess in real life the performance of boilers with weather compensation; the research concluded that weather compensation can deliver immediate energy savings in excess of 7% and enhanced room temperature consistency by preventing overheating. This equates to savings of approximately £65 per annum. The average cost to the end user of an outside temperature sensor for weather compensation, when installed alongside a boiler, is just £33³. Meaning payback under this scenario is achieved in just one year and savings continue for the system lifetime. In a retrofit scenario costs would be around £100 for weather compensation and an additional £100 if installed alongside hydraulic balancing. Meaning costs are still very modest compared to the savings achieved, with a short payback period of just over three years. Potential future smart development could see delivery of hardware-free weather compensation which would come as part of a package included in a smart control upgrade requiring no additional installation cost beyond the smart control.
- Viessmann consider these improvements as part of a pathway approach to achieve improvements in efficiencies in heating systems delivering long-term benefits. Recognition of weather compensation in policy interventions such as ECO not only supports the aims of the scheme but also sends a signal regarding the importance of boiler efficiency improvements such as this.

5.

How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Building regulations are a primary opportunity to improve the standard of energy efficiency in the UK's building stock. However, Building Regulations do not yet go far enough to improve the energy efficiency of new buildings. Updates to Building Regulations could ensure that low flow temperature heating systems and system plus measures are installed in all new builds. This would ensure the UK is not left with a further legacy of buildings which require costly retrofit to improve their energy efficiency. In addition, installation of low-carbon heating in the future would be easier because the heating system would already be enabled for this. Where new build can be improved through regulation, subsidy can then be directed towards existing buildings that require retrofit heating systems through schemes such as the Renewable Heat Incentive (RHI). Overtime such schemes should enable cost-reduction to deliver a self-sustaining market for renewables and low-carbon technologies. The pathway to zero carbon should be reinstated.

³ See policy paper 2 'Developing tailored support for "boiler plus" solutions' for more details

6.	<p>What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?</p>
<p>The power, heat and transport sectors are becoming ever more interrelated; electricity is increasingly destined to heat building as well as power them (such as heat pumps or combined heat power systems in place of fossil fuel boilers) and energy from buildings is used to power a growing number of electric vehicles. Ensuring collaboration and avoiding inconsistencies across these sectors will be important to the supply of infrastructure; In particular, where inconsistencies may discourage investment or job growth. For example, installers can become deterred by high training costs or lack of information on new technologies, causing fewer to enter new sectors instead opting to stick to the status quo. This limits the number of installers delivering low carbon or renewable measures. Similarly, consumers can also be deterred, for example if not enough information is available on a new technology or if there is too much information on several technologies. This can limit their interest in installing low carbon measures. Ensuring installers are equipped with the right information to share with consumers can help to overcome this.</p>	
7.	<p>What changes in funding policy could improve the efficiency with which infrastructure services are delivered?</p> <p><i>Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.</i></p>
<p>With regards to funding policy it is important to carry out thorough market research into which methods will motivate consumers to make changes whilst at the same time ensuring robust methods for managing budget. This will help minimise scenarios where a scheme is under-utilised because it doesn’t provide enough incentive or where a scheme is closed rapidly because it is over-subscribed (typically called ‘boom or bust’).</p>	
12.	<p>What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?</p> <p><i>Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions</i></p>
<p>We would support more recognition of the longer-term wider benefits of improvements to energy in buildings. As outlined in answer to question 1, having buildings suitable for purpose for both domestic and commercial use can have wide-ranging benefits such as improved health of UK citizens from living in warmer homes and on the UK economy through more manageable fuel bills. These benefits should be recognised when carrying out cost-benefit analyses.</p>	
<p>Energy</p>	

19.	<p>What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?</p>
<p>Decarbonising heat is strategic priority for government. One of the most important points in achieving required levels of decarbonisation is to ensure industry and investors are given clear signals on policy direction. Under previous governments schemes have been developed setting a direction and industry has been quick to develop approaches and supply chain for delivery. However, frequent changes such as to the Renewable Heat Incentive (RHI) or scrapping of schemes such as the zero carbon homes regulations mean industry and investors quickly lose confidence. Without a steady and growing supply chain in the low-carbon, renewables and energy efficiency sectors longer-term targets will be harder to achieve.</p> <p>A long-term direction should be set that considers a mix of technologies appropriate to the various types of buildings and their uses in the UK. This includes renewables and low-carbon technologies such as biomass, CHP, gas heat pumps and fuel cells and energy efficiency measures such as boiler controls, weather compensation, system balancing. Government should provide subsidy for strategically important technologies to support commercialisation and to bring technology costs down to achieve self-sustaining markets. At the same time technologies that are already cost-effective such as boiler controls and system balancing can be implemented through a gradual tightening of regulations.</p> <p>It is also worth noting that the majority of the installation network is familiar with gas boilers and very little else. To effectively implement de-carbonisation, installers need to be part of the solution, as they provide the initial options to consumers and without their support the adoption of low carbon solutions will not be realised. Therefore, the construction of separate regulation and certification requirements for installers to bring their skills up to date, should be carefully planned and costs to the installer minimised.</p>	
20.	<p>What does the most effective zero carbon power sector look like in 2050? How would this be achieved?</p> <p><i>Note: the “zero carbon power sector” includes the generation, transmission and distribution processes</i></p>
<p>The Committee on Climate Change (CCC) provide a pathway to low-carbon heat in the UK in their 2016 document ‘The future of heating in UK buildings’. We are broadly supportive of the proposed illustration of how UK heating could look in 2050. This includes; ‘in rural areas buildings not connected to the gas network could switch to biomass or heat pumps’ and ‘buildings connected to the gas network could switch to ... heat pumps, while some others could continue to use gas/biomethane. Low carbon heat networks could be built and extended’.</p> <p>In order to achieve this, as outlined in answer to question 19, there needs to be a clear and consistent policy pathway which provides confidence to industry and investors regarding the outlook for the zero carbon power sector. Subsidy will be required to ensure commercialisation of some technologies whilst the use of other technologies which are already cost-effective can be increased through gradually tightening of regulation.</p> <p>However, regarding the CCC recommendations for hydrogen, power-to-gas is a more realistic and proven route to decarbonisation, whereas hydrogen, as CCC point out, requires further feasibility and public acceptability to be proven. Power-to-gas can also</p>	

rely on renewable sources, does not need carbon capture and storage, or the mass storage of hydrogen, or the wholesale conversion of the gas infrastructure or the replacement of existing gas appliances.

To create synthetic methane gas (CH₄) for injecting into the grid, power-to-gas uses excess wind and solar electricity to split water into hydrogen and oxygen by means of electrolysis. The hydrogen is then mixed with carbon dioxide from a biogas system and converted, using a microbiological process, into methane gas. The methane may then be fed into the natural gas grid or stored. In addition, there is also a process for upgrading technology for raw biogas supplied by biogas and sewage plants. As a scalable technology, power-to-gas can provide almost unrivalled energy storage capacity - an advantage over hydrogen, which is voluminous and expensive, and over electricity, which suffers standing losses.

The synthetic methane can be used for gas heating as a low carbon heating solution, or used to generate electricity through combined heat and power (CHP) units. As a fuel, it can be stored and transported with minimal impact.

An example of where this technology has been proven is at Viessmann's head office at Allendorf in Germany, where the methane produced by power-to-gas is being fed back into Germany's natural gas grid. This is a major part of a combination of measures, known at Allendorf as Efficiency Plus, which has reduced the consumption of oil and gas by 60 percent and cut CO₂ emissions by a massive 80 percent.

The biological methanation process at Allendorf runs under a moderate amount of pressure and at relatively low temperatures. It directly processes the carbon dioxide contained in the raw biogas, meaning the CO₂ doesn't need to be present in high concentration or purified form. This is significant because it opens up new procurement paths. Smaller sewage treatment and biogas plants, in which no biogas purification is performed, can now also be considered as CO₂ sources. This is an additional benefit as it increases our capacity to capture CO that would be produced by natural plant decomposition and use it constructively.

As outlined power to gas is already proven and has potential in the UK. Minimal incentives and support can bring forward more projects in the UK and support with delivery of a cost-effective route to decarbonisation.

21.

What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

As outlined in answer to question 20 we consider power-to-gas an important strategic technology in the heat and power sector. The benefits of power-to-gas are relevant to the growth in use of low carbon vehicles as the power, heat and transport sectors are becoming ever more interrelated; electricity is increasingly destined to heat building as well as power them (such as heat pumps or combined heat power systems in place of fossil fuel boilers) and energy from buildings is used to power a growing number of electric vehicles.

Dealing with a whole systems approach instead of dealing with sectors in silos will prove more effective in meeting renewables targets in the long-term.



Virgin Trains East Coast: submission to the NIC's National Infrastructure Assessment (NIA) consultation.

February 2017.

1. About Virgin Trains East Coast

- 1.1 Stagecoach and Virgin are working in partnership to operate the East Coast inter-city route under the Virgin Trains brand.
- 1.2 We launched the new East Coast franchise in March 2015 and are investing £140 million aimed at improving the passenger experience which has already seen the refurbishment of our entire existing fleet.
- 1.3 May 2016 saw the launch of 42 additional services (22,000 extra seats) per week between Edinburgh and London.
- 1.4 We will shortly see the launch of 65 new Virgin Azuma trains providing 12,000 extra seats for a new and expanded timetable, increasing capacity into King's Cross by 28% during peak time and enabling Edinburgh-London journey times to be cut to around 4 hours.
- 1.5 We have been running the West Coast franchise for 20 years in which time we have more than doubled passenger numbers, cut journey times, expanded our timetable and grown our passenger satisfaction scores.

We currently run 157 weekday services on the ECML and 111 Saturday/Sunday services with a grand total of 1,009 trains per week.

This will increase further from 2018 with the launch of our 65 new Azuma trains and expanded timetable increasing services to existing destinations as well as bringing direct services to other towns and cities for the first time.

21.1 million journeys were made on Virgin Trains services on the ECML in 2016.

2. Executive Summary

- 2.1 Britain's railway network is vital for economic growth, to create jobs, support UK businesses and to enable housing development.
- 2.2 Passenger numbers on the UK's rail network have doubled over the last 20 years.
- 2.3 The East Coast Main Line (ECML) is a vital rail artery which already generates more than £300 billion to UK plc. The long-distance high speed services generate significant premiums for the Government, accounting for approximately one third of farebox income.
- 2.4 The ECML connects local and regional economies with each other, the national economy and to Europe on routes totalling over 936 miles from northern Scotland all the way down to London.
- 2.5 Our ECML services support local and regional economies across the 'Northern Powerhouse' in Yorkshire, Nottinghamshire, Lincolnshire, Durham and Northumberland. The ECML is a vital tool therefore in supporting the Government's Industrial Strategy.



- 2.6 The ECML however has not seen the level of investment seen on the West Coast Main Line (WCML) meaning that key infrastructure assets on the ECML, such as signalling and wiring is over 30 years old and reaching the end of its design life.
- 2.7 This is having a negative impact on services, hitting punctuality and thereby undermining UK productivity and economic growth.
- 2.8 Stretching from Inverness down to London via the north east, Yorkshire and the east midlands, the ECML has a key role to play in helping rebalance the UK economy.
- 2.9 An investment of between £2 billion - £4 billion over a 10 year period as recommended by Network Rail would help would unlock the ECML's currently restrained potential and bring significant economic benefits both locally and for the national economy.

Independent research compiled in 2016 for the East Coast Main Line Authorities (ECMA) – which represents the local and combined authorities along the ECML route - shows that an investment of £3 billion starting from 2019 will generate £9 billion of benefits for the UK economy.

This investment in the ECML would maximise the benefits of HS2, with an extra £5 billion being unlocked for the UK economy initially, then rising to £9 billion when combined with the benefits of the eastern leg of HS2.

3. The current challenge

- 3.1 The ECML is currently restrained by infrastructure assets which, having being installed during the modernisation of the line in the 1980s, are naturally reaching the end of their design life.
- 3.2 These include signals, cabling, power supply equipment and overhead wiring.
- 3.3 The biggest issue from a performance point of view is overhead wiring.
- 3.4 Passenger numbers on the ECML have more than doubled since the 1980s modernisation programme.
- 3.5 This means the strain on this infrastructure is having an increasingly noticeable impact on passenger journeys.
- 3.6 Disruption caused by faulty infrastructure hits not only passengers' onboard experience but hits the UK economy and of course the revenue returned to the DfT.
- 3.7 In congested areas on the route, there's a significant need for additional tracks, grade separated junctions, removal of level crossings, and lengthening of platforms in strategic locations.
- 3.8 While HS2 will be useful in providing lots of extra long distance capacity, HS2 will not alleviate the many bottlenecks and weaknesses in the current infrastructure.

Over the summer of 2016 services on the ECML suffered from significant delays due to faulty overhead wires at Ranskill, near Retford in Nottinghamshire.

As a result of the Ranskill dewirement, over the period from 6th September to 11th September, we handled over 24,000 Delay Repay claims from delayed passengers which equated to around £1.5 million.

4. Boosting economic growth both locally and nationally



- 4.1 The ECML already links communities and economies across many different counties and regions, linking smaller towns to nearby cities as well as providing a long distance inter-city connection.
- 4.2 From 2018, our planned expanded timetable for our 65 new Azuma trains will not only increase the services to existing destinations such as Leeds, York and Bradford, but also bring direct services for the first time to Huddersfield and Middlesbrough.
- 4.3 This will bring more services, more seats and reduced journey times, on both existing routes but also connecting certain economies directly with each other for the very first time.
- 4.4 This will support the Government's ambition to drive economic growth in every region of the country and boost UK productivity through better connectivity.
- 4.5 However, investment and improvements are needed now to ensure the benefits of these services are delivered and built upon in the coming years as passenger numbers increase further. If we cannot make the basic infrastructure more resilient then upgrades will not be able to deliver the full benefits expected.

For its size Middlesbrough currently has the poorest rail service to London of any city in the country apart from Bradford. However, Virgin Trains will be introducing direct Middlesbrough-London services from 2021.

Independent research by the local authority has found that the introduction of a direct Middlesbrough to London service every 2 hours could generate upwards of £5.8million per annum in additional GDP.

5. Unlocking the ECML's potential through investment

- 5.1 With the introduction of our 65 new Azuma trains from 2018 and the increase in the number of electric trains on the ECML (increase in Govia Thameslink traffic and replacement of Hull Trains' and TransPennine Express's diesel trains with electric/bi-mode trains) the overhead line infrastructure on the ECML needs to be more resilient.
- 5.2 Resilience is the most important issue to be addressed to improve punctuality and performance and unlock the true potential of the ECML.
- 5.3 Replicating the investment seen on the WCML would help bring about this improvement.
- 5.4 The 2008 upgrade of the WCML at a cost of £8 billion removed bottlenecks and increased line speeds through four-tracking and extensive re-modelling along with renewal of existing assets such as the power supply.
- 5.5 This enabled Virgin Trains to deliver a new high frequency timetable, increasing capacity and line-speed which enabled us to increase services to places including Manchester, Birmingham, and Chester and up to Scotland along with new services to places such as Wilmslow.

An investment of between £2 billion - £4 billion is required on the ECML.

To replicate the benefits seen on the WCML as a result of the 2008 upgrade, Network Rail estimates that an investment of between £2 billion - £4 billion is required over a 10-15 year period from 2019.



5.6 As part of this investment, the following schemes should be delivered which would significantly improve performance, reliability and cut journey times:

- Full closure of all level crossings on the ECML.
- Full portalisation of the overhead line equipment, and renewal of life-expired overhead line components.
- Palisade fencing along the full ECML (replacing post and wire fencing) to eliminate the many instances of trespass and animal incursion onto the high speed railway
- Grade separation at Newark flat crossing to cut ECML journey times and provide capacity to increase east-west service frequencies.
- Increase in linespeeds from 125mph to 130mph-140mph in targeted locations, to enable Newcastle-London journey times to be cut to under 2h30 and Leeds-London to under 2h00 (taking advantage of our new Azuma trains which have both ERTMS Level 2 and 140mph capability).
- Other grade separation such as from the West Riding to the ECML north of Doncaster on the Up line (towards London).
- Increasing linespeeds between Doncaster and Leeds to cut journey times.
- Through routing of trains through Darlington enabling them to make a quicker approach
- **Digital Railway** – VTEC are very supportive of the need to develop a digital railway infrastructure and believe it is vital to solve the issue of capacity and remove restrictive signalling logic.
- This requires the delivery of the Digital Railway systems, especially ERTMS (European Rail Traffic Management System) Traffic Management and C-Das with Full ERTMS Level 2 throughout ECML.
- This will allow VTEC to enhance its train services through: timetable planning to the second rather than to the minute; more effective management of the mixed traffic on the ECML; and making on-the-day, real-time changes to our train plan that are effective and are communicated to our customer systems, improving reliability and recovery from delays. (This is affected however by the delay in delivering ERTMS in control period 5 - as originally planned – having now been deferred to control period 6).

6. The role of the National Infrastructure Commission

- 6.1 Virgin Trains welcomes the opportunity to submit to the NIC's first consultation.
- 6.2 We acknowledge the value in the NIC providing impartial, expert advice on major long-term infrastructure challenges.
- 6.3 Investment in the ECML will not only benefit existing passengers in the short-term but it will also drive long term growth and productivity in the regions it serves.
- 6.4 With rail passenger numbers set to grow across the whole rail network, it is important that one of the longest and busiest intercity routes in the UK is fit for purpose.
- 6.5 We believe that the NIC would be a powerful advocate for investment in the ECML.
- 6.6 The Department for Transport is currently evaluating the investment priorities for rail Control Period 6 and an influential voice, like the NIC's, will further strengthen the case for investing in the line.

National Infrastructure Commission call for evidence

- 1) **Water UK is pleased to respond to this call for evidence.** We are a membership organisation which represents a range of water service providers, including all major statutory water and wastewater companies in England, Scotland, Wales and Northern Ireland.
- 2) **We appreciate the call for evidence is by its very nature, cross cutting, and there are questions that are not relevant to the water industry.** We have therefore grouped our responses, with the relevant question number in brackets.
- 3) **The supply of water and waste water services are critical to our economic, social and environmental wellbeing. We have a good track record but lots still to do meet future needs on water and waste water, using demand and supply side measures** (1, 4, 22, 23)

Companies in England and Wales have invested more than £130 billion since privatisation in 1989, and have ensured safe, reliable drinking water supplies, efficient wastewater and water recycling services, and improvements in the environment.

However, the challenges to come are significant. Water UK's recent long term water resources report¹, which we have shared with the NIC, suggests there is a significant and growing risk of severe drought impacts arising from climate change, population growth and environmental drivers - pressures that will also be suffered by waste water services.

Challenges associated with existing drought risk (resilience) and reductions in available water to protect the environment are immediate and need to be addressed over the next 10 years. Beyond that, increasing populations and hotter temperatures will drive up demand for water. The hotter temperatures will increase evaporation during spring and summer and, although the impact of climate change on rainfall is uncertain, the possibility of more prolonged dry periods cannot be excluded.

Work has been continuing on long term water resources to understand better the gaps that still remain, including the extent to which companies are using adaptive planning methods in their draft Water Resource Management Plans. A brief paper covering this is attached as Appendix 1.

Water UK's Water resources long-term planning framework explored the extent to which demand management could form part of the sector's solution to the growing gap between supply and demand. Demand management has a fundamental role in providing a greater level of resilience, and to reduce the potential risk of investment that might be regretted at a later stage.

The report recognised the case for considering more extensive programmes of demand management, and, as you might expect, there is a range of views amongst companies,

¹https://dl.dropboxusercontent.com/u/299993612/Publications/Reports/Water%20resources/WaterUK%20WRL%20TPF%20Final%20Report_FINAL%20PUBLISHED.pdf

depending on size, structure and geographical location, about the most effective way of achieving reductions this way.

In some companies' view, programmes of measures need to strike a balance between a level of ambition that provides more significant savings than those realised at present, and a recognition of the risks associated with an over-reliance on projected savings that rely on wider factors.

Issues to note include the extent to which some of the more ambitious strategies identified in the report rely on significant behavioural change, as well as significant future innovation to reduce costs below their current levels to make the options economically feasible. For these to be realised, they would also rely on significant regulatory and policy support – for example, in mandating high levels of water efficiency in new build homes.

A variety of conditions exist within the sector, with a significant difference between the wetter north and west, and the drier south and east which, as an area classified as one of severe water stress by the Environment Agency, is one where compulsory metering is an option companies can consider. Companies' differing levels of headroom, coupled with differing growth projections mean that, while some companies can offset projected growth through demand management measures alone, this is not possible for others. In the Thames Water region, for example, demand management can offset up to half of the high levels of expected growth. In some cases, therefore, while demand management remains a central element of companies' response to the supply demand deficit, supply-side measures will be essential to bridge the gap.

Some of our smaller companies, feel that the market is able to deliver far more robust and cost-effective embedded demand-side measures, particularly with new build properties, the majority of which will be built in the water resource critical areas of the South and East of England. For example, Albion Water says it has clearly demonstrated that it is possible to create embedded demand-side measures into these new communities, using water for toilet flushing and external use, potentially reducing potable demand to 80 litres per head per day with no loss of service and no financial penalty to customers (usually a benefit). These structural solutions, Albion says, reduce peak demand on potable systems considerably, thus improving network asset utilisation, as well as addressing local drainage and sewerage challenges.

In terms of the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand (Q23): Water UK has led a sector wide initiative in this area, 21st Century Drainage, and had the opportunity to present the work to the Commissioners last year. We outline the work of the Programme in more detail later in this submission. We have worked very hard to ensure the programme covers all administrations, and we have support from the governments, economic and environmental regulators of all four nations of the UK.

4) A more holistic, joined up and outcomes-based approach is key to future success (3, 6, 9, 10, 11, 24)

The pressures we have already identified around population growth have led to another primary priority for successive governments – housing growth. Sufficient housing is imperative for a functioning society, but often, planning for new housing developments come first, and infrastructure is considered afterwards – it should be the other way around. There is a significant potential for community level infrastructure that both saves water and reduces flood risk - e.g., communal rainwater harvesting for garden use, permeable paving, green roofs for community buildings, front lawns and community green spaces – these should be the first and default options for proposed developments. However, while water companies are exploring their ability to play a much greater role in one aspect of this, namely, SuDS adoption, it remains a matter of regret that the more integrated approach of Schedule 3 of the FWMA 2010 was never implemented.

It is clear for both water resources and wastewater and water recycling services that we will need all the “tools in the box” – and many incremental improvements will, cumulatively, make a significant difference to the overall pressure on resources.

It has become increasingly clear to many companies that integrated catchment management, dealing holistically with the problems of too much and too little water, is a sensible method of planning for the future given the uncertainties of climate change and population growth. According to the consultancy, Indepen, an estimated 13 billion pounds per annum is spent on supporting the environment and agri-environment schemes:

Catchment spending by purpose



Annual spending on England's catchments (£m) - by purpose				
Purpose	Total England (£m)	Total Southern Water region (£m)	Total South West Water region (£m)	Total Wessex Water region (£m)
Pollution control and enhancing natural capital of land	7,883	827	533	496
Rural land management	2,444	361	292	167
Water company - sewage treatment	1,277	174	100	116
Pollution control	1,231	157	60	111
Green infrastructure	761	67	24	45
Conservation management	354	35	31	30
Catchment regulation	302	30	18	25
Green growth	84	4	8	3
Flooding, drainage and raw water for supply	5,699	453	113	287
Water company - drinking water collection and initial treat	1,389	59	63	46
Flood damage	1,280	112	39	74
Water company - sewers and drains	1,196	134	55	66
Drainage and irrigation	931	78	25	53
Inland flooding- capital	412	31	24	17
Inland flooding- operations	230	24	12	17
Research	165	14	5	10
Inland waterways	97	-	-	3
Grand Total	13,353	1,280	755	783

The money is often used in a piecemeal and disjointed way, with catchment schemes sometimes working against each other. A key blocker has often been the regulatory system itself, which can discourage collaborative working - for example, the pooling of resources to achieve outcomes that are desirable to all parties in a catchment, thus making

the most effective use of finite resources. Often, catchment operators have had to find ways of working around the regulations, rather than being empowered by a regulatory structure which supports and encourages collaboration.

The policy work presently being undertaken by government to provide an alternative to CAP could present an ideal opportunity both link water and agricultural policy and to support more catchment based collaboration. Without this, such solutions are always difficult as they may well breach the “polluter pays” principle. A new, effective regime will require all parties to agree a different style of outcomes and investment approaches; one whose compliance assessment is flexible, and where existing controls of diffuse pollution are developed further developed so as to be effective and then enforceable.

5) For both water supply and drainage, the key now is how the available evidence is used in the forthcoming regulatory processes (22, 23,24)

Within a regulated industry such as the water sector, delivery of long term outcomes for customers and society are heavily influenced, and in many cases determined, by regulatory processes.

In England and Wales, companies will be incorporating and building on the evidence from the long term water resource report in their next 25-year Water Resource Management Plans. These plans will also form a key foundation of companies’ business plans for the next periodic review by Ofwat of price and service levels in England and Wales, PR19 – business plans which will also incorporate the latest available evidence from the 21st Century Drainage programme.

Through different mechanisms – for example for England and Wales via the Strategic Policy Statements due to be consulted on shortly by the UK and Welsh Governments respectively – the UK and devolved governments have the opportunity to provide a strategic steer on the short, medium and longer term priorities for the sector.

6) For drainage, the key is better capacity assessment and simplified accountabilities (22,23,24)

Wastewater planning has some catching up to do to achieve the sophisticated approach companies employ in water resource planning (hence the 21st Century Drainage Programme), and this may take more than one AMP to achieve, but the water industry is both ambitious and confident that the work being done through the 21st Century Drainage Programme will lay solid foundations upon which to build in future years.

The water industry has an excellent record of achievement so far, which we detail in the 21st Century Drainage Communications document:

<https://dl.dropboxusercontent.com/u/299993612/Publications/21st%20Century%20Drainage/21st%20Century%20Drainage>.

If those responsible for urban drainage systems are expected to take further control they should be given powers to control the entry of surface water, plastics etc., into the system. To do that the ownership and accountability / responsibilities for urban drainage need to be reviewed to simplify the landscape and ensure there is a single controlling mind to

investigate, understand and then direct solutions. As so many parties are currently involved in the drainage landscape, it has sometimes been difficult for companies to ask customers meaningful questions about flood resilience and water companies' role in this.

7) We have identified that water supply measures are affordable but have more to do on waste water (5, 8, 23)

While we recognise that consumers will face a range of potential pressures due to investment in essential infrastructure, the investment needed to increase resilience of water supplies is relatively modest compared to the cost of drought.

In most areas the additional costs of becoming resilient to 'severe' drought events are less than £4 per household customer per year, if the right measures are taken early enough. Bill impacts would not be immediate: they will take effect gradually as investment in demand reduction and supply options are delivered. The 'central estimate' of the benefit, that is, of the value customers place on avoiding severe restrictions, is ten times more than this cost, and is still four times greater than the cost even if low case estimates of the benefits are assumed.

As already mentioned, Water UK has led a sector wide initiative in this area, 21st Century Drainage

The Programme has commenced with two prioritised main projects:

- Firstly, a strategic urban drainage planning tool, not dissimilar to that used for determining the long term water resource needs of water companies. A key project underway within the scope of the Programme is that of drainage capacity management. The project aims to better understand the linkage between current and future pressures on available hydraulic capacity and in turn on outcomes, to facilitate the development of optimal long term interventions by:
 - Reviewing and developing high level methods for the assessment of the available capacity of sewerage systems;
 - Assessing the uncertainties around future pressures;
 - Developing an associated framework that utilises the above information to facilitate long term (25 years +) and contextualise the associated interventions, and
 - Developing effective visualisation techniques to inform relevant stakeholders.
- Secondly, we are developing new design guidance for storm overflows which prioritises investment at an affordable pace.

We are also commencing a piece of work to define and agree a set of wastewater resilience metrics to ensure that we, as a sector, can track progress effectively.

These projects will provide the basis for water companies to cost the AMP7 (2020 to 2015) investment requirements for their drainage assets within the context of the longer term resilience needs of catchments. The first two projects are jointly led with the Environment Agency and promise real benefits to the sector's customers as well as to the

environment. The first conclusions should be ready for both projects in early spring; we will of course share any findings with the NIC as soon as possible.

Further projects have been outlined for delivery over the next two to three years in what will inevitably be an iterative process. The important principle has been to prioritise this Programme to ensure that we deliver the long term planning tools first. Subsequent projects will focus on, for example; innovative solutions, identification of impediments to change, enablers, how best to nudge customer and business behaviour, and evidence gathering to support the need for policy change..

We are in a better place now that organisations with responsibilities across the drainage landscape have joined together to work collaboratively on this 21st Century Drainage Programme. We look forward to embedding long term planning within the sector and enhancing the resilience of the UK's drainage infrastructure such that we are able to effectively manage the challenges of climate change and population growth for people and the natural environment.

A factor that could have an impact on the affordability of both water and wastewater services is the future availability of finance from the European Investment Bank.

The European Investment Bank (EIB) is currently the largest single lender to the UK water industry, with EIB debt being around 13% of gross outstanding debt at March 2016, and over £6.5 billion borrowed by the ten water and sewerage companies in England and Wales over the period 2005-2016.

Companies currently borrow from the EIB for several reasons, including the flexibility of being able to readily borrow in a variety of formats (fixed rate, floating rate or index-linked) and to vary the timing of drawdown of loans for minimal costs, and the ability to raise substantial amounts of index-linked debt.

The primary benefit of EIB lending to water companies, and their customers, however, is the lower rates that lending is provided at compared to other sources of debt financing.

At this point, it is unclear whether the EIB will be able to maintain its role as a provider of finance the UK water industry following the UK's withdrawal from the EU; if it does not, then other things being equal, costs to customers will be higher.

8) We have made progress on resilience but have plenty still to do (23, 24)

The industry is actively involved in several areas which are providing more detail to our understanding of resilience:

Water UK led the formation of Water and Wastewater Resilience Action Group. Its objectives are:

- o To define qualitative standards for resilience across England and Wales.
- o To share best practice where appropriate.
- o To engage widely with relevant stakeholders.

Water UK NIC call for evidence submission

- o To identify and provide support for individual proposals for research especially where such support will act as a catalyst in encouraging further funding from other sources.
- o To actively seek ideas for research in areas of members' needs but which do not have sufficient funding available from elsewhere.

The group has already started work on defining some metrics for resilience, in preparation for the 2019 Price Review. The work on wastewater is being led by the 21st Century Drainage Programme.

We have also worked closely with Defra on the National Flood Resilience Review, assessing the resilience of critical infrastructure to flood events. Companies have undertaken lengthy reviews, investing where necessary.

We would be happy to expand on any of the topics covered in this response in greater detail.

APPENDIX 1: APPLICATION OF ADAPTIVE PLANNING THROUGH THE STATUTORY WATER RESOURCES MANAGEMENT PLANNING PROCESS

Introduction:

In response to increasing levels of future uncertainty, the water industry has modified the way in which it plans future resilience and investment to mitigate risks to supply during drought events. As part of the preparation for the 2019 round of statutory Water Resources Management Plans (WRMPs), UK Water Industry Research (UKWIR) commissioned two sets of guidance that are intended to support better planning in the face of uncertainty, namely; ‘WRMP 2019 Methods – Decision Making Process Guidance’ and ‘WRMP2019 Methods - Risk Based Planning’. These are referred to by the Environment Agency WRMP19 Water Resources Planning Guidance (WRPG), so the principles of resilience testing, links to operational drought measures and flexible methods for planning future investments in the face of uncertainty now form a core part of the WRMP19 process.

Because of the potential need for large scale inter-regional solutions to water resources needs in the future, the Water UK ‘Long Term Water Resources Framework’ identified a need for ‘adaptive planning’ across the water industry, possibly with a requirement for a national level adaptive plan to complement the WRMP19 process. However, following the release of that study, and as a result of the new focus of the WRMP19 WRPG, it is now apparent that those companies and regional organisations that are facing significant future risks to water resources resilience have started to adopt ‘adaptive planning’ type methods themselves as part of the WRMP evaluation process. This has two key advantages over a national level approach:

1. The analyses are carried out to a greater level of detail than could be achieved by a national level plan using methods that are targeted specifically to each region and water company.
2. Water companies are able to liaise with their own customers to understand what level of risk they are willing to face and how they would prefer the water company to adapt to future uncertainties.

Based on this, Water UK therefore considers that the WRMP process remains the best way to adapt to future risks and uncertainties. Evidence relating to the nature of the adaptive planning that is being undertaken, and the best approaches to dealing with any remaining gaps in the planning process, are provided below.

The Industry Approach to Adaptive Planning.

The fact that WRMPs are updated every 5 years means that the WRMP process was already, to a certain extent, an inherently ‘adaptive’ planning process before the new methods were introduced. However, previous WRMPs generally relied on a Net Present Value (NPV) type economic optimisation approach that used a single estimate of the future supply/demand balance to determine investment. This meant there was a risk that investment in water resources would not represent ‘best value’ in the face of future uncertainties. Water companies also tended to plan for a single level of drought risk (a ‘drought design scenario’), which was represented by the data available in the historic record.

Under the new WRMP19 guidance, water companies are now adopting a mix of methods for decision making and the management of risk, which are geared towards the particular nature of the pressures and uncertainties that each company faces. The UKWIR guidance notes

incorporate a specific ‘problem characterisation’ process that allows water companies to review the risks and uncertainties in their own water resources plans and adopt an approach that is suitable to their own situation. In some cases the exact approach is still being developed by some water companies, but a general summary of the methods that have been selected for use in WRMP19 is provided in Table 1.

Table 1: Summary of ‘Extended’ Planning Methods Being Adopted for WRMP19.

Type of Approach	Description	Reason for Adoption	Number of Companies adopting
System-simulation	Methods that use a simulation model of the water resources system to examine how different investment options perform across a defined range of drought severities and futures (particularly climate change futures) to determine which approach represents ‘best value’ in the face of uncertainty	In most cases these methods are being adopted because the <i>resilience</i> of potential future investments varies depending on how climate change and demand develop over time. Companies may also need to evaluate supply risks to customers using a number of different, water storage related, metrics.	>10 (includes WRSE and WRE regional modelling efforts, plus at least 3 companies outside of those regions) ²
Aggregated ‘real options’	Methods that use simpler representations of future supply and demand in economic models, but concentrate on identifying the ‘least regrets’ approach to near term investment in the face of very large future uncertainties. The ‘tactical’ timing of investment is particularly highlighted under this approach.	Companies adopting these methods generally face the largest range of uncertainty in the future supply/demand balance, in particular as a result of uncertainties over the amount of license that is at risk because of the need to protect the aquatic environment. The water resources benefits of investments that are being considered are generally less uncertain, but there is a large risk of inefficient investment if the wrong shorter term plan is adopted.	1-2
Hybrid methods incorporating ‘true’ adaptive planning	WRMPs that incorporate both of the above types of modelling, and represent future investment strategies as adaptive plans that include monitoring and trigger points to allow the plan to be adapted as the identified future uncertainties are resolved.	Companies that are adopting this approach tend to face large near term investment needs and very large future uncertainties, including technical uncertainties over the benefits of new schemes as a result of future hydrology and drought patterns under climate change.	2

² WRSE – ‘Water Resources in the South East’; WRE – ‘Water Resources in the East’

Both the WRSE and WRE initiatives include regional level system-simulation models that are being used to investigate the ‘best value’ investment approach across a number of water companies for a range of futures and drought severities. There are some differences in approach (for example, WRE is multi-sectoral) and the decision making methods do differ between the two initiatives, but the basic principles are very similar. The water companies that lie within those two regions are either using the data and findings from those studies to carry out their own, more detailed, ‘best value’ analyses for the WRMP19 investment plans, or are carrying out complimentary studies using their own system simulation or ‘real options’ type approaches.

Possible Gaps in the New WRMP Process.

In the ‘Long Term Water Resources Planning Framework’ document, Water UK identified that there is a risk that regional scale investments (e.g. large inter-regional transfers) could be difficult to identify and promote unless national level co-ordination is adopted. However, the water industry has actively taken this on board through a combination of bilateral negotiations and discussions between the regional groups and those companies that could potentially provide raw water transfers to those regions. In addition, the WRPG requires that all companies assess the capability of their resources and drought intervention measures across a range of drought severities, so water companies are now better able to compare like with like when they are planning for transfers. It therefore appears that this risk is now being addressed through the statutory WRMP process.

The ‘Long Term Water Resources Planning Framework’ document did identify one further adaptive planning type risk that is unlikely to be captured by the new WRMP process. Under some futures resources can start to become so constrained that demand management measures need to be introduced across those areas that are not currently water stressed in order to allow sufficient transfers to the most water stressed regions. Because such measures would require national level policy intervention, it is difficult to see how this would be captured within the WRMPs or regional studies without some form of national level monitoring and review. This is important, because *the levels of demand management that were contained within the WRLTPF included an assumption that such measures would be used if necessary*. If this strategy is not available then excessively costly resource development or demand side measures may be required under the more adverse futures. Similarly, if the large scale transfers described within the WRLTPF are found not to be viable through the WRMP process, then this will need to be flagged to policy makers as a potential risk to future supplies.

Water UK therefore considers that there is still a need to monitor how drought resilience, climate change and demand are changing at a national level to determine if such a policy risk is materialising. However, because such risks will take some time to materialise, and because all of the relevant data are contained within the WRMPs, it would appear that the most efficient way to do this would be through a high level review that is carried out after each set of final WRMPs is published. Any need for adaptation beyond the current statutory regime could therefore be reviewed once every 5 years following the WRMP process.

A Water Efficiency Strategy for the UK – Consultation



November 2016

Waterwise 180 Piccadilly, London, W1J 9HF

Foreword

Recent evidence shows that we will see increased demand for water from all sectors, and reduced supply because of changes in weather patterns leading to natural water shortages and also because the legislative response to these shortages will restrict water abstraction and potentially, water use. At the same time, we will see greater stress on the water supply networks from extreme weather events and increased demand.

So how will the UK water sector be resilient in the face of these challenges?

This was the question addressed by the recent Water UK report Water Resources Long Term Planning Framework (2015-2065). One of the key conclusions from this work was the need for a greater focus on demand management and water efficiency. This strategy responds to the Water UK report and looks at how water efficiency can be delivered and considers the policy and regulatory changes needed to achieve the extended and enhanced water efficiency scenarios in the Water UK report.

The Water UK report, the upcoming Periodic Review of water company plans, the opening of the water sector to greater competition, the UK exit from the European Union and the increasingly obvious effects of climate change make this a good time to take stock and develop a strategic approach.

A broad range of issues are discussed in the strategy, including:

- Water and energy efficiency in homes – new rebate schemes and enhanced product labelling, large scale retrofit programmes to deliver lower water consumption, reduce household bills and cut emissions
- Water, people and communities– large scale behaviour change and communications programmes to establish a water saving culture
- Water and urban developments – incentives for developers and joined up blue and green infrastructure, that gives greener homes without increased costs and provides healthy resilient spaces and places for people and nature
- Water and the circular economy – tools for water and wastewater reuse, to extract the maximum value out of our use of water
- Water technology, innovation and jobs – citizen science projects, better links between academia and the water sector, an incubator for water efficient products, leading to jobs and economic growth

This strategy outlines the changes to policy and practice that would enable water efficiency to deliver these things. It is a UK Strategy but recognises the differences between the countries that make up the UK. This version of the strategy is the consultation phase and we welcome input from everyone in shaping the final strategy document.

[Name redacted]
[Job title redacted]

Table of Contents

Introduction	1
Why do we need to become more water efficient in the UK?.....	2
Water energy nexus.....	3
How far are we from best practice?.....	4
What is water efficiency and what is our vision?	6
Water, people and communities – changing behaviours .	7
A water efficiency framework for competition.....	10
Non-domestic retail competition	10
Domestic retail competition	11
A framework for water efficiency in retail competition.....	11
Water Sensitive Cities – improving water efficiency in our urban environment.....	13
Social Housing.....	13
Water Efficiency in New Developments.....	13
Retrofits	15
Products and labelling.....	17
Strengthening adoption of the Water Label	18
Water Calculator	18
Rainwater harvesting and greywater reuse	19
Product Innovation	19
Water company delivery and regulation	21
Tariffs.....	21
Improving delivery of large scale domestic retrofit programmes	21
Integrated water management and resilient infrastructure	23

Integrated Water Management.....	23
'Smarter' water infrastructure.....	25
Conclusion and next steps	27
Summary of consultation questions	28
Appendix A – Water efficiency strategies and plans across the UK.....	30

Introduction

The UK faces a number of water challenges. Climate change will lead to increasingly erratic weather patterns, this means less certainty over river flows and rainfall, leading to more floods and droughts. This also casts doubt on the assumptions around the reliability of traditional water sources like groundwater abstraction or reservoirs. Climate change will also mean that the UK will be required to produce more food, as other parts of the world become less suitable for agriculture, and this will require more water use in the UK for irrigation. At the same time, increased population will mean that there will be a greater demand for public water supply.

The extremes of weather and the changes in demand will put an increasing strain on water infrastructure. The links between water and energy will also become more critical, because water is required for power generation and fuel production and at the same time energy is also used to pump, treat and heat water. There will also be issues relating to the interrelationship between water supply and the natural environment. Summer river flows will be significantly lower in the coming decades, and there will be competition for water between public water supply abstraction, power station cooling and agricultural irrigation. Furthermore, lower river levels will cause issues for effluent dilution.

Water efficiency can play a significant role in addressing the challenges faced by the water sector and beyond. Water efficiency is one of the few tools that can address both climate change mitigation and climate change adaptation, it can help the UK meet its climate targets and make the country more

resilient to droughts and floods. It can reduce pressure on infrastructure and it can offset the need for new infrastructure. It can help reduce water and energy bills for households and businesses. It can create skilled jobs and it can offer export opportunities for British innovation. It is at the interface of engineering, social science and ICT and is a modern high-skills sector that could create jobs.

Waterwise is an independent, not for profit organisation with the vision that water will be used wisely, everywhere, every day. We are supported by water companies, product manufacturers, consultancies and others working in managing demand for water. We have developed this consultation with our supporters and input from government and regulators.

Recommendations are provided in **bold, italics and underlined** throughout the document.

Please complete the consultation response form at this [link](#) or email responses **by 31 January 2017** (info@waterwise.org.uk).

Waterwise will be meeting directly with stakeholders over this consultation period also. The final strategy will be launched in Spring 2017 and will include an action plan based on the recommendations in this consultation.



Why do we need to become more water efficient in the UK?

In September 2016 Water UK released their Water Resources Long Term Planning Framework (2015-2065) report ([Water UK, 2016](#)). New modelling techniques and a 50 year planning horizon help to consider the impacts of climate change, population growth, environmental protection measures and trends in water use on water availability. This identified that we are facing longer, more frequent droughts and more acute droughts in future than previously thought. The difference between supply and demand could be significant by the 2040s.

Based on the latest long term national water resources planning research by Water UK – without significant innovation and increased water efficiency we will need expensive large water transfer schemes and new supply options to be built. The report outlines extended water efficiency practices (smart metering, tariffs, retrofitting 65% of properties, new home standards 105 litres per head per day and reduced leakage through active leakage control and pressure management) as well as enhanced water efficiency (all new homes achieve 105 litres per head plus extensive retrofitting, large-scale mains replacement for leakage). The report also highlights significant policy and regulatory support to achieve cost effectiveness to deliver the ‘extended’ demand management strategy.

If we do not take action the impacts of water scarcity will be wide ranging, from impacts on river flows and biodiversity to constraints on economic development, power shortages,

reduced food production and stresses on social cohesion. Yet despite the diverse impacts of water scarcity, these are not widely understood beyond government, regulators and other organisations that are directly involved with managing water resources.

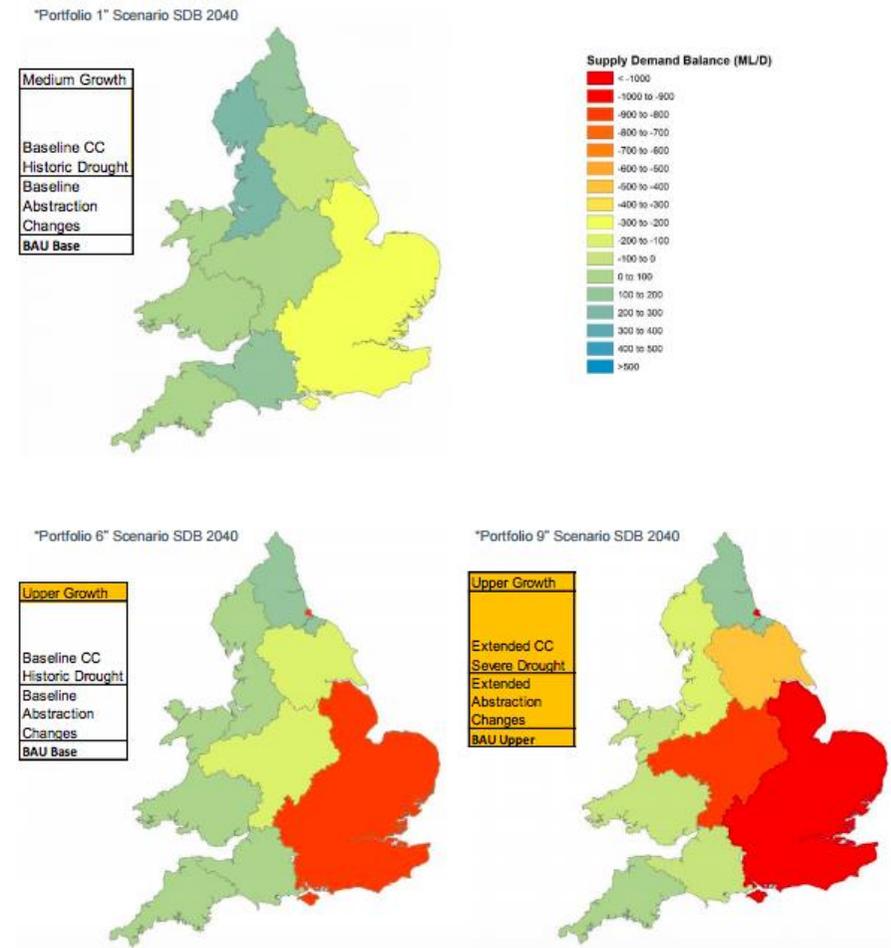


Figure 1 Supply demand deficits project to the 2060s (Water UK, 2016)

Q1. Do you think that water scarcity is a serious threat to the UK?

Q2. Do you think that there needs to be greater consideration given to the impacts of water scarcity and if so by whom?

Q3. Do you think that increased water efficiency is a legitimate response to the threat of water scarcity?

Water energy nexus

Heating water in homes for cooking, personal washing and cleaning produces 5% of the UK's greenhouse gas emissions and a quarter of CO₂ emissions from homes – it is the second biggest use of energy in homes, after space heating, and before gadgets and appliances. By wasting less hot water in homes – through more efficient fixtures and fittings and more efficient use of hot water from taps and showers - these can impact positively on carbon targets. Wasting less hot and cold water will reduce the carbon footprint of the water industry, which would as a result need to pump and treat less water and wastewater (and in turn make the sector more resilient to climate change). The water industry produces 1% of total UK greenhouse gas emissions and Scottish Water is Scotland's largest user of electricity. In short, wasting less hot and cold water cuts carbon emissions, decarbonises the economy and support the creation of new green jobs and technologies.

- ◆ Energy efficiency and fuel poverty retrofit/ advice programmes should include water efficiency measures

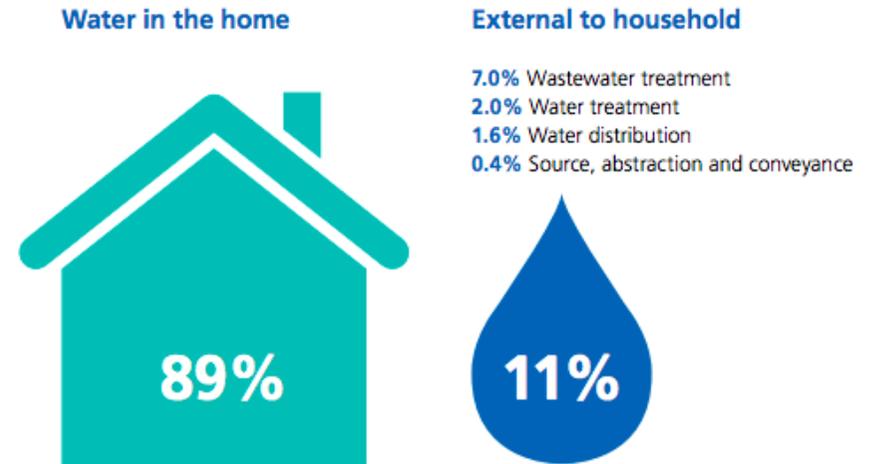


Figure 2 Proportion of carbon emissions from heating water in the home, excluding space heating (*Environment Agency and Energy Saving Trust, 2009*)

Q4. How can we better integrate water and energy efficiency programmes?

How far are we from best practice?

There is currently no agreed definition of delivering best practice water efficiency, however there are many approaches emerging and these are being investigated by the International Water Association. An international assessment released in May 2016 ranked **London 34, Birmingham 28, and Manchester 26 out of 50 major cities** for water efficiency (Copenhagen ranked first). These low scores reflect the progress that needs to be made on metering, water reuse and innovative water charging schemes ([Arcadis, 2016](#)).

The latest assessment of water company performance by the Consumer Council for Water identified a slight increase in water consumption over the past year. Their key findings include ([CCWater, 2016](#)):

- Over the past five years, there has been a downward trend in the amount of water that households are using each day, although fluctuations can be seen throughout the years. However, in 2015-16, there was a slight increase in the amount of water that customers use each day (Figure 3)
- Unmetered households use more water (around 30 litres per person per day more) than metered households

	2011-12	2012-13	2013-14	2014-15	2015-16	Trend
Industry Average	145.8	140.1	141.5	138.6	139.6	
Water and Sewerage Companies						
Anglian*	144.8	136.2	135.1	133.4	135.4	
Dŵr Cymru	152.1	144.4	144.6	141.5	138.5	
Northumbrian	146.2	140.5	141.2	141.9	144.7	
Severn Trent	125.0	120.9	129.3	126.4	130.4	
South West	134.5	136.7	136.9	134.6	136.6	
Southern	156.7	143.4	140.8	134.8	132.0	
Thames	160.6	154.7	156.2	150.9	149.3	
United Utilities	132.0	128.0	129.1	130.0	130.0	
Wessex	139.8	136.3	138.4	138.8	138.1	
Yorkshire	136.0	133.4	136.2	133.0	133.1	
Water only companies						
Affinity	157.6	148.5	154.7	148.3	152.2	
Bournemouth	146.4	142.4	144.1	138.4	133.6	
Bristol	142.0	141.0	144.0	143.0	141.1	
Cambridge	140.7	133.1	130.1	130.5	132.9	
Dee Valley	138.3	135.5	132.9	130.4	134.9	
Essex & Suffolk	153.0	147.4	151.9	151.0	150.7	
Hartlepool	123.7	123.1	124.7	119.9	127.5	
Portsmouth	160.0	149.0	148.0	145.5	143.3	
South East	167.2	159.4	155.6	148.2	161.2	
South Staffs	135.6	127.6	131.0	129.0	128.9	
Sutton & East Surrey	168.6	161.5	166.5	161.1	157.9	
* Anglian includes Hartlepool						

Figure 3 Per capita consumption 2010 to 2015 (CCWater, 2016)

Water UK have developed a dashboard called “[discover water](#)”. This now includes water consumption and leakage data at the individual water company level. There is an opportunity for this dashboard to combine data from several indicators in order to index companies on their water efficiency performance.

- ◆ **The Water UK dashboard and future resilience indicators within this should reflect best practice water efficiency**

There are many international water efficiency examples that could be considered as best practice; parts of Spain and Denmark have managed to reduce per capita consumption of water to 100 litres, without the use of greywater recycling or large-scale rainwater harvesting (IWA, 2016); places like Denver USA or Singapore have developed mass public engagement programmes either through government intervention or marketing; Israel has implemented circular economy principles with 100% reuse of wastewater for agriculture; Singapore has developed closed loop wastewater to driving water systems and Japan has implemented wide scale rainwater harvesting through legislation.

The Water UK long term water resources planning framework developed a water resources zone based approach to per capita consumption targets in their scenarios. This recognised the variation within and between companies and how water efficiency could be achieved. Figure 4 illustrates how a target that reflects the initial consumption could be applied rather than a flat target for all water resource zones. In the US approaches that assess best practice water use/ water budgets at a household level have been used and there has been nationwide and state-wide comparative assessments.

- ◆ Develop indicators/ targets around per capita consumption and best practice

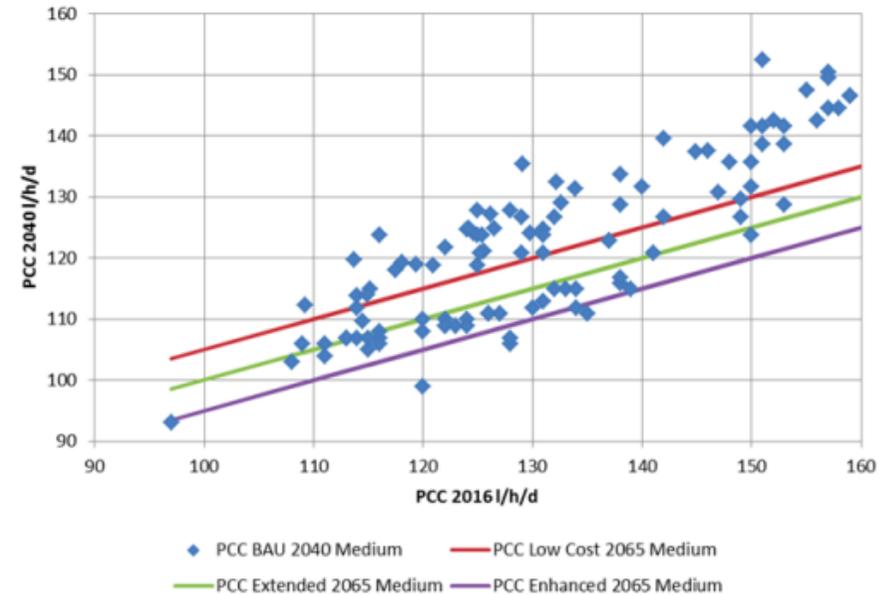


Figure 4 Developing water resource zone based per capita consumption targets (Water UK, 2016)

Q5. How can we better measure and monitor best practice water efficiency in the UK? Is per capita consumption the best indicator?

Q6. Could the UK match international best practice and achieve a per capita consumption of 100 litres? And if so how?

Q7. What other indicators or approaches could be used to help monitor progress or set targets towards greater levels of water efficiency?

What is water efficiency and what is our vision?

For the purpose of this strategy we will use the following definitions:

- Water efficiency involves ensuring the maximum value of water by reducing waste, effectively doing more with less.
- Water conservation involves restricting water use, effectively doing less with less
- Demand-side measures include water efficiency, water conservation, metering and leakage reduction (as opposed to supply side measures such as new reservoirs in water resources planning)

Being water efficient is using the minimum amount of water required to carry out the specific task. By improving water efficiency less water is wasted and the economic, social and environmental value is maximised. Water efficiency has an important role to play in the green economy, an inclusive society and a thriving environment. Water reuse and rainwater harvesting also have a strong role to play in efficient urban water management.

Water saving is something we can all be a part of everyday as shown in the themes for Water Saving Week (Figure 5), held annually in March.

Our vision for this strategy is:

‘A UK in which all people, homes and businesses are water efficient, achieved through smart technology, and regulatory and legislative frameworks for water, energy and housing sectors that complement each other’

Question 8: Do you agree with our definition and vision for water efficiency in the UK?



Figure 5 Water saving week themes

Water, people and communities – changing behaviours

There is a growing and identified trend in the UK towards resource-efficient behaviour. In recent years advice programmes and incentives have targeted energy efficiency, but Waterwise research indicates that households are also keen to be more efficient with water (see some of the key messages from our tracker survey in Box 1).

Box 1: Key findings from Waterwise and Ideal Standard Water Efficiency Annual Tracking Survey in Great Britain (GB) (2016)

- Only 14% of GB adults that pay for their water via a fixed rate bill don't take any actions to specifically reduce their water usage. This reduces to 6% among GB adults with a water meter.
- 82% of GB adults with a water meter reduce their water usage in order to save money, whilst only 30% of those with a fixed rate bill save water for the same reason.
- In 2015 70% of respondents answered yes when asked if they personally take actions to try and save water, in 2016 88% said that they take action.
- There appears to be a lack of communication regarding water efficiency with 62% (in 2015) and 67% (in 2016) of respondents reported having had received no help, information or free water saving devices in the past year. This is highest in Wales, where 85% have not received this. Further, 18% of those that do not take any action to save water did so

because they “had not thought of saving water before”

There is a need to generate a water saving culture throughout the UK. This could be achieved through a large scale combined communication campaign, which would need the involvement of water companies, government and other key stakeholders in order for it to be delivered effectively. This would also require continuous local communications, regularly, for reinforcement of the message.

A recent research project by Kings College London (Lewis, 2016) has identified that there is a lack of awareness of the range of behaviour change methods and a need to build skills/capacity in water companies to deliver this. Of greatest importance is improving the capacity and confidence of water companies to properly evaluate behaviour change programmes. Waterwise are developing a new social science for water network for water to help address this. We are also writing a behaviour change handbook that directly addresses the concerns identified.

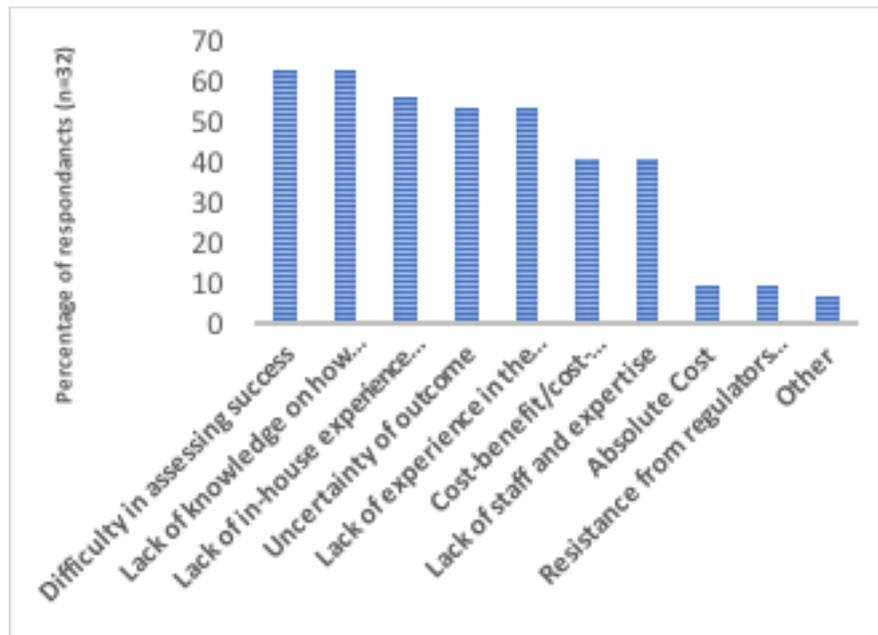


Figure 6 Water utility responses on behaviour change (Lewis, 2016)

There is a lack of consistent messaging and little co-ordinated joint action between water companies and this may become even more difficult as competition is introduced for non-household customers in April 2017 and potentially household customers in the future. The 2012 drought highlighted the importance and benefits of having joined up messaging, however it also demonstrated issues around a lack of awareness and understanding in the community on water resources issues such as supply and groundwater. Findings from Australia ([Turner et al., 2016](#)) indicate that as watering restrictions and communications are removed consumption can increase.

The 2012 drought was the first time that a new range of Temporary Use Bans were implemented. A project for UK Water Industry Research was undertaken to understand the impacts of these restrictions on water use both qualitatively in terms of customer views and quantitatively in terms of water use. Although the impacts of water use were hard to statistically support due to the timing of the implementation with heavy rainfall and flooding, there was a clear message from businesses and households that they'd like better communication in the run-up to a drought. Earlier communication around the drought led to some water company customers having a better understanding of the issues, which possibly supported reduced consumption.

A [UK Drought Portal](#) is now being produced using various standardised indexes of precipitation, evapotranspiration, streamflow and groundwater levels. These enable communication of drought at a higher resolution and easier comparison between different parts of the country. There is also a need to communicate water demand and water storage for each water company to help raise awareness of water resources amongst the general public. The Water UK Discover Water dashboard could be extended to include this.

[SaveWater South East](#) is a partnership of six water companies in the South East, the Environment Agency and Waterwise. It was set up to increase the awareness of water as a finite resource and create a water saving culture by working together via joint communications and projects. It is also looking to work together with other stakeholders interested in water efficiency. The outcomes from this

partnership could help inform wider regional or national water efficiency programmes.

- ◆ *Recognise that developing a water saving culture is a shared endeavour and should not be seen as purely a job of the water industry*
- ◆ *Develop a national water efficiency communication platform as a partnership between Government, the third sector and Water companies*
- ◆ *Behaviour change approaches should be further refined to support water companies in broad communications and integrated with retrofit or metering programmes*
- ◆ *The water companies and the Met Office, CEH, EA, NRW, SEPA should combine resources to provide a water information system for the UK that includes drought and water supply to inform customers and policy makers*
- ◆ *Future guidance on implementing Temporary Use Bans during drought should include considerations beyond the water sector and include more involvement from product developers*
- ◆ *Government should provide guidance for local councils on how they should interpret their water efficiency duties (Water Act 2003)*

Q9: Do you agree with the recommendations for building a water saving culture?

Q10: How can we bring together partnerships to deliver this wider level of awareness?

A water efficiency framework for competition

Through retail competition for water, customers are/will be free to change from their existing monopoly water company to another water supplier. This is really about the “customer-facing” services including billing customers, handling payments, reading meters, and taking calls from customers about network related issues. It does not include water resources management, water and sewerage treatment, or management of water or sewerage networks. These are referred to as upstream competition (Figure 7).

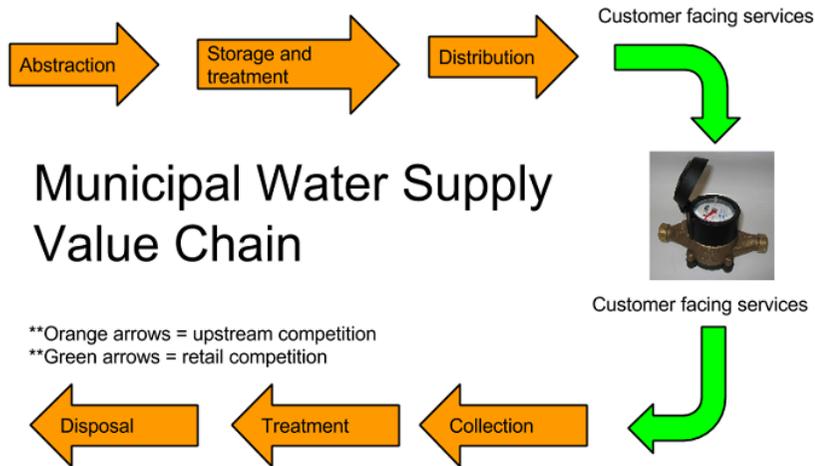


Figure 7 Retail competition elements of the water value chain highlighted in green

Traditionally water companies have a limited relationship with their customers, focussing only on billing or repairs when something goes wrong. Several companies have delivered targeted programmes to businesses, but in general it has been limited to water efficiency services supplied in terms of

online audit checklists or audits for large/ key customer groups only.

Non-domestic retail competition

From April 2017 1.2 million businesses and other non-household customers in England will be able to choose their water retailer. In Wales only businesses using more than 50Ml/year can choose their supplier. This has been possible in Scotland since 2008. In 2014 Business Stream reported saving customers £43m through water efficiency, 20 billion litres of water and 34,000 tonnes of carbon dioxide emissions since 2008 in Scotland ([Business Stream, 2014](#)). The public sector in particular in Scotland is projected to save £36m over four years.

As retail competition is introduced for non-households there are several challenges for water efficiency. These include:

- Capacity to deliver water efficiency services
- Customer awareness of competition and water efficiency services
- Some water companies have outcome delivery incentives from Ofwat linked to non-domestic water efficiency that need to be delivered in this price review period (before 2020)
- Water Resources Planning and access to data to support forecasting
- Bundling water as the cheapest service along with others such as telecoms and energy with higher margins – this would reduce any price signals towards water conservation.

Domestic retail competition

Ofwat have identified disruptive technologies as a potential opportunity with competition. These include improved customer engagement around billing and smart metering. Introducing more smart technologies into homes such as leak monitors or point of use devices such as shower monitors could enable behaviour change. Smart metering in particular is a key innovation that could help customer engagement and behaviour change to reduce water consumption. Ofwat's emerging findings of the costs and benefits suggest that retailers may find innovative ways to lower metering costs, including installation of smart metering with more innovative tariffs and water efficient products ([Ofwat, 2016](#)).

The emerging findings on the costs and benefits of residential competition suggest that water efficiency could have a net benefit of between £98m and £398m. This along with the £177 potential metering benefit would make a large impact on the less innovative and competitive scenarios.

Although Ofwat are only beginning to analyse the costs and benefits of domestic competition, many challenges are similar to non-domestic competition and water efficiency delivery is at the heart of this. Potential concerns outlined by Ofwat and in discussion with stakeholders for this strategy include:

- Customers who don't have access to technology (e.g. internet) can be significantly disadvantaged and are less likely to switch supplier.
- Water Resources Planning – reduced access to customer data due to communication restrictions on wholesalers

- Significantly reduced benefits if water efficiency measures are not implemented
- During drought without clear and consistent communication between retailers there will be much less effective implementation of temporary use bans (watering restrictions) and behaviour change to reduce consumption
- A race to the bottom based on prices – The latest research from CCWater suggests found that 44% of households would need to save over £40 a year before switching retailer, which is unlikely given the margins possible.

A framework for water efficiency in retail competition

Retail competition has the potential to improve water efficiency through:

- Billing and metering
- Water audits and water efficiency measures
- Alternative water sources

To achieve the above outcomes, we need to raise awareness of retail competition and water efficiency services, develop and run training programmes to increase skills and capacity in water efficiency services, and develop an effective comparison approach to help businesses choose retailers based on these services. There also needs for more consideration of how to ensure that all members of the water sector promote water efficiency as the sector fragments, this would include non-regulated participating such as Third Party Intermediaries (TPIs). Ofgem define these in the energy sector as “switching websites, energy brokers and energy efficiency advice providers who interact with energy

consumers” ([Ofgem, 2016](#)). TPIs can offer advice and products to assist with a range of functions including water procurement, efficiency and management.

- ◆ *Develop a water efficiency framework to support new retailers in delivering water efficiency, identify capacity gaps, and provide an independent assessment against the framework to inform consumer choices*
- ◆ *Ensure that as the sector fragments all parties in the water sector deliver water efficiency, this should include non-regulated elements of the sector (e.g. TPIs)*

Q11: Do you agree with the opportunities and challenges outlined for water efficiency from greater retail competition for water?

Q12: Do you agree with the recommendations for developing a framework for water efficiency in competition?

Q13: How can we ensure that non-regulated members (e.g. TPIs) of the water sector help to deliver water efficiency?

Water Sensitive Cities – improving water efficiency in our urban environment

Social Housing

Social housing stock still makes up a significant proportion of properties across the UK, on average of 18% across the UK in 2012 ([ONS, 2014](#)). Local Authorities and Housing Associations regularly run retrofit programmes and there is an opportunity to procure water efficient devices to help reduce water and fuel poverty. Waterwise research (for the Greater London Authority) revealed that 80% of social housing has baths but not showers – this is in part because much of the stock was constructed before showers were considered a standard fitting, and in part because social housing standards such as Decent Homes do not require installation of showers as part of refurbishment ([Waterwise, 2009](#)). This is significant as an average bath uses 80 litres of hot water compared with 32 litres for four minute shower with a water efficient showerhead.

In Wales “Guidance on water and associated energy efficiency for the Welsh Housing Quality Standard for retrofit programmes” was published in 2012 ([EST and EA Wales, 2012](#)). The guidance set out the key reasons for saving water in social housing and detailed what providers can do in procurement and retrofit programmes. It was estimated that if every social housing property in Wales had water-efficient taps, a toilet, and a shower retrofitted then combined energy bills could be reduced by a staggering £3.5 million a year. Similar guidance could be developed for the Scottish Housing Quality Standard or the Decent Homes Standard in Northern Ireland.

- ◆ **Water efficiency should be included in social housing standards (i.e. Decent Homes and Welsh Housing Quality Standard). Any refit or upgrade of existing social housing should include the installation of showers in homes where there is only a bath. Develop voluntary guidance and partnerships with water companies.**

Water Efficiency in New Developments

Although water efficient fixtures and fittings are often no more expensive than inefficient products there is still a perception that it costs more for developers and affects marketability of homes. An opportunity to address this is through an incentive related to the infrastructure charges posed by water companies on new developments (provided for in the Water Act 1991). A variable infrastructure charge linked to the installation of labelled water efficient fittings and fixtures would incentivise greater water efficiency in new developments. Ofwat and Water Companies can agree on the specifics of these approaches with developers. Additionally, there is the potential for part of the developer cost saving to be put towards a fund for water efficiency behaviour change in those homes or delivering wider water neutrality in the area.

Waterwise are trialling this approach with Southern Water in Eastleigh. Developers in Eastleigh are being offered a 50% discount in their water infrastructure connection charge for new builds if they use fittings rated A or B under the European Water Label. The incentive is simple and easily verifiable and uses market incentives to reward developers for environmental improvements. It means that developers can improve environmental standards at no cost and with almost no administrative burden, householders get higher quality

fittings and lower running costs and there are benefits to the aquatic environment and improved water security. The discount is funded by Southern Water but this should be offset by the water efficiency savings generated. This trial is a good example of public, private and third sector organisations working together to develop solutions that work for everyone. This is a truly sustainable approach.

This is the first time this type of approach has been tested and the results will be fully evaluated and the potential for wider roll-out will be assessed. Other water companies are working on similar approaches for water efficiency or water reuse and there is an opportunity to share knowledge in this area.

- ◆ **Variable infrastructure charges to be implemented for new developments to encourage water efficiency measures**

Water efficiency in new developments has been improving, however there are still opportunities to reduce water use and a need to understand actual vs reported water use figures. Changes to Part G of the building regulations in 2010 required that the water use of a home (calculated using the Water Efficiency Calculator for New Dwellings) is no more than 125 litres per person per day. The [Housing – Optional Technical Standards](#) in the National Planning Policy Framework also set out how local planning authorities can set out Local Plan policies requiring new dwellings to meet the tighter Building Regulations optional requirement of 110 litres/person/day.

The Building Research Establishment's Environmental Assessment Method BREEAM development accreditation scheme is the most commonly used assessment of water efficiency for non-households. The [water component](#) provides

up to five credits towards an overall score for a building. A potential limitation with this approach is that it doesn't currently require products to meet an approved standard (e.g. based on a water label) and this in turn doesn't help transform the market for water efficient products and appliances beyond the non-household sector. BREEAM assessment is often a local planning requirement.

- ◆ **Water efficiency standards need to be linked to water labelling and incentives**
- ◆ **Develop a training programme to support new water retailer and also facilities managers in delivering water efficiency services**

New planning frameworks with an increased role for local communities should take forward water neutrality partnerships – with homes, businesses, schools and hospitals in the area receiving a water efficiency retrofit to avoid an increase in overall demand as a result of new local development. For example, Neighbourhood Planning in England gives communities powers to set such policies through a neighbourhood plan and when they grant planning permission through Neighbourhood Development Orders and Community Right to Build Orders for specific development.

Local Area Agreements should require water efficiency in local planning policies. Pilots and incentives should be developed to provide community-scale water provision and sustainable urban drainage – building resilience to flooding and scarcity. Severn Trent Water and a range of partners are trialling physical changes (homes and streets), behaviour

change, and independent testing facilities in their Urban Demonstrator Project ([Severn Trent Water, 2016](#)).

- ◆ **New planning frameworks with an increased role for local communities should take forward water neutrality partnerships**
- ◆ **Local Area Agreements should require water efficiency in local planning policies.**

Retrofits

With less than 1-2% of the total building stock each year being new build, 70% of total 2010 building stock will still be in use in 2050 ([Retrofit2050, 2014](#)). The built environment is currently responsible for over two thirds of total carbon emissions and a majority of public water supply use.

Waterwise research suggests that a partnership approach to water efficiency is the most cost-effective. Partnership retrofitting and behaviour change campaigns tend to show greater uptake, greater engagement and greater water, carbon and financial savings, and to be more innovative than solo approaches. There is a role for social enterprises, co-operatives and community organisations to work together with Government and the water sector to deliver water efficiency. The establishment of partnerships and trusts for resource efficiency could also deliver social and economic benefit to local communities.

Water closet (WC) leakage has been identified as a major issue in the UK. Recent research on around 300 toilets concluded ([Ballinger and Gilbert, 2015](#)):

- On average, approximately 4.1% of WCs were found to be leaking.

- Average leakage rates of 215 litres/toilet/day (based on the sample mean) and 72 litres/toilet/day (based on the sample median) were derived from the study
- Total wastage from WC leakage is estimated to be 397 Ml/day (based on the sample mean) and 133 Ml / day (based on the sample median)
- The overall contribution of WC leakage to the average per capita consumption is between 1.65% and 4.63%.
- New properties (post-2000) are most likely to have leaks and 81% of these are associated with flush valves
- ◆ **The government to work with water companies and other partners to develop large-scale water efficiency retrofit schemes across the UK, including through establishing partnerships**
- ◆ **Raise awareness of the need for compliant products among retailers and suppliers, plumbers and the customers. Further customer and stakeholder education is also required regarding compliance. This could be achieved through the provision of advice and information.**

Tools like the Royal Institute of Chartered Surveyors (RICS) SKA refurbishment guide should drive greater water efficiency retrofitting and we would like to see the building sector adopting these type of approaches as standard.

Q14: How can we improve water efficiency in social housing across the UK?

Q15: What further incentives and standards are required to increase water efficiency in new homes?

Q16: How can we increase the number of water efficiency retrofits being undertaken?

Q17: What further incentives and standards are required to increase water efficiency in new non-domestic buildings?

Products and labelling

An effective water labelling scheme is essential for transforming the market so that consumers can purchase water efficient devices. The UK currently has the European Water Label and Smart Watermark to help identify water efficient products. As of 2015 the Water Label had 88 registered brands and 8,000 registered products. Although there has been some increase in use of the label in stores and online, it is not widely visible. The links with building standards and the Waterwise/ BMA water calculator have driven use for new developments. We can learn from experience in Australia and the USA to further develop and strengthen water labelling the UK.



Figure 8 The European Water Label

The Water Efficiency and Standards Labelling (WELS) scheme in Australia calculated a saving of 70,000 ML/year

water (Figure 9), 5.5 MT/year of carbon dioxide, and AUD\$520m/year in household utility bill savings. The labelling scheme has been combined with a range of wider programmes including rebates on efficient product and appliance to help transition the market.

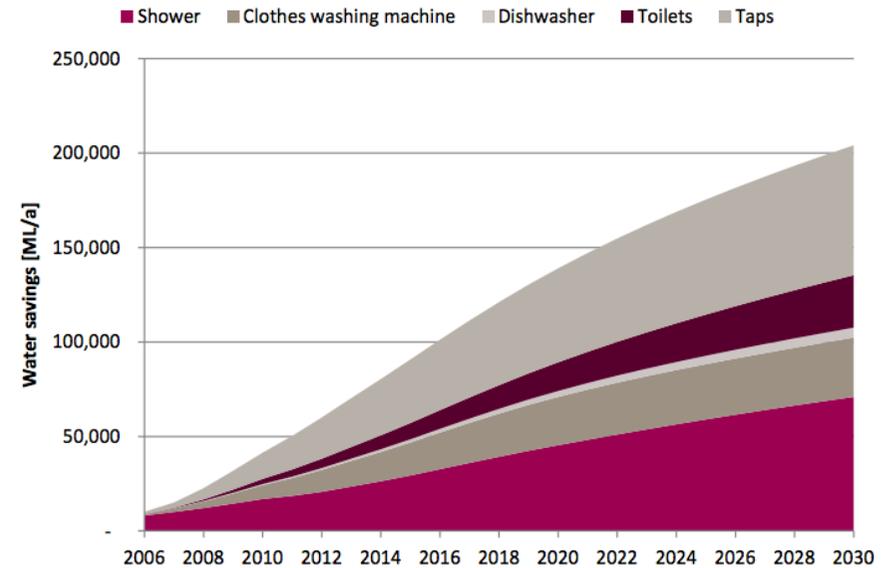


Figure 9 Historical and projected water saving from water labelling and increased water efficiency in Australia (ISF, 2015)

The US Environmental Protection Agency's Watersense labelling scheme has saved more than 1.5 trillion gallons of water since 2006 (approx. 6.8 million megalitres), 78MT of carbon dioxide, and USD\$32.6 billion in savings in consumer water and energy bills. In 2015, 16,110 labelled produced were available (USEPA, 2015). The programme also extends to labelling of new homes and through social media and

drought communications is well integrated into overall water efficiency programmes.

Strengthening adoption of the Water Label

A labelling scheme on its own isn't the end goal. We need further uptake of the label and promotion on products, in stores, on websites and linked to building/ procurement standards. Incentive programmes that require the label, such as reductions to developer charges or rebate programmes, can also help this market transformation.

Rebate schemes have been essential for driving market transformation and the uptake of the Water Efficiency and Standards Labelling scheme in Australia. For example, the rebate scheme in Western Australia was funded by the State Government and delivered through the water company and resulted in 170,000 new water efficient washing machines being installed. The number of Perth households installing dual flush toilets increased from 36% in 1992 to 84% in 2006 and front loading washing machines increased from 7% to 25% (Marsden Jacobs Associates, 2009). Rebate programmes run by water companies in the UK could better support a market transformation than current free giveaways. This would enable consumer choice, which is especially important where homeowners are refurbishing their kitchens/ bathrooms.

The government in Northern Ireland is considering amending the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009 to include a performance rating for water fittings. This could be linked to the Water Label to support changes in other parts of the UK. This effect was seen with the plastic

bag charge implemented in Wales, then Scotland, Northern Ireland and England.

- ◆ *Undertake an independent review of the effectiveness of The Water Label*
- ◆ *Water companies should be incentivising the use of water efficient devices and fittings, through rebates similar to those used in the USA and linking eligibility to the European Water Label.*
- ◆ *Northern Ireland to consult on mandatory water efficiency standards*
- ◆ *Link public sector water standards to the water label to encourage manufacturers to use the label and produce more efficient products*
- ◆ *Review BREEAM accreditation and link the water components to the Water Label to help support a wider market transformation*
- ◆ *Water efficient devices listed in the HMT/Defra ECA Green List being zero rated for VAT, which should be possible after the UK leaves the EU*

Q18: Should water companies incentivise the uptake of water efficient devices and fittings through rebates and other financial levers?

Q19: Should the UK Government give water efficient devices a zero VAT rating?

Water Calculator

Waterwise and partners produced [The Water Calculator](#) to link the Water Label with Part G of the building regulations and the Code for Sustainable Homes. The calculator has won awards and is used daily by a range of architects and other building industry professionals.

There is a need to modernise the calculator so that it reflects the latest water efficiency technology, changes to building standards, and opportunities to link with incentive schemes around water company developer charges and public procurement. The calculator could also be extended to provide a portal for new non-domestic water retail companies to provide water efficiency options for their customers.

- ◆ **Waterwise will revise the water calculator linked to the Water Label in line with the latest standards and communicate this further with stakeholders**



Figure 10 Screenshot of The Water Calculator website

Rainwater harvesting and greywater reuse

Rainwater harvesting and greywater reuse have been implemented with mixed experience in the UK. A report on the carbon implications of these systems in 2010 suggested that due to pumping and treatment they are often more carbon intensive than the public water supply ([Environment Agency et al., 2010](#)). Additionally, the payback periods can be long on some systems.

Since that report there has been advances in technology around pumping and sensors to better link with wider objectives such as reducing flood risk. However, there remains a gap in research, skills and accreditation for these systems compared with countries such as the USA and Australia. The WATEF Network has attempted to address some of these issues, however there is still a need for more industry and academic research to inform labelling and standards. Issues include:

- Water regulations and water quality
- Public acceptance
- Ownership and maintenance models
- Land availability for installation of community scale rainwater and greywater reuse systems
- ◆ **Undertake further research on the costs and benefits of rainwater harvesting and greywater reuse**
- ◆ **Assess accreditation and training standards for installation of rainwater harvesting and greywater reuse**

Product Innovation

The products being supplied by water companies in retrofit programmes to households have changed little since the first

mail-out of devices in response to Ofwat Water Efficiency Targets in 2011. The UK has a long history of innovation in manufacturing and includes several technology hubs that could be utilised to develop smart water products including point of use measurement and behaviour change feedback devices. With climate change leading to more extreme weather and drought internationally we can also export products.

A range of new products and technologies include:

- Smart point of use water measurement devices – showers etc.
 - Smart rainwater butts that empty when needed for stormwater attenuation
 - Airflush toilets
 - Ultra-low flow products
 - Improved customer engagement displays and devices
- ◆ *Develop a water product incubator programme based on an Innovate UK funding challenge*
- ◆ *Use the Waterwise bi-annual water efficient product awards to promote and stimulate research and innovation*



Figure 11 Range of retrofit devices and innovations available for retrofit programmes

Q20: How can we strengthen the Water Label to transform the market towards more efficient products?

Q21: What other options are there for product innovation in water efficiency for the UK and how can we incentivise these?

Water company delivery and regulation

Metering

The UK is one of the few countries in the developed world not to have either full water metering or a clear programme to implement universal metering. At present 50% of households in England and Wales are metered and this is projected to increase to 61% over the next five years ([CCWater, 2015](#)). In England, the policy position on metering is that water companies can compulsorily meter customers if they have been designated as being in an area of water stress (by the Secretary of State based on evidence from the Environment Agency). In Scotland there are some meter trials but the current level is close to zero, whilst in Wales the Welsh Government is looking at the benefits of smart meters.

However, the Southern Water Universal Metering Programme (UMP) has shown that domestic metering can save 16.5% ([Ornaghi and Tonin, 2015](#)). If people do not pay for the amount of water they use, there is no financial incentive to use water efficiently. For unmetered customers, it is important to seek alternative ways to incentivise the efficient use of water.

- ◆ **Freedom for water companies to introduce full metering for benefits beyond water stress status**
- ◆ **All homes in England and Wales to be fitted with water meters by 2020, supported by tariffs to protect vulnerable customers. Supported by a political commitment and based on a wider cost-benefit analysis**

Tariffs

Metering with appropriate tariff structures - such as the rising block tariff (wherein the unit charge rises for progressively higher volumes of water is taken by customers), or a seasonally-varying or aridity-indexed tariff (wherein water costs more per unit when it is less plentiful) – has the potential to be a major incentive to water efficiency in the future. In their latest water resources plans, a number of water companies have announced substantial selective metering programmes that are predicted to generate considerable reductions in consumption. There should be support for appropriate and smart metering to manage the demand for water; however, the social and economic implications of such an approach need to be properly factored into policy and practice, with appropriate provisions being made for the disadvantaged.

Some companies are also thinking outside the usual range of tariffs towards incentives. Gamification and discounts/ prizes linked to reduced consumption at a household or community scale are an example of this.

- ◆ **A new round of tariff trials linked to smart metering and the potential for retail competition to be supported by Ofwat and Water Companies**
- ◆ **Evaluation and dissemination of new incentive approaches**

Improving delivery of large scale domestic retrofit programmes

With universal metering programmes including home visit programmes for water efficiency there has been an increase in the total number of visit undertaken. In the current water company delivery period, there are hundreds of thousands of

planned home visits. However, there is wide variation in the level of water saving achieved and the quality of delivery. We can learn from the range of approaches and their level of uptake and water savings achieved.

The evidence base for water efficiency, developed by Waterwise and the industry, has been used as an essential resource in many water resources management plans and the Water UK long term water resources planning framework report. However, there is a need to collate up to date figures. This will help understand variation between companies and programmes.

- ◆ *Increase roll out of Waterwise Water Efficiency training to water companies across the UK*
- ◆ *Provide a database of companies that have trained staff or use trained contractors to provide assurance to Ofwat and the general public about the efficiency and reliability of delivery in water efficiency programmes*
- ◆ *Update the water efficiency evidence base*

Q22: Do you agree with the recommendations on metering and tariffs?

Q23: From your experience in delivering or receiving home visit linked to retrofit programmes, how can the industry support improvements and knowledge sharing?

Q24: How can we improve the evidence base for water efficiency to better share learning on the latest large scale water efficiency programmes?

Integrated water management and resilient infrastructure

The Ofwat resilience task and finish [group](#) defined resilience:

Resilience is the ability to cope with, and recover from, disruption, and anticipate trends and variability in order to maintain services for people and protect the natural environment now and in the future.

Although water efficiency was not included as a direct recommendation it is implicitly part of recommendations: increasing public engagement and education; ensuring clear routes for funding legitimate resilience investment; ensuring coherent planning at both a regional and national level; improving the understanding of risk and failure; ensuring water services are resilient under different water sector structures; developing benchmarking, standards and metrics; and, ensuring existing plans are stress tested.

Integrated Water Management

There are many different names and definition for integrated water management. In this strategy, we are referring to a holistic whole water cycle approach to managing water resources, water quality, and flood risk management. Water efficiency is often seen as one part of a silo (water resources) and there is a need to join up retrofit and behaviour change projects with water company programmes on sustainable

drainage and catchment management. Box 2 outlines an example of a more integrated approach to water management implemented in Sydney, which could also be applied under the competition and regulatory regime in England and Wales. Through multiple instances of semi-autonomous systems such as Central Park nested in a city we can balance decentralised and centralised infrastructure.

Box 2: Upstream competition case study: Central Park Sydney

This innovative new development is served by [Central Park Water](#), servicing 4,000 residents and 15,000 workers and visitors daily. The world's largest membrane bioreactor system, with ultraviolet and reverse osmosis treatment in the basement of the building, provides water to 50-70% of non-potable uses including toilet flushing, washing machine use and garden/green wall irrigation.



Figure 12 Central Park Sydney showing green walls (Photo: Hans Veneman, Creative Commons, Flickr)

Water sources include:

- Rainwater from roofs
- Storm water from impermeable surfaces/planter box drainage
- Groundwater from basement drainage systems
- Sewage from an adjacent public sewer
- Sewage from all buildings within the Central Park community
- Drinking water from the public water main

Wider benefits stated by Central Park Water include lower infrastructure charges for developers, quicker land release speeds for development and lower bills for customers. Central Park Water also supply recycled water to surrounding buildings, including the Institute for Sustainable Technology.

A range of similar schemes are developing in New South Wales, including an additional eight communities and more than 25,000 dwellings. As of April 2015, the economic regulator IPART reported 28 current licences under the Water Industry Competition Act 2006 are supporting these developments.

By joining up sustainable drainage programmes with water efficiency programmes, behaviour change and retrofits of homes can be more effective. A major supply deficit is

projected for London by Thames Water, and we are also facing sewer capacity issues due to surface water inflow. There is the potential to consider the city as a water supply catchment through water capture and reuse. A similar situation exists in our other large cities.

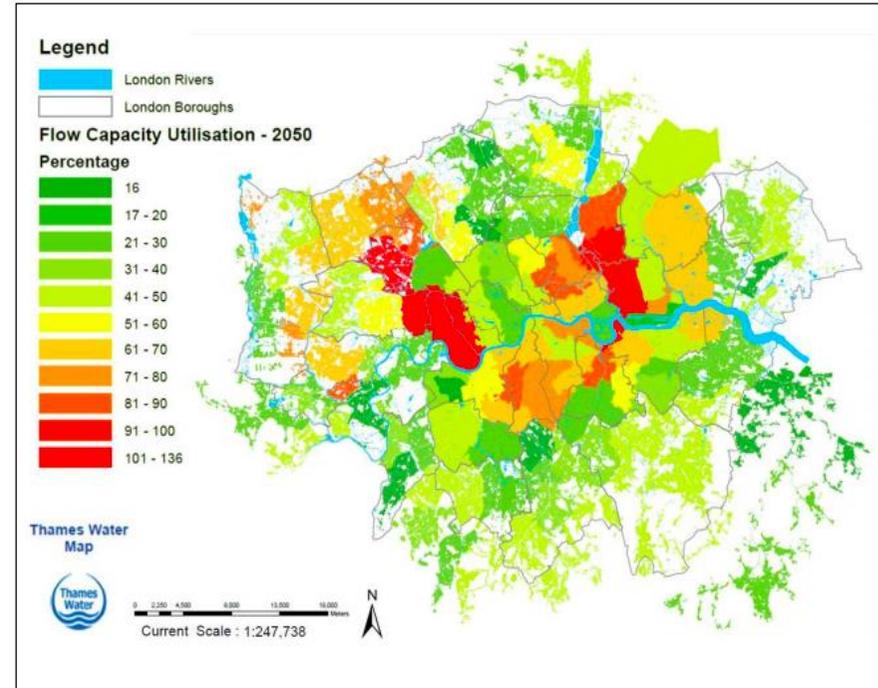


Figure 13 Sewer flow capacity in London (GLA, 2016)

Competition isn't the only option. An alternative community model is taking shape in the South West of England. This is called [RainShare](#) and involves connecting those with excess water, including roof runoff, with those who need water. The first example of this will be between householders and an adjacent allotment for growing vegetables. In the UK,

innovative approaches on water reuse have been implemented by water companies in the North West Cambridge development and at the Olympic Park in London. Both schemes required innovative thinking from water companies and clear partnerships with the developer, the University for Cambridge and the London Legacy Development Authority in London respectively.

- ◆ **Retrofit sustainable drainage (SuDS) and Water Sensitive Urban Design (WSUD) projects should include water efficiency**
- ◆ **Identify opportunities for water efficiency within distributed infrastructure systems to provide nested semi-autonomous areas within cities and improve resilience**

'Smarter' water infrastructure

There is increasing recognition of the need to better utilise Big Data such as smart metering information and the Internet of Things (e.g. sensors) to better manage water. These technology trends can potentially revolutionize the Water sector, by providing highly detailed data and actionable insights throughout the water lifecycle; from production and distribution, through to consumer engagement. Low-cost internet of things (IoT) based sensing devices (e.g. flow, pressure, quality) monitoring, analysing and transmitting data throughout the water network (from a well to a household) can have a significant effect on the entire water value chain. The technology-driven pollination of water data with other data sources (e.g. weather, energy) and systems (e.g. smart home, Cleanweb, open data) can further increase opportunities for extracting value from the data. Such benefits are apparent in the Energy sector, a perfect example of the application of Big

Data technologies. Energy utilities enjoy state-of-art Big Data systems to monitor, analyse, and automate energy production, management, and demand. At the same time, they have joined a growing ecosystem of consumer-centric products and services for energy monitoring and automation that provides them with further data, capabilities, and insights.

There is a need for a debate within the water sector about the amount of open data. More open data would enable greater public engagement with water and the development of more ICT solutions, which could aid water efficiency. However, there is also a need to protect privacy and consider the ethics of data collection and use.

The level of metering in the sector has grown dramatically in the past ten years and companies are now starting to install smart meters. These should provide information that will aid network optimisation and customer facing information to drive water efficiency. But there needs to be more work on the use of smart rather than big data. Water companies need to focus on what data is needed and how this should be gathered. Metering is not the only option and neighbourhood meters for network optimisation combined with in-home sensors that can provide data directly to customer's smart phones in one approach that can provide an alternative.

- ◆ **Support innovation and wide-scale adoption of big data analysis and the internet of things to support greater understanding of demand and behaviour change in water efficiency programmes**
- ◆ **Review the data needs of the sector, assessing what data is needed and how it should be collected and used**

- ◆ **Increase availability of Open Water Data, including anonymised information on water demand and outputs from water efficiency pilot projects**

Q25: Do you agree with the recommendations for improving water efficiency in cities and urban developments?

Q26: What are your views on data collection and accessibility?

Conclusion and next steps

Climate change and population growth are placing increasing pressure on water resources in the UK. Growing demand and the need to protect the environment are pushing water companies to deliver greater levels of water efficiency.

There is a need for a coordinated approach to delivering water efficiency in the UK and our initial review of stakeholders has identified key brokers in this. We also recognise that a country specific and region specific approach is also required in delivery to engage with water customers and change behaviours.

This consultation document sets out a range of key issue areas developed with Waterwise supporters. The aim of the strategy is to provide the evidence to support government action in this area and for water companies and other stakeholders to reference as they develop their next round of plans. We also set out a range of actions for further research and collaboration and are seeking input on these. Additionally, we would welcome any input on research and evidence to further support this strategy.

Through this strategy we are also seeking to deliver against the International Water Association’s 17 principles for water-wise cities (Figure 14). In particular, water-wise communities.

Please complete the consultation response form at this [link](#) or email responses by email **by 31 January 2017** (info@waterwise.org.uk).

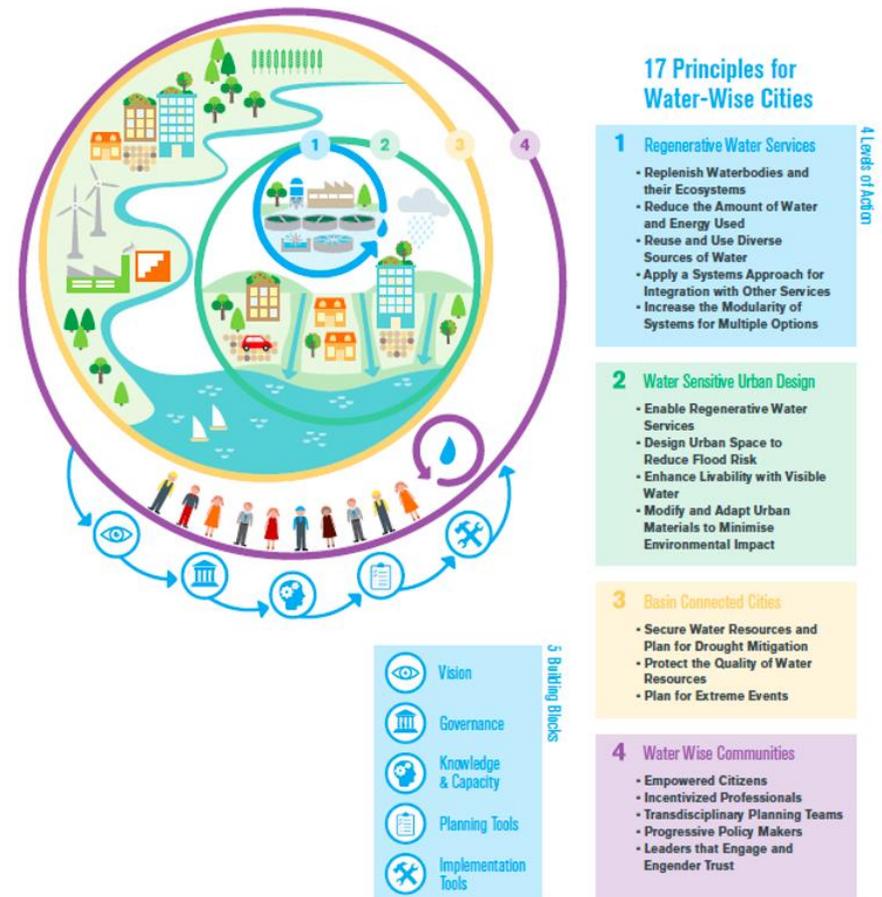


Figure 14 Principles for water-wise cities (IWA, 2016)

Summary of consultation questions

The consultation questions are listed below and you can respond to these by email (info@waterwise.org.uk) or our online [form](#).

Q1. Do you think that water scarcity is a serious threat to the UK?

Q2. Do you think that there needs to be greater consideration given to the impacts of water scarcity and if so by whom?

Q3. Do you think that increased water efficiency is a legitimate response to the threat of water scarcity?

Q4. How can we better integrate water and energy efficiency programmes?

Q5. How can we better measure and monitor best practice water efficiency in the UK? Is per capita consumption the best indicator?

Q6. Could the UK match international best practice and achieve a per capita consumption of 100 litres? And if so how?

Q7. What other indicators or approaches could be used to help monitor progress or set targets towards greater levels of water efficiency?

Question 8: Do you agree with our definition and vision for water efficiency in the UK?

Q9: Do you agree with the recommendations for building a water saving culture?

Q10: How can we bring together partnerships to deliver this wider level of awareness?

Q11: Do you agree with the opportunities and challenges outlined for water efficiency from greater retail competition for water?

Q12: Do you agree with the recommendations for developing a framework for water efficiency in competition?

Q13: How can we ensure that non-regulated members (e.g. TPIs) of the water sector help to deliver water efficiency?

Q14: How can we improve water efficiency in social housing across the UK?

Q15: What further incentives and standards are required to increase water efficiency in new homes?

Q16: How can we increase the number of water efficiency retrofits being undertaken?

Q17: What further incentives and standards are required to increase water efficiency in new non-domestic buildings?

Q18: Should water companies incentivise the uptake of water efficient devices and fittings through rebates and other financial levers?

Q19: Should the UK Government give water efficient devices a zero VAT rating?

Q20: How can we strengthen the Water Label to transform the market towards more efficient products?

Q21: What other options are there for product innovation in water efficiency for the UK and how can we incentivise these?

Q22: Do you agree with the recommendations on metering and tariffs?

Q23: From your experience in delivering or receiving home visit linked to retrofit programmes, how can the industry support improvements and knowledge sharing?

Q24: How can we improve the evidence base for water efficiency to better share learning on the latest large scale water efficiency programmes?

Q25: Do you agree with the recommendations for improving water efficiency in cities and urban developments?

Q26: What are your views on data collection and accessibility?

Appendix A – Water efficiency strategies and plans across the UK

A number of strategies and plans already exist or are in preparation that can help deliver water efficiency. These are outlined below:

- Final Water Resources Planning Guideline ([Environment Agency and Natural Resources Wales, 2016](#)) – the 2016 guideline requires water company plans to be: “Demonstrating how you will fulfil your obligation to promote water efficiency and your plans for increased customer metering, thereby reducing abstraction and its impact on flows and groundwater levels”
- Water White Paper ([Defra, 2011](#)): We must use water more efficiently and be careful to avoid pollution in using our drains. We will encourage and incentivise water efficiency measures, for example under the Green Deal. We will encourage voluntary water efficiency labelling to enable customers to choose more efficient products. We will also collaborate on a campaign to save water and protect the environment, working with water companies, regulators and customers to raise awareness of the connection between how we use water and the quality of our rivers.
- Defra 25 Year Plan – In response to the National Capital Committee’s third State of Natural Capital report, the Government has committed to producing a 25 year plan for a healthy natural economy ([link](#))
- National Infrastructure Assessment – the National Infrastructure commission announced in May 2016 that they will be developing an assessment with a 30 year timeline and this will include water, sewerage and flood defences ([link](#))
- Water Strategy for Wales ([2015](#)): will assess and consult on options for encouraging reduction in water consumption. “This will include working with the water companies and other interested parties to encourage and incentivise engagement and action on water usage; to challenge perceptions; to promote the benefits of water efficiency; and carry out further investigation into the costs and benefits of metering.”
- Scottish Water – Water Efficiency [Plan](#) 2011-2015: The strategy sets their three key areas around engaging with customers, improving assets, and working with stakeholders.
- Sustainable Water - A Long-Term Water [Strategy](#) for Northern Ireland (2015-2040): Progress delivery of difficult crosscutting policies such as water efficiency, surface water management and water and sewerage funding and regulation; Managing water consumption by improving water efficiency in homes and businesses; The long-term target is to reduce average water consumption from 146 l/h/day to 130 l/h/day.

- Continue to invest in education and public awareness campaigns to promote water efficiency and the value of water, supported by continued work of the Water Bus and school visits, and other educational means.
- Develop and implement a public awareness campaign highlighting the benefits of water efficiency and how it can lower energy bills
- Consider regulatory options in which all future residential development is water efficient and aims to achieve a maximum consumption figure of 130 l/h/day. Carry out pilot projects to test and compare the cost effectiveness of different water efficiency / reuse technologies (for both retro-fitting and new build). Consider amending the Water Supply (Water Fittings) Regulations (Northern Ireland) 2009 to include a performance rating for water fittings. Develop and implement policies in respect of retro-fitting water efficiency/ recycling measures in homes and businesses.
- Draft Mayor of London Water Strategy ([2011](#)): The Mayor believes that Londoners should have a secure supply of water that is affordable, safeguards the environment, and a water infrastructure fit for a world-class city.
 - Point 1. Improve the water efficiency of London's existing buildings through retrofitting simple cost-effective measures. This saves Londoners money and offsets the demand for water from new development.
 - Point 2. Ensure all new development is super water efficient. This reduces residents' bills (all new development is metered), the need for new water resources and the impact on the environment.
 - Point 3. Raise Londoners' awareness of the financial benefits of increased water efficiency – many Londoners would be able to save money by being more water efficient and even having a water meter.
 - Point 4. Increase the number of homes that have a water meter. Paying for the volume of water consumed is the fairest way to pay for water, yet less than a quarter of London's 3.2 million homes have a meter. Having a meter helps consumers be aware of how much they are using and provides information to help control their bills.
 - Point 5. Change the way Londoners pay for their water. The current system does not encourage or reward water efficiency, nor sufficiently protect those who cannot afford to pay
 - Point 6. Continue to tackle leakage. A quarter of our water is lost in leakage – this is water we pay for but never receive. A one per cent drop in leakage would provide enough water for 47,120 people.

The National Infrastructure Assessment: Call for Evidence

Wessex Water Services Ltd Response, February 2017

Introduction

Wessex Water is the regional water and sewerage business serving 2.8 million customers across the south west of England including Dorset, Somerset, Bristol, most of Wiltshire and parts of Gloucestershire and Hampshire.

Within this Call for Evidence paper, we have focussed our response on the Water and Wastewater and Flood Risk Management questions; however, we have also provided information associated with the crosscutting themes and other topic areas. We believe that the infrastructure that we provide cannot be understood in isolation. There are wider infrastructure challenges that are representative of the area we serve and have impacts on our ability to operate. Therefore, we have provided some insights into current challenges around energy and digital communications.

We welcome the opportunity to share our ideas and challenges and to provide evidence to support the success of alternative approaches. Within this response there are five core themes, which are common across many sections, these are:

- The need for more integrated infrastructure planning and delivery across sectors and political boundaries- we are leading the way in this area through the production of an Adaptation and Resilience Plan within the Bristol Avon Catchment
- Recognition of the need for multi-functional greenspaces within developments to provide drainage, amenity and therapeutic spaces, delivering better living and working environments
- The need to change legislation around the 'right to connect' surface water to foul sewerage systems to ensure appropriate drainage solutions at a local level
- The need for good data in order to change behaviours and enable demand management options to succeed, we have provided evidence on the work we have done around wastewater measurement and demand management measures for public water supply.
- Operating at a hydrological catchment scale enables more holistic planning for drainage and flooding aspects, however this often requires operating beyond political boundaries that can be challenging despite the duty to co-operate between local authorities. Our Adaptation and Resilience case study highlights the advantages associated with this new and, we think, better way of working.

In terms of energy, as a water company this contributes to a significant proportion of our ongoing operational costs. Due to government policy and rising non-commodity cost elements of power bills, there will be a marked increase in our costs next year. For context, there will not be a commensurate increase in consumption levels due to our on-going commitment to energy efficiency across our operations. For example, next year's electricity bill will be >£2M more than this year due to these non-commodity costs. One in particular, the capacity market will add approximately £0.75M to our bills simply due to increased costs being levied on consumption between 4 and 7pm on winter weekdays.

With respect to digital communications, our activities are increasingly becoming more automated with the opportunity to monitor and manage treatment works remotely. In order to maximise these opportunities, in a way which would be better for our customers - in terms of incidence responses and lower staff time to travel and work on sites- we need good digital and telecommunication systems. Wessex Water operates across a largely rural area where 3 or 4G communication systems are not available or sufficiently reliable, reducing the opportunities for more remote solutions.

Question	Response and supporting evidence
<p>1) What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?</p>	<p>Water and sewerage infrastructure is essential to enable economic growth, to enable housing developments and industrial expansion whilst protecting public health and the environment. We operate within a region with a strong growth agenda, particularly in the West of England. Between 2001 and 2011 the population of the West of England grew by 9%, and by 2025, a further increase of 19% is anticipated.</p> <p>Sustainable water and sewerage services are essential to enable this growth.</p> <p>It is also essential that the planning and provision of this infrastructure are integrated with the longer term development plans to ensure that the assets are sustainable, constructed in the most cost efficient manner and are also resilient to future pressures such as a changing climate and economic variation.</p>
<p>2) How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?</p>	<p>N/A</p>
<p>3) How should infrastructure be designed, planned and delivered to create better places to live and work?</p>	<p>Wessex Water is leading a pioneer project bringing together the two Local Enterprise Partnerships (LEP) and two Local Nature Partnerships (LNP) within the Bristol Avon catchment to develop an Adaptation and Resilience Framework to enable further economic and housing growth. Further details are included in Appendix 1.</p>

<p>How should the interaction between infrastructure and housing be incorporated into this?</p>	<p>It is our aspiration that there is collaboration with other providers and strategic planners to develop a single infrastructure plan that delivers the needs of the catchment over a 25-year time horizon, taking account of development, transport and drainage needs in a sustainable, joined up way. The delivery and funding of such a plan would be collaborative to maximise the skills, expertise and commercial advantages of the individual organisations to deliver efficiencies to customers.</p> <p>Infrastructure needs to be designed, planned and delivered through a holistic systems approach with greater understanding of the risks and opportunities across sectors and political boundaries at the appropriate scale (hydrological catchments). This includes housing, transport, flooding, public health, green and blue infrastructure to enable the most beneficial solutions and efficiency delivery. The integrated approach means that infrastructure is planned with consideration to upstream and downstream constraints, opportunities and receptors, rather than in isolation.</p> <p>The Adaptation & Resilience Framework for the Bristol Avon Catchment is a pilot project that begins to address these issues by bringing greater integration between sectors and organisations around spatial planning at a catchment scale by building up evidence at a sub catchment scale. The project provides a vehicle for multiple organisations (Environment Agency, the four West of England Unitary Authorities and Wiltshire County Council, West of England LEP and Swindon LEP, Wessex Water and Bristol Water, Wildlife Trusts, Catchment Partnership and Highways England) to plan for better-integrated solutions to shared risks.</p> <p>We recognise the wide value of more integrated and sustainable drainage solutions. The use of more sustainable solutions, integrated with green and blue infrastructure, can provide multi-functional spaces within developments enabling space for amenity and recreation, alongside drainages, flood attenuation and water treatment.</p> <p>Albion Water (which is 51% owned by Wessex Water) has been working with developers to enable improved water, waste and drainage planning at the early stages of the development. This results in more sustainable solutions and reduced bills for the homeowners. This also enables provision for multi-function space within the master planning to enable sustainable drainage and green spaces to improve amenity and recreation.</p> <p>https://www.albionwater.co.uk/developers/our-projects/upper-rissington-gloucestershire</p> <p>There has been much research that highlights the benefits of nature and greenspace to health and wellbeing, e.g. Marmot Review, Royal Society of Wildlife Trusts and MIND, have all commissioned research to evaluate the benefits provided.</p>
---	---

<p>4) What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?</p>	<p>Demand management for water supply services</p> <p>A key aspect of our Water Resources Management Plan is to reduce the demand for customers: https://www.wessexwater.co.uk/waterplan/</p> <p>We aim to continue to reduce demand and leakage by accelerating metering in our region by installing meters in households when customers move house and by providing enhanced water efficiency services to help customers reduce their water use further.</p> <p>We have been increasingly making the link between water efficiency and affordability for customers. We offer free combined water and energy efficiency home visits to customers who are struggling to pay, and promote water meters where we think this will help.</p> <p>Our customers consume on average 143 litres per person per day and just over half of households have a meter.</p> <p>Perceptions about our climate and leakage mean customers are often sceptical about the need to become more water wise. Almost all, however, are interested in ways that they can reduce their bill – or in other ways that they or their community can be rewarded to use less water. Customers typically feel they have little knowledge of, and control over, their water use and bill.</p> <p>While a majority of customers support an acceleration of metering there remains a vocal minority of unmetered customers who do not. Customers are generally in favour of smart meter technology, mainly because they believe it will enable them to make bill savings.</p> <p>However, we recognise that there needs to be a twin track approach between demand management and the provision of supply side interventions.</p> <p>Demand management for sewerage services</p>
---	--

	<p>Demand management is seldom used for sewerage/drainage services due to a lack of measurement technology that is affordable, accurate and reliable. However, at Wessex Water we believe it can be with the advent of new technology.</p> <p>Without measurement, it is not easy to send out demand management signals. To address this, Wessex Water have been behind the development of a unique wastewater meter that has the ability to be used for fiscal charging purposes at a domestic/business level. With this sort of measurement, price signals can be more easily used to encourage demand management. Whilst this technology is still in its infancy, its potential nationally is massive.</p> <p>http://www.dftl.co.uk/in-the-press/leicester-mercury.html</p> <p>https://www.instituteofwater.org.uk/news-post/wessex-water-wins-the-institute-of-water-national-innovation-award-2015-sponsored-by-mwh/</p>
<p>5) How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?</p>	<p>Decisions about maintenance levels are usually driven by risk and delivery is about cost effectiveness whilst maintaining levels of service.</p> <p>Decisions about construction of new assets is usually driven by the requirement to meet higher standards of service or resilience.</p> <p>Within a finite pot of funding, we believe priority should be given to maintenance. New assets should only progress if demonstrably cost-beneficial for the bill payer or environment.</p>
<p>6) What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?</p>	<p>Competition between suppliers generally results in lower costs of delivery. Ofwat, the economic regulator of the water industry, recognises this and it has developed policies that are intended to facilitate the development of new markets in water trading and bioresources (sewage sludge).</p> <p>Government policies could encourage the development of new markets for drainage and flood defence infrastructure, with water companies bidding (alongside each other and all other potential suppliers) to provide solutions at a local and regional level.</p>

Companies exposed to broader objectives (such as the provision of drainage and flood defence infrastructure) will need to be compensated for investments undertaken, particularly if these social objectives are not funded through a regulated price control. Water companies are required to reduce internal and external flooding through outcome delivery incentives, which form part of their regulated income because these outcomes are directly related to customer service. Were water companies to bid for work in the supply of drainage and flood defence infrastructure, the income from this work would be unregulated but if the solution offered, were in the same catchment area, customers of the water company would, no doubt, benefit directly from the reduced risk of flooding.

Collaboration between utility companies might provide opportunities to improve the supply of infrastructure services. For example, the delivery of a new road might allow for additional infrastructure (mains water pipes, telecoms cable laying, etc.) but this would require better information sharing and an understanding of proposed investments across the area.

The integrated strategic infrastructure plan referred to in question 1, could provide a higher-level view of maintenance requirements and enable the opportunity to work with other infrastructure providers to identify co-ordinated approaches. For example, working more closely with the Lead Local Flood Authority and the Environment Agency around the repair and maintenance of local drainage or flood defence assets could identify efficiencies by planning and undertaking the required work at the same time. We are beginning to work in this way in Wiltshire by co-ordinating our flood risk efforts within one combined team in Wiltshire Council, co-funded by Wessex Water.

Leading on from a combined infrastructure plan, a maintenance plan could be developed. It should be noted that there are many assets that require the same skill sets to maintain, whether that is mechanical and electrical skills, pipe cleaning or rehabilitation/replacement or grounds maintenance work (e.g. maintaining parks and SUDs). In some instances, this could be shared amongst relevant delivery partners and co-funded, for example, drainage and flood defence assets operated by water companies, LLFAs and the Environment Agency.

We strongly believe in advocating collaborations and partnership approaches to delivering innovative and shared solutions. This is demonstrated through our strong support of the Dorset and Bristol Avon catchment partnerships. More information is available here:

<https://www.wessexwater.co.uk/dorset/>

<https://www.wessexwater.co.uk/bristolavon/>

	<p>These Partnerships enable the wider discussion and understanding of shared issues to develop more innovative solutions, such as the Bristol Avon Adaptation and Resilience Framework and the EnTrade nitrogen offsetting platform which we have developed in Poole Harbour:</p> <p>https://www.entrade.co.uk/Content/4869%20EnTrade%20leaflet.pdf</p> <p>EnTrade is a nutrient-trading platform, which enables business-to-business transactions between farmers and the water company to reduce nitrogen leaching into groundwaters, therefore negating the need to provide expensive and unsustainable water and wastewater treatment systems.</p>
<p>7) What changes in funding policy could improve the efficiency with which infrastructure services are delivered?</p>	<p>We believe that the current funding policies enable a non-regulated part of a water company to bid to deliver infrastructure services for other providers, such as Environment Agency or Local Authority flood defence structure construction should it wish to.</p> <p>The current Grant in Aid mechanism for flood defence provision precludes a regulated water company from bidding for these construction contracts but this is not the case for non-regulated construction or maintenance businesses that have been established.</p>
<p>8) Are there circumstances where projects that can be funded will not be financed? What Government interventions might improve financing without distorting well-functioning markets?</p>	
<p>9) How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increased</p>	<p>Greater integration across sectors in planning, operational and maintenance plans outlined at a catchment and sub catchment scales would bring a greater awareness of shared risks and opportunities to mitigate against risks upstream and downstream in individual catchments and across the whole catchment. Collaborative working aligning</p>

interdependence across sectors?	plans would bring a greater understanding of the weak points in the system the interdependent risks. Refer to earlier question & case study.
10) What changes can be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?	<p>The current planning system is insular and constrained by political boundaries.</p> <p>We believe that by planning at a wider scale, such as at hydrological catchment scale, it would enable more holistic solutions to be developed and promote a better understanding of the in-combination upstream and downstream effects of developments. For example, the knock-on impacts of housing developments further up the catchment can lead to greater flood incidents further downstream, or not recognise opportunities for more natural flood management systems for flood attenuation much further up the catchment. This is a key theme addressed through our Adaptation and Resilience Framework (Appendix 1).</p> <p>The planning system and infrastructure governance done at a catchment and sub catchment area with greater integration across sectors would bring awareness of how upstream activities can affect downstream assets etc. Decisions with an understanding of the wider identified risks, costs and routes to delivery would result efficient delivery of infrastructure.</p>
11) How should infrastructure most effectively contribute to protecting and enhancing the natural environment?	<p>Climate change impacts mean that infrastructure may become increasingly more reliant on the ecosystem services provided by the natural environment in terms of reducing flooding and impacts from high temperatures. Holistic master planning with opportunities for low carbon transport adjacent to well-connected green spaces that connect the natural environment both inside and outside urban areas can provide multifunctional landscapes, which can address multiple risks. Water, climate and health sensitive urban design should lead the design of infrastructure.</p> <p>The ‘right to connect’</p> <p>A key issue that continues to exacerbate adverse environmental impact from new development is the continuing ‘right to connect’ enjoyed by developers. Whilst the Government’s original plan was to remove this under the Floods and Water Management Act 2010, Schedule 3 of the Act has never been enacted in England (whereas it has been in Wales). The right to connect enables developers to connect surface water run-off from new development into combined sewers on affordability grounds i.e. if they consider it too expensive to send surface water to a surface</p>

	<p>water receiver such as a ditch or watercourse or to ground, then they have a right to connect to a nearby public foul sewer.</p> <p>The consequence of this is a cost avoidance from the developer, which is passed onto the existing regulated sewerage customer, greater combined sewer overflow spills and increased risk of downstream sewage flooding.</p> <p>This is unsustainable development as the development is not paying for the cost that it incurs.</p> <p>Whilst we do not believe there is a need to remove the right to connect new foul sewers to existing public foul or combined sewer network nor indeed surface water from surface water sewers (the sewerage company has a duty to provide this additional capacity). However, it is critical to prevent surface water from new development to be allowed to connect into combined/foul systems due to ‘affordability of development’ issues. See recent article from experts supporting this view: http://wwtonline.co.uk/news/separation-of-stormwater-‘key-to-health-of-sewer-networks-3386#.WJH1Q01vhD8</p> <p>As mentioned previously, we believe that greater provision of sustainable drainage systems, natural flood management and nutrient / biodiversity trading platforms have the potential to address many of these issues at source and promote a better environment as a result. Typically, these options will be less expensive to operate over the longer term. Further details on the application and advantages of sustainable drainage systems can be found at:</p> <p>CIWEM report on SuDS susdrain website CIRIA SuDS Manual</p> <p>Albion Water is currently demonstrating more sustainable options for water and waste management on new developments. (Question 3). This includes the provision of greywater and rainwater harvesting as an integral part of development planning. Integration of these options at an early stage reduces the environmental impact of the development.</p> <p>A good example of how infrastructure investment across different companies can lead to enhancement of resilience of supply services as well as enhancement of the environment can be found in Appendix 2.</p>
12) What improvements could be made to current cost-	

benefit analysis techniques that are credible, tractable and transparent?	
22) What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?	<p>The water sector already has an effective mechanism through the Water Resources Management Plan. However, we recognise that 5-year investment plans can be a blocker to larger supply side options, e.g. an additional resource in the Thames Water area. High investment supply side projects tend to be delayed in the hope that small scale demand management options can fill the gap in the interim. Wessex Water was unusual in having a Water Supply Grid funded over an 8 year (2 AMP period), further details are available in Appendix 3.</p>
23) What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?	<p>Our experience is that new development is often placed ahead of sustainably drained new development. This is because drainage matters and the cost consequences for ensuring that satisfactory arrangements have been made for sustainably drained new development are often considered too late in the planning process. Sustainable drainage often (but not always) requires more space and can sometimes require greater investment to ensure the right infrastructure is provided.</p> <p>If, however, recognition of these needs are not made early on at the viability stage of new development, shortcuts and non-ideal solutions are often made to shoehorn drainage provision in as more of an onerous afterthought and costly inconvenience rather than an integrated and often value-adding element of a new development.</p> <p>Recent changes in governance have enabled greater consultation and discussion amongst responsible bodies but there is still limited joined up delivery on the ground.</p> <p>One body responsible for drainage functions would be an improvement- recommendation from Environment, Food and Rural Affairs Committee.</p>
24) How can we most effectively manage our water	<p>Planning, operational and maintenance plans across sectors done at a catchment and sub catchment scale. This can bring greater awareness of risks/faults in the systems, which may affect other infrastructure providers or other</p>

<p>supply, wastewater and flood risk management systems using a whole catchment approach?</p>	<p>organisations, which could be resolved more efficiently by others or by pooling budgets with multiple organisations. More integrated master planning that create water, climate and health sensitive places can have multi-beneficial solutions beyond water and flood risk management systems. Appendix 1 details the work in the Bristol Avon Catchment.</p> <p>Wessex Water is the first water company to trial an innovative Catchment Permitting option for reductions in phosphorus discharges from our sewage treatment works at a large geographical scale. This solution has enabled phosphorus removal to be delivered under the water Framework Directive. Due to the disproportionate cost exemptions within the Directive a traditional solution at individual sites would have failed the cost benefit assessment. This catchment scale solution delivers the required phosphorus reductions at a cost of £20m less than the traditional approach: https://gis-services.wessexwater.co.uk/storymaps/environment/stour/documents/Investigations/4688.pdf</p>
<p>25) What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?</p>	<p>Wessex Water has managed flood risk using a risk matrix approach for a number of years. See diagram below.</p> <p>It works on the principle that where impact/consequence of flooding is higher, acceptable standards of protection should be higher.</p> <p>All properties/areas that have experienced flooding and lie above the line of acceptable risk form part of the prioritisation process for investment to reduce risk. Company targets are set based on a total risk score, which is made up of the sum of all the risk scores from each part of the risk grid.</p>

Flooding Risk Matrix: Number of Properties / areas				Impact					<table border="1"> <thead> <tr> <th>Nr of Properties /areas above the line of acceptable risk</th> <th>Total Risk Score</th> </tr> </thead> <tbody> <tr> <td></td> <td>51509</td> </tr> <tr> <td>407</td> <td>10943</td> </tr> <tr> <td>662</td> <td>14864</td> </tr> <tr> <td>432</td> <td>12232</td> </tr> <tr> <td>607</td> <td>11590</td> </tr> <tr> <td>188</td> <td>1880</td> </tr> </tbody> </table>		Nr of Properties /areas above the line of acceptable risk	Total Risk Score		51509	407	10943	662	14864	432	12232	607	11590	188	1880
				Nr of Properties /areas above the line of acceptable risk	Total Risk Score																			
					51509																			
407	10943																							
662	14864																							
432	12232																							
607	11590																							
188	1880																							
Very Low					Very High																			
Fields (Surface water) Minor Garden (s/w) Roads (Surface water)		Major Garden (Surface) Fields (Combined)		Road (Combined) Minor Garden (Combined)		Major Garden (Combined)		Internal																
2		3		5		6		10																
Probability	Very High	5	2:10yr	19	31	196	133	28	407	10943														
		4	1:10yr		45	368	189	61	662	14864														
		3	1:20yr			13	44	375	432	12232														
	Very Low	2	1:30yr				69	538	607	11590														
		1	1:50yr					188	188	1880														

Example of Flood Risk Grid used by Wessex Water to visualise and prioritise flood risk and investment prioritisation.

Such an approach could be adopted more widely than sewage flooding risk, and extended to be used for pluvial, fluvial, groundwater, coastal flooding risk.

Using a single approach to flood risk across the country and across the flood risk management organisations, could bring a cohesive and joined up approach to prioritising flood risk reduction investment across the UK.

26) What are the merits of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Greater communication, planning, and management between sectors is needed to address increasing climate change risks. Understanding of the upstream/downstream impacts allows us to plan more intelligent solutions which can be incorporated into the public realm and create better-designed spaces.

Natural Flood Management (NFM) may have a role in reducing peak flows or slowing down flows as we become more aware and begin to factor in ecosystem services provided by natural capital wider more integrated urban design

	solutions that address water, climate and health impacts should become more mainstream in the design of our infrastructure.
--	---

Case study: market approaches to resilience (Bournemouth resilience supply)

In the south of our region we have worked with Bournemouth Water to improve have improved the interconnection between our water supply networks, allowing up to 20 MI/d to be transferred in either direction should one company have an issue affecting the resilience of their supplies to customers. A significant improvement has been achieved in resilience by making each other's water infrastructure available for use by the neighbouring company should that be necessary.

Case study: smart abstraction licences – reducing the impact of abstraction on river flows while maintaining resilient water supplies

One of the key objectives of our water supply grid project is to reduce the amount of water we are allowed to abstract from the Hampshire Avon catchment. Detailed studies between 2005 and 2010 showed that if we were to abstract at our full authorised rate there would be a significant effect on the river flow and its environment. The reductions in authorised abstraction, 25 MI/d, will be implemented in April 2018 following the grid's completion.

However, as originally planned, these reductions would locally have reduced the resilience of our supplies. We would not have been able to use existing infrastructure to deal with short-term operational outages or rising nitrate levels at sources which are not subject to a reduction to improve river flows.

To maintain and improve resilience against these threats we developed revised abstraction licence conditions with the Environment Agency, which allow us to maintain abstraction for short periods to deal with operational outages and for longer periods when nitrate levels (and river flows) are high. While these revised abstraction licence conditions are very complex, they ensure that the environment is protected at the same time as ensuring that we avoid stranding assets that would make water supplies less secure.



Case study: The water supply grid

The water supply grid is an eight-year project to improve the security of supply for customers. New pipework is connecting areas of our region with a water deficit to areas with surplus water. This will allow us to continue meeting demand for water during drought periods as well as in normal weather conditions. It will also help us reduce the water we abstract as required in some places to improve river flows and protect their ecology.

The project comprises more than 25 new schemes across Somerset, Wiltshire and Dorset, involving more than 150 km of pipeline, 30 new pumping stations and 11 new storage tanks. The diagram shows the main new links, including a major north-south pipeline running from north of Poole to the centre of our region, and a number of smaller connections and extensions. By joining up our main supply pipes in this way, we are able to do a number of things at once: meet demands for water, deal with groundwater sources suffering from higher nitrate levels, and deliver environmental benefits without developing new water resources or providing additional treatment.

Careful construction is very important as our region is environmentally rich, containing many protected species and a variety of designated sites including Sites of Special Scientific Interest (SSSIs), County Wildlife Sites, World Heritage Sites and Areas of Outstanding Natural Beauty (AONB). We intend to build the new pipelines in ways that cause minimum disruption to local communities and minimise construction traffic movements.

So, we carry out comprehensive environmental and engineering surveys, which help us understand and address environmental and community considerations, both during design and construction. We use construction techniques such as trenchless technology to pass under sensitive river locations, railways and major roads, and we re-use excavation and construction materials where feasible.

We are consulting local interest groups and members of the public to ensure their views are incorporated into pipeline routes and the design of new buildings. The project, which began in 2010, will be completed in 2018, with some elements finished in 2013.

The project comprises more than 25 new schemes across Somerset, Wiltshire and Dorset, involving more than 150 km of pipeline, 30 new pumping stations and 11 new storage tanks.



The National Infrastructure Assessment: Call for Evidence - West of England Response

Summary

The West of England (WoE) is a significant driving force for economic growth in the UK. Growth has exceeded the national average over the past 15 years, productivity is highest of all core cities and the **region is a net contributor to the UK economy**. The region has a strong track record on innovation and knowledge-intensive industries, a growing workforce with high levels of skills, growing high value-added industries and considerable strength in export-heavy industries. The motorway, rail, air and port infrastructure make this a **truly super-connected city region** and this connectivity facilitates a high proportion of local businesses competing internationally.

However this success cannot be taken for granted. Recently productivity growth has dipped, growth has not translated into jobs post-recession and jobs created across growing industries have failed to offset big job losses in other areas. Crucially, the region's infrastructure is under strain:

- Housing availability is increasingly constrained, house prices in the West of England are the highest of any core city relative to median earnings
- Congestion and reliability of public transport is a growing problem; levels of congestion are amongst the highest in the UK, public transport plays a much smaller role than in other areas - only 6% of residents of the West of England use public transport to get to work.
- There is significant variation of broadband speed and connectivity across the region.
- And the workforce is set to grow a further 5.2% over the next 10 years, adding to the pressure.

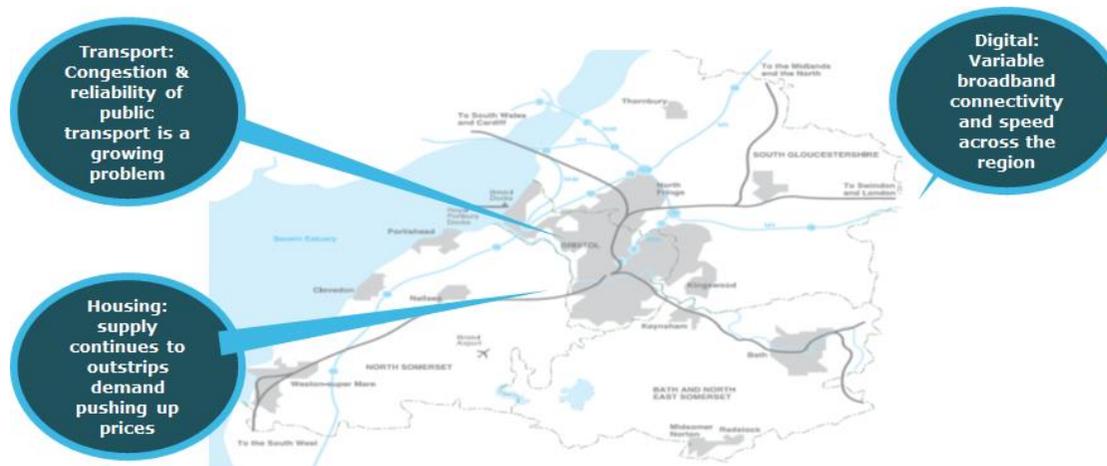


Figure 1: WoE Challenges

The West of England position as a transport hub means that problems on the region's road and rail network have knock on effects for neighbouring regions.

The West of England authorities are working together to address these challenges with **a strategy to plan transport infrastructure and houses together** – the first of its kind in the UK. This 'Joint Spatial Plan' (JSP) will be a Statutory Development Plan document that will provide a strategic overarching development framework for the West of England to 2036. Along with the parallel 'Joint Transport Study', these plans will allow strategic decisions to be made to deliver integrated housing, employment and transport opportunities so we can build sustainable, diverse communities which are well connected to job opportunities. The new West of England Combined Authority will play a crucial role in driving the strategic delivery of a high skilled, competitive local economy that facilitates inclusive growth for a diverse population and in which quality of life and prosperity is protected for future generations.

As an international gateway, a net contributor to the Treasury and a City-region with a new devolved governance, the West of England offers huge potential to test innovative and ambitious proposals to deliver effective infrastructure and identify the productivity and economic uplift arising. We are determined to ensure that the West of England continues to play its role as a key driving force for growth in the UK. We would like to work with the Infrastructure Commission on a focused piece of work to explore the potential for;

- **A funding pool to make our own strategic decisions** (arising from national and local strategic planning)
- **Building upon existing relationships and partnership work** e.g. Wessex water, HE funding into the Joint Transport Study, EA engagement with Avonmouth/Severnside and JSP
- **Piloting projects to test solutions locally;** some examples of possible projects are set out below but we would like to explore the options with the Commission.

As highlighted in detail in the Core Cities response to the NIC call for evidence, for places to work effectively it is crucial that infrastructure is seen in a holistic way. This is critical to avoiding the knock on effects that are obvious at a local level; such as the health and social care implications of vulnerable households living in inefficient homes that they cannot heat or power; or the economic and health consequences of a failure to invest in low carbon transport systems. It is vital that consideration of future infrastructure provision has regard to:

- Resilience – to climate change, geo-political events, etc.
- Efficiency and sustainability.
- Environmental & social standards – investment in infrastructure offers an opportunity to build high environmental and social standards in to the tender and design specifications, potentially building a competitive advantage in building low carbon infrastructure for the UK
- Interconnectedness of the regulatory system.

Background

The West of England covers the four unitary authorities of Bath and North East Somerset, Bristol City, North Somerset and South Gloucestershire. Centred around the cities of Bristol and Bath, the West of England City Region forms its own unique area with a history of global trade and connectivity, diversity of people and jobs, strong productivity, high-value employment, and a skills base to match with a proven track record of success. With an economy worth some £31.7bn, the West of England is a net contributor to the UK economy.

The West of England is a super-connected region both nationally and internationally. It is a motorway intersection serving the M4 corridor enabling powerful economic relationships through to Swindon, Oxford, Cambridge, London (East) and Newport, Cardiff, Swansea (West). Likewise the M5 connects the South West and the nationally significant energy projects at Hinkley and Oldbury and offers access to the Northern Powerhouse via the West Midlands.

Bristol Airport and Bristol Port offer growing international connectivity and both have significant growth plans, with the Airport seeking expansion from 10m to up to 20m passengers per annum, and additional deep water container capacity proposed at the Port. However, despite **Bristol Airport being named the UK's best performing airport** in January 2016 for a second consecutive year; plans to increase passenger numbers are constrained by the surrounding infrastructure, and the productivity growth of the Port risks being curtailed by the withdrawal of the rail electrification proposals.

The UK Government's recently published "Industrial Strategy" recognises that ports are hubs for employment and it suggests that improving connections to ports can help to promote trade and create jobs. **Bristol Port deals with imports and exports from almost every continent** and its West-coast position, close to the centre of the UK, makes it extremely attractive to customers seeking to move goods to and from the Midlands and M4 corridor. The Port is a multi-modal transport hub providing storage and processing facilities within its secure estate.

It remains crucial that Bristol Port's links by sea, road and rail are not compromised by conflicts with passengers and commuters and that congestion on the transport networks is addressed to maintain the Port's competitive advantages associated with rapid movements of cargoes to and from the Port.

Publication of the Hendry Review has been welcomed and its conclusion that any tidal lagoons in the Severn Estuary must not impact established commercial organisations such as the Port of Bristol, but we would caution against the conclusion that Tidal Lagoon Swansea should be seen as proof of concept. The Port of Bristol's potential sensitivity, as nationally significant infrastructure, to the future cumulative effect of massive lagoons in the Estuary, needs to be understood fully.

As a city-region **we would urge that developments further into the Severn Estuary are not permitted to proceed until the impacts on the Estuary are understood fully, and mitigation developed.** The unregulated development of Tidal Lagoons will have devastating effects on the environment and established users of the Estuary.

The West of England faces a huge congestion challenge with no resilience, which poses a significant threat to productivity and an increasing threat to air quality. Infrastructure provision through to 2050 increasingly needs to contribute to a modal change away from car dependency and supporting both public and low carbon transport. Delivering that modal shift requires a public transport system is reliable and an attractive alternative.

The region-wide Joint Transport Study undertaken by the 4 Authorities has already identified a **transport infrastructure deficit of more than £7.5bn** to meet the region's existing and future development needs to 2036, at least twice as much as the West of England Councils are currently spending on building transport schemes. The emerging Joint Transport Plan will need to address a compelling congestion challenge by expediting arterial and radial routes in and across the city region so as the local population can access local employment. Whilst funding can be sought through partnerships with the likes of Network Rail and Highways England and funding from developer contributions through the planning system, there will still be a significant deficit. Opportunities for financial incentives and financial approaches to demand management will need to be considered, such as built in charging mechanisms (e.g. car parking). The region will also look to further opportunities through devolution for local accountability of budgets and assessment of transport priorities. The establishment of a West of England Combined Authority for example and an annual Investment Fund of £30m will afford some **transport projects to be expedited with dedicated local funding** that was previously subject to costly and prolonged competitive national pots. Devolution is a significant opportunity to match expedited delivery with local accountability and one that the region would like to maximise.

Rail and rapid-transit offer the most ambitious opportunities for the region but also the most expensive and often with greatest risk. We have therefore provided below some very specific ambitions for rail in the region and **invite the Government to explore the West of England as a pilot region for an innovative new approach to the funding and delivery of local rail schemes**. Critical to the sustainability of the region will be the delivery of the electrification of the mainline, the redevelopment of Temple Meads Station and the delivery of our MetroWest Phases 1 & 2.

We are therefore working together with a range of strategic partners across the public and private sectors to tackle this infrastructure and investment deficit. The devolution of powers and money to the region from central government means we have responsibility for a local transport budget and a new Key Route Network of local authority roads that will be managed and maintained within the region and an investment fund to be informed by a robust and integrated statutory planning framework.

Affordability of homes in the West of England is also a critical issue with average house prices being between 7-9.5 times the average earnings across the Authorities. This is not an issue confined to the West of England but it is particularly acute here. Ensuring that our workforce has access to appropriate range and type of affordable homes in the right places to access employment opportunities is critical to ensuring sustainable economic growth. The JSP will provide the framework to deliver up to **105,000 net additional new homes between 2016 and 2036** of which, around 32,200 (30%) should be affordable homes. The four authorities' existing Core Strategies make provision for some 66,000 dwellings meaning there are up to 39,000 additional dwellings that

need to be planned for through the JSP spatial strategy. We need to explore the mechanisms for delivery and how to address the shortfall of delivering affordable homes in particular social rent products that can help to provide housing opportunities for all of our workforce.

The distinctive regional geography also offers opportunity, with the expansive Severn Estuary already subject to two nationally significant **nuclear projects set to provide 12% of the nation's energy**. The Estuary also affords opportunities for **innovative energy solutions, combined with flood defence schemes** that can open economically viable areas of the existing floodplain.

Case Studies & Specific Proposals

The rest of this submission sets out some examples of the sorts of case studies that we would like to discuss with the Commission. These highlight some of the key infrastructure issues faced in the region where involvement from the infrastructure commission could provide support to unblock progress.

1. Commitment to support for the delivery of the infrastructure to relieve the £7.5bn deficit identified by our Joint Transport Study.
2. Create a pilot with the WoE that looks at funding alternatives linked to the delivery of local rail schemes, to create an equal risk and reward framework that will encourage more third party investment in the rail network.
3. A national infrastructure approach to the provision of heat networks; energy efficient investment in UK homes supported by a zero carbon approach to planning policy and building regulations; single infrastructure budgets to deliver place-based solutions; national research into maximising energy demand management; additional revenue support for innovative energy projects; development of demand-side measures on the local electricity networks
4. Resource to deliver a water drainage strategy which meets new demand and fulfils drainage, health and environmental issues collectively
5. Create an Integrated Catchment Management approach with all key stakeholders to create an Adaptation and Resilience Framework that enables greater awareness of the integrated risks between sectors. Complemented by expansion of an innovative catchment based social prescribing demonstration project to improve the public health, water quality and amenity provision across a large geographical area.
6. A package of digital infrastructure measures to enable the region and the country to compete internationally

Transport case study: Better aligning the risks and rewards of investment in rail improvements

The rail network in the West of England has the potential to provide a catalytic change in travel behaviour, provide a focus for urban redevelopment around existing and new stations and be better linked to other modes to enable a truly multi-modal transport network. The West of England has carried out extensive modelling to define the first set of improvements (Metrowest Phase 1 & 2) in partnership with Network Rail and is continuing to plan for the future with Network Rail as part of the West of England Joint Transport Plan.

Unlike other forms of infrastructure, the planning and delivery of new and improved rail infrastructure is more complex and more difficult to link to financial beneficiaries in order to generate private sector contributions to new schemes. Equally the relatively short return periods used when calculating economic benefits suppress BCR and tend to favour other modes when attracting DfT funding.

The West of England rail network also serves as a strategic cross roads for rail at a national level and the interaction of local and national services results in the infrastructure upgrades required to expand local services, having to fund signalling and permanent way improvements on the 'national corridors'. While this is not unreasonable, the additional benefit to Train Operating Companies in increasing passenger supply for national routes is not factored into or recycled back to fund the scheme. These issues make Local Authority funded rail improvements difficult to deliver with all risks placed on the promoter and no financial upside should the scheme be successful.

It is clear to us that change is needed to how third parties and in particular local government, channel investment in the national rail network. The current arrangements all too often force local councils to be the sole promoter of a scheme, exposing the council to all the costs and all the risks in a context of a network that is owned, regulated and operated entirely separately from the councils. The result of this is the promoting council has very little control of the cost and the risks of the scheme and is reliant on Network Rail to develop the scheme and manage the design development. Clearly local councils are not best placed to be the sole promoter of a rail scheme, but they do have a role to make worthwhile investments in the network. One of the key recommendations of the Shaw Report 2016 was that Network Rail need to lever in more investment in the network from third parties including local government. However **the current system places 100% of the cost and risks upon the third party promoter, which in our current experience is difficult to manage given the lack of control and input we have into the delivery process.** The current model will probably not deliver the scale of investment from third parties, advocated in the Shaw Report. The model needs overhauling to **maximise the potential for leveraging in third party investment, where costs and risks are shared between the third party and Network Rail.**

- What is the proposed remedy?

In order to overcome this the NIC should consider how the funding and delivery of Local Rail schemes can be speeded up and developed to create **an equal risk and reward framework to encourage more third party investment in the Rail Network**. Equally the ability within the **planning system to link the funding of the scheme to direct and indirect beneficiaries of the scheme** would accelerate delivery. Using our experience as third party promoter of rail schemes over several years, we have set out in **appendix 1**, a mechanism for how costs and risks could be shared between the third party and Network Rail. Ultimately the rail industry must be structured in such a way to deliver projects on time and on budget.

- How does this fit with the national context?

Many other City Regions have similar transport infrastructure issues to resolve and rail has the ability to provide long term sustainable solutions that would create a significant behavioural change. When looked at in a multi-modal context, **rail is normally the preferred mode for medium and long distance journeys** due to its ability to move large numbers of people quickly to a single point.

- How does this address the objectives of the National Infrastructure Commission (i) support sustainable economic growth across all regions of the UK, (ii) improve quality of life

Future employment growth is likely to be focused in city centres, major towns and in sector clusters out of town, the expansion of the local rail network to **move people quickly and with resistance to congestion over the long-term**, to these locations, supports sustainable growth.

- What will the benefits be locally?

Metrowest Phase 1 & 2 have been designed to **reduce the use of private cars on existing transport corridors to free up road space for bus rapid transit and cycling and crucially reduce some existing congestion hotspots on the strategic road network**. Proposals for further targeted expansion of the local rail network would aim to increase this impact further.

Energy case studies

- What is the issue?

The energy infrastructure of the UK is currently experiencing radical change as it continues its journey from a centralised system reliant on fossil fuels to a **decentralised and embedded energy system, with more intermittent renewable generators and fuels for power, heat and transport**. In addition the

effects of smart digital technological advances experienced by other industrial sectors e.g. high street retail, have yet to be implemented within the sector, but will undoubtedly transform the provision of energy services within the UK.

The West of England has long been recognised as being a centre for the new sustainability and environment entities established in the later quarter of the 20th Century, along with being a leading UK centre of excellence for digital technologies (e.g. SetSquared). It is the collaboration of knowledge-based and innovation companies within the region that will drive the new business arrangements and opportunities within the energy sector, which the region is attempting to capture through **the development of sustainable energy, growth and digital infrastructure**. The WoE is doing this because it reduces carbon emissions, increases local wealth, reduces the social and health impacts of a fossil fuel energy system (e.g. air quality, fuel poverty), increases the security of supply thereby attracting industry and commerce and improves the quality of life for our residents, thereby making our region more attractive for inward investment.

- What is the proposal?

There are a number of principal infrastructure and policy interventions that can make a significant difference to the provision of sustainable energy and growth for the region. These are as follows;

a) Heat networks

The development of infrastructure should be considered in the context of efficiency and the delivery of heat, which represents 45% of the final UK energy demand. **The WoE would like to see a national infrastructure approach to the provision of heat networks**. These allow delivery of heat to be undertaken in the most efficient and low carbon manner, while improving the overall efficiency, resilience and capacity of the UK energy system through the increased use of combined heat & power plants on heat networks. In Bristol we are currently developing two heat networks within the city centre either side of the floating harbour, while at a regional level we are currently investigating the development of a heat network in Avonmouth that would bring waste heat from our industrial processes to the City centre via the new developments in South Gloucestershire around the former Filton Airport to the north of the city.

b) Energy efficiency

The WoE strongly support the UK Green Building Council's well evidenced response to the NIC's call for evidence in autumn 2015 for a wide-scale and deep retro-fitting of energy efficiency measures to homes. We suggest that **energy efficiency investment in UK homes** should be seen as an infrastructure investment.

In addition to retro-fitting, a clear and strong policy decision is needed now regarding **zero carbon planning policy and building regulations** as they are impacting on current building stock and currently acting as a barrier to zero carbon solutions. Current building regulations and design standards are also resulting in building stock which will constrict the extent to which zero carbon solutions can be delivered over the next 50 years.

c) Regulatory change

The UK currently has a silo approach to infrastructure from regulators whether government or OFregulators. For example: Bristol is seeking to develop holistic cross-discipline infrastructure solutions to build a resilient and 'future city', the prime example of this being the Temple Quarter Economic Zone (TQEZ), where the Council is interlinking local and national transport, city physical and economic development; research and academic capacity and utility heat and superfast broadband infrastructure, to build an economic zone which creates sustainable, future resilient economic growth over this century. However, this is against a backdrop of regulation which is established to achieve economic efficiency within its "silo" rather than economic efficiency across a programme of place-based infrastructure. **The WoE strongly advocates place-based single infrastructure budgets / programmes to enable holistic and efficient development of placed-based infrastructure.**

In addition, the WoE assert that local authorities should be a statutory consultee to other utility and infrastructure entities investment plans to ensure that these investment plans overlay and interlink with the economic development and growth plans of the region.

d) Smart systems

The UK is well behind its international competitors in the delivery of full fibre infrastructure to the premises. Portugal and Spain has 60% coverage compared to 2% in the UK. This is already impacting on our reputation as digital leaders and in the medium to long term, will impact on international inward investment decision making unless it is addressed. The recent NESTA Digital City Index confirmed none of the UK cities surveyed scored highly on digital infrastructure because of this.

In this context, the WoE would welcome **opportunities to accelerate investment through the Government's Digital Infrastructure Investment Fund**, whilst recognising the £400m funding allocation for the whole of the UK is relatively small compared with the size of the task. It will therefore likely have to be targeted at Cities to deliver the best return on investment. Further investment will be needed in fibre moving forward in order for WoE to remain competitive with peer cities in Europe. The public sector has an important role in facilitating this through aggregation of demand.

In terms of the energy system specifically, the WoE would suggest that the maximum potential for demand management is yet unknown. As a country we have yet to fully integrate advanced software in terms of the internet of things and also in behavioural demand response. **We would strongly advocate a**

range of quick separate research lines of enquiry across a range of academic disciplines into the potential. It should also be noted that many of these possible interventions in the demand side will be at the local level and will require involvement of local government in a number of capacities, there is significant risk to this as public sector finances across the country are under increasing strain.

However, the introduction of smart meters in the domestic market has provided the ability to understand usage and enable utilities to understand consumption, thus allowing the potential to change payment processes/structure e.g. to 30 minute pricing. This facilitates moving consumer demand to high cost and low cost, thus pricing can be used as a mechanism to shift energy consumption to more appropriate times of the day e.g. less demanding times. Through smart metering we may encourage residents to be more energy efficient e.g. turn off lights.

e) Funding allocations

The WoE would assert that there are a considerable number of **energy infrastructure projects and programmes that are “stuck” in the development pipeline due to the human resource capacity constraint in terms of skills, numbers and experience** within both the public and private sector. The principle area of difficulty is in the pre-feasibility / development phase of any programme. To that end we advocate that public sector funding, or funding to the public sector should include small elements of **revenue funding to unlock the pipeline** based on a five to ten leverage factor i.e. for every £1 of public sector grant would leverage five to ten of project value, which could be both public/private funded projects. **A combined grant and pre-agreed / authorised loan facility would enable projects to be enacted quickly.**

In addition to any new interventions, government energy policy needs to stabilise as energy projects in particular are struggling to secure investment as **policy uncertainty around subsidies etc. means investors are not willing to commit to long term projects.**

f) Demand-side

The WoE recognise that we can play a significant positive approach to assisting **the development of demand-side measures on the local electricity network** and increasing the take up of embedded generation systems.

Demand side management and embedded generation will be key to a flexible and robust electricity system in the future. **Micro generation at the local or community level will form part of the energy mix** underpinned by a centralised base load of gas/nuclear generation when required. Wherever possible embedded generation linked to energy storage will be able to increase the length and frequency of demand side management, allowing the National Grid to increase the flexibility of the energy system.

The WoE would strongly advocate that **all the scales of demand side response are appropriate for future energy storage technologies**. Technologies employed at the transmission and distribution levels will provide additional levels of redundancy and contingency scales and allow the Grid to balance the energy mix at times of stress. The domestic scale will be able to benefit hugely from localised energy storage, which depending on type – battery, hot water or phase change materials – will allow householders to have a level of energy independence which when aggregated nationally can be used to shave peak demand where required. We have already installed batteries at the domestic scale linked to embedded generation.

- How does this fit with the national context?

Without a fundamental change in the energy system across power, heat and transport then sustainable growth will not be attainable and will ultimately lead to the UK missing its greenhouse gas emission targets. On a global scale it will be a small-scale contributor to the acceleration of climate change and the resulting economic, social and environmental impacts.

- How does this address the objectives of the National Infrastructure Commission (i) support sustainable economic growth across all regions of the UK, (ii) improve quality of life

The provision of the locally embedded and decarbonised energy systems linked to smart digital systems support the provision of sustainable economic growth and improved quality of life for the residents and businesses of the WoE. In addition, it continues to **support the region's leading edge industries** and entities within this region.

Water supply and demand case study: Resourcing Water Drainage Strategy alongside the Joint Spatial Plan

- What is the issue?

The West of England has ambitious growth plans as set out in the emerging Joint Spatial Plan (JSP). A key objective is to ensure that new development is properly supported by and aligned with the necessary infrastructure in a timely way. This includes both water supply and drainage. Discussions with infrastructure providers have indicated that **substantive network improvements are required to support the scale of development proposed**. This is particularly an issue for urban extensions and new settlements which will require significant network development. Bristol & Wessex Water are responsible for the delivery of water supply and sewerage treatment in the West of England, and like all utility companies, they are required to produce **5-year business plans** for approval by OFWAT. This **short time horizon is not helpful** in the context of JSP / planning for growth and providing certainty to the development industry over 20 years

- What is the proposed remedy?

The West of England UAs are preparing an Infrastructure Delivery Plan (IDP) to accompany the JSP and address the issues raised above. **Additional resource to address the water drainage part of the IDP would be beneficial.** This would enable formulation of a water drainage strategy which meets new demand to enable the timely progression of development in an innovative way. This approach would enable **a plan for the expansion of the water drainage network to support the growth locations in an efficient way.** This could include;

- the establishment of a multi-disciplinary agency to strategically oversee the management of water and waste water (such as the Dutch Water Boards¹) to bring together the currently fragmented stakeholders and silo operations. the closure of some treatment plants which would help enhance the viability & good planning of some locations and the expansion of other plants which would facilitate the most efficient operation of network
- Inclusion of multifunctional drainage mechanisms which help to mitigate climate change & provide green infrastructure (eg SuDs), which facilitates active travel modes & recreation
- Improvements to the water drainage system embedded in the new strategy for growth which is robust for the very long term to avoid the needs for ongoing, expensive ad hoc interventions with reduced maintenance costs and long term reliance.

- How does this fit with the national context?

This plan would help to **deliver economic growth and accelerate the provision of new housing** as well as facilitating preventative health objectives, for both physical and mental health.

- What will the benefits be locally and how does this address the objectives of the National Infrastructure Commission? (i) support sustainable economic growth across all regions of the UK, (ii) improve quality of life

¹ Dutch Water Boards levy their own taxes (through pollution) and receive central government finances. They are responsible for quality of surface water (canals, lakes, ponds and streams), policy making, planning and building, issuing permits and treatment of sewage.

The supply and affordability of housing in the West of England is one of the key challenges facing the city-region. A multi-disciplinary and longer term approach to water drainage will enable the provision of new housing and maximise development viability which facilitates the support that can be given to achieving the optimal development outcomes and enhances the quality of life for existing and new residents

Catchment Area Planning Case Studies: Adaptation and Resilience Framework Pilot and Social-Prescribing Pilot

- What is the issue?

To improve efficiency and reduce duplication, infrastructure should be designed, planned and delivered through a holistic systems approach with greater understanding of the risks and opportunities across sectors and political boundaries. **The UK Climate Change Risk Assessment (July 2017) has identified Flood Risk and Heat Stress as the two high risk issues that need to be addressed in the next five years.**

Adaptation measures are required to protect infrastructure from loss of capacity, or failure, as a consequence of increased risk from flooding and heat stress. Such measures could include **increased investment in green infrastructure in key locations** to provide multi beneficial solutions and a related pilot is underway to tackle the growing threat of pharmaceuticals in the riverine environment. This 'social-prescribing' pilot will be dependent on well-planned, accessible green infrastructure.

Spatial planning done at this scale and with greater integration across sectors enables an understanding of the interdependent impacts of upstream land use changes on downstream assets. Stronger integration between sectors in strategic planning, as well as ongoing asset management and maintenance, can help mitigate against failure of multiple infrastructure systems.

Surface Water Flooding is currently the responsibility of unitary authorities resulting in different levels of technical understanding of the issues, data and possible multi-beneficial solutions as well as different levels of capacity and financial resources to address the issues. A catchment scale approach enables a coherent plan to be developed where expertise and resources can be pooled across unitary authorities and more targeted consultancy services can be brought in. The recent flood resilience review highlighted that there are gaps in how the business case for flood risk is made paying little attention to the transport, digital communication, and energy network corridors between properties.

- What is the proposed remedy?

The Adaptation & Resilience Framework for the Bristol Avon Catchment is a pilot project that begins to address these issues by bringing greater integration between sectors and organisations around **spatial planning at a catchment scale** by building up evidence at a sub catchment scale. The project provides a vehicle for multiple organisations to plan for better integrated solutions to shared risks.

The Adaptation and Resilience Framework enables a greater awareness of the integrated risks between sectors and at different levels within individual organisations, from strategic planning to asset management on the ground. It improves **sharing of data and mapping, enabling pooling of budgets to deliver collaborative and multi-functional solutions**. It enables issues to be addressed at source rather than by end of life costly solutions.

An integrated Catchment Management approach allows all parties to have sight of the competing demands for the provision of roads, cycle ways, pedestrian footpaths, on street parking and green infrastructure. This project does not require a significant overhaul of organisational responsibilities but rather facilitates improvements between organisational communication and planning and more efficient expenditure of resources. **Additional resource to pilot this approach across the catchment would enable tangible benefits to be demonstrated which could then be rolled out nationally** and through the Adaptation and Resilience Framework multiple organisations can begin to understand and plan for the wider risks from climate change.

The wider costs and potential solutions could be captured through existing planning processes such as the Strategic Flood Risk Assessments (SFRA) (stage 1 and 2) for new developments. By surface water modelling upstream from development sites as part of the SFRA, evidence can be built up to locate where the most appropriate areas for green infrastructure provision to protect development sites should be. It also provides a mechanism for developer to understand and contribute to investment in green infrastructure to protect development sites from surface water flooding.

Embedding principles around Green Infrastructure and sustainable urban design can address issues of heat stress and flooding through incorporating integrated water, climate and health sensitive urban design.

Green Infrastructure also has a critical health role. Wessex Water is working with B&NES Public Health department, the University of Bath and a number of NGOs to test the effectiveness of social prescribing to improve societal health by offering alternatives to pharmaceuticals for those at risk from lifestyle conditions (e.g. Type-2 Diabetes, Obesity). The study is a snapshot covering a maximum of 70,000 people within the most deprived areas of Bath, working with three GP practices, over a four-year period. Without intervention, pharmaceuticals will continue to pass through to river systems through the sewerage network.

Social prescribing includes options such as walking, gardening, green gyms as well counselling, art groups and integration projects to offer exercise, social inclusion and support as an alternative to the prescription response. Strategic planning of green infrastructure is therefore hugely complementary to delivery. There has been much research from organisations such as Mind and the Marmot Review (2010) demonstrating the benefits of access to the

environment on societal health and wellbeing. However, in order for social prescribing to be effective receptors are required, these include the support networks, education and amenities which make access to greenspace easy and non-threatening to the public. In the WoE we would like to trial an innovative catchment based social prescribing demonstration project to improve the public health, water quality and amenity provision across a large geographical area. **A demonstration of this scale would cost £2.5m to deliver** and would link with a potential 'Innovative Catchment Trial' as part of the PR19 Water Industry National Environment Programme, described in the Environment Agency's Draft Chemicals Strategy.

By way of alternative, Wessex Water has identified that in order to broadly achieve the Environmental Quality Standards for pharmaceuticals across the Bristol Avon catchment, **approximately £550m capital investment would be required at sewage treatment works** serving more than 10,000 people. This would increase the average water bill by £200 per year, putting additional strain on customers and potentially driving an increase in anxiety and depression. It should be recognised that these end of pipe treatment technologies are energy and chemically intensive processes.

- How does this fit into the national context?

Planning at a Catchment scale is in line with the future direction of DEFRA outlined in the 25-year plan for the environment which is due to come out later this year and may become a recommendation in the National Adaptation Programme. This is also in line with the Climate Change Act 2008 where local authorities need to proactively plan with their partners Adaptation measures and is in line with many of the recommendations that came out of the recent Flood Risk review. It aligns with Defra's direction to water companies advocating the Catchment Based Approach.

Support for innovative social and early interventions can significantly reduce the expense of infrastructure resilience required to tackle the threats to river systems and catchment areas through the likes of pharmaceuticals.

- What will the benefits be locally and how does this address the objectives of the National Infrastructure Commission? (i) support sustainable economic growth across all regions of the UK, (ii) improve quality of life

The catchment based strategic planning alongside the JSP will enable co-ordinated local approaches to flood risk mitigation that supports the supply of land for housing and employment growth and for sustainable development of physical and green infrastructure that delivers a quality of life, addressing the emerging challenges to society.

Digital Case Study: Package of Interventions

- What is the issue?

Variable connectivity currently limits sustainable economic growth and the quality of life for residents in the West of England. An accelerated transition to ultrafast speeds and widespread availability of full fibre (fibre-to-the-premises FTTP) connectivity is required for its future prosperity, and to improve choice and competition in the market.

Improved connectivity has the potential to transform public services, such as tele-health, and **reduce public expenditure in the future**. The West of England has a strong knowledge-based economy which needs excellent connectivity to compete with developed economies currently making the transition to ultrafast and full fibre. Businesses across the wider economy in the region need good connectivity as the norm in order to invest and grow.

Within the West of England as a whole, OFCOM 2016 Connected Nations data shows:

Local authority	Super Fast Broadband % availability	% Indoor 4G coverage	Ultra Fast Broadband % availability
Bath and North East Somerset Council	83	55	0%
Bristol City Council	93	97	1%
North Somerset Council	82	62	0%
South Gloucestershire Council	92	77	1%

A significant amount of the West of England is rural and this is reflected in the data. However, even within the urban areas, significant connectivity issues exist for residents and businesses. The West of England has a growing alternative network sector specialising in full fibre connections, however the city-region's broadband infrastructure is still dominated by BT and Virgin Media. Many homes and businesses lack a choice in provider, particularly away from

our urban areas where BT Openreach dominate. Investment decisions by incumbent operators have been selective which has led to many business parks / trading estates being poorly served. **Market failure in SFBB provision has resulted in several thousand SMEs only able to access superfast speeds through an expensive, dedicated lease line.** These are often slow to install, subject to long contracts and have a high monthly cost. They therefore lack choice and competition in their business broadband offer. With the trends of cloud computing and the ongoing shift of processes online, connectivity is vital to the future prosperity of the city region's economy, our ability to attract future inward investment and retain existing sectors, e.g. digital and creative, many of whom are dependent on faster connectivity.

Digital connectivity plays an important role in social and economic inclusion. Approximately, 18k residents in Bristol alone lack access to superfast broadband, with many more across the West of England. Digital exclusion in turn leads to additional need for other infrastructure, such as transport infrastructure as people are unable to work from home, or from peripheral locations.

Public services can also benefit from improved digital connectivity, the West of England has been successful in transferring many services online and delivering efficiency savings. Research projects in the region are demonstrating the potential of a new generation of services which offer the potential to transform public service delivery. These services require a step change in connectivity and a universal service to avoid further exclusion for vulnerable groups with high service needs.

The West of England is already **a leader in the research and development of smart city solutions** – such as connected and autonomous vehicles, smart electricity grids and the internet of things. These emerging areas are being tested on the City Region's research and development testbeds, such as the Bristol Open Network. This enables businesses to develop and test new commercial services in a safe environment. However, it is likely that the **real world connectivity, speed, reliability and general quality of connections will need to improve if the economic, social and environmental value of this research is to be realised.**

- What is the proposed remedy?

A package of interventions could help the city-region address its connectivity issues and facilitate this transformation. We are already developing some of these as part of a strategic approach to connectivity across the West of England but require national action to deliver others.

- Ensure the whole of the West of England is covered by a Broadband Delivery UK (BDUK) partnership, currently Bristol City Council is not included. This restricts funding and connectivity provision within the city.

- Ensure that new developments are built with UFBB and fibre as standard and a 2nd choice of BB infrastructure provider to help develop a more competitive market. This will require support through revision of the National Planning Policy Framework.
- Full fibre voucher scheme (FFVS) for businesses and residents to help stimulate demand and create new market opportunities.
- Provide infrastructure subsidies for upgrades in areas of the City-region experiencing market failure with no superfast broadband offer and to ensure key infrastructure has been upgraded e.g. BT Telephone Exchanges.
- Community wi-fi concessions focussed on areas of high footfall and district centres. On-street wi-fi is known to help the economy to grow.
- Ensure the City-region's business parks and small trading estates have a FTTP offer and competition between providers. Extend the use of council-owned ducts to full fibre providers to raise revenue for councils and help them extend their networks.
- The West of England has exceptional research and development expertise in our universities and businesses and we have created a world class testbed in the Bristol Is Open (BIO) network which is currently being extended to create an Open Programmable City Region (OPCR). Continued investment in this testbed and in projects which can exploit it fully is needed.
- Investment in 5G is needed and the West of England presents a good opportunity for pilot projects exploiting the BIO/OPCR infrastructure to create a 5G wireless city centre and replicate this in other urban centres in the WEST OF ENGLAND.

In addition, this could be supported by

- Better use of existing national fibre networks e.g. Highways England, JANET and Network Rail to improve choice and competition in our local connectivity market by making better links to national backhaul networks.
- How does this fit into the national context?

The UK as a whole faces a productivity challenge; improved digital connectivity will result in **productivity gains for businesses**. It will also improve the **attractiveness of the UK as a location for inward investment**.

- What will the benefits be locally and how does this address the objectives of the National Infrastructure Commission? (i) support sustainable economic growth across all regions of the UK, (ii) improve quality of life

Improved digital connectivity will have a positive impact on sustainable economic growth within the West of England improving the quality of life for residents and the potential for the transformation of public services, with the **potential to reduce public expenditure in the future**.

Links and Additional Resources

1. Appendix 1: Working example of Rail Remedy (attached)
2. The West of England Joint Spatial Plan – Towards an Emerging Spatial Strategy Consultation

https://www.jointplanningwofe.org.uk/gf2.ti/-/756738/23366789.1/PDF/-/West_of_England_Joint_Spatial_Plan_Towards_the_Emerging_Spatial_Strategy.pdf
3. The West of England Joint Transport Study – Transport Vision Summary Document Consultation

https://www.jointplanningwofe.org.uk/gf2.ti/-/756738/23366789.1/PDF/-/West_of_England_Joint_Spatial_Plan_Towards_the_Emerging_Spatial_Strategy.pdf

West of England

Bath & North East
Somerset Council



North
Somerset
Council

South Gloucestershire
Council

Sir John Armitt CBE FREng FICE
Deputy Chair, National Infrastructure Commission
C/o City and Guilds
1 Gilspur Street
London
EC1A 9DD

Date: 22 December 2016

Reply to: [redacted] [name redacted]

Tel: [redacted] [phone number redacted]

Email: [redacted] [redacted]

[e-mail address redacted]

Dear Sir John

WEST OF ENGLAND REGION

Thank you to you and your colleagues on the Infrastructure Commission for visiting Bristol and for meeting with South West colleagues and with colleagues from the West of England region.

As West of England, we will be following up with evidence to your commission in the New Year but we wanted to reinforce the message that the West of England region should be considered as the centre of a highly productive economic region rather than as a part of the South or South West.

The West of England forms its own unique area with a history of global trade and connectivity, diversity of people and jobs, strong productivity, high-value employment, and a skills base to match with a proven track record of success second only to London. Yet, despite these attributes, possibly even because of them, successive governments have overlooked its promise with the risk that the region will plateau losing further growth for the benefit of all, and we're starting to feel the effects. A lack of investment into key infrastructure projects threatens to close the gate on growth at a time when the UK needs it most. We believe that it's time for policymakers to stop looking over our shoulder to the distant South West or to see our City Region as an outlier of the M4 corridor. We have a unique offer to the country and a significant role to play. Put simply, it's time to invest to put the Great Western Gateway on the map to help ensure Britain has a place on the global stage.

Our strategy to achieve this is simple and compelling. We are working together – the authorities of Bath and North East Somerset, Bristol City, South Gloucestershire and North Somerset, along with our Local Enterprise Partnership – to make the best case for investment so as to develop our strained infrastructure which holds us back from ever more success. We have created an integrated housing and transport plan so we can build sustainable, diverse communities that want to live and flourish here and contribute to the success of the West of England. We are attracting knowledge-rich businesses to invest here creating more jobs, more prosperity and more opportunity for people that live and work

in our region and for the country as a whole. We are integrating all of this with our universities to ensure we have the skills that meet the needs of our region and the needs of the employers that come here.

This seems so obvious. Yet it is unique. Other areas require heavy investment to regenerate and to get them to the starting blocks. Some have not come together for the benefit of their communities and are advancing disparate, poorly formed ideas. Some haven't even turned their attention to the importance of investment for growth. It is only the West of England that has a track record of success, a plan for delivering even greater opportunity, a united set of partners with a clear, consistent vision, and the geography required to trade [REDACTED]. The evidence in support of the West of England is overwhelming.

In [REDACTED] contribution to the UK has outperformed the national average: we generated £3,900 per person above other regions of England, making us one of the highest contributing Core City areas. That kind of performance has not happened by chance. Our region boasts one of the highest skilled workforces in the country owing to four universities that develop top talent, and our ability to attract and grow industries that keep our graduates in the area. The West of England has become an incubator for high-value sectors including advanced engineering and aerospace. Nearly a third of employees working in the area are employed in knowledge-based industries and tech manufacturing. Productivity in our City Region is the highest in the UK outside of London, and our region is far more than big business. SMEs born in the West of England have the highest survival rate in the UK.

Undoubtedly, ours is an area where highly-skilled people work, but it's also a region that a diverse population of people call home. The West of England continues to attract and retain residents who recognise our cities and towns as a gateway to a thriving art scene, an established creative industry and a reputation for bringing in the latest music talent: ours is a place where communities are forged as much through common interests as by proximity. These things combined have meant that Bath and Bristol regularly top national surveys identifying the best and coolest cities in the UK.

However, success is not without its challenges. Between 2001 and 2011, the population grew by 9%, more than in any other City region. By 2025, we expect our population to increase again by 19%. As the population grows, so too does the strain on our transport networks, housing supply and broadband connectivity. The effects are showing. Bristol ranks 6th of 17 cities on congestion, while house prices in the region are the highest of any Core City relative to median earnings.

The region is truly international with 56% of its business with annual turnover over £1m having subsidiary officers overseas and many businesses are connected to the world through Bristol Port and Bristol Airport allowing them to compete internationally. Now, more than ever, we want to make sure the gateway to international trade remains open, to the benefit of both our region and our country. Undoubtedly, ours is an area where highly-skilled people work. But it's also a region that a diverse population of people call home.

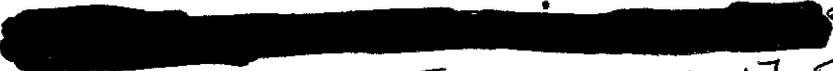
With the right investment and commitment from policymakers, we have the foundations in place so that, through the next decade, we can become the most prosperous region outside of London, and connected to the rest of the world.

The West of England looks forward to working with you and your colleagues in your important work for the Infrastructure Commission and we would be delighted to meet or speak again in the near future to discuss how we might work together to develop the infrastructure vision and plans for the West of England forward.

Yours sincerely



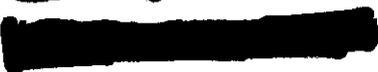
[signature redacted]



[name redacted] [job title redacted]



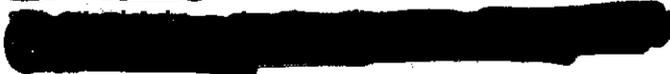
[signature redacted]



[job title redacted]



[signature redacted]



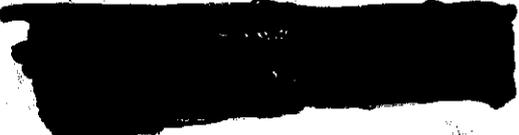
[job title redacted]



[signature redacted]



[job title redacted]



[signature redacted]



[job title redacted]



National Infrastructure Commission National Infrastructure Assessment Call for Evidence Submission from The Wildlife Trusts

1.0 Introduction

- 1.1 This submission has been developed by The Wildlife Trusts in response to the Commission's call for evidence to support the development of the National Infrastructure Assessment.
- 1.2 There is a Wildlife Trust caring for wildlife and wild places near you. We have a shared mission to create an environment rich in wildlife for everyone. We know that a healthy natural environment is the source of our prosperity and our wellbeing. We want to inspire people about the natural world so that they value it, understand their relationship with it and take action to protect and restore it. We are actively engaged in the planning system, promoting opportunities to improve the natural environment and review more than 60,000 planning applications a year. We have more than 800,000 members including 150,000 members of our junior branch Wildlife Watch. Every year we work with thousands of schools and our nature reserves and visitor centres receive millions of visitors. Each Wildlife Trust is working within its local communities to inspire people about the future of their area: their own Living Landscapes and Living Seas.
- 1.3 *A Living Landscape* is a recovery plan for nature championed by The Wildlife Trusts since 2006 to help create a resilient and healthy environment rich in wildlife and to provide ecological security for people. In *A Living Landscape* habitats are restored and reconnected on a large scale with the local community closely engaged. The vision is a primary objective of The Wildlife Trusts and builds on a groundswell of landscape-scale activity at a county level. The Wildlife Trusts have a long track record of delivering landscape-scale conservation. Across the UK there are now more than 150 Living Landscape schemes covering an area of more than four million hectares. These are being delivered in partnership with many different individuals and organisations, including farmers and landowners, water companies, land-based industries, local authorities, other NGOs, statutory agencies, local communities and volunteers.
- 1.4 We have an interest in this inquiry because any assessment of National Infrastructure must address nature and biodiversity considerations if planning is to fulfil its objective of achieving sustainable development¹.

¹ DCLG (2012) National Planning Policy Framework, Para 6

2. Key recommendations

By working with nature and not against it, the National Infrastructure Commission has a real opportunity to create a positive legacy by contributing to a healthy, sustainable and nature-rich future, which delivers multiple benefits for people, society and the economy. In achieving this, The Wildlife Trusts recommends:

- The commission's recommendations are founded on the five principles of sustainable development as set out in Government's UK Sustainable development strategy.
- Natural Infrastructure is recognised within the National Infrastructure Plan as a vital part of our national infrastructure and a priority for restoration alongside other infrastructure needs.
- Nature is incorporated into all major infrastructure development sectors and recognised as central to the decision-making processes of all developments.
- Infrastructure development is strategically and spatially planned, with local Ecological Network Mapping at the heart - to avoid damage to important natural assets and to maximise opportunities for natural solutions, restoration and enhancements.
- Rebalancing investment in flood defence and climate change resilience towards more sustainable natural solutions throughout the country.
- Greater levels of investment to support environmental retrofits to the existing road network are allocated in Roads Investment Strategy 2.
- Integration between the National Infrastructure Plan and local plans for housing to ensure new developments are well connected to essential services, transport and green space.
- The design of all new housing developments to incorporate green infrastructure and natural solutions that collect and capture water. With the nationally identified Garden towns and villages being exemplars of environmental sustainability and green infrastructure provision.
- All major infrastructure developments to:
 - have a visionary Green Infrastructure Strategy which sets out a measurable approach to achieve net gains for nature.
 - use the most up to date, locally relevant, ecological data and any survey data collected during development projects to be shared with local data providers.
 - have strategies for long-term monitoring of development impacts and mitigation/compensation requirements.
 - have strategies and funding for long-term management of green infrastructure.

3. General comments

- 3.1 This Government aspires that we will ‘*be the first generation to leave the natural environment in a better state than it inherited.*’ Achieving this, demands that the natural environment is seen as a thread of responsibility running through the activities of all Departments, not just Defra, and that all interested parties (Government, Business and civil society) work together in a new and focused way.
- 3.2 In the future, the pressures on land and the environment will continue to grow as the need for new housing, infrastructure and other development increases. Yet the growing population will also require clean water, space for food production, high quality soils and pollinators to support agriculture. It will also call for homes and communities to be protected from flooding during times of high rainfall through better catchment management and reduction in water flows from the land. The imperative for planners and decision-makers at all levels of government, will therefore be to ‘enable’ development to take place whilst also ensuring that the benefits and services we all receive from the natural environment are nurtured and sustained into the future.
- 3.3 Unfortunately, our actions as a society over the past century have undermined nature’s ability to support us – just as our need for that support has increased. Recent decades have seen steady declines in almost all UK species and natural habitats on land and sea, despite the fact that nature is our life support system. These declines affect how our environment soaks up extreme rainfall, absorbs carbon, and provides clean water. It affects the health of our soils, fish stocks and pollinators. It affects how we can adapt to climate change, the liveability of our cities and the productivity of our countryside. Nature has become more remote from us and less present in our daily lives. Over the same period, conditions such as obesity, diabetes, heart disease and depression have increased. **We need to halt and reverse trends and bring nature back. We need to invest more time, energy, commitment and money into nature’s recovery – because wildlife and wild places need it, and because our health, wellbeing and prosperity depend upon it.**
- 3.4 Government’s Natural Environment White Paper² recognised that environmental and economic goals are complementary and that long-term economic growth relies on services provided by the natural environment. The Economics of Ecosystems and Biodiversity study (2010)³ showed that protected natural areas can yield returns many times higher than the cost of their protection. A recent report by the Institute for European Environmental Policy⁴ likewise estimated that the economic value of ecosystem services from across the EU from the terrestrial “Natura 2000” network alone is worth between €200 and €300 billion per year. There are also multi-million pound opportunities

² HM Government (2011) The Natural Choice: securing the value of nature

³ Kumar, P (Ed) (2010) The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. The Economics of Ecosystems and Biodiversity (TEEB). United Nations Environment Programme, Geneva. [Note that TEEB has its own website: www.teebweb.org]

⁴ See IEEP (2011) “Estimating the Overall Economic Value of the Benefits provided by the Natura 2000 Network”. Available at http://circa.europa.eu/Public/irc/env/financing_natura/library?l=/benefits_natura_2000/estimating_benefits/project_reports/2000_benefits_main/_EN_1.0_&a=d and ‘Assessing Socio-economic Benefits of Natura 2000 – a Toolkit for Practitioners’ (September 2009 Edition) http://ec.europa.eu/environment/nature/natura2000/financing/docs/benefits_toolkit.pdf

available from greener goods and services, and from markets that protect nature's services.

3.5 The National Ecosystem Assessment⁵ calculates that the wrong kind of economic growth between now and 2060 would cost the UK £20.7bn per year because of the damage it would cause. By contrast, putting nature at the heart of development would save £33bn per year. Well managed and wild natural places provide lasting and substantial benefits to the economy and are ultimately the root of all our productivity – by tackling a wide range of health problems; reducing the severity of droughts and floods; improving our food security; absorbing carbon dioxide emissions; and making the UK a better, more inspiring place to live.

3.6 We need to move away from the Natural Environment being viewed as a barrier to development and economic growth. Instead we should be looking to create 'win wins' and in so doing, moving beyond polarized situations in which the choice is either development or the environment. How decisions are made now, across a range of government policy areas will leave a legacy for years to come. This legacy can be positive – and result in a healthy, sustainable and nature-rich future – if policy makers, planners and other decision-makers work with nature and not against it, to ensure it thrives and delivers multiple benefits for people, society and the economy. **The National Infrastructure Commission has a real opportunity to steer this positive legacy.**

3.7 **Natural Infrastructure is a vital part of our national infrastructure and should be recognised within the National Infrastructure Plan as a priority for restoration on a level footing with other infrastructure needs.** We recognise the Commission has a specific remit for transport, digital communication, energy, water and wastewater, flood risk management and solid waste. However, we urge it to consider the interdependence of these sectors with our natural world by **placing nature at the heart of how decisions are made on all infrastructure developments** and by doing so, taking forward the recommendation of the Natural Capital Committee that *'The national infrastructure plan should incorporate natural capital into each of the main infrastructure sectors, following the mitigation hierarchy for managing impacts. An investment programme for natural capital should also explicitly feature within the National Infrastructure Plan.'*

3.8 The remainder of this submission focuses on specific questions posed by the consultation under cross-cutting issues and flood risk-management. However, these are based on the vital role of our natural environment in delivering and supporting our strategic infrastructure needs, as set out in points 3.1 – 3.7 above.

4. Cross cutting issues

4.1 The comments below should be considered in response to questions 3 and 11 of the consultation.

Planning sustainably

4.2 With climate change presenting a significant and serious long-term threat to biodiversity and societies worldwide, it is vital to get infrastructure right – this means the right type,

⁵ See <http://uknea.unep-wcmc.org/>

the right location and in the right way. It should be driven by a sustainable, future-proof, approach that will be good for people, good for the environment and good for the economy in the long-term. One of the objectives of the commission is to ‘support sustainable economic growth’. In achieving this objective, **we urge the commission to ground its recommendations on the five principles of Sustainable Development**⁶ of living within the planet’s environmental limits; ensuring a strong, healthy and just society; achieving a sustainable economy; promoting good governance; and using sound science responsibly.

4.3 Understanding the need for infrastructure across the country, is a crucial starting point. It should:

- be informed by up to date local data, which evidences societal, environmental and economic needs. Long-term economic growth will not be achieved and maintained in a sustainable way if these elements are not integrated into the decision-making process.
- Be integrated. For example, transport and energy infrastructure should be integrated at national, sub-national, county/unitary and local levels; new communities/developments should be well-designed and located and connected with transport routes (including active travel), services, green space.
- avoid harm to the highest value environmental sites, such as SSSIs and Local Wildlife Sites and seek opportunities on and off site to enhance them through careful choice of location and design.
- engage stakeholders, communities and experts from the outset.

4.4 When planning new infrastructure, serious consideration should be given to retrofitting the infrastructure we have. The natural environment has become increasingly fragmented by roads and other development and a strategic approach is urgently needed to identify where natural connections can be made for people and wildlife over existing linear transport routes. There are also places throughout the transport network where areas of woodland, wetland, and grassland can be better managed to increase size, improve quality or re-establish links by creating new areas of habitat that can clean run-off, create sound barriers, capture particulates and absorb carbon dioxide. Road side verges, rail embankments etc, can be managed to provide wildlife corridors, which reach into and connect our towns and wider countryside.

4.5 The Wildlife Trusts welcomed the inclusion of designated funds within the Roads Investment Strategy 1 (RIS1)⁷ and believe these offer a chance to start fixing some of the deep-seated environmental problems created by past decisions, while also helping to maximise the environmental performance and value of the network into the future. Most of the projects benefitting from the funds are still in early stages. But two of those receiving funding are:

- The A38 / Stover Country Park in Devon - the designated funds are being used to treat highway runoff into Stover Lake as part of a wider project to restore historic assets and habitats.

⁶ HM Government (2005) Securing the future delivering UK sustainable development strategy

⁷ Department for Transport (2015) Road Investment Strategy: for the 2015/16 – 2019/20 Road Period https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf

- M5 Titford Pools – the designated funds are being used to restore water quality, reduce future contamination, improve and encourage the biodiversity value of the site; and improve its recreational value to walkers, cyclists and lake users.

4.6 Funding of this nature is extremely important and its **continuation at a greater level of investment into RIS 2 would be a welcome recommendation of the National Infrastructure Commission in its assessment.**

Planning strategically and spatially

4.7 Once the need is established, **infrastructure should be strategically and spatially planned, with Ecological Network Mapping at the heart.** Having a spatial understanding of where nature exists, where it needs to be restored and created, the benefits it currently provides, and how and where investment in nature can leverage multiple benefits should be an essential component of infrastructure planning (For more on Ecological Network Mapping, see annex1).

4.8 Used as the basis of planning, development and land-use decisions, ecological network maps can ensure that development is planned and designed in a way that both avoids and mitigates damage to our natural infrastructure through the targeted enhancement of local ecological networks. It is also a vital tool in understanding and considering the cumulative impacts of national infrastructure developments.

4.9 When combined with other environmental information (eg soil, water quality, flood risk), the resultant maps can unlock practical and pragmatic win-wins, where nature can be an integral part of the solution to pressing public policy issues, such as flooding and the need for access to nature near homes. For example, water companies interested in producing clean water through sound catchment management, can use these maps to identify where particular habitats, which play a part in filtering water (eg wetlands) could be enhanced or created. Ecological network maps have also been used to identify where habitat creation or restoration can re-establish naturally functioning floodplains and, thereby, provide flood control and enhanced protection for settlements downstream (see specific example under section 5.8 on Devon’s Culm Grassland).

4.10 The National Planning Policy Framework includes some positive policies on ecological networks, but it does not provide sufficient policy guidance for those involved in planning and development. **The National Infrastructure Commission could provide a strong steer to government to ensure ecological networks are properly mapped at the local level and fully embraced in Major Infrastructure Planning and design.**

4.11 Fundamental to the mapping of ecological network maps and decision making is access to ecological expertise and well-resourced, up to date, locally informed ecological data. It is not enough to rely on national datasets. Local Environmental Records Centres (LERC) and other local data providers should be seen as the ‘go to’ organisations by developers for pre-existing local ecological data (the value of this data is recognised in Highway’s England’s Action Plan⁸). In turn, developers should be encouraged to share with the LERC, any data gathered as part of the project (eg surveys for EIAs, SEAs/ HRA. **This data sharing would ensure that projects are informed by the most up to**

⁸ Highways England (2016) Our plan to protect and increase biodiversity. See: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441300/N150146_-_Highways_England_Biodiversity_Plan31o.pdf

date, locally relevant data and should be established as a standard operating practice for the National Infrastructure Commission.

Planning design and delivery

- 4.12 Natural Infrastructure should be integrated into the design of all hard infrastructure development at the outset, with the aim of achieving a genuine net overall gain for wildlife, both on and beyond the development. This should include robust adherence to the mitigation hierarchy and avoidance of high value sites, habitats and species in the location and design of the development. Where damage to existing natural assets is unavoidable, compensation measures should create more than is lost (net biodiversity gain).
- 4.13 Many infrastructure companies, including LiNet⁹ members, have (Network Rail and Highways England) or are considering (Transport for London) adopting policies for securing ‘net gain’ from development. Net gain projects deliver quantifiable and measurable benefits for biodiversity as well as providing a range of wider environmental enhancements, such as flood risk mitigation, enhanced air quality and opportunities for public engagement with the natural environment. **If the National Infrastructure Plan were to advocate the adoption of ‘net gain’ outcomes as ‘business as usual’ across all infrastructure projects it would be more likely to secure significant environmental benefits.**
- 4.14 **We recommend that each development is informed by a Green Infrastructure Strategy.** These strategies should be visionary and identify the opportunities to incorporate and enhance the surrounding natural environment with the aim of achieving multiple benefits and ultimately a net gain for nature. Strategies should be under-pinned by ecological network map(s) relevant to the development area and informed by a wide range of local experts with a knowledge of ecology, hydrology, technical design, pollution management etc. The earlier the natural environment is considered in the design process and the more key stakeholders are engaged, the more likely the development will maximise multiple benefits. This will make construction easier and more cost effective and help avoid any unnecessary and unexpected delays.
- 4.15 In 2014 The Wildlife Trusts produced a challenge report for HS2. *‘A greener vision for HS2: Ideas for large-scale nature restoration along the HS2 proposed route’*¹⁰. The report highlighted the environmental damage likely to occur as a result of construction of a High Speed rail link from London to Manchester and Leeds. But it also put forward an ambitious vision for large-scale nature restoration along the proposed route - creating and restoring large areas of habitat and providing new access to nature for people. The vision was well received by the HS2 Hybrid Bill House of Commons Select Committee and the likes of Costain and LFM.
- 4.16 The proposed vision was for a 1km ribbon of wildlife-rich landscape either side of the line – planned, established and run by a partnership of residents, landowners and local and expert groups. Recreated and naturally regenerated habitats would buffer, link and provide ‘stepping stones’ between wildlife sites. In time, there would be new meadows, woodlands and wetland expanses to explore, alongside existing farmland, communities

⁹ LiNET is an informal group of linear asset owning/managing sectors, with a shared aim to promote, embed and mainstream the use of green infrastructure (GI) as a tool for enhancing the resilience and reducing the whole life costs of national and local linear infrastructure assets.

¹⁰ The Wildlife Trusts (2014) HS2: The case for a Greener Vision <http://www.wildlifetrusts.org/HS2reports>

and housing. Green bridges, pathways and cycle tracks would reconnect communities cut through by the proposed line. This would spread the benefits of HS2 to many people along the route, rather than just those near its few stations. Funding for ongoing maintenance would be part of the HS2 legacy.

- 4.17 With just 1% of the HS2 budget (£130m plus c.£10m annual maintenance and rent), we believe this vision offered a firm commitment to the environment by achieving the creation of c.15,000ha of new/reconnected habitat; 120 miles of new foot and cycle paths. With the potential to provide net gains for wildlife and added value to people and communities from a relatively small proportion of any major infrastructure budget, **visions such as this should be a key requirement for all major infrastructure projects.**
- 4.18 Developers should give early consideration to the long-term management of green infrastructure in and around the development and how this will be undertaken once the development is complete. **Developers should plan and provide appropriate funding secured by a legal agreement at outline application stage for the long-term management of natural infrastructure.**
- 4.19 Clear **proposals should also be agreed for long-term monitoring** in relation to both the impact of the infrastructure development and the enforcement and implementation of any mitigation/compensation measures undertaken. Ensuring that the outcomes of such monitoring are used to inform and adapt future design and transport development.
- 4.20 With regards to housing and infrastructure, **there needs to be clear integration between the national strategy for infrastructure and local housing plans**, so that new housing developments are of a scale appropriate to their location and appropriately served by transport routes, services and green space. **Green infrastructure and nature should be at the heart of all new housing developments.** As a baseline, they must meet national access standards, provide a net gain for biodiversity and respect the existing landscape character. Developers should start by identifying existing habitat features and using them as the building blocks for the network of green spaces. The design of our buildings, towns and cities should recognise the value of natural solutions that collect and capture water, such as green roofs and walls, sustainable drainage systems, green space and gardens. These features all help to absorb the run-off from development, filtering pollutants and supporting flood prevention.
- 4.21 We would expect the nationally identified ***Garden towns and villages to be exemplars of environmental sustainability and green infrastructure provision***, in order to reflect the true principles of the concept. The prefix ‘garden’ must mean, truly sustainable and healthy places to live, not simply greenwash. The UK Green Building Council’s guide on Demystifying Green Infrastructure¹¹ includes several examples of housing developments that have sensitively incorporated Green Infrastructure throughout the development.
- 4.22 Gardens can do much to act as sponges and help stop water flowing too fast and overwhelming rivers. But evidence shows that flooding in our built-up areas is increasing because of the loss of garden space in favour of new development and hard standing. A

¹¹ UK Green Building Council (2015) Demystifying Green Infrastructure. See <http://ukgbc.org/sites/default/files/Demystifying%20Green%20Infrastructure%20report%20FINAL.pdf>

report¹² by London Wildlife Trust in 2011, revealed the scale of the capital's garden loss was at a rate of two and a half Hyde Parks per year. Hard surfacing (including decking and paving) increased by over 25 per cent in the hundred-month study period. In January 2014, 90% of the severe flooding in parts of West Sussex was believed to be coming from surface water run-off. In response, a local scheme (Arun and Rother Connections) was established to promote measures such as rain gardens and Sustainable Urban Drainage Systems to help prevent future flooding in the Arun and Rother river catchments.

4.23 There are many examples of where major developments have effectively contributed to protecting and enhancing the natural environment that could be extrapolated to major infrastructure works. Two such examples are Abberton Reservoir and Lorton Valley Nature Park.

Case study: Major development of Abberton Reservoir, Essex

Abberton Reservoir, owned by Essex & Suffolk Water, is situated 8km southwest of Colchester and is one of two water storage reservoirs. Covering 485 hectares, it supplies drinking water to one and a half million people in Essex and holds 46 billion litres of water. Its recent enlargement and enhancement transformed the site into a spectacular natural wetland, leaving a legacy to be enjoyed by future generations. Development included: raising the main dam by 3.2 metres; increasing the storage volume by 58%; building a number of smaller col (earth) dams around the edge of the reservoir; relocating the Essex Wildlife Trust Visitor Centre to a larger site; diverting the B1026; and modifying the causeway.

As a wetland site of international importance, it was essential that the environment was protected before, during and after construction. Much of the success of the scheme relied on early engagement with all community parties to ensure everyone had a say, so that everyone was happy with the outcome.

Case Study: Lorton Valley Nature Park. Dorset

Over many years, the extent of wildlife habitats and open space within the Lorton Valley had been reduced through development of a landfill waste site, drainage of the wetland and the construction of the Weymouth Relief Road on the western boundary.

The designation of the sailing venue for the London 2012 Olympic and Paralympic Games at Weymouth and Portland in Dorset provided a catalyst for wider investment in green infrastructure. By integrating existing nature reserves, ancient woodland and land secured through environmental mitigation for the new relief road, a new Nature Park was established in the Lorton Valley to the north of Weymouth town centre. The benefits involved reconnecting and enhancing biodiversity habitats; improving local landscape character; expanding local recreation and volunteering opportunities; supporting learning and play, especially for children; enhancing physical and mental health and wellbeing; and contributing to the local tourist economy.

¹² London Wildlife Trust, GiGL, Greater London Authority (2011) London: Garden City? Investigating the changing anatomy of London's private gardens, and the scale of their loss. See: <http://www.wildlondon.org.uk/sites/default/files/files/London%20Garden%20City%20-%20full%20report.pdf>

By taking a strategic approach to green infrastructure delivery, the work of various partners has been combined to establish a far greater environmental legacy from the Olympic and Paralympic Games than would have been achieved by organisations working separately. Existing sites have been improved and are now connected to provide a wider network of publicly accessible nature areas across Weymouth and Portland.

The consolidation of the landholding across the valley became feasible through the revised alignment of the Weymouth Relief Road that helped to unlock the delivery of the Nature Park. Detailed negotiations between Natural England and Dorset County Council resulted in a net increase in biodiversity over the long term. Greater support for wider environmental projects has now been established through policies set within the emerging Weymouth and Portland Local Plan.

Pooling expertise between all partners has helped to secure a mix of funding that may not have been accessible to individual organisations. The Nature Park has benefitted from coordinated investment, using existing resources of the various partners, the funding of mitigation measures from the County Council, Environmental Stewardship for enhanced landscape management from Natural England, and a successful joint bid for funding from the National Lottery. With added impetus gained from the Olympic and Paralympic Games, a quantum of investment has been combined to accelerate the establishment of the Nature Park for the benefit of local communities and visitors. (For more information see full case study¹³).

5. Food Risk Management

The comments below should be considered in response to questions 25 and 26 of the consultation.

- 5.1 Storms and flooding have caused significant damage across the UK, and climate change is likely to increase the frequency of such extreme weather in the future, costing Governments and taxpayers millions, and devastating communities and businesses. Heavy rain will always occur, but the effects in today's built-up areas are directly related to land-use upstream and our inadequate urban drainage systems. Inappropriate developments can change the hydrology of large areas, removing peat, culverting rivers and preventing the land from storing water - creating a real danger of further flooding downstream.
- 5.2 Much of the water that causes flooding runs off the hard surfaces of our roads, and hard infrastructure, rather than being absorbed by the earth. Drainage systems cannot cope with the volumes of surface run-off and the water quickly inundates homes and businesses. These impacts are all exacerbated where homes and businesses have been built in the natural floodplains of rivers and streams.
- 5.3 Engineered and “hard” flood defences are constructed in an attempt to protect vulnerable communities from flooding, and in some areas they are the only solution. But building and maintaining flood defences is expensive, running to hundreds of millions of pounds and it can only do so much. When a river is cut off from its floodplain by man-made flood defences, its natural spreading room is not available and it ceases to function naturally.

¹³ Natural England (2013) Lorton Valley Nature Park; Green Infrastructure Case Study (NE388), <http://publications.naturalengland.org.uk/publication/5269657?category=49002>

5.4 Many of our rivers are now disconnected from the land. Consequently, we have lost large areas of marshlands, reedbeds and wetlands that would help store water and filter out pollutants. Instead, the water, held in its artificial channel, moves straight through any built-up areas. Continual rain fall in the uplands, causes the river to burst its banks or overtop the flood wall.

5.5 **The Wildlife Trusts welcome the Commission's consideration of natural flood risk management in its first National Infrastructure Assessment and believe it is essential that Government prioritises investment in this area.** Wilder landscapes can provide the natural solutions to help prevent flooding in the future. Habitats such as upland bogs and moors, woodlands, wetlands and species-rich grasslands act as giant sponges, absorbing and holding water and slowing down water run-off into rivers, thus reducing the effects and ultimately the cost of flooding to society. We can also mimic these natural processes in urban areas, weaving water-holding habitats into the urban fabric - installing more green roofs on our houses, more permeable surfaces in our towns and cities and more sustainable drainage systems to capture excess water. And along the coast, natural habitats can be created that reduce the force of tidal surges elsewhere.

5.6 Flooding needs to be addressed through a range of solutions, but working with nature rather than against it is the key to a more flood resilient future. **Working with nature will reduce our vulnerability to the impacts of flooding and climate change and increase resilience in the future. It is cost effective and delivers many other benefits: creating niches for wildlife, increasing people's wellbeing and benefiting tourism and local economies.** We need to:

- Make the land work more effectively as a sponge by restoring water retaining habitats over large areas
- Create more places where flood waters can be held back or stored. These places often become recreational areas for people too
- Make more space for rivers
- Design into our buildings, towns and cities, places that collect and capture water, such as green roofs, sustainable drainage systems, rather than it torrenting off hard surfaces into rivers
- Create places on farmland which will store floodwaters and protect the best areas for food production - giving water room - eg create small flood storage areas on parts of the farms that are less productive - protecting a larger areas from extreme weather

5.7 There are already some excellent examples of how restored landscapes have made space for water, for example, in upland areas where old drainage ditches have been blocked and overgrazing reduced. This allows vegetation like sphagnum mosses and heather to regenerate, helping to hold water in the hills for longer and reducing peak flows downstream during high rainfall events.

5.8 Across the UK Wildlife Trusts are working on large-scale habitat restoration schemes which slow down water and reconnect rivers with their floodplains, making space for water. **We need these kind of approaches to be significantly extended across the country. This can only happen if investment in flood defence is rebalanced towards these more sustainable solutions.** There are many examples of natural

solutions and outcomes (see The Wildlife Trusts website¹⁴). But three have been highlighted below:

Case Study: Culm grasslands, Devon

Ecological network maps have been used to identify where habitat creation or restoration can re-establish naturally functioning floodplains and thereby provide flood control and enhanced protection for settlements downstream. Devon Wildlife Trust is working with farmers to deliver this. When restored, this habitat acts like a sponge to hold water following rainfall and release it slowly over time, helping to prevent flooding downstream.

Early results from a recent study of the hydrology of these grasslands undertaken by Devon Wildlife Trust in association with the University of Exeter show Devon's Culm grassland provide an extra 20% carbon storage compared to agriculturally improved fields. They also have four and a half times the water storage capacity - indicating that species-rich grasslands may be better at preventing downstream flood risk than intensively managed grasslands or grasslands that have scrubbed-up or developed mature woodland cover.

Case study: Slow the Flow – Pickering

Pickering in North Yorkshire was flooded four times in 10 years. This has had a big impact on communities. It is in an important landscape with multiple stakeholders. The aim of the Forestry Commission's Slow the Flow project was to demonstrate how the integrated application of a range of land management practices at a catchment scale can help reduce flood risk, as well as deliver wider multiple benefits for local communities.

The majority of the catchment area is owned by three land owners (Forestry Commission, the North York Moors National Park and Duchy of Lancaster). This was advantageous as it meant they could cooperate and work in partnership. Durham University helped with the science and evidence. They began by identifying which tributaries needed interventions in order to have the desired effects. This involved working out what was happening to the water.

Interventions considered and implemented to slow the runoff from the Public Forest Estate included riparian woodland, floodplain woodland enhancement of natural flood storage using large woody debris dams and timber mini bunds. Further downstream moorland gullies were blocked with heather bales to reduce rapid runoff. These are relatively cheap and easy to install. Part of the project involved harder flood protection measures for Pickering. Around 50% of these were funded by the District Council.

This approach isn't anything new - in 1928 'The Question of Forestry in Britain' was already talking about forestry solutions to flooding. But the Forestry Commission is now using the Pickering scheme as an example of best practice and promoting its approach elsewhere.

Case Study: The Nene Valley

The Wildlife Trust for Bedfordshire, Cambridgeshire and Northamptonshire is working in The Nene Valley on large-scale habitat restoration and creating functioning ecosystems as an integral part of land management – such as putting back river meanders. The aim is

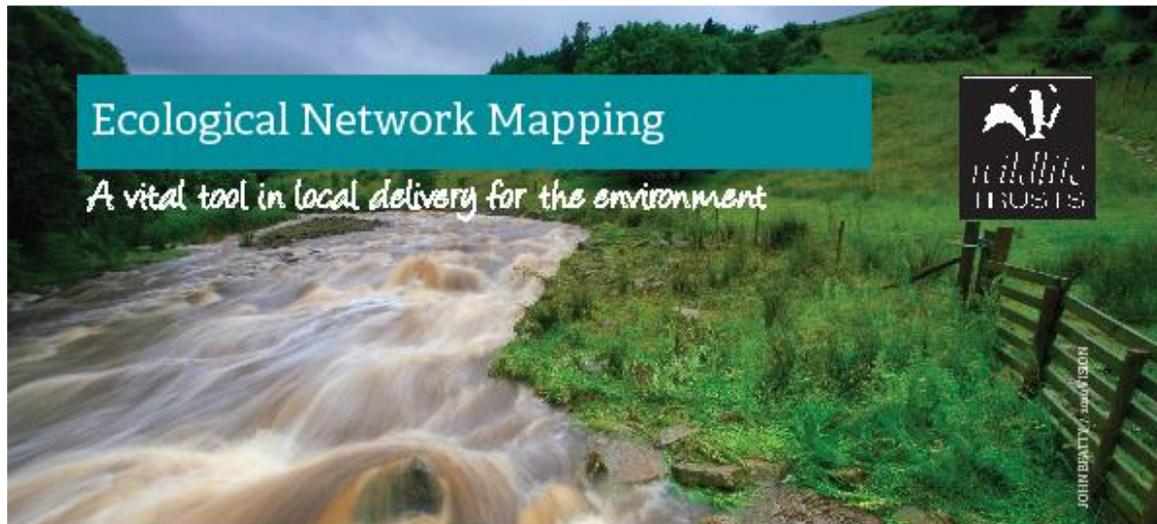
¹⁴ <http://www.wildlifetrusts.org/tacklingflooding>

to reap the benefits that natural support systems provide such as flood-prevention, waste management and cleaner air.

Part of this work includes a 16 mile long stretch of six restored sand and gravel quarries. The reserve stretches from Earls Barton in the south to Irthling borough and Stanwick, and has been linked by footpaths and waterways to create one of Europe's newest Special Protection Areas for vulnerable bird species. The site lies at the heart of the Wildlife Trust's 'Living Landscape' for Northamptonshire, and is located in one of the first Nature Improvement Areas. The nature reserve replaces a landscape of intensive farming with a progressively restored and managed river-floodplain wetland, which brings huge biodiversity benefits and habitat connectivity. It also enhances the river - making it a feature of ecological and landscape benefits, in addition to providing a drainage channel.

The Wildlife Trusts
10 February 2017

Annex 1 Ecological Network Mapping



Spatial blueprints for investment in nature

Wildlife Trusts across England have pioneered locally-driven approaches to ecological network mapping for several years. The maps have helped to guide their own landscape-scale conservation activities. They have also been a mechanism for engaging local people, landowners, planners and developers in taking positive action to protect and restore the natural environment.

When spatial ecological data is combined with other environmental information (e.g. soil, water quality, flood risk), the resultant maps can help to identify 'win wins' where nature can be an integral part of the solution to pressing public policy issues such as flooding and the need for access to nature near homes.

The maps, when integrated into the local planning process, can be used to identify how mitigation for housing and other infrastructure development can enhance local ecological networks – and more generally will ensure that nature is at the heart of strategic decision making and local 'place making'.

They can also provide the local basis for investment in natural capital, ensuring that public and private investment in nature is aligned where it will deliver multiple benefits for people, the economy and the natural environment.



My Wild City - mapping habitat creation opportunities in Bristol

What is ecological network mapping?

It is a powerful, strategic tool to identify where habitat protection, creation and restoration is required to retain or enhance a local ecological network and to secure nature's recovery.

'Establishing a resilient and coherent ecological network across England has been recognised as the strategic way in which to conserve biodiversity and ecosystem services while also making efficient use of scarce land and resources.' (Lawton et al. 2010)¹

Mapping an ecological network requires the best available spatial data from national and local sources. This should include information on core wildlife-rich areas such as SSSIs, Local

Wildlife Sites and all other priority habitats. Once these are mapped, it is possible to identify opportunities for habitat creation and restoration to achieve more, bigger, better and joined-up sites within a functional, coherent and resilient ecological network.

The maps can be created at a variety of local scales (e.g. catchment, local authority area, NIA) and if designed collaboratively across boundaries, can be used to identify where cross-boundary landscape-scale interventions may be needed to establish ecological networks across the country.

¹ Lawton et al. (2010) Making Space For Nature. HM Government

10 February 2017

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Highways and Transport
County Hall
Bythesea Road
Trowbridge
Wiltshire
BA14 8JN

Your ref:

Our ref :

Dear Sir / Madam

Re: National Infrastructure Assessment – Call for Evidence

The Swindon and Wiltshire Local Enterprise Partnership's (SWLEP's) Strategic Economic Plan (SEP) (<http://www.swlep.co.uk/strategieconomicplan.pdf>) sets out that Swindon and Wiltshire's competitive advantage is based on:

- A pivotal central southern location with geographic proximity to major economic centres including London, key airports, and coastal ports;
- A dynamic, knowledge-based economy with nationally important clusters in life sciences, advanced manufacturing, financial and professional services, digital and information and communications technology (ICT) and land-based industries;
- A resilient and attractive rural economy with world class landscape, heritage and visitor attractions;
- An economically significant military presence;
- Strong small and medium sized enterprise (SME) growth with high levels of innovation and business survival; and
- A vibrant economy with a skilled workforce and low unemployment.

Reflecting the above, we want to build on our economic opportunities (as set out in the SEP and Swindon and Wiltshire Economic Assessment 2016 - <http://www.swlep.co.uk/resources/document636067576937666000.pdf>) :

- Exploit our potential to attract further inward investment and support the development of SMEs in high value sectors to balance growth in the South East.
 - The Business Location Index 2015 prepared by Local Futures, in partnership with the Municipal Journal, shows both Swindon and Wiltshire to be amongst the top 5 business locations in England.
- Extend our reputation as a hub for specialist sectors in Life Sciences, Advanced Manufacturing; Financial and Professional Services; Digital and ICT and Land Based Industries

- Employment in knowledge-based industries increased by 15% between 2012 and 2014 to 65,600, nearly twice the growth experienced nationally (8.2% across Great Britain).
- The number of patents granted per 100,000 residents over the five-year period 2007-11 averaged 19.4 patents per 100,000 residents. This was more than double the rate found across England as a whole over the same period. Swindon and Wiltshire is ranked 8th in terms of business enterprise research and development (R&D) expenditure per full-time employee and the level of R&D spend is more than double the national average.
- Rapid population growth
 - The pace of population growth is fast. Swindon and Wiltshire have seen the fourth highest level of population growth in the country with an increase of 10.6% since 2004.
- Strong jobs growth forecast
 - Total employment in Swindon and Wiltshire is forecast to rise between 7-8% between 2015 and 2030. This equates to between 27,000-29,000 additional jobs over the period.

There are, however, economic challenges.

Competitiveness has been in decline. Taking the period 2001-2013 England experienced growth in nominal Gross Value Added (GVA) of 61.7%. In contrast Swindon and Wiltshire saw growth of just 50%. While Swindon GVA per head is above the national average (£30,900), it is below average in Wiltshire (£19,800). And, Wiltshire's UK competitiveness index score (UKCI) for 2016 of 96.6 is significantly below the UK average and has fallen from 97.4 on the 2013 UKCI, resulting in its ranking position falling by 10 positions from 122.

The type and quality of the housing in an area can have a significant impact on the health and wealth of local economies and the ability to attract and retain people depends on good housing and attractive and inclusive neighbourhoods. Between 2015 and 2026 there is a residual requirement for 42,480 new homes to be built across Swindon and Wiltshire; 23,171 of which are required between 2015 and 2021. In Wiltshire, however, housing affordability is a significant issue. In 2014, the median house price in Wiltshire was £217,500, 34% higher than the figure for England and Wales. The ratio of median house prices to median gross annual salaries in the county in 2014 was 10.5 compared with 8.8 in England and Wales.

Our strategic location and connectivity is both a strength and a weakness. It is no coincidence that the peaks in our historic economic growth coincided with the arrival of the Great Western Railway in the 19th century and the M4 five decades ago. A similar step change in transport investment is now required to deal with the area's inadequate transport infrastructure and to support our growth plans and opportunities. Of particular relevance in the context of this call for evidence, are a number of supra-regional transport infrastructure issues and requirements.

There is significant investment (£2.8 billion) underway for the electrification of the line between London Paddington and Cardiff via Swindon and Bristol Parkway, and the associated introduction of the Intercity Express Programme (IEP) trains from 2018. These investments will improve rail links between Swindon and north Wiltshire and London, reducing journey times to 45 minutes, but the Government decision to defer investment in the electrification of the railway line into Bath and Bristol Temple Meads will mean that the full benefit of this investment will not be realised. The completion of the full electrification project is therefore a priority for the region.

On the Strategic Road Network, it is essential for the economy of the South West, and especially that of Gloucestershire and Swindon, that the current studies into the dualling of the A417 'missing link' south of Cheltenham is translated into action through the delivery of this scheme as part of Highways England's Road Investment Strategy (RIS) 2 programme. This will particularly boost the motor manufacturing sector at Swindon, and will improve strategic connectivity between the West Midlands, the South West and the South East.

Looking eastwards, the Government commitment to investment in the East – West Rail project linking Oxford and Cambridge, and in the parallel Oxford to Cambridge Expressway, is welcomed, but opportunities to maximise the benefits on this investment should not be overlooked. Specifically, these include the potential to operate rail services between the West of England and Oxford, Milton Keynes and Cambridge utilising the new railway line. This would connect Bristol, Bath, Chippenham and Swindon with destinations in the South Midlands and East Anglia without the need to travel into London and change trains there, thereby freeing up capacity on the Great Western Line. These rail services would also help facilitate new rail stations at Corsham (where there is a cluster of high tech businesses centred around the significant digital infrastructure investment in the Global Communications Centre at MOD Corsham) and Royal Wootton Bassett (which is near to the Defence School of Electronic and Mechanical Engineering at Lyneham) in Wiltshire. A report commissioned by the Council (Corsham Rail Station Initial Feasibility Report, December 2015¹) included a high level assessment of a new train service from Bristol to Oxford based on one train per hour (12 services per day) calling at Bristol Temple Meads, Bath Spa, Chippenham, Swindon and Oxford. This assessment indicated the following demand and revenue outcomes: 330,000 journeys; £2.73m in base year rail revenues; and £4.112m of user benefits. With new stations at Corsham and Royal Wootton Bassett, the base year rail revenue figure increased to £3.781m.

Similarly, connectivity between Swindon and Oxford (and the M4 and the Oxford – Cambridge Expressway) would be greatly improved through the dualling of the A420 route connecting the two. This has specific benefits for the economies of both Swindon and Oxford, with manufacturing industry such as BMW having bases in both communities. The improvement of the A420 would also provide congestion relief for the M4 into London and the A34 South of Oxford, freeing up capacity on these routes for their core roles of providing strategic connectivity to the South East and the South Coast ports respectively.

Therefore, the next generation of NIC work needs to examine the potential for strengthening the strategic connectivity between Swindon, North Wiltshire and the West of England (acting as a gateway to the South West) and Oxford.

¹ <http://www.wiltshire.gov.uk/council/howthecouncilworks/plansstrategiespolicies/transportpoliciesandstrategies.htm>

Connectivity is also poor on the north – south axis within the 'Wessex' area that covers Dorset and the coastal ports in the south, the whole of Wiltshire, Bath and the intersection with the M4 corridor to the north. Wider economic benefits are being foregone due to this poor connectivity: the A46 / A36 corridor is constrained by having to pass through parts of Bath city centre; there are bottlenecks and capacity restrictions on the A350; and the rail corridor from Southampton through Wiltshire and on towards Bath, Bristol and Swindon has relatively long journey times. Better connectivity will help close current 'productivity gaps' in the area. Improved north-south connectivity will also benefit long-distance traffic, especially commercial vehicle movements, from the Midlands into the area and on to the south coast. Other economic benefits will be the 'unlocking' of much needed new developments, especially new housing sites at strategic locations. In recognition of the above issues, Wiltshire Council, Dorset County Council and Bath and North East Somerset Council have commissioned a 'Wessex: North to South Connectivity (Executive Summary attached)'. This study effectively forms an initial evidence piece to better enable Highways England to consider including options for improvements that could be taken forward as part of its RIS2 process. The NIC should help support this work as part of its National Infrastructure Assessment process.

I hope the above is helpful and I look forward to seeing the conclusions of this process in your Vision and Priorities document to be published in the summer.

Yours faithfully,

[signature redacted]

[name redacted]

[job title redacted]

[phone number redacted]
[e-mail address redacted]

National Infrastructure Assessment Call for Evidence

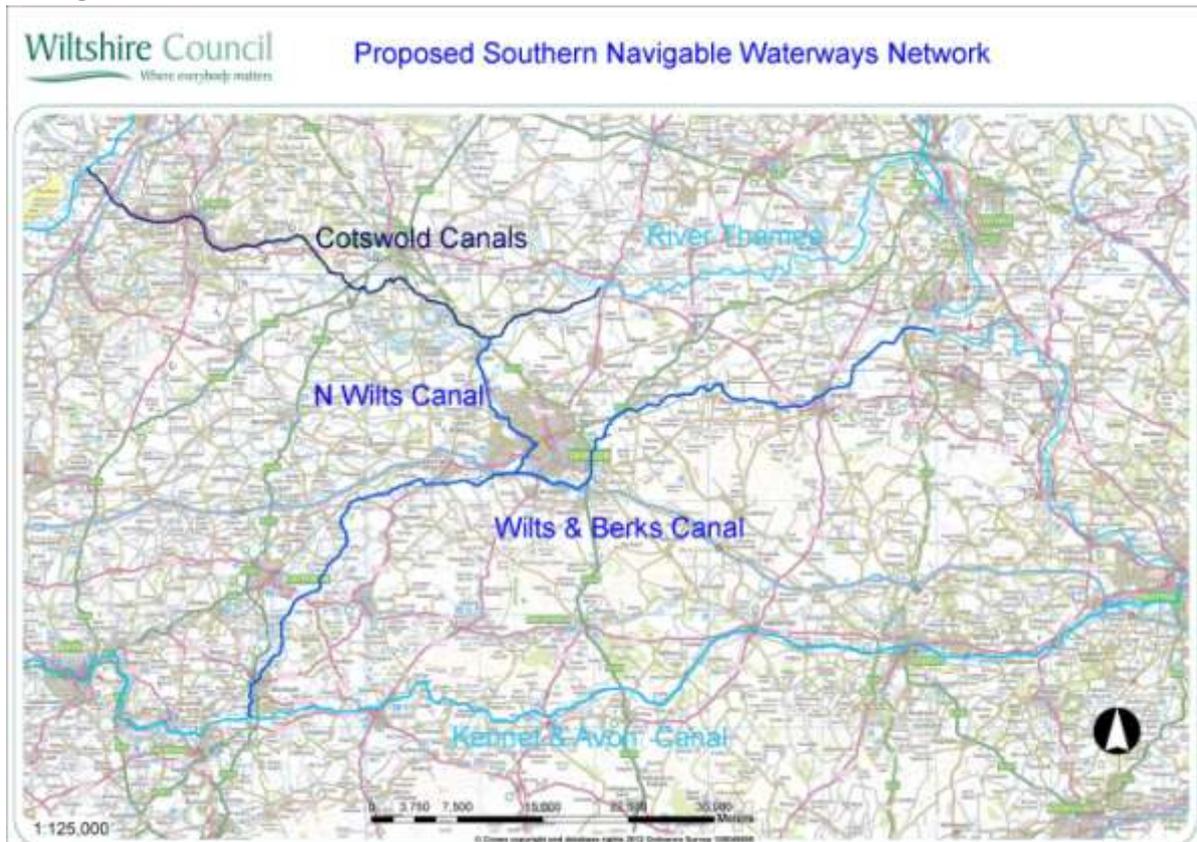
Restoration of the Wilts & Berks
Canal
Wiltshire Swindon & Oxfordshire

This evidence is submitted by [Name redacted] on behalf of the Wiltshire Swindon & Oxfordshire Canal Partnership.
 Contact email: [Email redacted] Tel [Telephone redacted]

Name	Data
Document no	
Document type	Response to Call for Evidence
Project	Southern Waterways Network – Wilts & Berks Canal
Client	

Revision	Date	Issued for/Revision details	Revised by
Draft 1	22 December 2016	First draft for WBCT comment	KWO
Draft 2	18 January 2017	Rewrite with additional information	KWO
Final	25 January 2017	Reviewed by WBCT Exec	

Background



Currently there is a large missing section of the former navigable waterways in southern England.

The restored routes of the Wilts & Berks, North Wilts and Thames & Severn Canals would produce at least £100m p.a. into the rural tourism economies of Wiltshire Oxfordshire and Gloucestershire based on the economic impact study of the Kennet and Avon Canal restoration. Added to this would be the transformational place changing effect on Swindon at the core of this network, and many regeneration opportunities in towns and villages along the route. Planning work on restoration of these canals is well advanced and significant sections have been, or are currently being restored.

The contribution to local life, healthy living (walking/cycling), volunteering, heritage, biodiversity, place setting, and flood management adds to the cumulative impact of these schemes.

The project team recognise that this may not be most obvious infrastructure for the Commission to consider but would suggest that the significant positive impact if the scheme's proposal merit further investigation especially given the likely return of fund invested.

This evidence is submitted by the Partnership delivering the Wilts & Berks & North Wilts canals so of necessity concentrates on these waters but there has always been close working with the Cotswold Canals project and the Commission are invited to view this report in an holistic way taking into account the whole southern waterways network.

This is an extract from the current restoration strategy for the waterway:-

- **The restoration of the Wilts & Berks Canal is supported by the Canal Partnership to deliver a community asset and green infrastructure linking Wiltshire, Swindon and Oxfordshire.**
- **The plans conform with national and local policies and plans and the Partnership seeks to continue the protection from development of the canal route for the life time of the current Local Plans**
- **Economic and social benefit will be significant which will be demonstrated in a Business Plan for each of the proposed programmes.**
- **Sources of funding for the project will be demonstrated in the Business Plan.**
- **A clear strategy for ownership of the canal corridor will be developed.**
- **Funding will be sought from third party sources wherever possible including substantial enabling development where relevant and possible.**
- **The delivery of the project will be over a number of years and be substantially completed in the period 2025-2031.**
- **Opportunities to use the waterway for local flood control schemes will be investigated and implemented where practical.**
- **The Partnership has already made accessible over 30% of the main canal route and the top priority is to complete landowner negotiations and obtain agreements to open all the towpath by 2018.**
- **Swindon is recognised as the hub of this restoration and the proposed Southern Canals Network. Waterfront Swindon will be developed as an urgent priority and will be connected to the national network at the earliest opportunity.**
- **To gain maximum public and environmental benefit at the earliest opportunity, discrete sections of the waterway will be restored to work as isolated and viable sections.**
- **Sustainability will be built into the plans to allow long term maintenance of the operational waterway.**
- **Community and volunteer participation are vital elements in both restoration and maintenance and they will be streamlined and**

accentuated to be a beacon of community empowerment and achievement.

- **During the Masterplanning phase, considerable emphasis will be placed upon use of new technologies in construction, harvesting of renewable energy and flood defences in clear demonstration of a fully sustainable national asset.**
- **The economic social and environmental value of the restoration and regeneration of the Wilts & Berks Canal has not to date been fully assessed and quantified. The Partnership will seek as a matter of urgency to fully define at a Programme level the likely Gross Value Added (GVA) and employment created by the restoration of the canal**

In preparing this document the questions posed by the Commission are used as headings for the relevant areas where the Canal Partnership believe this project can have positive impacts

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Investments required for the Southern Canals Network

Wilts & Berks Canal Rural	£400m
Wilts & Berks Canal Swindon	commercially funded
North Wilts Canal	£ 50m
Cotswold Canals	£300m
	£750m
Contingency	£150m
Total	<u>£900m</u>

These figures exclude current active projects

We would expect a project of this nature to be delivered over 20 years making an annual funding requirement of £45m

The immediate call on funding would be in the order of an estimated £25-30m to secure the land for the project via an Order under the Transport & Works Act

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

There is no specific research looking at this issue. Scottish Canals recognise that iconic structures like the Kelpies and Falkirk Wheel create specific tourism destination visits

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

The place making opportunities for towns like Swindon on the route with a revival of a town centre community are exactly what a waterway restoration can achieve creating a 'heart and soul' and acting as a catalyst for further improvements and developments . Examples are scattered throughout the existing canal network:

- Brindley Place Birmingham
- Gasworks development St Pancras London
- Paddington Arm London
- Queen Elizabeth Park London
- Salford Quays Manchester
- Oracle Reading
- Banbury
- Stallybridge

This is small sample of waterway restorations and associated regeneration that have transformed inner city/town areas . All have the waterway have a core of mixed used with associated housing creating a hub for communities centred around a waterway.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: "demand management" includes smart pricing, energy efficiency, water efficiency and leakage reduction. "Rebound effects" refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

In the context of canal restoration most of the work will be required to build new infrastructure- the majority of the canal route still exists in derelict form

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by "funding", the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

The aim of bringing this infrastructure project to the attention of the Commission is to demonstrate that third party Government funding to guarantee the viability of the scheme (eg the securing of the land via a Transport & Works Act Order would underwrite the security of investment for third parties (both commercial and grant giving). Delivery of the rural section will need to be funded from non-commercial sources but the current business plan for the Swindon will fund the canal from development opportunities.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Note: projects that "can be funded" but "will not be financed" refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

The project needs to use the Transport & Works Act to secure the route of the canal and to be the means for governance of the operation waterway – a swift and efficient implementation of an Order under this Act would efficiently deliver the land required to implement phases of the project in multiple locations. Permissions will be required from a number of Agencies and cross-Agency co-operation and working will be required to deliver the scheme (eg Environment Agency Natural England Local Authorities).

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

There will be significant opportunities to increase biodiversity and connectivity. The project has already identified the ecological and environmental issues that will need to be addressed in the form of mitigation. The scheme will deliver a significant net positive contribution to biodiversity and habitat creation.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent? Note: "credible" improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. "Tractable" improvements are those that can generate usable quantitative outputs. "Transparent" improvements are those that do not rely on 'black box' modelling and assumptions.

While some quantitative benefits are easily defined, others are not- for example public health where the opportunity to exercise in a safe, free to use, and pleasant location will without doubt increase walking and healthy pursuits but the actual net benefit of this healthy living is very hard to define. This issue was partially addressed in the 2009 Jacobs Report *The Benefits of Inland Waterways* however there is no easy formulaic way to define this and other benefits in a particular location. A further issue is the traceability of the actual benefit of the restoration as the restoration is often the catalyst to create new businesses which in turn generate employment and tax revenue etc.

Transport:

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies?

Note: "travel patterns" include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

Local walking and cycling routes are easily created in urban areas.

There are further opportunities for freight by water for materials such as aggregate or bulk waste.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Note: "high value transport investments" in this context include those that enable 'agglomeration economies' – the increase in productivity in firms locating close to one another.

Towpath cycling opportunities can add benefits to create travel patterns that do not involve use of cars and therefore can help in reduction of air pollution
Some urban locations are suitable for creation of waterbus services.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Note: this includes travel in and between rural areas, as well as between urban areas and international travel.

Longer distance cycling for inter-town commuting + leisure cycling and walking on suitably constructed towpaths

16. What opportunities does 'mobility as a service' create for road user charging? How would this affect road usage?

Digital communications:

17. *What are the highest value infrastructure investments to secure digital connectivity across the country (taking into consideration the inherent uncertainty in predicting long-term technology trends)? When would decisions need to be made?*

The linear nature and town to town connection of the waterway make the towpath an ideal opportunity for ducting for utilities and for extending the fibre optic network. Mobile communications masts can also be placed in the canal corridor.

18. *Is the existing digital communications regime going to deliver what is needed, when it is needed, in the areas that require it, if digital connectivity is becoming a utility? If not, how can we facilitate this?*

Note: the existing "regime" refers to the current market, competition and planning frameworks. "Digital communications" includes both fixed and mobile connectivity.

Energy:

19. *What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?*

The water body of canal used for local heating (heat pumps)

There are limited opportunities for hydro-power and linear location for solar panels

20. *What does the most effective zero carbon power sector look like in 2050? How would this be achieved?*

Note: the "zero carbon power sector" includes the generation, transmission and distribution processes.

21. *What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?*

Water and wastewater (drainage and sewerage):

22. *What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?*

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

Water transfer using the Cotswold Canals under active consideration by Thames Water for Severn-Thames transfer.

23. *What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?*

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

The restored canals can be designed to be part of attenuation schemes or for flood water transfer.

24. *How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?*

Flood risk management:

25. *What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?*

26. *What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?*

Note: "innovative technologies and practices" can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials

As response to Q 22 – the canal and off line storage can provide attenuation and retention of water in upper catchments.

Solid waste:

27. *Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?*

28. *What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be?*

Note: A "circular economy" is an alternative to a traditional 'linear economy' (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process

Appendix

Economic & Social Impact of the restoration of the Kennet & Avon Canal 2010 Update

Executive summary

The Kennet and Avon Canal runs for 87 miles, linking the River Avon at Bristol with the River Thames at Reading. The canal was restored to through navigation in 1990 and the restoration was eventually made secure through further work, completed in 2002 and supported by £25 million funding from the Heritage Lottery Fund (HLF).

Following the restoration, two phases of economic evaluations were undertaken to review impacts, carried out by Ecotec in 2003 and 2005. The present study, undertaken by the Economic Development Unit, British Waterways, updates the 2005 study to 2009, through:-

- Assessing the economic benefits delivered by the Kennet & Avon Canal for the local economy, arising from increased tourism and leisure activity;
- Determine and quantifying where possible the ecosystems services delivered by the Canal.

As far as possible, both sets of impacts are broken down by local authority area.

Where possible, impacts are compared with:-

- The pre-HLF project baseline in 1995, taking account of the fact that the canal was navigable throughout at this time, all be it with restrictions;
- An assessment of what was forecast would happen if the canal reverted to 30% cruiseway status, undertaken as part of the economic appraisal for the HLF project by Coopers & Lybrand in 1995.

Local economic impact

The study estimates that around 11.2 million tourism, recreation and functional visits were made to the canal in 2009. This compares with 7.7 million visits in 1995, a growth of 46%. Visits to the canal have continued to grow since the HLF project was completed in 2002. These visits generated some £42 million gross direct expenditure in the local economy by visitors to the canal in 2009. This rises to £55 million if indirect and induced spend is added.

This expenditure supports some 1,306 leisure & tourism-related jobs in the canal corridor. This has grown from 815 jobs in 1995, pre-restoration. The original economic appraisal supporting the application for HLF funding stated that a high proportion of these jobs would be lost if the canal reverted to 30% cruiseway. So the net jobs supported by the canal in its current navigable state are 1,230, compared with the situation if canal maintenance was reduced and navigation largely ceased.

In summary, direct and total visitor spend, plus annual visits and jobs supported, by local authority in 2009 was:-

Reading

Direct visitor spend	£664,000
Direct, indirect & induced spend	£863,000
Visits p.a.	188,000
Jobs supported	20

West Berkshire

Direct visitor spend	£12,293,000
Direct, indirect & induced spend	£15,980,000
Visits p.a.	3,491,000
Jobs supported	386

Wiltshire

Direct visitor spend	£14,459,000
Direct, indirect & induced spend	£18,796,000
Visits p.a.	3,344,000
Jobs supported	444

Bath & North East Somerset

Direct visitor spend	£14,698,000
Direct, indirect & induced spend	£19,107,000
Visits p.a.	4,193,000
Jobs supported	455

Total

Direct visitor spend	£42,113,000
Direct, indirect & induced spend	£54,747,000
Visits p.a.	11,216,000
Jobs supported	1,306

Additionally the Ecotec 2005 study found that between 1995 and 2005 there had been some £375 - £435 million private and public sector investment in canalside properties. (This work hasn't been updated in the present study.) Many of these were residential, but around 2,700 jobs were supported in commercial canalside developments, particularly in Reading. These jobs aren't necessarily directly related to the canal, but are supported by developments focussing on the regenerated canal corridor.

Impact on ecosystems services

It is recognised that inland waterways make a valuable contribution to people's quality of life. They provide recreation, transport and land drainage. They act as a focus for the regeneration of waterside areas. They provide an important environmental, landscape and heritage resource. In this study, such quality of life benefits have been expressed and analysed in terms of ecosystems services delivered. Unlike the expenditure by visitors and the resultant employment generated, these ecosystems services represent real increases in people's welfare, rather than a spatial redistribution of benefits.

In this analysis, relevant ecosystems services have been identified and the benefits quantified where possible. It hasn't been possible to place a monetary value on all identified impacts, although the major benefits have been captured. Therefore the values will underestimate the actual benefits delivered. The analysis has been made (at 2009 values) against three scenarios:-

1. The current position (2009);
2. The position prior to the HLF project (1995);
3. The position if the canal reverted to largely un-navigable (ie. 30% cruiseway) status.

The following annual benefits have been identified:-

Ecosystem service	Value 2009 (£s)	Value 1995 (£s)	Value – Un-navigable (£s)
Provisioning services			
Business creation & employment		Not applicable	
Property value enhancement (capital)	£150.9m	£150.9m	£65.7m
Cost effective transport		Not quantified	
Water supply		Not quantified	
Volunteering		Not quantified	
Regulating services			
Carbon saving – sustainable transport & renewable energy		Not quantified	

Land drainage	£2.1m	£2.1m	£0.0m
Waterway habitats	Included elsewhere		
Cultural services			
Recreation	£10.7m	£6.9m	£3.5m
Waterway heritage, landscapes & environment	£1.0m	£1.0m	£1.0m
Outdoor learning	Not quantified		
Cross-cutting services			
Health & well-being	Not quantified		
Wider tourism & regeneration benefits	Not quantified		
Total – annual value	£13.8m	£10.0m	£4.5m
Total – capital value	£150.9m	£150.9m	£65.7m

Note:-

1. All values are shown at 2009 prices, for comparison purposes
2. No change is assumed in property value enhancement between 1995 & 2009, although some growth can be anticipated because of improvements in the quality of the canal environs.

This shows a growth in benefits delivered of at least £3.8m per year since 1995. If the canal was to revert to largely un-navigable status (30% cruiseway) some £9.3m benefits per year would be lost, together with a fall of around £85m in the capital value of properties. These benefits compare with an annual cost of maintaining the canal of £2.5 million in 2009/10.

The estimated split of benefits and costs by local authority is:-

Bath & North East Somerset

Ecosystem service	Value 2009 (£,000s)	Value 1995 (£,000s)	Value – Un-navigable (£,000s)
Property value enhancement	£54.1m	£54.1m	£37.3m
Land drainage	£155k	£155k	£0k
Recreation	£3,983k	£2,590k	£1,295k
Waterway heritage, landscapes & environment	£189k	£189k	£189k
Total – annual value	£4.3m	£2.9m	£1.5m
Total – capital value	£54.1m	£54.1m	£37.3m

Wiltshire

Ecosystem service	Value 2009 (£,000s)	Value 1995 (£,000s)	Value – Un-navigable (£,000s)
Property value enhancement	£47.3m	£47.3m	£0.0m
Land drainage	£1,100k	£1,100k	£0k
Recreation	£3,177k	£2,065k	£1,033k
Waterway heritage, landscapes & environment	£464k	£464k	£464k
Total – annual value	£4.7m	£3.6m	£1.5m
Total – capital value	£47.3m	£47.3m	£0.0m
Annual maintenance cost			£1.4m

West Berkshire

Ecosystem service	Value 2009 (£,000s)	Value 1995 (£,000s)	Value – Un-navigable (£,000s)
Property value enhancement	£35.8m	£35.8m	£14.7m
Land drainage	£756k	£756k	£0k
Recreation	£3,316k	£2,155k	£1,077k
Waterway heritage, landscapes & environment	£319k	£319k	£319k
Total – annual value	£4.4m	£3.2m	£1.4m
Total – capital value	£38.8m	£35.8m	£14.7m
Annual maintenance cost			£1.0m

Reading

Ecosystem service	Value 2009 (£,000s)	Value 1995 (£,000s)	Value – Un-navigable (£,000s)
Property value enhancement	£13.7m	£13.7m	£13.7m
Land drainage	£70k	£70k	£0k
Recreation	£179k	£116k	£58k
Waterway heritage, landscapes & environment	£29k	£29k	£29k
Total – annual value	£0.3m	£0.2m	£0.1m
Total – capital value	£13.7m	£13.7m	£13.7m
Annual maintenance cost			Negligible



The National Infrastructure Assessment – Call for Evidence

About the Woodland Trust

The Woodland Trust appreciates the opportunity to respond to the National Infrastructure Commission call for evidence. Given the overriding importance of green infrastructure in the delivery of sustainable development we would like to take this opportunity to reiterate our call for green infrastructure to be considered as part of the NIC's remit. Notably, this was a key recommendation in the Natural Capital Committee's 4th State of Natural Capital Report¹. We hope that our submission will show the Commission that green infrastructure, particularly irreplaceable ancient woodland and newly planted woods and trees need to be a key component in the Commission's considerations on long term infrastructure provision, as per the Government's manifesto promise to 'protect your countryside, green belt and urban environment'.

As the UK's leading woodland conservation charity, the Trust aims to protect native woods, trees and their wildlife for the future. Through the restoration and improvement of woodland biodiversity and increased awareness and understanding of important woodland, these aims can be achieved. We manage over 1,250 sites across the UK, covering around 23,000 hectares (57,000 acres) and we have 500,000 members and supporters.

Questions and Answers

We have only answered the questions that fall within our charitable remit.

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of "highest value" should include benefits and costs, as far as possible taking a comprehensive view of both. "Long-term" refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

The Trust cannot comment on specific geographical priorities. But we would like to raise the issue of the importance of considering the natural environment from the outset. Whilst the Trust recognises that the development of infrastructure is critical, we ask that it is done with due consideration of the natural environment. The Trust believes the natural environment – both its protection and enhancing its ability to deliver vital ecosystem services to society - should be a starting point for all decisions on infrastructure provision. This is essential to delivering the current government's manifesto commitment that 'we will build infrastructure in an environmentally sensitive way'.

The Natural Environment White Paper (NEWP) published in 2011 must be at the heart of all infrastructure decisions. It outlines the Government's vision for the natural environment over the next 50 years and informs key areas of policy development in relation to conservation and

biodiversity. This includes a Government commitment to “providing appropriate protection to ancient woodlands.” In addition the NEWP confirms that “Departments will be open about the steps they are taking to address biodiversity and the needs of the natural environment, including actions to promote, conserve and enhance biodiversity.”

The NEWP also says “We will move progressively from net biodiversity loss to net gain, by supporting healthy, well-functioning ecosystems and establishing more coherent ecological networks.”

The evidence on which the Government has based these key policies in the Natural Environment White Paper is found in the Lawton Review. This recognises the importance of habitat networks, and reducing fragmentation of habitats. The review also stated that the government must “provide greater protection to other priority habitats and features that form part of ecological networks, particularly Local Wildlife Sites, ancient woodland and other priority BAP habitats”.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Green infrastructure is critical to creating better places to live and work. Woods and trees have the ability to deliver multiple benefits. Planting schemes should be bespoke to fit the needs of both the site and the community. Woodland creation can do everything from build resilience to flood risk and climate change to helping to instil an understanding and respect for the natural environment in children. Green infrastructure can play a critical role in softening the interface between hard infrastructure and housing.

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Natural infrastructure should be integrated into the design of more traditional infrastructure and retrofitted into maintenance and renovation projects. Additionally, it is important to consider whether a natural infrastructure approach could meet the objective, as opposed to hard infrastructure or using a combination of both.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by “funding”, the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

All funding mechanisms must ensure that any green infrastructure created is accompanied with appropriate legal agreements assuring it will be maintained and enhanced in perpetuity.

Careful ecological assessments and planning at an early stage can minimise damage and ensure that the required infrastructure and mitigation works are as effective as possible in enhancing biodiversity and public access.

It is also worth turning the question around to consider what happens if we don’t invest in certain infrastructure now. The NIC’s own research paper on population recognises that rising congestion

and pollution have the potential to stifle London's growth. This is backed up by a very robust evidence base, for example a report from the Royal College of Physicians states:

Each year in the UK, around 40,000 deaths are attributable to exposure to outdoor air pollution which plays a role in many of the major health challenges of our day. It has been linked to cancer, asthma, stroke and heart disease, diabetes, obesity, and changes linked to dementia. The health problems resulting from exposure to air pollution have a high cost to people who suffer from illness and premature death, to our health services and to business. In the UK, these costs add up to more than £20 billion every yearⁱⁱ.

This current work is an opportunity to mitigate this on-going challenge and to mitigate its impact in the future. As such the Trust seeks assurances that the Commission is taking these considerations into account at the earliest possible stage.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

The importance of protecting existing high value habitats and species should be considered as a primary concern for any infrastructure project. Linear infrastructure such as transport and energy corridors represent a significant risk to habitats such as ancient woodland. Yet careful ecological assessments and planning at an early stage can minimise damage and ensure that mitigation works are as effective as possible in enhancing biodiversity and public access.

The Trust would like to make particular reference to the importance of protecting ancient woodland. Ancient woodland is defined as an irreplaceable natural resource that has remained constantly wooded since AD1600. The length of time ancient woodland takes to develop and evolve (centuries, even millennia), coupled with the vital links it creates between plants, animals and soils accentuate its irreplaceable status.

Our ancient woodlands are quintessential features of England's much-loved landscapes – irreplaceable, living historic monuments which inspire us and provide us with a sense of place and history in an increasingly frenetic world

These are not The Trust's words, but taken from the government's own Keepers of Timeⁱⁱⁱ, written as a statement of policy to better protect and value ancient woodland. The Government Forestry and Woodlands Policy Statement (2013) confirms the Government's commitment to Keepers of Time by stating protection of our trees, woods and forests, especially ancient woodland, is our top priority.

Natural England's (NE) standing advice for ancient woodland and veteran trees (6 April 2016) recognises that ancient woodland is irreplaceable and that development of adjacent land, not just its direct damage can have a significant negative effect on ancient woodland. The Trust seeks assurances that the Commission is taking these considerations into account at the earliest possible stage.

Water and wastewater (drainage and sewerage):

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

We believe that a catchment approach to water management, integrating management of supply, waste water and flood risk, is hugely important. We welcome this question as its inclusion shows recognition of the need to consider water management at a wider landscape scale rather than simply considering hard infrastructure measures in isolation. Whilst man-made solutions (e.g. flood walls and water treatment plants) will continue to play a substantial role in many schemes, it is increasingly accepted that natural approaches to water management can also offer significant benefits. What is clear is that both approaches need to be looked at in tandem, to address both short and long term risk and to ensure that more affordable and appropriate options are considered alongside costly capital schemes. We would recommend the Woodland Trust report ‘Stemming the Flow – The role of trees and woodland in flood protection^{iv}’ for more information.

Flood risk management:

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: “innovative technologies and practices” can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

A joint publication by Forest Research and Confor – The Role of Productive Woodlands in Water Management^v (March 2015) – states that:

‘Society is increasingly threatened by flooding, while the water environment remains seriously impacted by a range of human pressures, including diffuse water pollution. There is strong evidence to support woodland creation in appropriate locations to help manage these issues....There is a strong case for further investment in well-targeted woodland creation to help meet a wide range of environmental and social goals, including contributing to the Floods Directive, Water Framework Directive, Biodiversity 2020, Greenhouse Gas reduction, climate change adaptation and growing the rural economy’.

Trees and woodland can reduce localised flooding and alleviate the effects of larger floods in a variety of ways, including:

- Water penetrates more deeply into the woodland soils (higher infiltration rates) leading to less surface run-off.
- Trees, shrubs and large woody debris alongside rivers and streams and on floodplains act a drag on flood waters, slowing down floods and increasing water storage.
- Trees protect soil from erosion and reduce the sediment run-off, which help the passage of water in river channels, reducing the need for dredging.
- The greater water use of trees can reduce the volume of flood water at source.
- Trees slow the speed at which rain reaches the ground, with some rain evaporating into the atmosphere - even in winter native deciduous trees intercept up to 12% if rainfall.

ⁱ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/585429/ncc-annual-report-2017.pdf

ⁱⁱ <https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution> Royal College of Physicians, Every Breath we Take, 23 February 2016

ⁱⁱⁱ <http://www.forestry.gov.uk/keepersoftime>

^{iv} <https://www.woodlandtrust.org.uk/publications/2014/05/stemming-the-flow/>

^v http://confor.org.uk/Upload/Documents/37_TheRoleofProductiveWoodlandsinWaterManagementConforMarch2015.pdf

Dear Sirs

I am writing on behalf of Worcestershire Local Enterprise Partnership to provide a specific response to Question 1 of the Call for Evidence ie “ What are the highest value infrastructure investments that would support long term sustainable growth in your city or region?

Working in partnership with LEPs, landowners, local authorities, train operating companies, Network Rail, MPs and others, Worcestershire is in the process of implementing 2 major rail infrastructure schemes to support the growth of our economy in line with the Strategic Economic Plan for the County (<http://www.wlep.co.uk/assets/WLEP-Final-SEP-310314-V-1-1.pdf>). These being the development of Worcestershire Parkway Station (<http://www.wlep.co.uk/government-green-light-worcestershire-parkway/> and http://www.worcestershire.gov.uk/info/20254/infrastructure_and_improvement_schemes/995/worcestershire_parkway_regional_interchange) and the redevelopment of Kidderminster Station. Both schemes are being developed in the context of an emerging Rail Investment Strategy for Worcestershire.

However, whilst both initiatives will add considerably to the economic growth potential of the County, full potential will only be realised by the improved connectivity to London and the South East through the reduction in journey times. The game changer intervention here being the investment in the development of the North Cotswold Line as envisioned in the attached document which has the full support of Worcestershire LEP.

Two substantial events have already been held to progress this ambition. On 12th February 2016, Stakeholders, including LEPs, DfT, businesses, MPs and others attended an event Chaired by Lord Faulkner (<https://www.witneyconservatives.com/news/david-cameron-attends-conference-about-north-cotswold-rail-line>) that detailed the Vision (attached) and started to build the Business Case for action. On 29th November 2016, a further event was held at the Houses of Parliament, again Chaired by Lord Faulkner, which agreed to establish a Task Force to take the project forward. Worcestershire LEP and Oxfordshire LEP are currently finalising the Terms of Reference of the Task Force which will engage further with businesses to build a case based on economic growth.

I would commend this initiative to the National Infrastructure Commission and if you have any further queries, please do not hesitate to contact me.

Regards

[Name redacted]
[Job title redacted]

Worcestershire Local Enterprise Partnership
5 The Triangle
Wildwood Drive
Worcester
WR5 2QX

* [email address redacted]

 [telephone number redacted]

M. [mobile telephone number redacted]

 www.wlep.co.uk

2016 ANNUAL REPORT



Worcestershire
Local Enterprise Partnership



[Click here to view our 2016 Annual Report](#)



WWF-UK
Registered office
The Living Planet Centre
Rufford House, Brewery Road
Woking, Surrey GU21 4LL

Tel: +44 (0)1483 426444
info@wwf.org.uk
wwf.org.uk

National Infrastructure Assessment - call for evidence

WWF-UK RESPONSE

10 February 2017

SUMMARY

WWF is a leading global conservation organisation, employing over 5,000 staff in more than 100 countries and with more than five million supporters across the world. We are at the heart of global efforts to address the world's most important environmental challenges. We work with governments, businesses and communities to promote sustainable patterns of development so that both people and nature can thrive. Together, we're safeguarding the natural world, tackling climate change, and promoting prosperous and resilient economies.

It is now widely recognised that a healthy natural world is the foundation of a productive and resilient economy. Yet, from the serious flooding incidents we have seen in recent years (which have been caused at least in part by the way river catchments have been managed), to the health-related impacts of urban air pollution and associated human and economic costs - the evidence shows that we are failing to protect and invest in our natural assets, and that this is already affecting the UK's economy and the well-being of its population. If unabated, these trends will have profound implications for the nation in the future. Accordingly, government, business and wider civil society are increasingly recognising the need to structure economic policy so that it promotes investment in our natural assets and makes the transition onto a sustainable, resource-efficient, low-carbon economic trajectory.

ANSWERS TO QUESTIONS

2. How should infrastructure most effectively contribute to the UK's international competitiveness? What is the role of international gateways for passengers, freight and data in ensuring this?

WWF has produced a Greener Budget Report in the last two years, making recommendations about what the Treasury should include through economic policy measures in the Annual Budget that would help to move the UK economy onto a more sustainable growth path. The reports show why that is essential, if we are to remain competitive and prosperous as a nation, in a future resource- and carbon-constrained global economy; one in which climate mitigation policies that will promote the shift to a low carbon economy, and growing resource scarcity including water shortages and increasing competition for land, will change the rules of the game.

Infrastructure development has a crucial role to play in supporting this shift to a low carbon, climate-resilient, and resource-efficient economy. It should:



President: His Royal Highness,
The Prince of Wales KG, KT, GCB, OM
Chair: Sir Andrew Cahn KCMG

Chief Executive: Tanya Steele WWF-UK a charity registered in England and Wales number 1081247 and in Scotland number SC039593, a company limited by guarantee registered in England number 4016725. VAT number 733 761821
100% recycled paper

- Undertake stress testing to assess the impact of future environmental risks to UK infrastructure and the UK economy.
- Be developed in conjunction with the industrial strategy, putting low carbon growth at its heart, for example by setting an objective to become a world leader in the development and integration of low-carbon energy systems with export potential, and which supports the development of a sustainable bioeconomy that can generate considerable growth and jobs.
- Be developed in conjunction with the Emissions Reductions Plan, and include investment in energy efficiency as a key plank of our infrastructure strategy.
- Be developed in conjunction with the 25 Year Environment Plan, which by investing in the UK's natural capital should generate significant improvements in productivity and competitiveness such as through improvements in air quality and health, soil quality, and flood and drought resilience all of which boost productivity.
- Include investment in green infrastructure as a key part of our infrastructure strategy, as green infrastructure can both complement and protect traditional infrastructure and can provide a more cost-effective solution in some cases.

International connectivity is very important for the UK economy, particularly as the Government seeks to negotiate new trading relationships both with and beyond the EU. But the Government must factor the reality of climate change into its international connectivity strategy. Aviation is the most high-carbon form of transport, so its use should be limited as far as possible. For example, video-conferencing can substitute for business travel, saving companies money and increasing productivity, as demonstrated by WWF-UK's One in Five Challenge¹. International rail can also substitute for air freight, as demonstrated in January 2017 by the first UK arrival of a freight train from China². Rail freight is both cheaper and greener than air freight.

Demand for business flights has fallen both in percentage terms and in absolute terms since the turn of the century³, which means that despite all the talk about expanding airport capacity to boost business, much of this new capacity would in fact be used for leisure.

By developing a low-carbon connectivity strategy, which prioritises digital, marine and rail connectivity while reducing reliance on aviation, the UK can remain competitive while meeting its legally binding domestic and international climate change obligations. Failure to meet our climate change objectives will of course result in great damage to the UK economy and to UK connectivity, with ports, airports and international rail terminals all highly vulnerable to climate change impacts such as sea level rise and heightened flood risk.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Green infrastructure can contribute to creating better places to live and work. Green infrastructure such as urban green space can often have important co-benefits, contributing simultaneously to improved health, reduced pollution, flood resilience, recreational and cultural benefits etc. For example, there is a growing literature showing how urban green space can boost mental and physical wellbeing, improve educational attainment, reduce anti-

¹ WWF-UK, 2014. One in Five Challenge Annual Report 2011/12 http://assets.wwf.org.uk/downloads/one_in_five_report.pdf
WWF-UK 2011. Moving on: Why flying less means more for business http://assets.wwf.org.uk/downloads/moving_on_report.pdf?_ga=1.230376666.736520801.1416495376

² Campaign for Better Transport, 2017. First ever freight train from China to the UK arrives <http://www.bettertransport.org.uk/blog/better-transport/first-ever-freight-train-china-uk-arrives>

³ Aviation Environment Federation, 2015. The Great British Runway Myth...why there is no need for a new runway <http://www.aef.org.uk/uploads/Runway-Myth.pdf>

social behaviour, through psychological impacts, increased recreation and improved air quality. The Natural Capital Committee showed that £2.1 billion in healthcare costs could be saved if everyone in the UK had access to good quality green space⁴.

Infrastructure and housing development are closely linked, as new housing generates new infrastructure needs. Where such developments are located will have a big impact on environmental outcomes, which in turn can have a big impact on the people living in that area. A key issue is around flood resilience. Poor management of our land and waterways have contributed to increased flood risk, as more development on flood plains has taken place, and agricultural production practices and adaptations to waterways have exacerbated the problem. The likely impact of climate change on UK weather will be increased precipitation leading to more flooding events, which, as the UK population is already too aware, are very costly. The winter 2015/2016 floods look set to have cost the economy at least £5bn. UK flood defences designed to withstand a 1 in 100 year flood (including those built as recently as 2013) have already failed to protect some local populations and businesses during the storms in late 2015, suggesting a failure to understand the scale and probability of future weather-related threats.

Green infrastructure solutions can address this, and it is vital that the government's forthcoming review of flood defences takes account of the crucial role that improved management of natural capital can play in a cost-effective and future-proofed UK flood strategy.

In accordance with forthcoming revisions to HM Treasury's Green Book on natural capital, information on natural capital impacts and risks should be added to the existing infrastructure pipeline evidence base for all projects in order to help potential investors evaluate investment options⁵.

However, the NIP also needs to recognise that many natural assets are vital 'natural infrastructure' in their own right – providing a range of vital public services of considerable value – and as such should be afforded 'infrastructure' status in the UK's infrastructure planning frameworks. The government has already clearly stated its vision that all public policy should reflect this⁶. Thus natural infrastructure investments should be considered in a consistent way against other infrastructure options, to assess priorities for funding.

The Scottish government is already making progress in this area, having explicitly included investment in natural capital as a key element of its economic strategy – and including priority natural infrastructure projects in its latest National Planning Framework (for example, the Central Scotland Green Network is one of 14 major infrastructure priorities, alongside others such as national broadband).

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

⁴ Natural Capital Committee, 2015. The state of natural capital: protecting and improving natural capital for prosperity and wellbeing, 3rd Report to the Economic Affairs Committee.

⁵ Infrastructure UK and HM Treasury, 2012. National infrastructure investment pipeline. Excel workbook. First published December 2012.

⁶ Defra, 2015. Open Environment speech by Elizabeth Truss. Defra, London, UK.

Water demand

In terms of water demand management, significant water use reductions can be achieved through the installation of water meters. For example, Southern Water's Universal Metering Scheme (just completed) achieved reductions of 15% average use, and up to 30% peak use in critical periods (i.e. when water is scarce). Evidence from the US and Australia suggest further reductions can be achieved through tariffs and reward schemes. In terms of rebound effects, there is some evidence that water savings are maximised just after installation – this makes sense as installation often goes hand in hand with communications and awareness. Indeed awareness-raising is critical for all demand management measures (for example, changes in tariffs only work if people understand the different tariff options). So rebound effects can be countered to some extent by frequent communications. For more information see:

- WWF Itchen Initiative and smarter demand management discussion paper http://assets.wwf.org.uk/downloads/itchen_initiative_report_march_30th.pdf
- Independent Walker Review <https://www.gov.uk/government/publications/the-independent-review-of-charging-for-household-water-and-sewerage-services-walker-review>
- Fairness on Tap http://assets.wwf.org.uk/downloads/fairness_on_tap.pdf
- Waterwise Evidence Base

There are also opportunities for demand management interventions on the wastewater side. For example, using Sustainable Urban Drainage Systems (SUDS) to reduce the amount of rainfall run-off from urban areas that ends up in combined sewers, thereby reducing the volume of wastewater requiring treatment. It's also important to recognise that savings on the water supply side mean savings on the wastewater side (i.e. less water in, less water out). However, we are not aware of any work to quantify this.

Energy demand

There is significant potential for demand management, both in our power system and within our homes.

The deployment of increasing amounts of renewable generation will result in a greater need for demand side management in the **power sector**. The Committee on Climate Change found that Demand Side Response (DSR) in conjunction with greater storage and interconnection would be vital for ensuring security of a system with large amounts of renewable capacity. At the same time smart meters and time of use tariffs stand poised to move consumers towards being “prosumers”, thereby creating more opportunities for demand management in the domestic sector⁷. The greatest opportunities for domestic demand management will occur when heat pumps, electric vehicles, and battery storage systems are deployed on the system in sufficient numbers.

We now turn to **energy** demand management in the domestic sector. Our homes are a significant element of the UK's **energy infrastructure**, accounting for 36% of total UK electricity consumption and 51% of total gas consumption in 2015⁸.

The UK **existing domestic building stock** is old and we are in the bottom third for thermal efficiency when compared with our European neighbours⁹, with considerable potential for improvement through increased fabric efficiency. Failure to address this problem risks increasing the costs of balancing the energy system in future, as in many cases,

⁷ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/467024/rpt-frontier-DECC_DSR_phase_2_report-rev3-PDF-021015.pdf p.9

⁸ DECC (2016) Energy Consumption in the UK

⁹ UK ACE (2015) The cold man of Europe

energy efficiency can meet demand for energy services at a lower cost than supply-side measures¹⁰.

Failure to assess demand-side opportunities when making supply-side decisions risks policy objectives being achieved at greater cost than necessary¹¹. Investing in the fabric efficiency of our buildings will help reduce overall energy demand, in turn helping to reduce the scale of investment required to balance the future energy system.

According to a 2014 study by Verco and Cambridge Econometrics, an ambitious programme of domestic retrofit would lead to carbon reductions of 23.6MtCO₂ per annum by 2030, after accounting for direct, indirect, and economy-wide rebound effects. This is roughly equivalent to cutting the CO₂ emissions of the UK transport fleet by one third.¹²

Transport demand

Limiting transport demand and shifting demand from higher-carbon to lower-carbon modes of connectivity will be essential for meeting the UK's legally binding domestic and international commitments on climate change. Demand management is particularly important for car and plane travel, as these modes of travel are particularly polluting and increases in demand have tended to outstrip increases in vehicle efficiency over recent decades.

Car travel can be shifted to public transport (e.g. bus or train) or active travel (e.g. cycling or walking), resulting in substantial air quality and general health improvements as well as reduced carbon emissions. Passenger air travel can be replaced by train or video conferencing, resulting in reduced costs and increased productivity. Road and air freight can be shifted to rail or sea, resulting in reduced costs and an improved safety record.

The Committee on Climate Change (CCC) is clear in its advice to Government that demand management is an essential component of efforts to decarbonise transport, without which technological gains from improved vehicle efficiency and fuel switching to biofuels or electricity will continue to be cancelled out by increasing demand¹³. The CCC is also clear that aviation emissions should be held at 2005 levels in 2050, allowing for some 60% increase in passenger numbers with increased fuel efficiency. The Government must set out a framework for achieving this target.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Competition in the **water services sector** could, like in Scotland, mean that companies put a greater emphasis on customers and compete on service (as opposed to price). While there are some concerns that competition would break up 'natural' geographic monopolies (and perhaps disconnect customers further from the environment where their water is sourced), there are opportunities. For example, we hope that competition would reveal data/information about where water is coming from and the losses at different stages in its delivery. This would help drive demand reduction.

¹⁰ Cambridge Econometrics (2014) Building the future

¹¹ Green Alliance (2015) Getting More From Less: Realising the Potential of Negawatts In the UK Electricity Market

¹² Verco and Cambridge Econometrics (2014) Building the Future: The economic and fiscal impacts of making homes energy efficient
<http://www.energybillrevolution.org/wp-content/uploads/2014/10/Building-the-Future-The-Economic-and-Fiscal-impacts-of-making-homes-energy-efficient.pdf>

¹³ CCC, 2016. Meeting Carbon Budgets – 2016 Progress Report to Parliament <https://www.theccc.org.uk/publication/meeting-carbon-budgets-2016-progress-report-to-parliament/>

Collaboration between water companies with NGOs is crucial. Wessex Water said that “engaging with the catchment partnership has fundamentally changed our business plan”. The following are needed to help foster collaboration and deliver the Catchment Based Approach (CaBA):

- multi-year seed funding of catchment partnerships in order to leverage private sector investment;
- procurement processes that enable NGOs to deliver. (Many of the big utilities are set up to procure big contracts from multi-national engineering firms for delivery, making it difficult for NGO partnerships as the Rivers Trust charities to go through the procurement process.)

Competition also has a vital role to play in driving down the costs of building new **energy infrastructure**. With regard to low carbon power, competitive auctions have been proven to bring down costs to consumers¹⁴; clearing prices in the 2015 Contracts for Difference (CfD) auction were significantly lower than the administrative strike prices set prior to the auctions. Furthermore, the NAO found that, when compared to initial FiD enabling contracts awarded to selected low carbon projects, competitive auctions clearly delivered better value for money¹⁵.

In order to drive further cost reductions in this area, the Government must set out the timing and amount of future CfD auctions, and should outline the post 2020 Levy Control Framework. Clarity for investors is the key to realising supply chain efficiencies. In Denmark this has resulted in record breaking prices for offshore projects.¹⁶ The Government should also ensure that there is a route to market for the cheapest forms of power generation, onshore wind and solar¹⁷. Allowing these technologies to compete would drive down costs to consumers and ensure that the cost of decarbonisation is not back loaded onto future consumers¹⁸.

Effective competition must be underpinned by access to the market for new technologies. Globally, energy and technology markets are innovating rapidly and the UK’s regulatory framework needs to be suitably responsive to ensure the UK is well placed to capture opportunities. As the NIC identified in their Smart Power report, new and innovative technologies such as storage and demand management currently face a number of barriers to market entry which puts them at a disadvantage compared to more traditional forms of electricity generation. The WWF-UK convened business taskforce on renewables found that since privatisation a complex regulatory framework has built up which distorts the market in favour of incumbent and long established technologies. The taskforce recommended that the Government should remove barriers in the electricity market in order to increase competition and maximise cost reductions.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered? Note: by “funding”, the Commission means who pays for infrastructure services. and how, e.g. user charges, general taxation etc.

Using techniques such as natural capital assessment that capture the value of the multiplicity of benefits provided by green infrastructure is important, as looking only at one type of benefit will result in its undervaluation. And thus finding ways to pool funds across

¹⁴ <https://www.frontier-economics.com/documents/2015/03/lcp-frontier-economics-next-uk-auctions-renewable-contracts-difference.pdf>

¹⁵ <https://www.nao.org.uk/wp-content/uploads/2014/06/Early-contracts-for-renewable-electricity1.pdf>

¹⁶ <http://www.power-technology.com/features/featuretracking-europes-surge-of-cheap-offshore-wind-power-5725995/>

¹⁷ <https://about.bnef.com/blog/wind-solar-boost-cost-competitiveness-versus-fossil-fuels/>

¹⁸ <https://www.theccc.org.uk/2016/10/13/concrete-action-needed-to-meet-uk-climate-commitments-following-paris-agreement-and-brexit-vote/>

departments of government that stand to gain from the various different benefits rather than trying to tackle these issues in isolation is also important¹⁹.

For example, as noted above, improving the quantity, quality and use of green space could play an important role in reducing costs relating to mental and physical ill-health. Funding of green space is primarily a Local Authority responsibility, yet much of the benefit is realised by other areas of government, including by the National Health Service, Public Health England and Department of Health, as well as the Department for Work & Pensions (through reduced work absence and benefits dependency) and the Department for Business, Innovation & Skills (through improved workforce productivity). Improved cooperation and joint-funding of natural capital projects across departments, as part of overall UK health care policy, could cut overall costs and improve value for money.

To provide another example: the annual cost of flood damage to properties in England and Wales is projected to rise from £1.2 billion (current average) to as much as £12 billion by the 2080s²⁰. Natural capital flood and coastal risk management (FCRM) solutions can deliver on many government policy objectives, safeguarding businesses, homes and local economies, improving health and storing carbon. Potential beneficiaries include the Treasury, Department for Business, Innovation & Skills, National Health Service, Department of Health, Department for Transport, Department for Work & Pensions, Department for Communities & Local Government, Home Office and Ministry of Defence. Improved collaboration and co-funding would provide greater incentive for flood risks to be considered in departmental planning processes, spread the cost and improve value for money.

Offsetting or compensation payments can play an important role in financing natural capital. Infrastructure development plans should fully embed natural capital concepts, ensuring that all publicly funded infrastructure investments make a positive contribution to protecting and enhancing the UK's natural environment (a government commitment²¹). Thus all infrastructure developments should fully address impacts on natural capital according to the established mitigation hierarchy (avoid, minimise, restore, offset). A mandatory national offsetting scheme should be introduced, to which all infrastructure projects should contribute in order to compensate any unavoidable damage, and ensure a net positive impact on our natural capital. This offsetting scheme should pool finance generated through offsets to finance priority natural capital investments, as identified through the 25 Year Environment Plan with advisory inputs from the Natural Capital Committee.

In addition, we need to see greater coherence in public funding, so different funding sources do not conflict with each other. For example, greater alignment is needed between the objectives and timelines associated with CAP payments, EA flood defence, and water company investment, to ensure we get the best value for the money we are already committed to spending - only central Government can bring them into line to ensure all objectives are met cost effectively. We also need taxes, fines and penalties for pollution and breaches of environmental regulation that reflect environmental damages, with monies raised recirculated into enhancement.

In addition, there is a need to look how to reward farmers better for managing their land in a way that helps contribute towards the construction of more green infrastructure, via more targeted public expenditure, and other arrangements such as Payments for Ecosystem Services. The chance to redesign agricultural policy after the UK exits the European Union provides an opportunity to reshape payments to farmers so that they support the delivery of public goods including green infrastructure that contributes to reducing flood and drought risks and improved water quality.

¹⁹ A Greener Budget Report 2015, Sustaining our Prosperity in a Changing World, WWF-UK

²⁰ HR Wallingford, 2012. The UK Climate Change Risk Assessment 2012: Evidence Report Summary. Defra, UK

²¹ Defra, 2015. The government's response to the Natural Capital Committee's third State of Natural Capital report Defra, London, UK.

Other innovative financing mechanisms could also be considered, such as Environmental Impact Bonds, which involve borrowing upfront to pay for investment in green infrastructure, which will generate public savings in future, thus facilitating repayment of loans. Green Alliance has made innovative proposals for how new markets for land and nature can be generated, through the creation of National Infrastructure Schemes²².

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets? Note: projects that “can be funded” but “will not be financed” refers to projects that can be paid for, but where the upfront costs of construction cannot be raised at an efficient price and/or with an appropriate risk sharing balance between the different parties. General government financing policy (i.e. the issuance of gilts) is out of scope.

Green infrastructure is an innovative approach, and can sometimes be expected to generate a positive rate of return only in the long term. Sometimes a proportion of the benefits are not monetisable even if they yield important benefits for society. In these situations some form of blended finance or impact investment may be needed, or patient capital or capital that is willing to take greater risks. It is not easy to see where the provision of such finance might come from in the UK. The Green Investment Bank could in principle play this role, but given its imminent privatisation and likely focus on investments with a higher rate of return, it may be less willing to finance these types of projects, and address such market failures. The Natural Capital Financing Facility²³ – established by the European Investment Bank - provides an example of the type of mechanism that could potentially support investment in natural infrastructure. Consideration could be given to the establishment of such a mechanism in the UK.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors? Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

In our 2015 A Greener Budget Report, we proposed that the Treasury adopts a natural capital stress testing approach to assessing the risks from future environmental degradation / natural capital depletion to the economy, and different sectors within it. A similar approach could be adopted in relation to impacts on infrastructure, also as a way to analyse the resilience of different potential future infrastructure development trajectories to future environmental risks and trends. We welcome the fact that stress testing relating to future flooding risks has now been conducted through the Flood Resilience Review. But this approach could be broadened out to cover other types of risks, and its impacts on the wider economy also considered, including interdependence across sectors.

Stress testing is used widely in the UK banking sector to evaluate risk exposure and resilience of financial institutions. It has been used by banks for internal risk management since the 1990s, and gained further momentum following the 2008 financial crisis²⁴. In this context, stress testing is used to examine the ‘health’ of a bank in terms of its capacity to maintain its lending and trading activities under different future economic and financial scenarios.

More recently, a number of initiatives have sought to measure carbon risks in the financial sector better (for example, the Bank of England is investigating the potential influence of

²² http://www.green-alliance.org.uk/natural_infrastructure_schemes.php

²³ <http://www.eib.org/products/blending/ncff/index.htm>

²⁴ Bank of England, 2013. A framework for stress testing the UK banking system. A Discussion Paper.

climate change externalities on the stability of the financial system²⁵), and have also adopted a stress testing approach. Thus a similar approach could be adopted to help assess and manage risks associated with changes in natural capital.

A natural capital stress test could identify the exposure of UK Plc and individual economic sectors to potential changes in stocks of natural capital and associated service/benefit provision, and inform decisions about what level of assets should be maintained to mitigate risk (and associated policy / investment requirements). The test could explore the potential economic (and budgetary) implications associated with a range of different scenarios, related for example to changes in specific UK and international natural assets (e.g. watercourses or forest cover) and/or relevant drivers/pressures (e.g. extreme weather events, global warming and population growth). As the process is refined, interactions between scenarios, natural capital assets and/or economic sectors could be explored²⁶.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

A well-designed offsetting scheme could help to make the planning system more efficient and deliver better environmental outcomes. Rather than requiring expensive, site-specific mitigation measures to protect certain species, which often cause unwelcome last minute delays for developers, planning decisions could be taken in line with an overall plan of how best to protect that species within the area. Natural England or another environmental body can be involved in the design of that overall plan. Thus NE would work with the relevant Council early on in its planning process in order to identify the likely adverse impacts from an envisaged development and identify appropriate mitigation measures, which can include offsetting payments made by the developer to support the provision of a better habitat for that species in an alternative location. Woking Borough Council is currently pilot-testing this approach²⁷. WWF believes that properly designed and implemented, biodiversity offsetting can and should achieve net gain for biodiversity, and generate additional finance for investment in natural capital. WWF-UK also believes that it is vital that biodiversity offsetting is implemented within the context of coherent, long-term national strategy for enhancement of natural capital.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

This has been the theme of our other responses in this document. We believe this can best be achieved by:

- Incorporating natural capital assessments (or assessments of the value of nature in terms of its economic and social benefits in other words) into infrastructure development decisions. As emphasised by the NCC, integrating natural capital into the National Infrastructure Plan (NIP) is crucial.²⁸
- Applying the mitigation hierarchy to all infrastructure investments, and undertaking offsetting or compensatory payments where environmental damage is unavoidable to ensure a positive gain for natural capital overall.

²⁵ Michael Sheren, Senior Advisor at the Bank of England, at “Redesigning finance for low-carbon green growth”, House of Lords, 14 October 2015.

²⁶ A Greener Budget, 2016, Choices for a Prosperous Future, WWF-UK

²⁷ <https://www.gov.uk/government/consultations/great-crested-newt-pilot-scheme-in-woking-opportunity-to-comment>

²⁸ Defra, 2015. The government’s response to the Natural Capital Committee’s third State of Natural Capital report. Defra, London, UK.

- Considering opportunities for green infrastructure on an equal footing with traditional infrastructure solutions.
- Undertaking stress testing to assess the resilience of future infrastructure trajectories to future environmental risks.
- Supporting the shift to a low carbon economy, including by supporting energy efficiency measures.

All of these issues are expanded upon elsewhere in our consultation response.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent? Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

Appraisal of infrastructure investments should fully operationalise the recent additions to HM Treasury’s Green Book in line with NCC recommendations²⁹ which include: adopting a clearer framework for assessing how people value changes in natural capital; more coverage of how environmental changes can impact on firms’ profits; assessing impacts of projects on stocks of natural capital, including irreversibility, uncertainty and uninsurable risks.

We would also recommend that natural capital assessments are applied to large scale infrastructure developments, using tools such as InVEST³⁰, a freely available software tool that enables users to map and value ecosystem services, and allows decision makers to assess and quantify trade-offs associated with alternative management choices, and to identify areas where investment in natural capital can enhance human benefits and conservation. This can provide a practical approach to assessing the natural capital impacts of infrastructure development choices in a particular location, and has been applied to assist with infrastructure development decision making. The Natural Capital Project provides a library of relevant information including for example a report on: “[Entry Points for Considering Ecosystem Services within Infrastructure Planning: How to Integrate Conservation with Development in Order to Aid Them Both](#)”³¹, a report on ‘[Natural capital and roads](#)’, and another on: ‘[Key lessons for incorporating natural infrastructure into regional climate adaptation planning](#)’.

13. How will travel patterns change between now and 2050? What will be the impact of the adoption of new technologies? Note: “travel patterns” include both the frequency and distance of trips taken, as well as the mode of transport used. This covers both personal and commercial travel, including freight.

Adjustments to travel patterns will be needed alongside technological improvements to ensure that transport can make a proportional contribution to achieving the UK’s legally binding domestic and international climate change objectives³². See question 4.

²⁹ Maddison, D & Day, B, 2015. Improving Cost Benefit Analysis Guidance. A Report to the Natural Capital Committee.

³⁰ <http://www.naturalcapitalproject.org/invest/#what-is-invest>

³¹ <http://onlinelibrary.wiley.com/doi/10.1111/conl.12201/abstract;jsessionid=85D224003BB6312263356657B3294691.f02t02?systemMessage=WOL+Usage+report+download+page+will+be+unavailable+on+Friday+27th+January+2017+at+23%3A00+GMT%2F+18%3A00+EST%2F+07%3A00+SGT+%28Saturday+28th+Jan+for+SGT%29+for+up+to+2+hours+due+to+essential+server+maintenance.+Apologies+for+the+inconvenience.>

³² CCC, 2016. Meeting Carbon Budgets – 2016 Progress Report to Parliament <https://www.theccc.org.uk/publication/meeting-carbon-budgets-2016-progress-report-to-parliament/>

In terms of new technologies, electric vehicles (EVs) have the potential to be transformative on a number of fronts:

- Electrification reduces both CO₂ and particulate emissions (and zero emissions in use for Battery Electric Vehicles, BEVs), whether or not the energy input is low-carbon/renewable, as electric motors are more efficient than the internal combustion engine (ICE).
- However, it is the combination of EVs with renewable electricity that holds most promise. EVs can help enable greater penetration of renewable electricity by storing electricity when not in use, and potentially discharging electricity back to the grid at times of high demand. This results in a flexibility benefit to the grid and economic benefit to the consumer.
- EVs also represent a major industrial opportunity for the UK. With stable support from Government, the UK can become a world-leading manufacture of EVs for both the domestic and international markets.

14. What are the highest value transport investments to allow people and freight to get into, out of and around major urban areas?

Air quality and climate change should be seen as the twin drivers of transport investment in urban areas. Electrification, modal shift to bus, rail and active travel, and potentially the use of sustainable biomethane in freight can all result in significant benefits to both the climate and air quality.

The phase-out of diesel vehicles and their replacement with low-carbon alternatives should therefore be an urgent priority. Diesel cars and vans should be replaced with EVs. Diesel HGVs could be replaced by gas engine vehicles, combined with a sustainable supply of biomethane and appropriate methane slip mitigation measures.

Government should also provide stronger support for increasing efficiency in freight logistics.

15. What are the highest value transport investments that can be used to connect people and places, as well as transport goods, outside of a single urban area?

Sustainable long distance passenger travel should be supported through investment in the railways and a fairer tax regime for aviation to reverse the current privileged status of aviation.

Sustainable long distance freight would also involve greater and better use of the railways. It will also require substantial investment in the hydrogen economy and/or deploying wireless dynamic charging technology for roads.

16. What opportunities does ‘mobility as a service’ create for road user charging? How would this affect road usage?

Both mobility as service and road user charging should be considered as potential policy levers for decarbonising transport, as they can both result in modal shift/demand moderation.

19. What is the highest value solution for decarbonising heat, for both commercial and domestic consumers? When would decisions need to be made?

The most cost-effective means of decarbonising heat is to reduce heat demand. As noted under question 4, the UK's housing stock is in the bottom third for thermal efficiency compared to the rest of Europe. An immediate and ambitious programme of domestic energy

retrofit, combined with stringent regulations to ensure the efficiency of new build is required to minimise heat demand.

A programme to bring all homes up to an Energy Performance Certificate rating of C by 2035 would help to eliminate fuel poverty and deliver the carbon abatement needed to meet carbon budgets. To achieve this, a total of £100 billion of investment would be required over a 20-year period. This could be achieved by Government providing zero-interest loans to encourage householders to invest, or by regulating minimum energy efficiency standards at the point of sale³³. The latter approach would require minimal public spending, and although would impose a cost on households these would be recouped in the long-run through lower energy bills³⁴. This spending (on domestic labour and goods) compares to the £15 billion spent every year by UK households on increasingly imported gas for heating³⁵.

This energy efficiency programme would meet the criteria HM Treasury apply for determining their top 40 infrastructure requirements. It would also fit with the eight characteristics of infrastructure identified in HM Treasury's valuation guidance. In addition, classifying energy efficiency as infrastructure is consistent with the way energy efficiency is considered by a range of international organisations such as the European Investment Bank (EIB) and the International Energy Agency (IEA)³⁶.

Alongside investment in domestic energy efficiency, existing technologies for decarbonising heat should be rolled out as fast as possible. In particular, heat pumps are a viable solution for homes currently off the gas grid, and district heating should be considered in urban settings. District heat networks provide the added benefit of providing low cost bulk energy storage, which in future could be used to help balance the electricity system (for example by converting excess electricity to heat as is already done in Denmark to balance their high-renewables grid).

Further options for decarbonising heat include the use of hydrogen and biomethane. These need to be developed, tested and analysed before a decision is made on rolling specific technologies out at scale. There are however sustainability issues associated with both these technologies. Hydrogen needs to be assessed in terms of its reliance on carbon capture and storage and continued use of fossil fuels. The use of biomethane in the gas grid needs to be developed as part of a wider bio-economy strategy, considering the various potential uses of biomass and the best way to deploy them across the economy for maximum value. Sustainable biomass is a limited resource, and needs to be targeted at those sectors of the economy where other options for decarbonisation are limited. Robust sustainability standards such as the Roundtable for Sustainable Biomaterials are also essential for ensuring that biomass feedstocks are responsibly sourced, preferably from wastes and residues rather than virgin crops or trees.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved? Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

WWF-UK's *Positive Energy* report shows that 60% of electricity demand can be met by renewables in 2030. The Committee on Climate Change recommends that the cost effective pathway to the 2050 emissions reduction target set by the Climate Change Act require a decarbonised power sector 2030³⁷. In order to bring emissions from this sector to below 100g Co₂/kWh the CCC recommends 282 TWh of low carbon generation in 2050 and 55% of

³³ E3G (2015) Taking back control: where next for household energy efficiency policy in the UK?

³⁴ Cambridge Economics (2014) The Economics of Climate Change policy

³⁵ ONS (2015) Quarterly Energy Prices

³⁶ Frontier Economics, Energy Efficiency as Infrastructure, Sept 2016

³⁷ <https://www.theccc.org.uk/wp-content/uploads/2015/10/Power-sector-scenarios-for-the-fifth-carbon-budget.pdf>

generation from renewables. Offshore wind plays a large role and deploys at a rate of at least 2GW per year. Onshore wind and solar have a route to market and flexibility options balance the system. Over the next 25 years the costs of wind and solar will tumble rapidly³⁸.

With rapid price reductions, battery storage will start to play a significant role in the electricity market³⁹. BNEF predicts that the rise of EVs will drive down the cost of lithium-ion batteries, making them increasingly attractive to be deployed alongside residential and commercial solar systems. Storage will enable a lower carbon, lower cost energy system where consumers can take greater control of their electricity usage. At the transmission scale, storage can aid the System Operator in mitigating the variances in supply and demand. Storage will also reduce the overall amount of new generating capacity that is needed and will enable more effective system operation. This enhanced security of supply will allow investment in low carbon generation to be optimised as well as reducing overall energy costs to consumers. At a domestic level, storage will allow consumers to take greater control of their electricity production and usage (becoming so-called “prosumers”), furthering the decentralisation of the electricity grid. Penetration of domestic scale storage links closely to deployment of electric vehicles and take up electric heat. Coupled with the smart meter roll-out, storage will enable a lower carbon, lower cost energy system where consumers can take greater control of their electricity usage.

At the transmission scale, storage will aid the System Operator in mitigating the variances in supply and demand. Storage will also reduce the overall amount of new generating capacity that is needed and will enable more effective system operation. This enhanced security of supply will allow investment in low carbon generation to be optimised as well as reducing overall energy costs to consumers. At a domestic level, storage will allow consumers to take greater control of their electricity production and usage (becoming so-called “prosumers”), furthering the decentralisation of the electricity grid. Penetration of domestic scale storage links closely to deployment of electric vehicles and take up electric heat. Coupled with the smart meter roll-out, the integration of domestic storage and generation presents a considerable opportunity to develop the wider network.

21. What are the implications of low carbon vehicles for energy production, transmission, distribution, storage and new infrastructure requirements?

Increased penetration of EVs (battery electric vehicles, BEVs, and plug-in hybrid electric vehicles, PHEVs) is sometimes characterised as a challenge for the electricity system. WWF-UK believes that on the contrary, EVs present significant opportunities for strengthening the electricity system.

Even under an ambitious scenario where EVs account for 75% of all cars in the UK by 2030, a realistic worst case peak demand due to EVs is still below 10GW, which is within the range of National Grid forecasts of load growth⁴⁰. This scenario has all EVs demanding power at the same time. But this is never likely to happen as not all EVs are driven each day and there are different arrival times home.

EVs offer significant benefits beyond reductions in CO₂ emissions (see question 13), especially for households and businesses with solar PV. Households and businesses can choose to charge their EVs using self-supply (e.g. from PV during the day) or use a charge delay device to charge at times of low demand/price and a high share of renewable supply (e.g. in the middle of the night). This can greatly reduce costs as well as emissions, especially compared to conventional fuel – managing the timing of EV charging, to utilise lowest grid

³⁸ <https://about.bnef.com/blog/mccrone-energys-long-term-changed-last-year/>

³⁹ <https://about.bnef.com/blog/coal-and-gas-to-stay-cheap-but-renewables-still-win-race-on-costs/>

⁴⁰ WWF-UK, 2011. Electric avenues: Driving home the case for electric vehicles in the UK. http://assets.wwf.org.uk/downloads/electric_avenues_fullreport.pdf

CO₂ intensity, would increase the carbon savings of EVs from 23% to 41% in comparison to ICEVs by 2030⁴¹.

Furthermore, EV users can also opt to discharge energy from their EVs back to the grid at time of high demand/price. Smart charging tariffs that reward drivers who are prepared to surrender some of their battery capacity would help to encourage the storage potential of EVs.

Finally, in order for EVs to reach their full economic and environmental potential, it will be essential to continue increasing the share of low-carbon, renewable electricity in the UK, and some investment will also be required in local distribution systems and transformers, which are smaller scale and lower specification than national level transmission systems and therefore less able to handle surges in demand.

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute? Note: “demand” includes domestic, commercial, power generation and other major sources of demand.

- Universal metering across the country is absolutely essential to addressing the supply-demand deficit. Metering is crucial for implementing sustainable abstraction licences (where every permit includes a “hands-off” flow condition so that abstraction ceases when flows drop to critical levels). Metering is also important for understanding who is using what and when – such information is needed before supply-side options such as transfers from different catchments are pursued. For further information please see:
 - WWF Itchen Initiative and smarter demand management discussion paper http://assets.wwf.org.uk/downloads/itchen_initiative_report_march_30th.pdf
 - Fairness on Tap http://assets.wwf.org.uk/downloads/fairness_on_tap.pdf

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand? Note: this can include, but is not necessarily limited to, governance frameworks across the country.

- Update and maintain existing wastewater and sewage networks to make them fit for a changing climate and an increasing population.
- Require water companies to put in place long-term wastewater management plans (akin to Water Resource Management Plans) that ensure investment in ageing infrastructure to fix leaks and blockages, and an increase in network capacity to prevent sewer spilling and flooding. These would be opened out for stakeholder consultation. (At present for water resources, water companies have a statutory process where they consult on and submit to Secretary of State for sign off Water Resource Management Plans. These look 25 years ahead and ensure that supply is sufficient to meet demand (to a certain level of service), taking into account climate change, environmental sustainability and population growth. There is no parallel process for wastewater, which means that this takes a more ‘break and fix’ approach.)

⁴¹ WWF-UK, 2011. Electric avenues: Driving home the case for electric vehicles in the UK. http://assets.wwf.org.uk/downloads/electric_avenues_fullreport.pdf

- Take action to stop raw sewage overflowing into rivers from pumping stations, treatment works and other assets which can exacerbate flooding, as well as polluting rivers and damaging wildlife.
- Minimise urban creep, require permeable paving surfaces and significantly extend sustainable drainage systems (SuDS) to reduce surface water flooding, and also to provide biodiversity, recreation and water quality benefits.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

(1) Investment in the Catchment Based Approach (CaBA)

Discussions with companies and catchments at part of our WaterLIFE projects have made it clear that government multi-year investment in catchment partnerships is absolutely vital to achieve CaBA. This initial investment can help leverage private sector and other investment in natural capital.

(2) Ensuring baseline regulation. Smarter, properly targeted, adequately enforced regulation is a vital back bone to the 25 Year Environment Plan. This regulatory backbone should comprise three core things:

- i. The 25YP should include binding targets that defend and extend those set out in the WFD and other key European legislation. The scope and ambition of the WFD makes it one of the most important pieces of environmental legislation ever passed. The Environment Agency estimate that getting to good status where all benefits outweigh costs (which equates to about 75% water bodies) would generate £8BN net value to UK economy. These rewards have not been reaped because of poor implementation of the WFD. Therefore the government must reiterate its intentions and commitment to the WFD in the 25YP, and ensure that the WFD's binding targets are a key part of 25YP. This will ensure that planning now (e.g. Water Company PR19 and what replaces CAP) is sufficiently geared up to meet the WFD 2027 deadline and recoup that £8BN value.
- ii. Investment in natural capital should be underpinned by a fair and level playing field – with clear catchment rules to control pollution and abstraction that everyone complies with regardless of their sector. Such rules are a key part of 25YP. Abstraction reform is a key opportunity to put in place controls on abstraction, but it's also clear that controls on diffuse pollution are urgently needed. Following a Judicial Review initiated by WWF in 2015, Defra and the EA now need to consider using Water Protection Zones and other regulatory tools such as General Binding Rules to control pollution. Market based approaches also offer opportunities in the right circumstances, but must work hand-in-hand with regulation.
- iii. The 25YP should set out that, post Brexit, legal mechanisms to hold the government to account for delivery of the 25YP are crucial. The EC currently has oversight and reporting of EU environmental law: it acts as a watch dog and this has led directly to many of the UK's environmental improvements. It's crucial that there are equivalent mechanisms post-Brexit to ensure institutional oversight, clear consequences for failing to deliver and opportunity for public and NGOs to hold the government to account.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk? Note: “innovative technologies and practices” can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

When it comes to flooding, we must shift from trying to defend against defined flood events in particular locations to taking effective, economically viable and environmentally sustainable action that enhances our resilience to flood risk across whole river catchments.

No single solution will act as a silver bullet for flooding; we need a package of targeted measures that are proportionate to the risks and that deliver maximum benefit for limited taxpayers' money.

WWF's work with the Chinese Ministry of Water Resources (<https://www.adb.org/sites/default/files/publication/30246/flood-risk-management.pdf>), during which we reviewed the history of flood management internationally, highlights the fact that the most effective approaches aren't just based on engineering. So we need complement engineering approaches with social and environmental considerations in order to address the drivers of floods (linked to climate and land use) and the vulnerability of communities (which link to access to information, insurance, warning systems, emergency plans, etc). This calls for a portfolio approach to flood risk management, which balances process measures (early warning systems, planning etc), communications, flexible “grey” infrastructure and maintenance/restoration of critical “green” infrastructure (or natural flood management (NFM) approaches).

Evidence from research and practical experience suggest that NFM approaches can contribute significantly to flood risk reduction and that they can also provide “bonus features” alongside flood risk reduction – such as improved water quality and enhanced biodiversity – which means that they are economically attractive.

For example, WWF Scotland's River Devon trial project showed that, measures such as blocking obsolete field drains and restoring upland woodland could reduce peak river flows downstream by 11%. Larger schemes in the Netherlands, US and China have shown even more impressive results, in terms of floodwater storage and risk mitigation, from ensuring that areas of floodplain and wetlands are maintained or restored:

- The goal of the Dutch “Room for the River Programme” is to give the river more room to be able to manage higher water levels. At more than 30 locations, measures have been taken that give space for the river to flood safely. This will allow the branches of the Rhine to cope with a discharge capacity of 16,000 cubic metres of water per second without flooding. As well as increasing safety, the measures will also improve the overall environmental quality of the river region.
- In the US, the Yolo Bypass is a 240km² floodplain with levees that protects Sacramento from flooding. The Bypass takes up to 80% of the Sacramento River's floodwaters during major events. In addition, the floodplain is used for agriculture and large areas of floodplain wetlands provide critical habitat for wildlife, including many wetland species which are declining elsewhere. (<https://www.adb.org/sites/default/files/publication/30246/flood-risk-management.pdf>)
- Wetland management projects on the Yangtze river in China have restored lakes and wetlands in a way that store flood water, improve water quality and help restore bird and fish populations. One restoration project in Hubei province involved opening sluice gates to reconnect three lakes to the river during peak flows. This effectively restored 448km² of wetland and providing 285m³ of floodwater storage. (<https://www.adb.org/sites/default/files/publication/30246/flood-risk-management.pdf>)

Recommendations for the UK government:

1. Invest in natural capital (which recognises the intrinsic value of biodiversity) by ensuring national funding for targeted large-scale river restoration and creation of wetlands to increase storage in lowland wetlands.
2. Invest in, commit to and extend catchment management approaches – recognising catchment partnerships' essential role and expertise to tackle flooding.
3. Use some of the substantial taxpayer funding for farm subsidies to reduce upland run-off and soil erosion. Where voluntary measures are failing improve the enforcement of existing regulations to change farming practices.

N.B. The portfolio approach to risk management is also important to drought risk management. Addressing water resources shortages isn't just about supply-side solutions such as water transfers or increasing reservoir storage. A balance of demand measures, process measures and flexible grey infrastructure and maintenance/restoration of critical green infrastructure is needed.

27. Are financial and regulatory incentives correctly aligned to provide sufficient long-term treatment capacity, to finance innovation, to meet landfill and recycling objectives and to assign responsibility for waste?

WWF-UK is calling on the Government to develop a bioeconomy strategy with natural capital and resource efficiency at its heart, to support the UK's broader circular economy and climate change objectives⁴². This strategy should ensure that biomass is responsibly sourced and deployed efficiently and effectively across the economy. One of the key planks of such a strategy would be operationalising the cascading use principle, which means ensuring that biomass resources are used and reused first and foremost for food or materials, with energy only recovered once the biomass is on the brink of biodegrading and has no further material use.

Current bioenergy policies and incentives do not support cascading use. For example, the Renewable Transport Fuel Obligation (RTFO) incentivises the use of crops for biofuel while the Contracts for Difference (CfD) scheme supports the burning of wood for power generation. This is particularly illogical when both these sectors have multiple other, more sustainable options for replacing fossil fuels. We are encouraged by the lack of additional CfD funding for biomass and recent proposals to cap the use of crop-based biofuels.

The bioeconomy strategy should realign Government policy to favour food and material use of biomass, and its reuse and recycling, to keep carbon locked up in solid biomass for as long as possible. This will help to meet landfill and recycling objectives. Bioenergy from residual biomass should be targeted at sectors that require specific fuel characteristics, such as industry and aviation, and potentially shipping and freight.

28. What are the barriers to achieving a more circular economy? What would the costs and benefits (private and social) be? Note: A “circular economy” is an alternative to a traditional ‘linear economy’ (i.e. make, use, dispose) in which products are designed and packaged to minimise waste, and resources are kept in use for as long as possible, e.g. through re-use, recycling and greater recovery of materials through the waste management process.

Promoting the circular economy would help us to compete in a future carbon- and resource-constrained global economy. It would also generate jobs and growth. But currently incentives for the development of a circular economy are weak. Industry figures are increasingly calling on the government to do more to promote the shift towards circularity,

⁴² WWF-UK, 2017. Bioeconomy: risk or opportunity for nature and climate? <http://blogs.wwf.org.uk/blog/climate-energy/bioeconomy-risk-opportunity-tackling-climate-change/>

particularly by improving policy incentives, access to affordable capital and government procurement rules, and by publishing a clear plan of action based on a strategic, whole-economy approach⁴³. Many of the UK's competitors in Europe, Asia and the Americas have already made such commitments and are reaping the rewards⁴⁴.

A wide range of policies and economic instruments could be considered to promote a more circular economy, and promote growth of the bioeconomy, including⁴⁵:

- increasing the lower rate of landfill tax and a tax on incineration,
- introducing a primary resource tax and targeted product taxes,
- differential VAT rates,
- pay-as-you-throw policies,
- 'feebate' schemes,
- increasing access to finance for resource efficiency measures (particularly for SMEs),
- including targeted use of public funds to improve the investment profile of projects / reduce risk, and
- strengthening and broadening public procurement policies to favour bio-based products, with a preference for reused and recycled products, certified to FSC or RSB standards.

Contact	<name redacted> <role redacted> WWF-UK
Email	<a href="mailto:<email redacted>"><email redacted>
Date	10 February 2017

⁴³ RWM, 2014. Ever-Decreasing Circles: Closing In On The Circular Economy. Report from the RWM Ambassadors. September 2014.

⁴⁴ A Greener Budget Report 2015, WWF-UK.

⁴⁵ A Greener Budget, 2015, WWF-UK; EAC, 2014. Growing a circular economy: Ending the 'throwaway society'. Environmental Audit Committee, London, UK; RWM, 2014. Ever-Decreasing Circles: Closing In On The Circular Economy. Report from the RWM Ambassadors. September 2014; Green Alliance, 2013. Resource resilient UK – A report from the Circular Economy Task Force. Green Alliance, London, UK.

Introduction

We welcome the opportunity to respond to the National Infrastructure Commission's (NIC) call for evidence on the National Infrastructure Assessment (NIA). We make three main recommendations:

1. Integration of natural infrastructure within other infrastructure planning – natural infrastructure are diffuse systems, so can be affected by small changes to new and existing assets. We highlight the importance of building resilience into the system and ensuring that impacts on the environment are minimised. We also urge the NIC to integrate natural infrastructure where possible into the design of strategic infrastructure projects from the outset and opportunities for retrofitting natural infrastructure into existing assets. These are small but significant ways of bolstering our resilience to the challenges of climate change and population growth.
2. In addition to integrating natural infrastructure there is also a strong case for large-scale natural infrastructure investment: habitat creation and restoration to deliver our infrastructure needs. For example managed realignment projects to protect against flooding, creation of farm ponds to reduce water demand from agriculture and large scale urban green and blue space development to reduce pressure on our sewerage systems. Such options also deliver other benefits including health and well being, reduced urban heat island effect, improved water quality and enhanced biodiversity which more traditional infrastructure lacks.
3. We recommend that the NIC undertakes, or recommends a process for achieving, a natural infrastructure asset register, based on an analysis of the scale, condition and maintenance investment needs of natural infrastructure that delivers ecosystem services. This opportunity mapping can help to understand the quality of the asset base, the scale of investment needs and to maximise multiple benefits and natural infrastructure delivery.

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Investment in natural infrastructure can be extremely cost effective compared with other forms of infrastructure. Damage to these assets can be costly: soil degradation in England and Wales costs farmers and wider society an estimated £1.2 billion per year in lost productivity, flood damage, reduced water quality and other costs. By contrast, investment in natural infrastructure can be extremely cost effective. The Natural Capital Committee concluded that there was a strong economic case for “Wetland creation on around 100,000 hectares... benefits cost ratios of 3:1 would be typical, with to 9:1 possible in some cases”. According to the Environment Agency, achieving “good” status for all water bodies could bring £21bn of benefits at a cost of £16bn.

The benefits that accrue from well-planned natural infrastructure investment may be cross-sectoral and inter-generational and cross-societal. For example, there is great potential for large-scale managed realignment projects (c. 100,000 hectares) around the UK's coastline, which could defend communities, businesses and critical infrastructure from flooding and the impacts of climate change, while providing amenity value and important habitat. WWT's Steart Marshes project cost £20.7 million, while the Environment agency's assessment of the natural capital of the site in 2015/2016 was between £15 and £28 million. It supports local agriculture and aquaculture, as well as providing habitat, amenity and flood defence.

The Government should undertake a mapping exercise to identify the most cost-effective opportunities for natural infrastructure investment across a range of habitat types.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Quality of life can be improved by incorporation of green and blue spaces in places of work and in communities. As well as providing direct health benefits, such as cleaner air, natural urban infrastructure can contribute to mental and physical health and wellbeing.

Greenspace has been associated with lower levels of stress (Thompson et al., [2012](#)) and reduced depression and anxiety (Beyer et al., [2014](#)), while interacting with nature can improve cognition for children (Taylor and Kuo, [2009](#)) and individuals with depression (Berman et al., [2012](#)) People who move to greener urban areas benefit from sustained improvements in their mental health (Alcock et al., [2014](#)). There is also specific evidence that higher levels of visibility of blue space is associated with lower psychological distress (Nutsford et al [2016](#)).

This is also a social and demographic issue. The Natural England Monitor of Engagement with the Natural Environment found the percentage of children taking visits at least weekly was noticeably higher amongst those not in the Black, Asian and Minority Ethnic (non-BAME) population (74%) compared to those in the BAME population (56%). The percentage who never visited (in the 12 months prior to survey) was higher among the BAME population (17% compared to 11% amongst the non-BAME). The percentage of children taking visits at least weekly was also higher amongst members of the most affluent, compared to the least affluent group (77% compared to 65%). The percentage who never visited was higher among the least affluent population compared to those in more affluent groups (14% compared to 9%).

Investment in green infrastructure is a cost-effective approach to tackling chronic health problems. For every £1 invested in Green Gym infrastructure, £2.55 has been saved in the treatment of inactivity related illness (based on life cost averted savings). If every household in England were provided with good access to quality green space it could save an estimated £2.1 billion in health care costs, according to [Natural England](#).

Urban green infrastructure can also be vital for wildlife, helping to connect up pockets of habitat, in accordance with the Lawton Principles.

All infrastructure projects should aim to maximise the provision of green and blue space, taking into account these wider benefits. For example research indicates that there is a strong positive perception and preference for water in urban environments (Volker & Kistemann [2012](#)). This should include redevelopments and commercial developments in urban areas, as proximity to housing is most likely to maximise the social value of greenspace.

4. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Demand management is currently underutilised within the water sector. Much more could be done to reduce demand than currently. Innovation in demand management is low, encouraging innovation could make great improvements.

Residential demand management

Water companies could drive much greater demand management through the development of a wide package of measures through the next Price Review (PR) process. This needs buy in from and to be facilitated by Government and Ofwat to encourage such measures before resorting to large supply side options before it will be considered by water companies. Such measures should include education measures for the general public to better understand issues around water scarcity and use. Packages of measures should include a combination of smart metering, social tariffs and environmental tariffs. Initially we would welcome a number of in depth pilots. These need to be set up and monitored for a number of years not just 6 months. This will help inform further PR processes and address issues such as uncertainty. Universal metering and particularly a wider role out of smart meters additionally assist in better understanding the actual scale of leakage within water company assets. The sustainable economic level of leakage (SELL) is not helpful in driving leakage reduction as water companies are able to simply do the minimum required rather than driving distinction.

Current average per capita consumption is 139 litres per person per day. Three water companies average 130 litres per person per day whereas two companies average consumption at 161 litres per person per day. Consumption in metered households currently get down to average 123 litres but range from 106 litres to 158 litres and there is a huge differential between metered and non-metered households; the latter average at 153 litres (180 litres maximum unmetered company average, 133 litres minimum)¹. This highlights how much gain can be made simply from metering, but also the huge variation between water companies.

The need to meter should not solely be made with respect to water scarce areas as it is currently. Our water demand should be considered from a countrywide perspective driving demand down across the country. These statistics show the huge gains in demand which could be made if all feasible households were metered, together with social tariffs, a programme of public education and efficient

¹ DiscoverWater <http://www.discoverwater.co.uk/amount-we-use> (accessed: 27th January 2017)

plumbing retrofits. It could easily be conceived that demand could be driven down by 30 litres per person per day – roughly equating to 2,100 million litres of water saved every day.

There are many examples of water efficiency measures that have driven efficiencies in the region of 14–30% reduction in water use². Many of these approaches are not yet being delivered in England and those that are could be more ambitious. So substantial savings could still be made.

- Estonia drove water consumption down from nearly 200 litres per inhabitant per day to under 100 in 15 years through increasing the value of water.
- Houston delivered a number of successful pilots which included an education programme, plumbing retrofits, audits, leak detection and repair, an increasing-block rate structure, and conservation planning. As a result in 2002 they predicted a 7.3% reduction in water demand by 2006 and savings of more than \$260 million.
- In Tampa, Florida their landscape evaluation program resulted in a 25% drop in water use. Measures included high efficiency plumbing retrofits, an increasing-block rate structure, irrigation restrictions, landscaping measures, and public education.
- Cary in North Carolina have a water conservation program which consists of public education, landscape and irrigation codes, toilet flapper rebates, residential audits, conservation rate structure, new homes points program, landscape water budget, and a water reclamation facility. These aim to reduce retail water production by an estimated 4.6mgd by the end of 2028, a saving of approximately 16% in retail water production. These savings reduced operating costs and have already allowed Cary to delay two water plant expansions.

Few UK examples consider community scale demand management – e.g. large scale multi-dwelling water re-use in new development. Such projects need wider than water company buy in and would need to be considered at the outset of a large development and include public engagement. Such projects do not currently feature in water companies’ business plans and consideration should be given as to how to incentivise innovative demand management.

Water efficiency and energy efficiency are linked – a large proportion of our energy use goes towards heating water. Therefore water efficient and energy efficient new build requirements would go a long way to reducing demand in both water and energy. For example a lot of water is wasted when running the tap/shower to get the hot water through. Conversely energy would be saved if less water was being heated.

However, it is not just water companies who are responsible for reducing water demand. Industry and the general public need to better understand that water is a finite resource that needs to be managed sustainably. It is important for all stakeholders to take responsibility for demand reduction. There are efficiencies to be made within various industries and the retail sector. Regarding the former, there is currently little incentive to do so as water is cheap and their abstraction licenses

² US Environmental Protection Agency (2002) Cases in Water Conservation: How Efficiency Programs Help Water Utilities Save Water and Avoid Costs

allow them, in most situations, the amount they need. Regarding the latter there is concern that the new competition market may in fact reduce efficiency in this sector rather than drive it as it is likely to drive prices even lower.

Agriculture

Given the dominant role of irrigated agriculture in global water use, management practices that increase the productivity of irrigation water use can greatly increase the availability of water for other human and environmental uses (Tiwari and Dinar, 2002). Of all sectoral water demands, the irrigation sector will be affected most strongly by climate change, as well as by changes in the effectiveness of irrigation methods³. It is the areas in the UK which are at greatest water scarcity which have the greatest agricultural demand for water. To date little has been done to incentivise demand change in agricultural water use, but there is potential for substantial savings to be made. Uptake of advances in technology is a step in the right direction, but ultimately we should be asking whether we should be growing the most water intensive crops in the most water scarce areas of the UK. Structuring incentives in a new food and farming system to move away from the most water intensive processes and towards water efficiency measures would be a substantial improvement over the current Common Agricultural Policy.

We recommend

- Energy and water efficient new builds to drive down energy and water demand and pressure on our energy, water supply and waste water infrastructure
- An ambitious package of measures including metering and public education to drive down water demand; price signals and incentives to drive down water demand in agriculture and other industry and encourage innovation in technology

5. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

Maintenance and repair of natural infrastructure is too rarely considered as an alternative to building new infrastructure. For example, instead of building new flood walls, investment in degraded natural assets should be considered as a cost-effective alternative, especially taking into account wider benefits.

A proper assessment of alternatives is hampered by a lack of knowledge of the state of repair of current natural assets and the investment needed for maintenance and improvement. Such an assessment could form part of an objective analysis of the amount of funds required to achieve the Government's ambition to be the first to leave the environment in better condition; it could help to

³ Intergovernmental Panel on Climate Change (2007) Fourth Assessment Report: Climate Change https://www.ipcc.ch/publications_and_data/ar4/wg2/en/ch3s3-5-1.html

justify and quantify the scale of investment in a new agricultural subsidy scheme focused on payments for public benefits.

Until consideration of restoration of natural assets is considered, it will not be possible to choose the most cost-effective solutions for a range of infrastructure needs.

6. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Competition and collaboration can both play an important role in the provision of environmental infrastructure services, such as pollination or flood risk relief.

For example, introducing an element of commissioning and competition in a post-Common Agricultural Policy (CAP) system for farm support could help to discover least-cost options for investment in environmental infrastructure. This would need to be supported by (1) targets and responsibilities for land-owners and businesses to improve natural capital and natural infrastructure to drive demand and (2) a clear system of mapping ecological opportunities, commissioning of interventions and monitoring of delivery. Examples of the way this could work include Dieter Helm's proposals for Catchment Systems Operators and WWT's proposals for [Catchment Commissioners](#). This approach could help towards delivering more sustainable land and water management and better integration of water supply, waste water and flood management.

Collaboration is also important where natural infrastructure assets are "landscape scale" and diffuse. These can be inhibited by a failure to cooperate by a singly land-owner. Current cooperative options under CAP demonstrate the multiplication effect of positive benefits where interventions are adopted over several farms. Collaboration can also help realise other funding pots and partnerships previously out of scope.

7. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Provision of environmental infrastructure services could be improved by updating the Treasury Green Book to reflect the latest in natural capital thinking. A new system of farm support could combine public subsidy and private markets, based on the principles of polluter pays and provider is paid.

Funding for green space and sustainable drainage systems is often difficult, especially with respect to retrofitting and current cuts within local authorities. Incentives to reduce surface water runoff would help to promote retrofitting of SuDS and a more flexible approach to collaborative funding could help deliver greater multiple benefits for example flood funding and WFD funding.

8. Are there circumstances where projects that can be funded will not be financed? What government interventions might improve financing without distorting well-functioning markets?

Natural infrastructure investments are hampered by a range of market failures. There are not enough disincentives to avoid environmental damage and environmental improvements are not properly rewarded.

At small scale, this leads to poor everyday decision-making. For example, sustainable drainage systems are not planned properly because the costs fall upfront on a developer, whereas the benefits accrue gradually to communities and wildlife. Similarly, farmers are not incentivised to invest in sustainable practices because of the short-term and area-based focus of agricultural markets and support systems.

At large scale, the major upfront costs of projects like managed realignment are usually only funded through collaboration between Agencies and NGOs, instead of attracting more reliable forms of funding like flood grant-in-aid.

New markets and new ways of internalising environmental costs/benefits could overcome this barrier. Setting Government objectives for habitat creation, creating markets and rewards for sustainability in a new farm subsidy system could help to provide the certainty of long-term revenues needed to create financing options.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Efforts to speed up the planning process must be balanced against quality (including environmental resilience) and overall efficiency. In some cases, the Government's efforts to streamline the planning process has led to less resilient developments and associated infrastructure; in other cases, reducing regulation can be counterproductive and, in fact, slow down efficient development.

For example, the Government's reluctance to update urban flood resilience policy has led to increased flood risk and delays in planning.

Well-designed sustainable drainage systems (SuDS) can be built affordably and without delay in nearly all kinds of development as well as retrofitted in established developments. This can reduce flood risk, safeguarding homes and other infrastructure, at the same time as providing amenity, habitat and water quality improvements.

Current national and local policy does not provide clear governance arrangements around SuDS whilst promoting SuDS in large developments. Without clear direction and responsibility for delivering, adopting and maintaining SuDS leads to long discussions between developers and planning authorities around SuDS options.

A number of local plans have included statements to the effect that SuDS cannot be used as part of green/open space requirements, this means that developers have to use additional space to create SuDS and green/open space which reduces viability options. It is believed that this approach is taken because of a perceived concern around public safety and SuDS systems. It would be useful to issue guidance around how and where green infrastructure sits within the planning system and to clarify

such issues. A recent Welsh Government report⁴ highlights that viability training for local planning officers is a good way forward. We would advocate this to include a better understanding of how green infrastructure options may or may not affect viability.

In addition Highways Authorities can have a contradictory approach to developers and local authorities proposed SuDS schemes leading to further delay. Highways Authorities have no legal driver to adopt SuDS and have an automatic right for run-off to be released direct into water courses, regardless of quality. This conflicts with all the work being done to improve water quality under the Water Framework Directive by water companies, local authorities and others. If water run-off from highways was required to pass through SuDS in new development this could help improve water quality and reduce issues around design of SuDS and drainage in a new development. This would facilitate development and agreement over drainage systems, removing the often current perverse situation of dual systems for residential runoff and road runoff.

We recommend

- The removal of developers automatic right to connect and Highways Authorities right to discharge into a water course

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

- Include ecological expertise at the design stage and design for multiple benefits, including maintenance planning
WWT in partnership with RSPB have published guidance on designing SuDS for multiple benefits which can be downloaded [here](#).
It is not enough to assume biodiversity benefits from green infrastructure. It is not only the type of system used but how that system is designed and managed. A simple sedum green roof offers far less biodiversity benefit compared with those with more diverse vegetation. Green roofs can be designed and developed to incorporate microhabitats customized for particular species and/or more closely mimic natural habitats, with varied microtopography (including hollows and "clifflets"), scattered rocks, rubble, dead wood, and roofs can even be designed and planted up as wetlands.
- Understand the importance of protecting existing habitats and species
Remnant natural habitat is usually more diverse than newly created habitat. There are two important factors to this: understanding where important areas for biodiversity are which shouldn't have infrastructure built on them and retaining pre-development habitat within a development site where possible.
- Requirements around compensatory habitat: establish a principle of net gain.
Where a project is viable but damages are identified, compensatory measures should be additional to the actions that are normal practice under Habitats Regulations and other

⁴ Welsh Government (2017) Longitudinal Viability Study of the Planning Process
<http://gov.wales/docs/desh/publications/170116longitudinal-viability-study-of-the-planning-process-en.pdf>

relevant legal protection. The role played by the site concerned in relation to the biogeographical distribution should be replaced adequately in order to establish a coherent network of habitats.

Moreover, compensation should be established early and upfront, with fail-safes built in. A site should not be irreversibly affected by a project before the compensation is actually in place. In instances where such habitat takes a long time to mature, extra compensation for interim losses should be assured. A precautionary multiplication factor should be applied to plans for compensation for environmental costs in order to guard against risk of failure in new habitat creation.

- Integrate natural infrastructure into design of more traditional infrastructure; retrofit natural infrastructure into maintenance and renovation projects; consider whether a natural infrastructure approach could meet the objective as opposed to hard infrastructure or using a combination of both.

12. What improvements could be made to current cost-benefit analysis techniques that are credible, tractable and transparent?

Note: “credible” improvements are those that generate results that are in line with robust evaluation findings for comparable schemes. “Tractable” improvements are those that can generate usable quantitative outputs. “Transparent” improvements are those that do not rely on ‘black box’ modelling and assumptions.

We recommend four particulars should be made when considering cost benefit analysis of infrastructure projects.

- 1) Natural Capital - The Natural Capital Committee in their third report recommended that the National Infrastructure Plan should incorporate natural capital into each of the main infrastructure sectors, following the mitigation hierarchy for managing impacts (avoid, minimise, restore, offset). An investment programme for natural capital should also explicitly feature in the National Infrastructure Plan. Within a natural capital approach it is important that social and environmental costs and benefits, including non-monetised, are accounted for within decision making. Natural infrastructure can offer a great value for money approach if accounted for properly.
- 2) Taking account of the long term – The Government has recently reiterated its commitment to leaving the environment in a better condition than it received it. In order to ensure this is true for future generations, the discount rate applied to cost benefit analysis must be quite low - considerably closer to zero than the Treasury’s Green Book value, for instance. A low discount rate does not simply highlight environmental impacts it increases the relative importance of the future, compared to the present. Many large scale infrastructure projects are very long-lasting with expected economic lifetimes spanning many decades, such as airports or nuclear power plants. Many physical infrastructure projects also have long-lasting environmental effects, beyond the lifetime of the project. In undertaking a cost-benefit analysis for infrastructure spending, a low-discount rate should be applied when judging the merits of

additional spending to reduce environmental impacts and increase natural capital and ecosystem services. This includes natural infrastructure projects, where societal benefits are often accrued over the long-term.

- 3) Alternative options - Cost-benefit analysis is often constrained by the range of alternatives it considers. When a highway is congested, building a bigger highway often seems like the appropriate option. The losses caused by congestion could well be great enough that the construction of the new, wider highway would win in cost-benefit terms. But such an analysis only answers the question, “If there were no choices except the status quo or the new road, which would be better?” Other options such as improved railroad and bus service, or urban planning measures to reduce transportation demand, might be even more attractive – if they were included. By limiting the analysis to the status quo vs. one preferred alternative, the framing of the question can often determine the answer. Reframing the question – for example, asking “What is the least-cost strategy for reducing congestion on a highway by a given amount?” – may yield a different solution⁵. In particular, natural infrastructure options should be considered as alternatives wherever possible.

20. What does the most effective zero carbon power sector look like in 2050? How would this be achieved?

Note: the “zero carbon power sector” includes the generation, transmission and distribution processes.

We welcome the NIC looking into the option of a zero carbon power sector and encourage this ambition. In order to achieve a zero carbon power sector we need to see the following:

- Greater efficiency in residential and industrial use e.g. carbon smart/zero carbon new homes which will help reduce the pressure on the power industry.
- Research and innovation into energy storage (to iron out the intermittent nature of renewables such as solar and wind), carbon capture and storage (as an important but previously unutilised piece of the tool box) and commercialisation of new technologies such as wave energy.
- Diversity of options and a well-connected grid – a zero carbon power sector must adopt a wide range of energy measures to provide the energy needed. There is no one energy source answer. We are fully supportive of renewable energy power, but each strategic option needs to be considered on a case by case basis to determine whether their impact on the environment is environmentally cost effective.
- Political will – the EU report Roadmap 2050 concludes that achieving a minimum 80% CO₂e reductions in 2050 based on zero carbon power generation in Europe is technically feasible and makes compelling economic sense.

Evidence indicates that campaigns to tackle water demand could be used to reduce the daily peak demand patterns which reduces the pressure on network pumping energy costs during peak use

⁵ Ackerman, F. (2008) Critique of Cost-Benefit Analysis, and Alternative Approaches to Decision-Making, Friends of the Earth.

times. Water companies can use demand-side strategies to also achieve efficiencies in the distribution of urban water (e.g. reduced energy for pumping in pressurised water system, pipe augmentation deferrals, peak energy demands)⁶.

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: “demand” includes domestic, commercial, power generation and other major sources of demand.

Within the UK water is not valued appropriately. Non-essential and commercial uses are often treated in the same way as the provision of essential, domestic supplies—in other words, water continues to be treated as a low-value and unlimited resource.

We need all sectors to work together to end the assumption that water should be an unlimited resource. Water scarcity is not just the responsibility of water companies. For example agriculture uses 70% of the UK’s water; any system needs to include agricultural changes as well as retail efficiencies and reducing household demand. However, we can do a lot better than currently to reduce household demand, but in order to be successful we need a system of smart metering and smart tariffs to protect the vulnerable (see answer to Q4).

Regarding supply options, there are environmental risks to be considered on a case by case basis and which need to be taken into account during decision making to minimise environmental risk and damage. Before large supply options are given a go-ahead it should be clear how demand options and leakage reductions are being optimised before considering supply options. Ensuring demand efficiencies are made will be vital to our resilience to more varied precipitation from climate change and to help deal with the challenges of an increasing population. One way would be to ensure all new houses are built to an energy and water efficient standard. As these houses would require metering, house buyers should experience reductions in water bills. High users who would find increased bills difficult to pay could be supported using social tariffs.

We will need a package of options in order to be most resilient but also need to ensure that cumulative supply options do not cause environmental degradation as well as considering the merits and risks of each individual option.

There is currently no join up between water resources, waste water management and flood management. A more holistic approach at a catchment scale is needed as suggested in Q24. By slowing the flow throughout a catchment, the environment will have a greater resilience to drying out in times of low precipitation, which ultimately will slow down our lead in to drought scenarios. Creating and restoring wetlands and ponds in the countryside (many of which have been filled in or drained) could

⁶ Beala, C.D., Gurung, T.R., Stewart, R.A. (2016) Demand-side management for supply-side efficiency: Modeling tailored strategies for reducing peak residential water demand, *Sustainable Production and Consumption*, 6: 1-11

reduce pressure on our water supply. Theoretically, to supply the entire current usage for irrigation water would require 13,000 ponds of 1ha area and 1m mean depth. This is approximately the same as the total number of 1ha water bodies that currently exists⁷.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Long term waste water plans

We currently have no long term waste water plans as we do with water resources. This would mean that waste water companies would have to develop supply and demand options over a 20 year period. Without a greater understanding of our asset base we can have no notion of scale of investment needs and no plan for capital or maintenance investment. We support the real time monitoring of combined sewer overflows. This will give us a better understanding of the scale of overflows and through a waste water plan be able to identify an approach to prioritising need. These plans should include a programme of work to identify where to best retrofit and deliver SuDS.

Manage water more holistically

A more holistic approach between water supply, waste water and flood management is needed. 2013 national policy statement for waste water states that demand management measures could achieve a reduction in sewer and treatment capacity required for England of greater than 1 billion litres per day⁸.

Water efficient homes

Currently developers have an automatic right to connect new development to the sewerage system, even if that system is at capacity. **At a very minimum sewerage companies should be statutory consultees in designing new developments and the automatic right to connect should be removed.** This will allow sewerage companies to have much more control over sewerage capacity. Additionally by reducing water demand as mentioned above can reduce pressure on the sewerage system. As such water efficient new homes, commercial development and infrastructure could help ensure our sewerage system is able to cope with increasing population. Small changes to existing infrastructure and considering the role of natural infrastructure within new infrastructure design can help address diffuse pollution problems and reduce pressures on the system.

A network of sustainable drainage systems

In addition to reducing demand, reducing surface water run off could substantially reduce pressure on the sewerage system. SuDS should be designed into new developments from the outset. Together

⁷ Biggs, J. (2007) Small-scale solutions for big water problems, Pond Conservation

<http://freshwaterhabitats.org.uk/wp-content/uploads/2013/09/Defra-small-scale-solutions090108.pdf>

⁸ DEFRA (2012) National Policy Statement for Waste Water: A framework document for planning decisions on nationally significant waste water infrastructure

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69505/pb13709-waste-water-nps.pdf

with a suitable retrofit programme SuDS will provide a buffer to future challenges. For example Thames Tunnel will manage current capacity but Thames Water acknowledge the need for a system of SuDS so that increasing population and urbanisation can be managed in London.

SuDS need a strategic rather than simply opportunistic approach looking at where they could be best applied. Achieving this will require a better understanding of where effective, high quality SuDS are already in place—there is currently no systematic assessment of where SuDS provision could be improved. An opportunity mapping exercise should be undertaken in our major urban areas (at the very least). This will increase understanding of where SuDS would be best placed from a geology perspective and a surface water flood risk perspective, but also regarding where they might be best integrated into current green space and also for joining up or creating stepping stones between green space. Ultimately a network of SuDS could be developed which will holistically provide surface water drainage with added benefits much better than ad hoc retrofitting. How such a network of SuDS works within a wider catchment approach should also be investigated.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

We fully endorse a catchment-based approach to water management, integrating management of supply, waste water and flood risk. There are a number of alternative models for achieving strategic natural and built infrastructure investment and water management at the catchment scale. One way would be to have a catchment commissioner. Catchment commissioners could be appointed landscape scale responsibility to deliver national targets in locally appropriate ways. They should identify multi benefit long term investments; ensure that environmental plans are integrated at development stage; enable long term funding for projects and create new commercial opportunities for investment in nature.

By using a whole catchment approach we are able to understand inter-relationships better and undertake large scale habitat creation and restoration in order to tackle water supply, waste water and flood risk management together. Being able to develop large scale measures to tackle multiple benefits can offer great value for money if an ecosystem services approach is taken alongside a traditional cost benefit approach.

Such an approach needs to identify measures across the whole landscape from the uplands through the urban environment, lowlands and coast. The measures should include a combination of more traditional hard infrastructure with associated natural infrastructure as well as small and large scale natural infrastructure, from leaky dams to the creation of floodplain meadows and a network of urban blue and green spaces and sustainable drainage. All stakeholders need to be engaged and the bigger picture needs to be managed by the catchment commissioner as individual projects are delivered.

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Natural flood management (NFM) schemes tend to be low-cost and can provide multiple benefits.

However, they cannot always be modelled with the same certainty as engineered solutions, their benefits may be long-term and diffuse, and they may require broader cooperation; these challenges can be overcome by building in incentives and strategic mapping for long-term delivery.

Some Natural Flood Management measures can be modelled and funded successfully – particularly those providing flood storage. However, the ways in which cost-benefit analysis for flood risk management capital and maintenance works are determined tends to favour large-scale, hard engineered schemes.

Measures with “diffuse” benefits (including many land management measures addressing infiltration and overland flows) are hard to justify under the current approach, even though they may deliver more benefits at lower cost in the long-term. NFM requires an integrated approach that seeks to restore natural processes to achieve multiple environmental benefits. A more flexible, integrated approach which can take account of the wide range of societal benefits is likely to lead to better and ultimately more cost-effective solutions to managing flood risk. At present, opportunities to incorporate NFM approaches alongside more traditional flood defences are limited by this narrow cost-benefit approach.

Natural Flood Management increases rainwater infiltration, slows flows and stores floodwaters. NFM can contribute to flood prevention in conjunction with traditional, engineered defences. Many NFM measures include an engineered component – there is a spectrum of interventions.

- **Improving infiltration:** habitat creation; arable reversion to grassland; soil structure improvement; reduced grazing; contour-ploughing; crop selection; blocking field-drains; channel buffer strips.
- **Slowing flows:** hedgerow planting; bank construction; upland grip-blocking; floodplain storage; woody debris dams; engineered ‘leaky’ dams; inter-tidal habitat creation; restoration of channel sinuosity.
- **Storing floodwaters:** two-stage channels; re-connection of river channels with their floodplains; engineered washlands; retention ponds and bunds.

Catchments characteristics vary widely. The challenge is to identify where NFM can reduce risks and the extent of land management change required. The Cumbrian Floods Partnership pilots will test co-ordination of environmental and flood management planning, new funding models, and integrated local planning. The Greater Manchester pioneer will also hopefully help to incorporate urban natural flood management measures into wider catchment management.

There is sufficient evidence to justify many types of measures:

- The Pickering NFM scheme slowed river peak flow by 15–20%, saving Pickering's museum and several homes, according to Environment Agency analysis. Around half of the reduction in flood water in Pickering was due to the upstream land management measures, and half through the effect of the flood storage area.

- The Southlake Moor scheme in Somerset used agri-environment and flood funding to restore a 200-hectare wetland SSSI and create formal flood storage of 1.2 million cubic metres.
- Upper catchment flood storage on Lustrum Beck to reduce risk to 150 properties in Stockton on Tees.
- Defra's Multi-Objective Flood Demonstration Projects (National Trust's [Holnicote Estate](#); [Making Space for Water](#); [Slowing the Flow](#)) all showed that NFM intervention reduces the impact of smaller floods (1:5, 1:25 year) and helps property that would not otherwise be cost-effective to protect.

New academic research shows that NFM interventions can desynchronize flood peaks at the catchment scale, and demonstrates that some NFM measures need to be applied over much longer timescales. Small communities are a challenge, where economic benefits may not justify the costs of hard defences. However, NFM can provide additional benefits (for example, recreation and tourism) which if properly accounted for can make NFM a cost-effective solution.

More significant impacts could be achieved if NFM was scaled-up and applied more widely. The recent Natural Flood Management Handbook published by the Scottish Environmental Protection Agency sets out an approach for producing a catchment plan. However, planning tools for deploying appropriate measures remain relatively immature. **Planning for NFM benefits needs to be integrated with local-level environmental planning for biodiversity and water quality.**

Opportunity mapping: Forestry Commission published the first national opportunity map in 2012 and offered enhanced rates of grant for woodland planting in priority areas for the last two years of the England Woodland Grant Scheme. This resulted in the planting of 1857 ha of new woodland targeted to reduce flood risk. **This kind of opportunity mapping should be undertaken for a range of different habitat types, including wetlands.**

NIA Call for Evidence
National Infrastructure Commission
11 Philpot Lane
London
EC3M 8UD

Yorkshire Water
Western House
Halifax Road
Bradford
West Yorkshire
BD6 2SZ

[phone number
redacted]

By email to: NIAEvidence@nic.gsi.gov.uk

10 February 2017

Dear Sir / Madam

National Infrastructure Commission - National Infrastructure Assessment Call for Evidence

Thank you for the opportunity to respond to the National Infrastructure Commission's call for evidence supporting the National Infrastructure Assessment.

As the monopoly water and waste water company for the Yorkshire region we are committed to delivering outcomes that meet the needs of our current and future customers, and protect the environment. We're committed to playing our part in responding to the challenges of climate change and population growth through adaptation and mitigation, which will contribute to the commission's objectives.

Our response addresses the questions raised regarding water and waste water and flood risk management. We have also provided our views on some of the cross-sector questions raised in the call for evidence.

We would welcome an opportunity in the future to discuss in more detail any aspects related to the areas covered in the assessment.

Should you have any queries regarding any elements of our response, please contact me at email address: [email address redacted]

Yours faithfully,

[Signature redacted]

[Job title redacted]

Enc.

Yorkshire Water Response to the National Infrastructure Assessment (NIA) Call for Evidence

Yorkshire Water has provided the following feedback in regards to the call for evidence published by the National Infrastructure Commission on 27th October 2016.

About Yorkshire Water

Yorkshire Water is a privately owned monopoly water and sewerage company delivering around 1.26 billion litres of drinking water a day to 5 million domestic customers and 130,000 businesses across the Yorkshire region. We also collect about 1 billion litres of waste water and safely return it to the environment.

We operate 695 water and waste water treatment works and look after 83,300km of water and sewerage pipework. In 2011 following new government legislation, we adopted 22,000km of private sewers.

We expect to be serving around 5.9 million customers by 2040, that's an extra half a million households in our region (the equivalent population growth of a city the size of Leeds). This will place increased demands on our water supply systems, the sewer network and waste water treatment works.

We welcome the opportunity to respond to the National Infrastructure Commission call for evidence to support the NIA, and would be happy to discuss any points raised in more detail in due course.

Please find our responses to the cross-sector questions: 1, 3, 4, 5, 6, 7, 9, 10, and 11 and questions 22 through to 26 which address water, waste water and flood risk management.

Cross-cutting issues:

1. What are the highest value infrastructure investments that would support long-term sustainable growth in your city or region?

Note: this can apply to national, regional or local infrastructure, where you consider it would best support sustainable growth in your city or region in practice. Considerations of “highest value” should include benefits and costs, as far as possible taking a comprehensive view of both. “Long-term” refers to the horizon to 2050 and should exclude projects that are already in the pipeline.

We have a number of water and waste water infrastructure projects in our plans and others in consideration as part of the development of our Water Resource Management Plan (WRMP).

There are many issues that add to the complexities of the drainage landscape, of which the effective control and management of storm water is one. Continued investment is required across our region to reduce the volume of storm water entering our sewers remove surface water and so enhance the capacity of our sewer network which will support future population and business growth (see response to question 23).

In addition water catchment and river restoration investments will help ensure continued flow of ecosystem services from the natural environment, including raw water quality and flood attenuation, supporting long term sustainable growth.

3. How should infrastructure be designed, planned and delivered to create better places to live and work? How should the interaction between infrastructure and housing be incorporated into this?

Infrastructure should be designed to protect and enhance the five capitals (natural, social, economic, human, and manufactured) in order to maximise flows of ecosystem services, as described in the protocol published by the Natural Capital Coalition ¹.

Housing growth is a priority nationally and locally within our region to support economic growth and improve quality of life. Indeed an additional 800,000 people are forecast to be living in the Yorkshire region by 2040.

The above five capitals and infrastructure needs (for other utilities as well as water/waste water) are essential factors in the planning process. It is vital that these are considered, especially in the context of future accelerated house building programmes.

¹ <http://naturalcapitalcoalition.org/protocol/>

5. What is the maximum potential for demand management, recognising behavioural constraints and rebound effects?

Note: “demand management” includes smart pricing, energy efficiency, water efficiency and leakage reduction. “Rebound effects” refer to the tendency for demand to increase when measures aimed at reducing or spreading demand also lead to lower prices or reduced congestion, undoing at least some of any demand reduction. For example, if smart meters reduce the cost of electricity in off-peak periods, this could lead to greater energy consumption overall, where a large number of individuals or firms take advantage of these lower prices by increasing their total usage.

There are a number of areas where demand management may assist with improving resilience of service, which we address in question 22.

In regards to water demand management the Adaptation Sub Committee ² suggests that across the England we could achieve a household per capita consumption (PCC) value of 92 litres/hour/day by 2050, assuming delivery of all the demand-side feasible options around household consumption and leakage and preferred options from companies WRMPs.

6. How should the maintenance and repair of existing assets be most effectively balanced with the construction of new assets?

As a water and sewerage company (WaSC) serving a large population over a wide area we continually have to balance the need for maintenance and repair of assets and network infrastructure with construction of new assets. Key factors when considering investment in new assets is whether we are effectively locking in to a high energy high carbon infrastructure, or are providing new solutions that take a more holistic view, and consider demand management and whole catchment management.

In regard to existing network infrastructure, UKWIR ³ undertook a common research study to assemble evidence to determine whether an increase in rates of renewal and/or rehabilitation of water and waste water network infrastructure might be needed to ensure long term stability.

Their analysis indicated that under most scenarios considered, rates on expenditure on renewal and rehabilitation of water mains and sewer networks will need to increase if long term deterioration in levels of service is to be avoided. The range of increased activity and expenditure will be dependent on a company’s relative network assets age and type.

Our regulatory framework with the introduction of totex helps companies develop the most appropriate solutions and removes the potential for capex bias within the industry.

² CCRA2: Updated projections of water availability for the UK Final Report (Aug 2015)

³ UKWIR - Long Term investment in Infrastructure (RG05B) Working Paper 5: Analysis (Oct 2016)

7. What opportunities are there to improve the role of competition or collaboration in different areas of the supply of infrastructure services?

Greater partnership working with local and national organisations such as local authorities, city region groups, and the Environment Agency is the ambition in order to develop the optimised solutions required for economic growth and to protect the environment. We recognise that collaboration often takes longer to deliver solutions, being dependent on commonality in agendas and available capacity and funding, therefore carries more uncertainty.

We have established a flood partnership steering group to identify opportunities to work together on flood risk. We engage with the Sheffield City Region and Leeds City Region groups and stakeholders across Hull to advance plans for future blue / green infrastructure development.

In regards to the role of competition in the supply of infrastructure, the future regulatory approach for water and waste water services in England and Wales (Water 2020)⁴ includes the promotion of more competition in the financing and provision of new infrastructure.

Ofwat's new regulatory approach aims to incentivise water companies to use direct procurement for customers (DPC) for high-value infrastructure projects, which may otherwise be provided by the water company.

8. What changes in funding policy could improve the efficiency with which infrastructure services are delivered?

Note: by "funding", the Commission means who pays for infrastructure services and how, e.g. user charges, general taxation etc.

Across utilities the debates on the balance between costs being recovered from current and future customers are ongoing. The water sector continues to operate a 5 year regulatory price control cycle and a framework where customers' preferences for services and their willingness to pay are evaluated. This in effect becomes the mandate for companies to deliver on their commitments.

There may be more cases in future where large schemes need to be considered outside usual funding and customer charging arrangements so that the long term challenges of climate change and large population growth can be addressed.

Through working in partnerships to deliver solutions at a holistic 'whole' system level, we can enable potential efficiencies from working together, unlock alternative engineering solutions and may enable consideration of alternative funding streams.

⁴ Ofwat Water 2020: our regulatory approach for water and wastewater services in England and Wales – overview (May 2016)

Consideration of how we can collaborate and innovate in funding across companies, local authorities, developers, regulators and government is essential in order to use all the tools needed to foster sustainable economic growth and improve people's quality of life.

Wider use of natural capital assessments in decision making could also draw in more beneficiaries of soft and hard infrastructure solutions and promote a role for payment of ecosystems services in the future.

We note the government's recent proposals to inject funds to deliver the infrastructure required to enable some accelerated new housing development programmes to progress.

9. How can we most effectively ensure that our infrastructure system is resilient to the risks arising from increasing interdependence across sectors?

Note: this includes resilience against external risks and/or problems that arise in one or more parts of the system.

To achieve resilient drainage infrastructure will require increased integration and the way in which we operate our business today will need to change. The current approach is to work in cooperation with Local Resilience Forums on business continuity planning, including the use of shared exercises to understand our collective resilience.

We have a key reliance on energy and information and communications infrastructure providers to deliver our services to customers. We work closely with them to understand risks based on common standards for resilience (for example all critical assets protected to 1 in 200 year floods).

Despite our local partnerships being successful to date there would be benefits in a more centralised risk management regime, including a role for a central body accountable for resilience planning. For example on flood prevention and protection to encourage wider use of catchment scale approaches and best practice and linking of local and national plans.

This presents a significant opportunity to advance how we, as a water and sewerage company (WaSC), can play a more active role and move the industry towards delivering its overall goal of providing ever more flexible, adaptive, resilient and sustainable, water and drainage systems for our customers.

10. What changes could be made to the planning system and infrastructure governance arrangements to ensure infrastructure is delivered as efficiently as possible and on time?

Water companies already engage through the planning process to:

- understand how their infrastructure is likely to be impacted from development that is planned to take place across the area they cover;
- highlight to planning authorities infrastructure constraints and phasing requirements and;
- plan for necessary infrastructure.

Ensuring the most appropriate drainage infrastructure is planned and delivered for growth is not always prevalent. Issues commonly arising include:

- a) Lack of information from developers on drainage proposals, resulting in reliance on drainage planning conditions;
- b) Lack of consultation with WaSCs on major planning applications;
- c) Limited ability for WaSCs to promote strategic and holistic solutions to drainage infrastructure through planning policy and development management
- d) Limited opportunity for WaSCs to encourage integrated water management strategies through planning policy and development management at a sub-regional and local level
- e) A lack of open long term plans for waste water infrastructure capacity and investment that can be used to influence spatial planning and identify opportunities for investment in other assets/solutions.

Water UK are currently undertaking a project on 21st Century Drainage⁵ seeking to identify the major risks for drainage in the future, and to provide options for policy makers. National policy should promote 21st century drainage infrastructure as a key element of infrastructure planning policy.

Strategic policy should support cross council boundary consideration and co-operation of drainage issues through the local plan process and engagement with the development of other strategic flood plans (e.g. Local Flood Risk Management Strategies, Flood Risk Management Plans and River Basin Management Plans).

Local level policy should support the appraisal and development of integrated water management strategies to support local plan policies and site allocations.

Consideration should be given to WaSCs becoming statutory consultees in the planning process for major development applications. Planning conditions should support foul

⁵ Water UK - 21st Century Drainage Programme (<http://www.water.org.uk/policy/improving-resilience/21st-century-drainage>)

drainage and SuDS conditions where applicable and encourage the effective monitoring and enforcement by relevant bodies.

Removing the automatic right of connection of surface water to the sewer system will enable us to prepare more intelligently to meet current and future needs by effectively managing storm water and creating future network capacity to support population and economic growth. Schedule 3 (sustainable drainage) of the Flood and Water Management Act 2010 (FWMA) should be implemented consistently. This requires that drainage systems are approved by the unitary authority before construction commences. We explain more on this under question 23.

11. How should infrastructure most effectively contribute to protecting and enhancing the natural environment?

We would welcome a wider use across sectors of the natural capital assessment framework to identify infrastructure options with highest benefits.

Policy and planning should be utilised to encourage blue / green infrastructure partnerships. Asset owners should think about not only the assets that they operate but also how to utilise adjacent assets owned and operated by others and to think about working collaboratively to identify and deliver more cost effective and environmentally sustainable solutions.

For example in order to tackle capacity constraints within a sewage network, implement blue / green infrastructure and active controls to create headroom by either removing or delaying flows rather than installing additional capacity through network reinforcement or storage. Such opportunities can reduce surface water transport and treatment costs, defer or negate investment in infrastructure upgrades, and reduce pumping costs and carbon output.

A key component of the periodic review regime is the National Environment Programme (NEP). The NEP includes requirements for water companies to undertake improvement schemes, or where more evidence is required, to investigate a particular problem. Each water company's NEP is different, as there will be different issues in every region. However there are some common areas, such as improving the quality of water that is discharged from sewage treatment works, ensuring that raw water abstractions do not impact adversely on habitats, and improving the quality of bathing waters.

We continue to uphold environmental protection standards, e.g. the Water Framework Directive (WFD), and the Urban Waste Water Treatment Directive (UWWTD).

Water and wastewater (drainage and sewerage):

22. What are most effective interventions to ensure the difference between supply and demand for water is addressed, particularly in those parts of the country where the difference will become most acute?

Note: "demand" includes domestic, commercial, power generation and other major sources of demand.

Supply-demand challenge

There is a growing risk of significant drought impacts across many regions of the UK from the effects of climate change in combination with the pressures of population growth and environmental drivers. The Adaptation Sub-Committee (ASC) of the Committee on Climate Change commissioned an assessment of projected water availability⁶ for the UK, which submits supply-demand balance deficits could be widespread by 2050 under a high population growth and high climate change scenario, and not only confined to the South East of England.

The implementation of supply side and demand side adaptations and interventions could substantially alleviate such deficits in the future. Key to alleviation is that household and business consumption reductions are implemented and sustained and measures within water company plans deliver the forecast yields.

There is a growing demand for water services – from domestic, agriculture and industry. This impacts on security of supply and leads to infrastructure stress. However, there is also a growing awareness and understanding that water is as important for cities as energy, digital communications infrastructure, or climate, and there are risks and opportunities related to water that will affect economic growth and prosperity.

Urbanisation will continue to change our built environment. 82% of the UK's population now live in urban environments, with growth predicted to continue. Water available is not being managed optimally. To better understand future needs and maintain the balance of supply/demand we need to expand our knowledge on water management.

There is a general perception there's no shortage of water. The public seem unaware of the problem of water scarcity – this is perhaps compounded by the fact we get high levels of rainfall. There is a public mind-set issue when it comes to using reclaimed water and this may be a barrier to uptake of recycling. Over the coming years we, as a society, are going to have to get used to re-use, and a better understanding of the value of recycling is vital to secure future supplies.

Integrated water management (IWM) is an effective way to make this transition.

⁶ CCRA2: Updated projections of water availability for the UK Final Report (Aug 2015)

Demand management

Behavioural change is required for household and business customers in order to drive a demand management response to water resource resilience. We are engaging with customers to help increase awareness and ultimately change behaviours. We are mindful of the potential difficulty of encouraging customers to reduce demand in areas that are presently not water stressed.

It is already clear that there is no single solution that will deliver a supply-demand balance. The range of solutions should include:

- the adoption of building standards for new builds (Wales has made progress)
- surface water drainage solutions
- dual systems with a potable and non-potable supply
- increasing the metered population

These all require significant collaboration and willingness from developers and local authorities and would take time to deliver measurable effects on overall demand. We recognise the potential tension between additional water supply requirements on developers and other cost pressures such as the need to provide appropriate percentages of affordable housing. We note that Water UK, Defra, and Ofwat are currently going through a process of considering potential changes in how developers are being charged, which may also influence this area.

Supply side management

Given the variability in future supply-demand deficits, intra- and inter-regional large scale water transfer connections and water trading may offer good value (raw and potable water). Such solutions would be bespoke to each water company and its neighbour's situation. There are significant technical, financial and environmental challenges which require further work to determine the benefits to be realised and the appropriate planning process.

We continue to focus on improving leakage positions year on year. Both the regulatory regime and our customer priorities encourage us to perform well in this area. We also recognise we have ageing network assets and the rates of expenditure on the renewal and rehabilitation of water mains and sewers will need to increase in the long term if deterioration in levels of service is to be avoided.

We are currently investigating innovative approaches to demand management and considering how applicable they may be to the Yorkshire region. The work to understand potential approaches is drawing on research and best practice from other parts of the UK and internationally.

In these areas the National Infrastructure Commission could be a powerful advocate for innovation.

23. What are the most effective interventions to ensure that drainage and sewerage capacity is sufficient to meet future demand?

Note: this can include, but is not necessarily limited to, governance frameworks across the country.

We acknowledge the challenges of maintaining and improving the condition and capacity of our sewers to meet the future demands of climate change, more frequent extreme weather events and population growth across our region.

Ageing sewer infrastructure lacks flexibility in regard to these demands. This restricts our ability to improve network resilience to future demands. It also hampers our ability to facilitate optimal risk and investment management decisions.

We work in partnership with city region groups within Yorkshire to encourage their strategic approaches to blue / green infrastructure. City region groups cover both urban and rural areas within their territories and we focus on the use of green infrastructure (GI) around streetscapes and new highways, including the use of storm water attenuation and sustainable drainage systems (SuDS).

There are however a number of policy and institutional barriers to implementing SuDS more widely. A recent survey on SuDS by the Chartered Institution of Water and Environmental Management (CIWEM)⁷ found that 70% of respondents think current planning policy does not sufficiently encourage SuDS and only 8% think the current standards are driving high quality SuDS. The report also highlights that there is no requirement for local authorities to report on SuDS uptake.

The government is undertaking a review of the automatic right of connection for surface water to sewers as part of its review of the Housing and Planning Bill. Although history may suggest the position will not greatly improve, progress has been made in devolved administrations.

In response to the European Water Framework Directive, Scotland introduced the Water Environment and Water Services (Scotland) Act 2003 for which it is a legal requirement for all developments of two or more properties to have SuDS.

Northern Ireland extended the powers of NI Water to adopt sustainable drainage systems and to require construction of SuDS through the Water and Sewerage Services Act (2016). The Act supports this by introducing restrictions on the right to connect new surface water sewers to the public network.

⁷ CIWEM - A Place for SuDS? (<http://www.ciwem.org/wp-content/uploads/2017/02/A-Place-for-SuDS.pdf>)

For England we need to remove the automatic right to connect for surface water to the sewer system, and consistently implement Schedule 3 (sustainable drainage) of the FWMA.

It is of particular importance to resolve these matters in the near term, as the need for high volumes of new housing across the UK is paramount. This housing pressure includes calls to increase housing density. Increased density drivers should be balanced with cost effective surface water infrastructure including GI.

The challenges for drainage infrastructure can be assessed in terms of hydraulic capacity and non-hydraulic impacts. Lack of hydraulic capacity or headroom will ultimately constrain development and economic growth. Sewer misuse adversely affects customer service, the environment, operational expenditure and regulatory performance.

GI can work better, cost less, be more reliable and provide more benefits than conventional infrastructure. There are many potential benefits of using GI including air quality, amenity, carbon reduction / sequestration, cool runoff temperature, creates green space and wildlife habitat, increased infiltration to groundwater and aquifer recharge, insulates buildings, rainwater harvesting, reduce runoff.

We should encourage creativity with water and foster right culture for GI, and importantly develop the right skills in the workforce. We continue to work with the sector through the 21st Century Drainage programme led by Water UK. This programme is the ideal vehicle from which to drive long-term thinking.

24. How can we most effectively manage our water supply, wastewater and flood risk management systems using a whole catchment approach?

Water companies have a significant role in addressing sustainability, improving water security and conservation. In order to maximise this we require a stable regulatory and market environment with a long-term focus. Integrated water management (IWM) is central to effective management of water, waste water and flood risks. Through development of an integrated model companies can manage their networks, abstraction and discharges in a dynamic controlled way balancing flows into treatment and controlling the energy costs associated with this activity. Related benefits could include river quality and environmental improvements, reductions in flooding incidents, energy and carbon footprint; and increased security of supply.

There are opportunities for a shift in how we can manage water in urban areas. The three streams of urban water cycle - potable water, wastewater and storm water are intricately linked. Greater integration of clean and waste water processes can be achieved, providing the adaptive capacity to more readily deal with the challenges we will face.

IWM does require engaged and active partnerships working together and there may be value in having a single body or organisation managing from the centre. Improving the

management of storm water will be an increasing imperative in the face of climate change and development. Legislation should be strengthened to encourage the provision of SuDS and water companies have a part to play in this alongside local authorities and developers.

Green infrastructure and upstream catchment management provides opportunities to recharge water tables and aquifers and benefits the environment.

Flood risk management:

25. What level of flood resilience should the UK aim to achieve, balancing costs, development pressure and the long-term risks posed by climate change?

The Adaptation Sub Committee⁸ have assessed future projections of flood risk for the UK and submit that we can expect a 150% increase in the expected cost of damages from flooding by the 2080s.

The report concludes that "additional investment in maintaining and enhancing flood defences and much wider uptake of property-level protection measures and SuDS would be needed to fully offset the increase in risk expected under a 2°C climate projection. Under a 4°C projection, not even this enhanced level of adaptation would be sufficient to completely offset the increase in risk."

Maintaining current levels of protection requires additional funding over and above that already allocated to the Environment Agency. We believe government should publish a long term strategy for flood risk management so that organisations can see how their activity can support the approach.

Again we reference enforcement of the planning system and implementation of Schedule 3 of the FWMA will support future resilience, as building continues on flood plains around the UK.

It is important to maximise the overall value of infrastructure design. Preferred options for infrastructure provision are based on financial accounting but effective inclusion of broader environmental and social impacts should now be incorporated. Clarity on drivers, benefits and beneficiaries would lead to better integrated solutions and may attract or unlock alternative sources of funding.

We require clarity about the schemes that will replace CAP and the agri-environment schemes so that we understand the policy landscape we are working in and determine appropriate investments to maintain or enhance current levels of flood resilience.

⁸ Climate Change Risk Assessment 2017: Projections of future flood risk in the UK (Oct 2014)

26. What are the merits and limitations of natural flood management schemes and innovative technologies and practices in reducing flood risk?

Note: “innovative technologies and practices” can include, but is not necessarily limited to, property level resistance and resilience, temporary defences, advances in predictive asset maintenance and innovative construction materials.

We are working with partners in our region on developing natural flood management (NFM) solutions, for example management of peatland and green infrastructure.

The evidence suggests that NFM can play a part in flood risk management alongside other measures (hard/soft engineering, removing surface water, not building in flood plains, property level protection, etc). NFM techniques can typically reduce the peak flood flow by around 10% and are best suited to managing more frequent, smaller scale flooding as well as having additional benefits such as biodiversity and amenity value.

Introduction in the building regulations of requirements to incorporate flood resilient materials and products would help improve the position, but would not address current housing stock that may come within a flood risk area in the future.

The effective control and management of storm water creates capacity in the waste water networks through hard and soft engineering solutions and active controls, which help alleviate the frequency and scale of flood events in urban areas.

End