National Infrastructure Commission

Congestion, Capacity, Carbon: Priorities for National Infrastructure

Report on Consultation Responses

ARUP

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Disclaimer:

This report was commissioned as part of the evidence base for the National Infrastructure Assessment. The views expressed and recommendations set out in this report are the authors' own and do not necessarily reflect the position of the National Infrastructure Commission.

1 Consultation Report Analysis

1 Consultation Report Analysis

1.1 Interim National Infrastructure Assessment

The National Infrastructure Commission (NIC) published its interim National Infrastructure Assessment (NIA) – the 'Consultation Report' – in October 2017 for consultation. The NIA examines seven key areas and sets out the vision and priorities for helping meet the country's needs up to 2050. The seven areas are:

- Building a digital society
- Connected, liveable city regions
- Infrastructure to support housing
- Eliminating carbon emissions from energy and waste
- A revolution in road transport
- Reducing the risk of drought and flooding
- Financing and funding infrastructure in efficient ways.

The consultation ran until the 12 January 2018; although the NIC accepted responses received after this date.

This report provides a summary of the responses received, including late submissions. It sets out the process undertaken for the analysis, provides an overview of the feedback received, and identifies the main issues raised. The remainder of the report is organised into nine sections, the first eight directly correspond to the sections in the Consultation Report and the ninth section summarises additional comments received.

1.2 Overview of Responses

A total of 235 responses were received from 225 respondents to the consultation. Five of which were identified as confidential submissions and therefore have not been included in this analysis report. The remaining 230 responses from 220 respondents were received from a range of organisations and individuals (Table 1.1), representing a wide variety of interests, industries and perspectives. A full list of respondents is provided at Appendix A.

Table 1.1 Respondent Type

Respondent Type	No. of Unique Respondents	Respondent Type	No. of Unique Respondents
Academic	3	Private sector: energy	25
Charity	3	Private sector: ICT	5
Individual	18	Private sector: transport	9
Industry/trade body	62	Private sector: waste	6
Local public body	32	Private sector: water	6
National public body	10	Third sector organisation	24
Private sector: other	17		

The Consultation Report contained 28 questions. The NIC invited consultees to provide responses of a maximum of 20 pages to some or all of the questions. Respondents were not required to base their submissions around the questions, although the majority chose to do so, (Table 1.2).

Table 1.2 Response Type

Response Type	No. of Unique Respondents
Structured response	157 (67%)
Unstructured responses	75 (33%)

1.3 Approach to Consultation Analysis

Upon receipt of the submissions, responses were logged with a unique reference number and allocated a respondent type, using the categories set out in Table 1.1. At this stage, any duplicate or additional responses from a respondent were identified. Responses were received in both digital (98%) and hard copy (2%) formats, the latter were subsequently digitised and both types have been analysed together using an identical method.

Structured responses were analysed to identify key issues and themes for each answered question, and any other general comments set out in the response which were attributed to individual questions or 'other' as appropriate. The same approach was adopted for the analysis of the unstructured responses. However, an additional first step was taken to allocate text to the Consultation Report sections and questions where possible and appropriate.

Respondents were encouraged to provide details of the evidence and data supporting their positions. A log has been created detailing the documents appended to responses for the NIC to consider during its ongoing work; however, this material has not been analysed for this report.

1.4 Report Structure

An overview of the comments received is presented in Sections 2 to 10 of this report. Sections 2 to 9 report the findings of the analysis of the 28 consultation questions against the chapter headings included in the Consultation Report. Where comments relate to the points raised in the Consultation Report but which is outside the questions posed by the NIC, this analysis is also reflected in these sections. Section 10 presents comments which related to the future of infrastructure but did not specifically address the questions or analysis raised in the Consultation Report.

1.5 Cross-cutting Themes

Many respondents welcomed the Consultation Report and its recognition of the need for coordinated and long-term planning for the nation's infrastructure. Some respondents highlighted that they particularly welcomed the inclusion of specific

topics within the report. There was also support for the need to learn from lessons from the past and ensure that these are taken on board.

Some respondents highlighted that they believed that the Consultation Report failed to (fully) address key topics. It was suggested the geographic scope of the Consultation Report was too narrow, with requests for further consideration of non-city regions and regional as well as national infrastructure planning.

A number of cross-cutting themes have been identified, which were raised across the different infrastructure types. These included:

- The need for revisions to or introduction of good Government policy on all types of infrastructure. This included the need for national strategies to more effectively co-ordinate infrastructure development and investment including with other forms of development.
- The importance of Government making timely decisions on infrastructure related decisions so that there is clarity on priorities for all infrastructure-related stakeholders.
- The benefits of Government providing more responsibility including funding to devolved areas to enable them to more effectively address infrastructure issues in their local area,
- The role of public communication in further educating the public on infrastructure related issues and in facilitating behavioural change.
- A call for more Government support for infrastructure including through funding, explicit support for a project etc.
- Clarity around policy frameworks post-Brexit.
- The importance of all sectors involved in infrastructure development having the necessary skills and expertise whether this be at planning, design or delivery stages. There were also calls for greater collaboration between stakeholders, the need for and use of better data in all stages of project delivery and for improved data sharing across the various infrastructure sectors.

2 Interim NIA Introduction

2 Interim NIA Introduction

This section addresses feedback received on the introduction including the responses to questions 1 to 4 and other comments received on the information contained within this chapter of the Consultation Report.

2.1 Question 1

The Consultation Report identified that "*the UK is preparing to leave the European Union. While the terms of exit are currently uncertain, this raises a wide range of issues. The Commission is focused on strategic issues (for example, the implications for environmental policies, such as the Habitats Directive) rather than delivery issues, which are the responsibility of the Infrastructure and Projects Authority (for example, the future supply of skilled labour).*" It sought views on: how the UK can maximise the opportunities for its infrastructure and mitigate the risks from Brexit. Some 92 respondents provided a response to question 1; this sub-section provides an overview of the comments received.

2.1.1 Maximising the Opportunities of Brexit

A number of approaches to maximising the opportunities that Brexit might bring were identified. These included:

- Investing in strategic infrastructure to support economic growth and boost productivity. Specific suggestions included highways and rail projects, tidal energy, and digital infrastructure. Some respondents referenced the importance in investing across all regions in order to allow them to contribute to the national economy.
- Making the best use of international gateways such as ports and airports, and ensuring they continue to benefit from access to international markets. Specific proposals included a 'free port' programme, or focussing on those ports best suited to new (for example, transatlantic) trading routes.
- Reforming planning to speed up the delivery of infrastructure projects.

Some respondents also highlighted Brexit as an opportunity to re-consider legislative and regulatory frameworks. For example, it was suggested that organisations with local, regional and national infrastructure responsibilities are re-aligned, that State Aid for infrastructure is re-considered, and that the Common Agricultural Policy is replaced with a framework which incentivises a natural capital approach to flood resilience and carbon sequestration.

2.1.2 Minimising the Risks of Brexit

Several of the respondents highlighted the importance of continued access to skills and resources post-Brexit, and the challenges around the potential end of the freedom of movement. Work to understand the current and future needs for the sector was suggested, and support was given to initiatives to improve domestic skills and resource – including vocational 'T-Levels' and flexible use of labour between companies. A number of respondents also suggested that the rights of

skilled EU nationals currently living and working in the UK should be protected, that access to EU labour should be retained in the short- to medium-term, and that those international firms, which are vital to the design, delivery and operation of national infrastructure should be encouraged to remain. It was suggested that the NIC should also refer to work already undertaken by professional institutions such as the Royal Academy of Engineering and the Construction Industry Council.

Concern was raised about the time required to develop domestic specialist skills such as engineering. To address skills requirements, support was provided for a careers strategy or skills strategy, and the value of qualified and experienced project managers in both the public and private sector was also raised.

The importance of access to funding and financing was highlighted, including continued access or establishing alternatives to the European Investment Bank, European Fund for Strategic Investment and Regional Development Funds to ensure access to low cost finance funding for infrastructure projects, or exploring new opportunities such as Green Bonds. It was suggested that a 'single pot' approach to regional funding should be taken which matches infrastructure investments to wider skills and social funding, and that more bespoke criteria for accessing grants and funding – reflecting specific needs and disparities – should be developed.

Some respondents stated that the Government should provide certainty and support investor confidence in infrastructure delivery. Suggestions to do this included: providing clarity on future trading and market access arrangements; maintaining a clear long-term legislative, regulatory and policy framework; and retaining certain existing arrangements, such as the Electricity Market Reform package or the regulatory role of Ofcom. Some respondents stated that existing regulatory frameworks, (such as the European Standards Organisations or Eurocodes), should be retained; others stated that, where new regulatory authorities and oversight functions are required, they should be replaced by like-for-like accountable bodies. Finally, there was some support for a transition or implementation period, or short-term harmonisation, to provide certainty.

In order to mitigate the risks of Brexit, some respondents suggested that UK legislation derived from EU regulations should be reviewed. However, several respondents believed that EU-derived laws relating to energy, climate change and the environment should be retained, replicated or strengthened.

A review of infrastructure priorities in the face of Brexit was suggested, including whether they can be afforded, and projects that provide access to European and global markets and boost trade (including road and rail freight at international gateways) should be prioritised. Government should better understand the status of current infrastructure and infrastructure requirements of regions but should avoid using exclusively value-for-money and urban-based metrics that do not address the needs of rural communities.

Several respondents referenced the need to continue to collaborate internationally on important issues, including climate change, science and research, and any developing European legislation, which will continue to affect the UK.

Finally, some of the respondents covered the future trading relationship with EU markets, including retaining access to the infrastructure supply chain, energy trading and export of technologies and professional services. Support for export growth was suggested. Conversely, others suggested ways to reduce dependence on foreign markets, for example, increasing the UK's ability to process waste and reducing energy demands.

2.1.3 Brexit's Impact

A number of uncertainties around Brexit were highlighted, including: the future UK-EU relationship; continued access to the single market and customs union and the resultant requirement for customs arrangements; post-Brexit regulations and standards; the impact on arrangements such as Euratom and the Internal Energy Market; and fluctuations in the value of sterling. Respondents highlighted the impact of such uncertainty on investment decisions and trade. One respondent suggested that the NIC should look specifically at the impact on border controls and customs on freight infrastructure.

2.2 Question 2

The Consultation Report identified that "*good design is essential to ensuring infrastructure that lasts, is useful and enhances both its environment and the quality of life of citizens*." It sought views on: how an expert national infrastructure design panel might best add value and support good design in UK infrastructure. Some 71 respondents provided a response to question 2; this sub-section provides an overview of the comments received.

2.2.1 Remit and Operation of the Panel

There was support for the principle of a national infrastructure design panel. Recommendations were made regarding the role and remit for the panel. The panel should:

- Define the principles of good infrastructure design nationally.
- Articulate the benefits of good design.
- Prepare a design vision which could be a potential first deliverable of the panel.
- Establish clear suitability criteria for selecting projects for design review.

It was suggested that the panel should provide guidance and resources to empower and support public bodies and organisations to enable (or to directly deliver) well-designed infrastructure. This could be through regular reporting on case studies, best practice and lessons learned from previous projects and other established design review panels, for instance HS2 and Highways England. Other respondents thought that the panel should have a role in influencing existing policy and regulatory frameworks (including planning policy and building regulations), as well as bringing together existing design guidance to ensure it is fit for purpose. For some respondents it was important that the panel has a national perspective to ensure that policy, guidance and standards are being applied consistently across different areas and projects.

It was suggested that a Panel could look at gaps in infrastructure, locations and the design quality of existing infrastructure.

There was a difference of opinion among respondents as to what authority the panel should have. Some respondents thought that it should be held accountable to, and be required to report regularly to, the NIC. Some suggested that in order to be effective, its role should be clearly established as part of the statutory planning process, with authority to not only make recommendations but also to act in decision-making and to apply sanctions. Conversely, other respondents stated that it was important that the design panel should not be allowed to encroach on the role of the statutory planning consents process, particularly with regard to mitigating the impacts of schemes and engagement with stakeholders, and should only be advisory. One respondent stressed that the remit and scope of the panel should be highly focussed to avoid 'mission creep' and a dilution of purpose.

It was noted that the panel should operate in a way that is fair, and that it should be objective and independent when making recommendations. In order to be effective, the panel needs to be properly resourced and have strong leadership. Based on existing experience, one respondent recommended setting up a highly structured administration and Code of Conduct to ensure a high quality and effective review service is delivered.

Some respondents also suggested that design review should be easily scaled to match the needs of an individual project, depending on the size, budget and potential impact of a scheme. For instance, underground gas and electricity infrastructure will likely require less design input as there are fewer visual impacts. It was also suggested that it is important that schemes should be subject to review throughout the whole life of the project. To add the most value, the panel should:

- Be focused on problem-solving.
- Have a role in setting the scope of a scheme before it is committed.
- Provide insight into the level and type of funding appropriate.

It was recommended that design guidance and reports published by the panel should be written in a language that is accessible and easily understood by a wide audience.

2.2.2 Panel Membership

Many respondents commented on the panel membership, emphasising the importance of ensuring the panel harnesses expertise from across different disciplines, sectors and geographies including urban and rural areas. Specific recommendations on panel membership included:

- Built environment, ecology and natural environment professionals.
- Membership organisations such as professional bodies and chartered institutions.
- Public sector and academia.
- Private sector industries.
- Local expertise and knowledge, who could act as local design champions.

2.2.3 Design Considerations

Respondents made wide-ranging recommendations on what the design panel should consider when undertaking reviews, and what outcomes the panel should be seeking to deliver. These are summarised below.

Place and Context

There was a strong focus on design responding to place and context, in particular reflecting the needs of the local area. Infrastructure should be appropriate in its context, including rural areas, and reflect local features and styles. The panel should push for schemes to not only mitigate impacts but also seek to improve local landscape and character. The need to consider the needs of rural areas was identified.

Innovation

A number of respondents commented on the value of a design panel in facilitating the sharing of ideas and the collaboration between stakeholders across multiple disciplines and sectors. This collaboration was seen to be key to securing agreement on shared visions and objectives, can identify key synergies between projects, and can support design innovation.

A recurring theme was the opportunity for the design review panel to both promote and enable innovation. This was considered important for delivering cost efficiencies for infrastructure providers and operators (and ultimately consumers), as well as delivering better value-for-money on investment. Particular areas where innovation could be explored include road design standards (to reflect road charging of electric vehicles), better integration of data flows to feed back into the design process, as well as challenging existing standards, which can often lead to over-engineering.

Environment

Several respondents emphasised the importance of environmental considerations for infrastructure design, from delivering clean energy, addressing climate change impacts and connecting to heat networks and Energy Recovery Facilities (ERFs), to avoiding the loss of important habitats such as ancient woodland. There were comments on the aspiration for infrastructure projects to deliver net biodiversity gains and to regard the natural environment as an asset rather than merely as a constraint. Sustainability performance should be factored into the design from the early stages to avoid costly retrofitting later.

Whole Lifecycle Design

A number of respondents focused on the value a design review panel could provide in ensuring design considers the whole lifecycle and long-term resilience of infrastructure schemes. Maximising the longevity of infrastructure was seen as a key objective, and this could be delivered by ensuring that infrastructure is adaptable to meet future needs, making use of retrofitting existing buildings, as well as maximising unused capacity and design quality of existing infrastructure.

It was suggested that infrastructure design could explore opportunities for standardisation and 'productisation' of infrastructure using modular solutions.

Defining 'Good' Design

Infrastructure design should move away from focussing on often narrow 'value-for-money' concerns and instead focus on maximising longer-term benefits, securing high quality and 'good' design.

Some responses explored what 'good design' should mean for the panel. It was generally suggested that design is not merely an aesthetic or functional concern but also encompasses social, economic and environmental outcomes. There was a focus on quality of life and wellbeing objectives; infrastructure should meet the needs of a wide range of people, and it should be affordable, accessible and inclusive (with specific reference to meeting the needs of an ageing population).

Notwithstanding this, respondents also mentioned the importance of considering project delivery and operation. The panel should also have an awareness of the technical, operational and safety requirements for each infrastructure sector. One respondent suggested that good engineering is at the heart of good infrastructure design, and this should be a focus for the panel.

2.2.4 Objections to a Design Panel

Some respondents objected to an infrastructure design panel. Good design was considered to be highly subjective, therefore design review and guidance has the risk of being overly prescriptive and could stifle innovation, leading to a 'tick box' exercise that legitimises poor design. Indeed, it was thought that infrastructure operators and providers themselves, and not a design panel, are best placed to identify synergies and innovation which they currently do as part of their normal functions to cut through restrictive regulation.

Some respondents thought that establishing a single 'design vision' was not feasible across the diverse infrastructure sectors to be considered by the panel. One respondent cautioned that review panels can lead to decision making that is not objective and evidence led, but instead highly influenced by a Government department's policies and concerns.

It was noted that a number of design panels are already established, such as those for HS2, Urban Design London, the Design Council and forthcoming review panel for Network Rail. Consequently, a number of respondents queried whether a design review panel was indeed necessary. Other's suggested that a national panel should coordinate these existing efforts rather than duplicate them. It was also noted that a design panel could impose potentially damaging costs to applicants, consumers and the public purse, as well as slow down the planning process. An advisory only status was suggested for the panel.

2.2.5 Other Measures

There were suggestions for other measures to support good design including:

- Early, ongoing and meaningful stakeholder engagement. A number of respondents suggested that the Government establish an independent Commission for Public Engagement based on the French model.
- A design methodology and appraisal process which focuses on long-term value rather than initial capital costs.
- Making best use of digital technology and data, including the Digital Twin approach to enable scenario-based modelling.
- Ensure that the historic environment is adequately considered through the use of tools such as the Constructive Conservation approach, the Heritage Works toolkit.
- Design tools, such as Design for Excellence, Real Options appraisal and Safety by Design.
- Establish a number of national advice panels on different sectors and technical areas; these could be set up in addition to a national infrastructure design panel.

2.3 Question 3

The Consultation Report identified that "*the Commission proposes to identify a small set of high-level metrics to assess the UK's progress in achieving high quality, resilient, affordable and sustainable infrastructure*." It sought views on: how the set of proposed metrics for infrastructure performance can be improved. Some 64 respondents provided a response to question 3; this sub-section provides an overview of the comments received.

2.3.1 Performance Metrics

There was a mixed response to the proposed metrics for measuring infrastructure performance. There was both support for and objection to the principle of establishing metrics, and there were wide-ranging comments on the scope of the metrics proposed in the Consultation Report. A significant number of respondents proposed additional metrics, some of which were of a technical nature reflecting the business focus of the respondent. Some others suggested metrics focused on measuring 'place' and reflected a very broad understanding of infrastructure that encompasses environmental, economic and social themes.

2.3.2 Limitations of the Proposed Metrics

A number of respondents commented that more detail was required on how the proposed metrics would be measured in order to understand their efficacy. Some were unclear as to how the metrics had been identified. It was suggested that the set of metrics should be more closely related to Government's objectives as set out in the Industrial Strategy, as well as the NIC's objectives. Other respondents stated that an objective assessment of trends, recent innovation, and priorities, as well as consideration of alternatives, should be undertaken first, and that metrics should then be derived from this work. It was noted by a number of respondents that the metrics should make use of existing standards and KPIs both within the UK and internationally.

Some respondents stated that many areas of performance are inherently qualitative, and cannot be easily reduced down to quantifiable figures, and this can create a bias that influences how schemes are measured. In some of these cases, a qualitative approach (potentially using 'score cards') could be developed instead. One respondent commented that the proposed metrics are 'backwards' looking and only reflect past performance, rather than looking forward based on a confidence in future performances.

A small number of respondents noted that the metrics could be more useful if they reflected more closely the needs and values of end-users and customers, which may not always reflect those of the operators and providers. An example was given that the digital communications metric on coverage by technology, if measured as a percentage of all UK properties or landmass covered, does not necessarily reflect the priorities for the majority of consumers, which may be more related to the degrees of coverage to highlight the worst affected areas. Another respondent noted that infrastructure users are more interested in services rather than fixed physical assets, and therefore metrics that track satisfaction with services should be prioritised.

A range of respondents stated that the performance metrics should focus on the whole life cycle of an infrastructure asset or system, which the current proposed metrics fail to do. For instance, those relating to emissions should include embodied energy as well as emissions arising from their operation. Equally, cost metrics should reflect both operational and capital costs. There was a suggestion that metrics could include a measure of propensity for end-of-life adaptive reuse.

Some respondents suggested that metrics should be subject to specific stakeholder and general public consultation before they are introduced. It was also suggested that the metrics themselves should be subject to regular review to make sure that the NIC continue to measure against the right objectives, which may change over time.

A number of respondents queried the concept of applying generic metrics nationally, as these are unlikely to meet local or sectoral needs. Instead, there was a suggestion to establish a framework at the national level, with flexibility built-in for local and sectoral-specific metrics to be added.

2.3.3 Inter-relationships Between Metrics

A number of respondents noted the inter-relationships and interdependencies between the different infrastructure sectors and themes, particularly those relating to resilience. It was suggested that this interdependence should be better reflected in how the metrics are identified and measured, and that this was important to consider infrastructure performance holistically to gain better system integration and efficiency. This could include new metrics that measure the link between transport (and other enabling infrastructure) with land use planning.

There was a concern that the metrics should consider secondary impacts. For instance, in measuring resilience in the energy sector, this should also be reflected in metrics that measure the knock-on impacts to a generator. One response noted the importance of undertaking an impact assessment of the metrics themselves to

ensure that any targets associated with them do not give rise to unintended negative consequences for providers and end-users.

2.3.4 Utilising the Metrics

There were a number of responses that commented on how the metrics could be used. Some respondents stated that it should be made clear that accountability for system performance lies with a wide range of actors, so that negative performance scores do not unfairly impact on only some parties and not others. For one respondent it was important that no single metric be used as a deciding factor for determining performance or success given the interrelationships between them; rather, the metrics should be used in combination. Another respondent commented that there was value in applying metrics now to existing infrastructure before applying it to new projects, to gain an understanding of the current state of play.

2.3.5 Infrastructure Sectors

Respondents generally commented on the metrics under either the sectoral or thematic headings set out in Appendix A of the Consultation Report. The proposed transport and energy sector metrics received the most comments, while waste and digital communications sectors received the least. Table 2.1 provides an overview of the points raised.

2.3.6 Additional Metrics

There was a very broad range of proposals for new and additional metrics over and above those set out in the Consultation Report. Many of the proposed metrics were focused on measuring place rather than individual infrastructure assets or systems. For instance, one respondent recommended that a common set of indicators be adopted across the UK that measures how city regions perform in terms of connectivity and liveability. These additional proposals can broadly be grouped as detailed in Table 2.2.

Table 2.2 Additional Metrics Proposed

Natural Environment	Economy	Society
Natural Capital Net Biodiversity Gain DEFRA's 25 Year Environment Plan Natural England's 'ecometric' The Woodland Trust's Woodland Access standard Natural England's Accessible Natural Greenspace standard Soil quality Green and blue infrastructure	Value Added to the Economy Number of jobs created Reflect local and national objectives Reflect the difference between places (north/south, rural/urban) Local Plan monitoring Planning consent and approval rates Long-term planning stability	Health and wellbeing Inclusiveness Social return on investment Housing delivery and quality Measure type, location and need for new education infrastructure Rail Safety and Standard Board's (RSSB) emerging Common Social Value framework Viability of communities Landscape impacts Heritage impacts

Table 2.1 Proposed Changes to Performance Measures

Key: (T) transport, (W) waste, (F) flood risk, (E) energy, (Wa) water, (D) digital, (O) other/general

Theme	Revisions to Proposed Metrics	Additional Metrics	Data Sources
General	(T) Assess each mode on its own merits (T) Assess all modes to the same level of scrutiny as the rail sector (O) Forecasting and modelling should be done against extreme scenarios not just central/base scenario (F) 'Number of properties flooded' should also come under other sector headings	(O) Safety (including Passenger Safety for transport sector) (O) Infrastructure efficiency	(T) Road Investment Strategy (T) Office of Rail and Road data (T) Network Rail data (Wa) Ofwat's 2019 Review of Prices (O) Sustainable Development Goals (Masterton et al, 2017)
Resilience to large shocks	(F) 'Risk of flooding and coastal erosion' metric should include risk from a 1 in 30, 1 in 100 and 1 in 1,000-year event (E) Account for potential for demand reduction and demand response (E) Account for resilience of individual generator stations as well as wider system (E) Clarify measure of 'diversity of energy sources' (E) Keep metrics under review to reflect change in demand-side generation (Wa) Use RAG 'drought stage' measure used by the Environment Agency (O) Align metrics to customer feedback/market research outcomes/surveys	(T)Resilience to large weather events (T) Resilience of support IT systems (W) Ground pollution (F) Risk from severe weather events (O) Wastewater resilience (E) Include auctions designed for on-demand power	
Everyday resilience	(F) Include impact on infrastructure assets as well as properties (E) Clarify if relates to just externally supplied energy or also demand-side generation (E) Change 'properties' to 'users' (E) Account for resilience of individual generator stations as well as wider system (E) Keep metrics under review to reflect change in demand-side generation (Wa) Number of properties that lose access to water (O) More detail on stress metrics (O) Assess impact of large shocks across network and on other systems (O) Align metrics to customer feedback/ market research outcomes/surveys (Wa) Water lost from leaks should also be included under everyday resilience heading	(T) Surface access capacity (E) Number of instances that a user loses energy (Wa) Impact of loss of water to transport and business (Wa) Number, frequency and duration of combined sewer outflows (D) Assess resilience of digital infrastructure to cyber security threats (O) Wastewater resilience (F) Flood prevention relating to tidal barrage schemes	(T) Network Rail metrics (2019 onwards)

Theme	Revisions to Proposed Metrics	Additional Metrics	Data Sources
Service quality	(T) Assess connectivity of services and level of service integration (T) Reflect connectivity between residential areas and employment locations (T) Disaggregate mix effects on network (W) Delete energy from waste metric due to negative environmental impacts (E) Clarify definition of 'quality of user experience'. Define for different service areas (E) 'Peak load shifting' should consider generation shifting and wind (D) Coverage by technology should reflect degree of coverage for an area, not for the whole of the UK (E) Smart meters in operation should distinguish between SMETS 1 and SMETS 2 meters in operation.	(T) Generalised journey time between each pair of stations on network	
Quality of user experience	(E) Clarify definition of 'quality of user experience'. Define for different service areas (E) Clarify how satisfaction is going to be measured (O) Align metrics to customer feedback/market research outcomes/surveys	(F) User satisfaction of flood defences (F) Kilometres of transport network at risk of being unavailable from flooding (Wa) Switching time between suppliers (Wa) Use CSAT, becoming C-MeX from 2020	(T) National Rail Passenger Survey
Cost	(F) Include impact on infrastructure assets as well as properties (E) Account for level of intermittency on grid of different energy types (E) Account for network and ancillary service costs (E) Apply fairly across all technologies (E) Use international comparisons (E) Measure for all energy users not just domestic (E) 'Cost of kWh of energy' should reflect distribution of bills around average (E) Consider pre-payment and pre-allocation (Wa) Cost of putting water into the supply, rather than only abstraction (O) Reflect availability of finance (O) Account for wider value of delivering CO_2 transport and storage assets	(F) Cost of repairs to a property	(T) Office of Rail and Road Industry Financial Information indices

Theme	Revisions to Proposed Metrics	Additional Metrics	Data Sources
Emissions	(T) Account for agglomerated CO_2 impacts of passengers travelling by multiple modes (E) Capture embodied emissions (E) Measure total emissions from the system not intensity (E) Use monetary metrics (E) Make use of BIM to deliver optimisation in cutting carbon	(T) Annual estimates of CO_2 from passenger and freight services (O) Measure emissions of NO_x (O) Measure amount of CO_2	(T) Office of Rail and Road annual estimates of CO_2 from passenger and freight services (E) Emission Performance Standard (GLA) (E) Reflect availability of finance Carbon Intensity Floor metric (GLA)
Environmental externalities	(O) Make use of monetary units where available (O) Air quality metric should reflect links between air quality and health (F) 'Quality of rivers and seas' metric should also sit under flood risk sector heading to reflect environmental risk from sewer outflow	(E) 'Pay as you pollute' (O) Amount of habitat destroyed (O) Economic externalities	(Wa) Environment Agency's Environmental Performance Assessment

Key: (T) transport, (W) waste, (F) flood risk, (E) energy, (Wa) water, (D) digital, (O) other/general

2.4 Question 4

The Consultation Report identified that "*cost-benefit analysis is a key source of evidence used to inform decisions on infrastructure investments. However, too often it narrows down to a preferred option without giving sufficient consideration to alternatives*." It sought views on: the sort of tools, beyond cost-benefit analysis, that would best ensure a full range of options are identified to inform the selection of future projects. Some 75 respondents provided a response to question 4; this sub-section provides an overview of the comments received.

2.4.1 Support of CBA

The respondents supporting cost-benefit analysis (CBA) mainly pointed out that the issues discussed in the report were not necessarily due to the method, but rather how it is applied and how many options are considered. Some respondents claimed that stakeholders prematurely favoured certain solutions due to, for example political, financial and reputational pressures. Other respondents claimed narrowing options were necessary to uphold efficiency, or that it was well suited to major infrastructure projects. Some respondents raised the need to ensure that the rigour of CBA as a method would not be sacrificed by incorporating poorly founded estimated metrics of wider impacts.

2.4.2 Limitations of CBA

Several respondents elaborated on the limitations of CBAs. This included their failure to include long-term value and wider benefits, as well as rural issues. Some respondents also emphasised its focus on short-term savings instead of the long-term value of projects, while other respondents mentioned its inability to take network-wide benefits into account. A few respondents further raised that CBA does not consider the type and scale of infrastructure needed in the UK, and does not allow for planning ahead, and that CBA fails to consider the investment objectives of funding bodies.

Some respondents were more particular, mentioning that metrics, such as travel-time savings, were overly emphasised, while land-value related to land use change was insufficiently captured. Other respondents mentioned the limitations of comparing infrastructure projects to a do-nothing scenario, which is not optimal. Several respondents mentioned the number of uncertainties involved in any CBA analysis, and encouraged the use of scenarios and sensitivity testing to mitigate for this. Additional CBA limitations raised by respondents included:

- Focuses too heavily on reducing initial costs rather than considering lifetime costs, resulting in sub-optimal schemes.
- Difficult to use in certain sectors, and the use of, for example, the HMT Green Book is not sufficiently synchronised across Government departments.
- Does not take funding and financing required for projects, multiplier and neighbourhood effects for a project into account, and that it tends to underestimate costs and overestimate benefits.

2.4.3 Limitations Concerning WebTAG

Some respondents specifically referred to the WebTAG tool, claiming the use of it could result in over- or underestimation of the impact of a scheme. Further limitations included noting its lack of recognition of additionality, its failure to sufficiently demonstrate that transport schemes could unlock housing growth, the insufficient quality and lack of synchronisation of the data used, its lack of understanding wider economic impacts, and the rare use of adaptation and refurbishment options. Additionally, a few respondents pointed to WebTAG's geographical analysis not being accurate enough, and that a wider geographical coverage is recommended which should include acknowledged units of analysis.

2.4.4 Alternatives or Suggested Changes to CBA

Both overarching and detailed suggestions were provided for either improvement of or alternatives to the use of CBA. Several respondents mentioned Natural Capital Valuation as an approach to account for environmental benefits, potentially revised for limitations such as data gaps and the inclusion of climate risks. Some respondents focused on social values and social return on investment. Several respondents suggested evaluating lessons learned from previous schemes, comparing similar projects to improve the use of CBA, and behavioural changes arising from previous interventions. Some respondents further suggested better use of qualitative research to support project evaluation. The importance of evaluating more dynamic and longer-term benefits was also raised by some respondents.

Most respondents suggested that CBA, or an alternative method, should include a wider, multi-criteria analysis in its approach. Examples of such criteria included using Defra's rural proofing guide, system-wide resilience, policy, carbon reduction and environmental issues, and societal and connectivity benefits. Considering whole life costs of a scheme was often stressed, as was the use of British and international standards.

Respondents stressed the importance of early stakeholder engagement, the necessity of thinking collaboratively in the process, including higher design standards, and a wider inclusion of the supply chain. Some respondents further suggested that presenting return on investment instead of benefits-cost ratio would be a desirable approach, which would enable wider comparisons with alternative investments with different risk levels.

Other suggested amendments and alternatives included:

- An approach that includes scenario-based planning, including for example future transport trends, should be utilised.
- CBA should include not only what is possible but what is desirable.
- CBA should not be based on overly detailed assumptions.
- The NIC should make use of sustainability appraisals to consider costs and benefits in whole area strategies.
- CBA should consider the ability to unlock new development sites (for example for housing).

- An alternative, lighter touch approach for smaller infrastructure schemes could be beneficial.
- The CBA should be amended to include additional criteria concerning benefits for an area's local economy, and should reflect different contexts in various places in the UK, seeking empowerment of local communities.
- Use of the HMT's Green Book and its Five Case Model is supported.
- A central repository of standard values to be used in CBA, including accurate capital and operational expenditure, which is as far as possible is consistent across sectors and regions.
- CBA needs to consider impacts across sectors, on the historic environment, over different geographies and against consumer priorities.
- CBA should adopt a problem-based approach where problems are identified and potential benefits assessed, linked with spatial plans and long-term funding packages.
- CBA should include savings related to travel time, and land value data.

2.4.5 Tools to Ensure Identification of a Full Range of Options

The respondents widely agreed that CBAs often considers too few options, and frequently suggested tools or other ideas to ensure the list of options were widened and tested. Some respondents particularly mentioned a more open approach, for example, that smaller schemes should be incorporated, that different transport options should be weighed against each other, or a more outcome-based methodology, such as dropping schemes that do not fulfil desired social outcomes. Some respondents further suggested a literature review identifying the cost-benefits of innovative approaches to identify the gaps.

Some recommended a pre-CBA or a 'sifting tool' to ensure wider considerations, other respondents emphasised secure funding to allow for more time to evaluate options, or that independent reviews should be held prior to the CBA with required evidence. Other respondents suggested that stakeholder engagement should be more widely conducted. The need to enable more collaboration across sectors and transport modes was also identified. Some respondents raised that the objectives considered should be cross-sectoral to allow for integrated strategic planning with flexible scenarios in an aligned regional vision, robust against uncertainty.

In terms of more specific approaches, the city simulation tool of the GLA was suggested, and recommended for use on wider areas than London to allow for comparison. The GLA further suggested the NIC should join the High Level Infrastructure Group which seeks to co-ordinate infrastructure development in London. The use of 'digital twins', an approach where a city/transport network is digitally copied, was also suggested, as was the use of digital social communication tools.

Lastly, some respondents suggested that the NIC could play a valuable role in widening the options through innovative and rigorous approaches.

2.5 Other Comments

A range of comments were received on the information included in Chapter 1 which did not directly relate to the questions posed, these are summarised below.

2.5.1 Approach and Methodology

Comments were made in relation to the approach and methodology for preparing the NIA, which included:

- A definition should be provided in the NIA of relevant infrastructure. It was noted that social infrastructure and green infrastructure should be more clearly presented in the NIA and that housing should be regarded as part of the country's national infrastructure.
- The NIC had demonstrated a thorough, consistent evidence-led approach to identifying key issues and the potential opportunities for addressing them.
- The NIA needs to be clear on what infrastructure is required for and what it is intended to enable.
- There is a danger that the UK's infrastructure challenge is seen as only relating to the three Cs of carbon, congestion and capacity. The scope of the NIA is much wider than this.
- The NIA should have looked at congestion, carbon and capacity jointly rather than in isolation. One approach to doing this would be a system strategic overview in line with strategic impact assessment principles.
- The Consultation Report lacks clarity of vision, is too aspirational and needs to be more practical in its application.
- The NIA should embrace the social model of disability and consider how investment can address the physical and societal barriers disabled people currently face.
- The Consultation Report places too much emphasis on emerging technologies, (for example autonomous vehicles), which have yet to be commercially proven or whose effects are unclear.
- The NIA places too much emphasis on large-scale infrastructure projects; the same outcomes could be achieved through better and more regular maintenance and upgrade of existing UK infrastructure and/or through demand management, efficiencies etc.
- Where the NIC decisions on infrastructure priorities rely on evidence this must be clear, concise and accountable. Linked to this, the NIA should identify where in the absence of Government policy this has made a difference to the assessment of need.
- On some topics, a lack of rigour was applied to evidence collation, assessment and prioritisation of infrastructure investment. Such errors should be addressed.
- There needs to be greater alignment between national infrastructure planning and natural environment planning.
- The Final NIA will need to demonstrate buy-in from sub-national bodies in England as well as Welsh, Scottish and Northern Irish governments. It will also need to demonstrate that the strategies work for all parts of the UK including rural areas and places outside the combined authorities.

- The national infrastructure strategy should have a long-term outlook, for example to 2100 at least.
- The interim review of the NIA should be undertaken every two and half years (as opposed to the five yearly review limits proposed).

2.5.2 Priorities

There was significant support for the seven identified priorities for the NIC. Support for the inclusion of the following topics was particularly highlighted: transition to low carbon economy, new housing construction and building a digital society. Some respondents suggested the list was incomplete and additional priorities were identified.

It was noted that a holistic approach is required to deliver these priorities and that further articulation on the process for development, deployment and timescales for action on the priorities is required.

2.5.3 Scenarios and Assumptions

Comments were provided on the scenarios and assumptions that underpin the interim NIA. These included:

- There is a need to consider the future of existing employment including potential employment change and loss, the associated impact on disposable income and implications for spending and demand on movement and transport. This includes assumptions around economic disparities within the UK.
- There is a need to consider changing models of car ownership, which are becoming more common in some urban areas and the impacts this may have on congestion.
- The NIA does not appear to recognise the potential to 'de-couple' economic growth and travel demand so that increased congestion is not an inevitable by-product of economic growth.
- The absence of a national spatial vision has meant that the NIC has developed its own scenarios, which will inform the strategies adopted by the final NIA and associated recommended infrastructure projects. This approach places greater weight on the NIC to demonstrate the transparency and democratic engagement in the development of the scenarios including the interaction between population and economic growth distribution and the provision of infrastructure.
- The NIC must be able to show why the scenarios which informed its understanding of infrastructure need have been selected, be able to justify the assumptions used to underpin the scenarios and explain how the scenarios help to meet wider Government objectives.

2.5.4 Sustainable Development

Comments were received on the NIA’s definition of sustainable development and the extent to which the NIA would support achievement of sustainable development across the UK. They included:

- The NIA should take into account of all three strands of sustainable development as set out in the National Planning Policy Framework (as opposed to the proposed definition).
- The NIA is not delivering on its objective to support sustainable development and growth across all regions of the UK; primacy is given to cost-benefit analysis based on long-term forecasting. A spatial effects assessment alongside some form of regional quota should be considered alongside cost-benefit procedures.
- The NIA does not adequately address greenhouse gas emission reductions required from the UK being a signatory of COP21; this requires reductions beyond that set out in the Climate Change Act (2008). It also does not critically assess proposals for carbon reduction with their consistency with climate change adaptation principles.

3 Building a Digital Society

3 Building a Digital Society

This section addresses feedback received on Chapter 1 of the Consultation Report including the responses to questions 5 to 8.

3.1 Question 5

The Consultation Report identified that "*the UK has invested less in 'next generation' infrastructure than many other advanced economies*." It sought views on: the changes that are needed to the regulatory framework or role of Government to ensure the UK invests for the long-term in globally competitive digital infrastructure. Some 57 respondents provided a response to question 5; this sub-section provides an overview of the comments received.

3.1.1 Regulatory Framework

There was some overlap in the answers to this question and those to question 7, which covered the commercial deployment of ubiquitous connectivity.

There was some consensus that the current regulatory framework is not fit-for-purpose for emerging technologies such as 5G. Overall, it was suggested that changes to regulation should be prioritised and should seek to provide certainty for investment decisions, support long-term planning, and enable leadership and innovation. Some respondents thought a more holistic and integrated relationship between regulation and policy on digital infrastructure is required.

It was argued that legislation should be flexible to accommodate future changes in digital infrastructure – for example, by allowing future risk to be shared across the industry, or for the full benefits of intervention to be able to be considered rather than being constrained by existing legislation. Some respondents also made references to remove barriers which hamper the roll-out of digital infrastructure, including planning, wayleaves and traffic management processes. The Department for Culture, Media and Sport's Barrier Removal Task Force was welcomed in this respect. Specific recommendations on reforms to the planning system included:

- Stronger requirements on developers to include provision for connectivity in new developments, for example, for developments of ten or more houses to require fibre connectivity.
- Increasing permitted development rights for key infrastructure.
- Roll out a standard wayleave agreement (such as the one developed by the City of London Authority).

On the other hand, it was argued by one respondent that the planning system already provided a suitable framework for the roll-out of future connectivity.

A view that digital infrastructure should be viewed as a universally available utility (in the same way as other utilities) was expressed. Several respondents covered the broadband Universal Service Obligation (USO), and suggested that amendments or a greater ambition (particularly in terms of coverage and speeds) is required. Specific suggestions included:

- The USO should reflect the economic and social benefits of delivering broadband.
- Concern was raised that the USO will not cover every property, particularly rural areas, and that the USO will distort the rural superfast broadband market by 'fixing in' sub-optimal speed contracts. Instead, the USO should reflect actual broadband delivery costs in rural areas.
- The USO should be developed as part of an integrated approach, covering mobile as well as fixed connectivity. For those areas excluded from the USO under the current proposals, 4G, fixed fibre, satellite and emerging technologies should be offered. Conversely, it was argued by another respondent that investment in wireless or other technologies would undermine the case for investment in fibre to the premises in rural areas.
- The USO should be 'future-proofed' by including an escalator on acceptable speeds, or setting a long-term or more ambitious standard (such as 30Mbs+). The minimum speed trigger should be defined in terms of household internet connections rather than properties.
- The USO should not have a cap on costs.
- The current target date of 2020 is unrealistic.

However, some respondents also stated that consideration should be given to the impact of the USO on market power and the commercial case for other suppliers to invest.

Several ways were suggested to incentivise investment through the regulatory and tax system, including providing tax breaks for deploying new infrastructure, reforming current business rates relief to reflect long payback periods, taxing profits rather than investment, and changing the business rate valuation process to support providers with a large number of small sites. Concern was raised around the upcoming end of fibre business rates relief and its impact on 5G roll-out.

With regard to the way that providers interact, there were suggestions that there should be a requirement to share data and hardware, with standards for gathering, handling, storage and quality of data. There was a specific suggestion that a database of existing (dark) fibre infrastructure (including publicly owned infrastructure) should be established, with access to this infrastructure at a fair and reasonable price.

In addition, there were a large number of very specific suggestions for regulatory reforms to support digital technologies. These included:

- Changes to the use of frequency channels, for example, the use of a 20 MHz wide channel in the 3.6-3.8 GHz band for low power indoor use, or the use of the 400 MHz band. It was also suggested that the coverage for each of the three 5G pioneer spectrum bands should be maximised.
- Reinvestment of future windfalls from the franchising or sale of wavelengths into future investment into digital infrastructure.
- New methods to support co-operation between providers, for example through duopolies, Neutral Host Obligations or a Neutral Host Operator.
- Changes to the powering of digital infrastructure, including roll-out of smart electricity metering of infrastructure.

- Concern around recent changes to Electronic Communications Code and the effect on landowners' willingness to release land for mobile masts.
- Other changes to regulation, including around Ofcom's powers of adjudication on disputed site rents, the ability of the public sector to facilitate commercial projects, and support for cost-effective Passive Infrastructure Access, dark fibre access and associated wayleaves to enable 5G roll-out.

3.1.2 Role of Government

Reference was made to the need for Government to champion the UK's digital infrastructure, across the whole of Government and its agencies (rather than just the Department for Culture, Media and Sport). Particular suggestions included: better inter-departmental data sharing; ensuring connectivity forms part of a modern industrial strategy; developing a long-term vision for connectivity; rolling out a 'digital first' approach across all policies; and adopting a new connectivity impact assessment to consider the impact a policy would have on connectivity and ensure opportunities are fully realised. It was also suggested that a single minister should be responsible for the Government's digital strategy. It was stated that the Government's approach to digital infrastructure should be joined up between policy and investment decisions, and should take a longer-term view.

It was also suggested that Government should better anticipate future digital infrastructure needs, and be willing to directly intervene or invest in to address those needs to improve or expand coverage and capacity. Suggestions included investment in rural areas or smaller urban areas, incentives to 'in-fill' low or no coverage areas, trials of new technologies such as 5G, or investment in security and resilience. One respondent stated that less use should be made of competitive bidding, reflecting that it can result in uneven investment and require a significant resource to bid. Another went further and suggested that digital infrastructure should be managed by a central organisation, with the private sector given the right to deliver services via the infrastructure.

In order to support long-term investment from both the public and private sectors, it was suggested that Government should establish a framework with clear priorities and outcomes, or assess the strengths and weaknesses before assisting in any particular sector. It was also suggested that digital investment should be nationally resourced, with projects assessed alongside all major national road, air and rail investments.

Examples were given as to how Government could work better with partners on digital infrastructure, including:

- With industry, the third sector and communities to understand their digital needs.
- With the digital infrastructure industry to target investment.
- With the construction sector to develop, deliver and embed digital technologies in construction.
- With the transport sector to support integration through digital technology, including Mobility-as-a-Service.

Respondents covered the need to ensure that the market for digital infrastructure is fair for providers and consumers. A response from a provider suggested that Ofcom should be more explicit in setting out the terms of the 'fair bet' that investors can expect a fair return for their risk, and that its current Wholesale Market Review contains proposals which would depress returns on past and prospective investments. Others stated that Government should ensure consumers are able to access services at reasonable prices, or support minimum specifications for major digital networks (such as a new set of mobile coverage obligations with mobile operators which deliver better coverage and customer experience).

It was suggested that Government should ensure a certain level of coverage, for example through a new mobile coverage obligation, or prioritising transport hubs and urban centres. Other suggestions included: Government should regulate the availability and use of ‘Big Data’; major public projects (such as HS2 and Thameslink) should consider how they can proactively enhance mobile infrastructure deployment; and Government should take advantage of the offer by Openreach to undertake commercial investment in deployment of digital infrastructure.

3.2 Question 6

The Consultation Report identified that “*fixed and mobile networks are converging. Both the technology itself and its uses are driving this increasing convergence*.” It sought views on: what the implications are for digital infrastructure of increasing fixed and mobile convergence. Some 28 respondents provided a response to question 6; this sub-section provides an overview of the comments received.

3.2.1 Fixed and Mobile Convergence

In general, support for (or recognition of the importance of) fixed and mobile coverage and their convergence was shown. The benefits of convergence to support connectivity in rural areas were emphasised, as well as providing greater economies of scope in the deployment of fibre networks by allowing providers to recover investment across a broader portfolio.

However, there were concerns raised around convergence, particularly around fixed wireless’s reliability, resilience and human and environmental disruption, and the increased user costs of mobile services. The challenge of agreeing or obtaining access from landowners to install necessary infrastructure on or under land and buildings was also raised.

It was also stated that rolling out fixed and mobile connectivity in parallel also presents demand-led challenges in seeking to meet consumer demands in a comprehensive manner. One respondent proposed that priority should be given to achieving a fast, reliable fixed connection to all, over 5G roll-out.

It was argued that a regulatory framework for convergence is required, as well as more support from Government. One respondent suggested that roll-out of technologies such as 5G should be centralised, whereas another proposed that Government should provide additional support to local government to drive

forward delivery with the private sector. On the other hand, it was argued by another respondent that fixed and mobile convergence is already occurring and will continue to do so without support.

Other respondents provided the following suggestions to enable convergence:

- Providing more information on speeds and coverage, potentially in an open access platform, to support investment decisions.
- Making fibre roll-out decisions alongside the requirements for 5G roll-out.
- Ensuring technologies allow speeds to be increased over time.
- Holding accurate location information and service speeds data to inform roll-out strategies.

3.2.2 Comprehensive Fibre

Generally, the importance of fibre connectivity – as being central to reliability, resilience, and future speed growth – was noted. However, there were mixed views on the relative merits of rolling out fibre connectivity incrementally over time (as opposed to pursuing a comprehensive 'fibre to the premises' strategy), with no consensus. Those who supported it thought it had a number of benefits, including: more cost-effective and more viable; best use of existing assets; achievable at a faster rate overall; and preferable in areas of low population and between urban areas. In addition, one respondent suggested that fibre to the premises may not necessarily have a long-term market future or be necessary due to advances in 5G and fixed wireless broadband.

On the other hand, those who preferred a comprehensive fibre to the premises strategy did so because they believed it to be: more efficient and less disruptive to deliver (including the opportunity to co-ordinate engineering works with other utilities); more affordable for the end user; and able to bring economic, competitiveness and productivity advantages. Some respondents also stated that a full fibre approach would also be fairer – for instance, arguing that an incremental approach would leave behind rural areas. Full fibre was also argued to support 5G roll-out by supporting transmitters and backhaul. Finally, one respondent reported that fibre to the premises costs are often overestimated and, conversely, fibre to the cabinet costs underestimated. They also stated that as copper cable and cabinets will eventually need to be replaced, it is only the case of bringing future expenditure forward.

Some respondents suggested that, rather than a choice between an incremental or comprehensive approach, a mixed approach is likely to be the most effective approach for example a mix of 'fibre to the cabinet' and 'fibre to the premises', as well as Direct Subscriber Line over ordinary copper telephone lines, or that more bespoke solutions should be considered where new cables are not practicable. It was suggested that a fibre infrastructure/deployment strategy, taking into account benefits and costs, is required. It was also suggested that the Government should support and incentivise more innovative methods of fibre to the premises roll-out.

Concerns were raised that retrofitting existing cables may not deliver the same long-term benefits as full fibre and may impact future connectivity speeds and

costs, and that reliance on older technologies (such as copper and aluminium wiring) holds increased risk of damage including flood risk.

3.2.3 Supporting Fibre

Respondents had a number of suggestions around supporting the roll-out of the fibre network, including:

- Bring in more ambitious roll-out targets – for example, there was a suggestion that fibre to the premises should be rolled out to all properties that have a copper phone line today by 2025, starting with those with the slowest broadband speeds.
- Support and incentivise roll-out. For example, there were suggestions that: landlords that offer high quality digital infrastructure to businesses should be rewarded; that the Government's Local Full Fibre voucher scheme should be improved to include a geographic coverage metric; and that policies which reduce barriers to delivering fibre spines and connections should be developed. It was also suggested that timescales for spending public investment in broadband should be made more flexible.
- The Government or other strategic bodies should shift to act as a proactive agent in the delivery of fibre – for example, directing investment into areas of deficit.
- Require developers through planning policy and in planning decisions to make provision for full fibre (or fibre-ready connections) within all new developments over a certain threshold (for example, ten properties). It was pointed out that major infrastructure should contain fibre at the time of design and construction given that the cost of installation is lowest at this point. Another suggestion was to work with Openreach to reduce the threshold for new developments to receive free fibre to the premises.
- Network providers should be supported to consider wider investment alongside delivering full fibre to new developments.
- Allow customers or groups of customers to ask for quotes for the installation of fibre to the premises.
- Provide access to multiple fibre providers to reduce cost of the service and ensure resilience, and consider the use of renewable technology sources for fibre networks.

More generally, respondents suggested that the roll-out of fibre should consider wider connectivity requirements and opportunities, including: supporting public Wi-Fi hotspots; incorporating Passive Infrastructure Access to ducts and poles; considering multiple fixed routes to major nodes and large cellular sites; and supporting micro cells. The fibre infrastructure needs of national critical infrastructure organisations may need to take precedence over domestic and commercial users.

Views were expressed on the bodies involved in delivering fibre. It was suggested that a more competitive market is required. It was also suggested that end-users who demand very high services should be responsible for providing their own final fibre connections.

One respondent suggested that alternatives to cellular and fibre connectivity (such as Low Power Wide Area Networks) should be investigated.

3.3 Question 7

The Consultation Report identified that "*connectivity has become a necessity where people live work and travel, in both urban and rural areas. Rural areas however continue to be excluded. The Commission want to know what role central and local Government should play to ensure ubiquitous connectivity*." It sought views on: what the key factors are that would encourage the commercial deployment of ubiquitous connectivity, including planning, co-ordination and funding. Some 37 respondents provided a response to question 7; this sub-section provides an overview of the comments received.

3.3.1 Encouraging Ubiquitous Connectivity

There was some overlap the answers to this question and those to question 5, which covered the regulatory framework and role of Government in investing in competitive digital infrastructure.

A number of respondents made general comments around ubiquitous connectivity, such as the need for the approach to be holistic, innovative and encourage best engineering solutions, and for there to be greater clarity on the definition of 'ubiquitous connectivity'. Most were supportive of the focus of the NIC on ubiquitous connectivity, though one respondent thought that issues around mobile connectivity had been missed.

There were many suggestions around how ubiquitous connectivity should be encouraged. Many respondents suggested that connectivity should be better reflected in planning policy, and taken into consideration in planning decisions. Suggestions for reforms included: embedding connectivity policies in national planning guidance, Local Plans, building regulations and growth strategies; requiring large-scale major developments to consider connectivity infrastructure; and engaging digital infrastructure providers and Ofcom early in the planning system. An arbitration system for wayleave access and costs was also suggested.

Some respondents made reference to a need for a national strategy or plan. Specific comments referred to: ensuring such a plan views digital infrastructure as an interdependent and interconnected system; future-proofing technology and capacity; and guiding overall specification and management of the network.

Funding for connectivity was also raised by several respondents, including: providing funding, incentives or alternative approaches to address market failure in uneconomic rural or not-spot areas, including 'final mile' fibre connections; or supporting small businesses to access connectivity through capital and operational funding. In considering funding, one respondent highlighted the choice between offering a service and charging related to the ease and cost of providing the individual service, or establishing a national standard level of service and charges, with cross-subsidisation.

Many respondents called for better co-ordination between stakeholders – for example, between operators and councils to manage street works and road works, including a 'one dig' approach. It was also suggested that more co-ordination with landlords and developers should occur to ensure design, materials and infrastructure of buildings support connectivity. One respondent highlighted the success of the deal between BT Openreach and Home Builders Federation, and called for a similar approach to mobile connectivity. Another argued for the use of local businesses and community groups to support roll-out of infrastructure.

Many respondents referenced the role of using existing transport and utilities infrastructure to provide digital connectivity, and ensuring that new or upgraded infrastructure is fully integrated with the deployment of digital connectivity. It was noted that attempts to maximise rental income inhibited joint working, and that restrictions around access to rail infrastructure hamper efforts to deploy, upgrade and repair connectivity infrastructure. To support this, recommendations included: aligning the rail and telecoms regulatory frameworks; considering any State Aid implications; improving working between parties; and establishing a commercially viable pathway between existing operators and the private sector through a trial. More generally, access to public assets for digital infrastructure should be provided at fair rates and without onerous access conditions, with public bodies prioritising long-term benefits over short term commercial gains.

Connectivity in rural areas was covered by some respondents. One proposed that there should be a shift in focus away from ensuring a minimum usable level of service, towards long-term support for investment of highest level of services in challenging areas. It was highlighted that farming businesses require connectivity over a wide area, and tend not to benefit from superfast broadband roll-out or reliable mobile signal.

Other comments included:

- Use of test areas to advance potential solutions.
- Review Ofcom’s policies, for example on competition, innovation and dominance.
- Allow greater freedoms for telecoms operators to compete and merge to create economies of scale.
- Introduce Business Rates Relief for new mobile infrastructure deployment, similar to fixed telecommunications deployment.
- Produce a national infrastructure asset register to facilitate the sharing of information, map dark fibre and ducting infrastructure, or develop an open networks policy which removes the ability for separate, isolated fibre networks.
- Drive demand for connectivity through a business voucher scheme.
- Make effective use of the spectrum, whilst also protecting critical services which rely on specific frequency bands.

3.3.2 Keeping Pace

A number of respondents covered how Government, Ofcom and the industry should ensure they keep pace with an increasingly digital society. Suggestions included:

- Ensure there is flexibility in any new legislation to allow operators to react to changing technologies.
- Review Ofcom's remit, powers, and licences. One suggestion was that Ofcom should be able to penalise delays in delivery of connectivity through fines, ensure reported performance is accurate, support partnerships and provide easily accessible information on coverage.
- Government should support digital infrastructure market growth, or invest directly in smart infrastructure. Concern was raised that the Government has previously held back innovation in digital connectivity, in comparison with other ubiquitous utilities and in other countries.
- 'Smart cities' agendas should be more closely linked to digital infrastructure policies.
- Government should fund digital infrastructure training and staff for local authorities, and ensure that their budgets allow them to operate a planning system which delivers digital infrastructure.
- Review permitted development rights and planning restrictions for digital infrastructure, including discrepancies between fixed and mobile technologies.
- Provide better access and funding to grants to enable communities to deliver their own digital infrastructure, and ensure consumers have clarity on technologies and products available and methods of switching. Meaningful metrics on services and coverage should also be made available.
- Provide greater information to developers on options for digital connectivity, and the likely impact on occupiers and property values.

3.4 Question 8

The Consultation Report identified that "*as infrastructure systems become more smart, complex and interdependent, the potential for unintended interactions in the system increases. As a result, the likelihood of accidents also increases. Greater use of digital connectivity can make the impact of these 'system accidents' (unanticipated interactions of multiple failures in complex, interconnected systems) accidents more damaging than ever before*." It sought views on: how the risks of 'system accidents' can be mitigated when deploying smart infrastructure. Some 23 respondents provided a response to question 8; this sub-section provides an overview of the comments received.

3.4.1 Understanding Risk

The importance of understanding the risk associated with systems failure was emphasised. It was suggested that potential risks should be identified early in the process and cover the whole life of the infrastructure, that contingency plans should be put in place, and that risk evaluation and planning should be regular (and a statutory and funding requirement). It was also suggested that systems should deploy predictive modelling and early indicators of failure, and enable a higher level of test automation.

Operators should understand interconnections and interdependencies between systems, and the impact on the risk level. This includes geographical

interdependencies (for example, hardware in the same location). There should also be an awareness of vulnerabilities in components and supply chain.

3.4.2 Systems Architecture

Considerable current infrastructure depends on hardware and software which is dated, increasing the risk of failure and deliberate attack. Many respondents made specific suggestions to improve systems architecture to improve resilience, including:

- Establish a live, common data environment hosted in a secure cloud environment.
- Work across different systems and platforms.
- Design system architecture which defends against malicious attack or malfunction, has the ability to self-heal, and allows for rapid response to cyber threats. It was suggested that systems should account for incorrect and/or sabotaged incoming data.
- Develop systems which have multiple communication networks, for example by requiring private fibre providers to provide a guest virtual channel.
- Duplicate hardware and software components to ensure there is no single point of failure, and over-provide processing capacity to cope with traffic spikes.
- Ensure resilient energy supply to smart infrastructure.
- 'Design in' data analytics and evaluation.
- Future-proof systems to ensure compatibility with emerging technologies.

However, one respondent suggested that it should be accepted that some systems accidents are inevitable but that the risk is likely to be lower than human-centred decision-making. It was also proposed that further research on smart infrastructure systems is required and should be supported.

3.4.3 Ways of Working

Some respondents made reference to knowledge management and project handover. Many respondents also recommended better joint working to reduce the risks of systems accidents. This included:

- Better cross-disciplinary working when designing complex systems.
- Adopting standards and co-ordinated practices across the industry – for example, across regulators or between operators and Government and the Government Digital Service. One respondent stated that Government and industry sectors should work together to develop (ideally international) frameworks.
- Close working with the software industry.
- Training end-users and communities.
- Improved knowledge management, identifying good practice, and sharing data and lessons learnt. For example, learning from safety critical software should be transferred to other complex systems, and project handover should be improved.

The formation of the National Cyber Security Centre was welcomed, though it was recommended that its remit should be regularly reviewed to ensure it can address emerging issues.

More generally, it was suggested that a comprehensive digital infrastructure strategy is required, that a dedicated Commission should investigate the likelihood of potential accidents, and that the digital environment should be supported with an extensive training programme. Consideration should also be given to the balance between right of access and use of data, and the right to privacy.

4 Connected, Liveable City Regions

4 Connected, Liveable City Regions

This section addresses feedback received on Chapter 2 including the responses to questions 9 to 11 and other comments received on the analysis contained within this chapter of the Consultation Report.

4.1 Question 9

The Consultation Report identified that "*the economic benefits of concentrating economic activity in cities is driving the growth of cities, but this is causing congestion on city transport networks and a shortage of land for housing. Congestion can't be solved by simply building more roads, and current arrangements for infrastructure planning aren't joined up with planning for new housing*." It sought views on: what strategic plans for transport, housing and the urban environment are needed and how can they be developed to reflect the specific needs of different city regions. Some 128 respondents provided a response to question 9; this sub-section provides an overview of the comments received.

4.1.1 Strategic Plans

The introduction of strategic plans, which cover larger geographies than existing local authority documents including was supported, for example, Local Plans or Local Transport Plans. Although it was noted that Strategic Economic Plans and Strategic Plans being prepared by Local Enterprise Partnerships and metro mayors could be utilised. Alternative approaches to strategic plans were suggested including:

- A vision for growth should be produced which forms the basis for a strategic transport plan, strategic economic plan and strategic spatial framework.
- A spatial plan should be produced which is supported by an economic strategy and transport plan.
- The strategic plan should form a set of linked transport, housing and urban environment plans.

Purpose and Content of Strategic Plans

A range of views were expressed on the proposed content of the strategic plans although comments received can broadly be grouped into the need for either:

- Strategic transport plans – the purpose of these could vary from promoting shifts to more sustainable modes of transport for passengers and freight and the benefits of transport orientated development, to encouraging the transition to new technologies/smarter infrastructure, to supporting the future of specific transport modes and/or meeting the needs of specific user groups.
- Integrated strategic plans – a range of views were expressed on the proposed content of these plans. However, there was an emphasis on bringing together land use (housing and economic development), all forms of transport and other infrastructure alongside integration with the natural and built environments.

Integrated strategic plans were considered by some to be particularly valuable where the area is subject to planning constraints. Such plans could ensure that the phasing of infrastructure and other development types is integrated so that all schemes take account of one another; that latent capacity in infrastructure is utilised first where possible; that plans incorporate future technologies; and that compact settlements, well-served by infrastructure are promoted. The plans could also be used to identify the need, priorities and sources of funding for infrastructure investment required to enable or support growth as well as providing guidance on placemaking, design standards and/or minimum density standards. The plans could also ensure that the implications of national infrastructure priorities for local infrastructure are recognised and planned for on a more integrated basis.

Some respondents emphasised the importance of strategic plans not solely focussing on a limited number of cities to deliver economic growth. There is a need to ensure that city regions are considered in the context of their regional and national supply chains and that the needs of rural areas are accounted for.

Role of Strategic Plans

A range of suggestions were made for how such strategic plans could 'fit' within the existing forward planning system, which included:

- Introduce an overarching national framework that provides high-level direction for lower tier plans, which could provide a high-level strategy for the next 30 years. This could also set out the process that should be followed for lower tier plans and funding regimes for identified priorities.
- Some respondents provided more detail on what the national framework should cover. Suggestions included: the need for a national planning spatial strategy which could address regional disparities; provide a spatial translation of the Industrial Strategy; focus on investment required to upgrade existing infrastructure and enable the transition to a low carbon society; set out how the aspirations in the Walking and Cycling Investment Strategy will be achieved; and provide a structure for investment in minerals/aggregates planning to address shortages of construction materials.
- Introduce a national transport strategy that focusses on sustainable outcomes and provides the framework for regional/local transport strategies providing clarity on priorities.
- Strategic plans should form part of a genuine forward planning system, setting the framework for Local Plans.
- That the requirement for strategic plans should not erode or devalue the need for a Local Transport Plan to be prepared.
- Introduce a duty on upper tier local authorities to prepare a 15 to 25 year spatial strategy which could cover economic development, land use, transport, environment, climate change etc.

Introduce a duty on local authorities to produce strategic plans that bring together land, transport and all related policy areas.It was also considered that there should be comprehensive coverage of spatial strategic plans; each could provide a clear vision and roadmap for each geography and spatial context. It was also noted that

the National Infrastructure Strategy (informed by the NIA) should become a material consideration in the preparation of strategic plans. A potential role for spatial development plans around distinct pieces of infrastructure (most likely transport projects) to maximise the potential for investment, housing and growth was also identified.

4.1.2 Preparing Strategic Plans

Respondents provided commentary on how they thought strategic plans should be prepared. There was support for strategic plans being evidence-led; some respondents provided further detail of the type of evidence expected to support strategic plans, which included:

- Adopt more progressive approaches to transport modelling including purposive and tactical visioning as opposed to predict and provide.
- Produce transport model for in, around and between urban centres, which provides clarity on deployment of transport interventions required.
- Undertake a mapping exercise to understand ecological opportunities at a landscape value level.
- Adopt ecosystems services approach and/or consider natural capital impacts in the production of the plan.
- Consider meaningful alternatives in developing the spatial strategy.
- Understand housing need (as opposed to demand) and balance this with appropriate sources of brownfield and greenfield supply.

There was also support for use of data/digital information to support strategic planning.

Respondents considered that strategic plans should be subject to consultation; with some advocating the adoption of a community centric approach to ensure local ownership and mutual benefits from the plan. The need for cross-party support on key issues was also identified.

Suggestions for how different Government bodies and agencies should work together included: national policy should encourage joined up strategic planning between upper and lower tier authorities and between strategic authorities; and that local authorities have track record of working together – the focus should be on different parts of Government and its agencies being more integrated.

Clarity should be provided on the timescales for producing and reviewing strategic plans; this could include the requirement to produce and/or review a strategic plan every five years. It was noted that strategic plans need to be prepared quickly and efficiently and be flexible and adaptable to change. Production of strategic plans should not delay preparation of Local Plans. Similarly, the preparation of the NIA should not delay strategic or local plan-making and associated planning decisions.

4.1.3 Reflecting the Needs of Different City Regions

Respondents were supportive of flexibility being provided on strategic plans to enable them to meet the needs of different areas. This reflects the view that the

closer decisions are taken to the challenges, the better the outcomes will be. Therefore, respondents considered that the boundaries and processes for producing strategic plans should be flexible to respond to the geography and nature of strategic issues which need addressing in that locality.

That said, it was noted that there could be benefits in identifying and sharing lessons learnt across the country. One respondent identified a need for a more consistent policy approach in some areas such as energy efficiency, water efficiency, sustainable urban drainage, digital cable, broadband speeds etc. and that Government should not encourage devolved authorities to establish their own local standards, policies and approaches in these areas.

Some respondents considered that current processes used to inform plan-making sought to reinforce regional disparities and/or didn't take account of regional differences and that this should be addressed. For example, trend based approaches (such as the Government's standardised methodology for calculating housing need or prioritising transport investments by looking at existing demand or GVA) reinforced current disparities between regions and urban and rural areas. There is a need to provide flexibility in approach and to ensure that changes in society which are not consistent with historic trends are adequately reflected.

Other respondents considered that the NIA should acknowledge the contribution made by London and the wider South East to the national economy. This included the associated importance of these area's infrastructure requirements and funding needs being met in order to support continued economic growth.

4.1.4 Additional Powers

For strategic plans to be successfully prepared and implemented some respondents identified that there is a need for governance and funding reform. There was support for the creation of strategic organisations including metro mayors/combined authorities and sub-national (transport) bodies as well as county councils taking on a more formal role. However, it was noted that any governance or funding arrangements should reflect the needs of the geography; that there was a need for devolution models which are appropriate for rural areas; that tried and tested models of delivery should be favoured; and that strategic organisations should be accountable. It was also noted that existing powers could be used to create a statutory joint authority for plan-making purposes, which then informs each Local Plan.

The bodies responsible for producing strategic plans must also be equipped with the skills and resources needed to do so. This included linking funding arrangements for large-scale infrastructure projects with long-term objectives around creating quality places that accommodate housing need and stimulate economic growth or public-sector investment in infrastructure only being provided where metro mayors take responsibility for housing delivery set out in strategic plans. Respondents also supported the NIC's proposal to produce toolkits to provide guidance on the preparation of strategic plans.

There was support for further devolution of transport related powers. In particular, for rail and bus provision in city regions outside of London and the potential for

transport authorities to take a greater role in the running and ownership of railway stations. It was also suggested that the current system of bidding for central Government funding should be replaced with devolution of funds to the relevant metro mayor or sub-national transport body so that they can choose how to spend the monies. This should be supported by a framework for long-term investment of infrastructure to enable long-term planning.

In terms of planning decision-making, it was suggested that national transport organisations and regional transport bodies should take a greater role. Decisions on new housing must be made having regard to infrastructure requirements and identified processes or application documents, which could support this objective being achieved.

4.2 Question 10

The Consultation Report identified that "*currently there is no stable long-term funding arrangement for the major investment needed in city transport outside London. Making this a priority would mean trading off against other objectives within limited resources for transport investment, which is especially difficult in the 2020s given existing commitments for major road and rail links between cities*." It sought views on: what sort of funding arrangements are needed for city transport and how far they should be focused on the areas with the greatest pressures from growth. Some 68 respondents provided a response to question 10; this sub-section provides an overview of the comments received.

4.2.1 Funding Arrangements

The importance of devising funding arrangements to suit local circumstances was emphasised. Many respondents suggested that funding powers for infrastructure investment should be devolved, and one respondent argued that bodies such as Transport for the North should have the full range of revenue raising powers as Transport for London. Specific suggestions included:

- Allowing and making use of greater public-sector borrowing including bonds, tax increment financing and borrowing against Community Infrastructure Levy receipts.
- New user charges, such as parking levies and road user charges. It was, however, argued that road user charging should not be to the detriment of the road haulage sector or rural areas.
- New types of funding mechanisms such as a revolving infrastructure fund.
- Cross-boundary funding such as local authority precepts or cross-boundary levies.
- Localised retention of taxes and rates.
- Greater local autonomy around the spending of funds once they had been raised.

However, others cautioned that scale of funding necessary for major projects means there will be an ongoing role for national funding to support local schemes, particularly in less buoyant areas. It was suggested by one respondent that a

reformulated rate support grant system should be used to support local investment, while another showed support for Government's recent Transforming Cities Fund.

Suggestions around reforms to the tax system were also made – for example, around Vehicle Excise Duty, Council Tax, business rates, and Stamp Duty Land Tax. New taxes such as Land Value Tax and employment or payroll-based taxes were also suggested, though one respondent highlighted that taxing increases in property value can be challenging because of the difficulty in demonstrating the 'cause and effect' of transport improvements on values.

Some respondents urged the Government to consider ways of capturing value from third parties that benefit from the infrastructure delivered, including land value capture. One respondent argued that a nationally-determined land value capture mechanism would be preferable to a project-by-project approach. However, it was also noted by another respondent that the value of contributions through this mechanism would vary geographically based on land values.

Some respondents highlighted challenges around the current transport funding regime and in particular competitive bidding. It was suggested that competitive bidding should be replaced by regular plan-based funding, or that it should only be used to fund innovative measures. One respondent suggested that a funding pool, which the third sector can bid for should be created.

Several respondents suggested that greater discretion and flexibility in the allocation of funding and financing arrangements was required, for example, being able to move funds across years or reallocate from other sources. Others proposed that there should be more certainty in funding, including long-term allocations or a 'single pot' approach for transport infrastructure on a city or regional level. For example, one respondent suggested that local authority transport budgets should be given the same long-term funding certainty as Highways England and Network Rail.

It was recognised that funding arrangements could be used to incentivise wider aspirations such as growth in sustainable locations, exemplar connectivity, or use of environmentally beneficial fuels.

Other suggestions included:

- Rethink scheme appraisals and business cases to better recognise and balance the benefits of small as well as large schemes, dis-economies of scale, and wider economic, public health and quality of life benefits.
- Deliver greater public ownership of transport so that profits can be re-invested.
- Attract more private sector investment in transport – for example, through providing more certainty and ensuring pathways to investment are uncomplicated.
- Speed up project delivery to allow for improved returns on capital.
- Ensure access to a mix of capital and revenue or maintenance funding, and make less of a distinction between the two.
- Ensure that funding for other major upgrades is not suspended whilst committed projects such as HS2, HS3 and Crossrail 2 are being delivered.

4.2.2 Areas of Focus

There were mixed views on which areas should be prioritised. Some respondents suggested that projects creating the highest value should be prioritised, taking into account the economic potential of different cities and the extent to which transport is constraining growth. Others, however, have argued that this approach is over simplistic, reinforces existing inequality and stifles new economic development, or ignores wider social connectivity considerations.

There was emphasis on the importance of providing funding that meets the specific needs of an area – referencing areas of high growth pressures but also less prosperous and/or less populated areas. It was recommended that national funders should be cognisant of different needs when comparing potential investments. It was also suggested that a national spatial plan would help to rationalise intra-regional planning and investment.

Concerns were raised about the geographic spread of investment, including the need to use investment to support smaller urban or rural areas, or to rebalance the economy away from London and the South East. However, one respondent emphasised that investment in particular regions should not be to the detriment of the South East, whilst another disagreed more generally with utilising a proportionate approach to funding across cities. Other respondents suggested that investment should be made in urban areas where such modal shift is more likely to be successful, or in small to medium cities where land and labour costs are likely to be lower. One respondent argued more generally that devolution should not focus exclusively on well-defined cities at the expense of two-tier areas with a large network of towns and smaller cities.

Other suggestions included:

- Taking a city-wide, multi-modal approach to transport investment; considering individual schemes as part of a wider network.
- Strengthening commuter routes and connections between rural and urban areas and between urban areas.
- Investing in local roads alongside the Strategic Road Network.

4.2.3 Responsibilities

A number of respondents covered the roles and responsibilities that different organisations should play in transport funding and delivery, including:

- Responsibility for the strategic transport network should remain with the Government, with more proportionate and consistent oversight – it was argued that the current system creates a fractured ‘patchwork’. It was suggested that the Government should commit to a portfolio of national infrastructure which balances high return on investment projects with lower return regeneration projects.
- Responsibility for smaller scale schemes should be devolved to local bodies (such as LEPs or local or sub-national transport bodies) to improve decision-making. Such bodies should be able to challenge the priorities and funding

levels being set at a national level. It was also suggested that there should be an increased or statutory role for cities in national infrastructure planning.
- Strategic planning between local authorities – it was suggested that devolution of powers or funding could be an incentive to (or be dependent on) such joint working. It was also suggested that local authorities should be provided with additional resources and technical capacity to assist with this.
- Better democratic structures and governance arrangements are required, including ways to ensure local accountability.
- Transport providers and central and local Government should work more closely together to agree future priorities. However, the NIC's view that the case for piloting local authority management of rail stations was challenged.

4.3 Question 11

The Consultation Report identified that "*capturing a greater portion of land and property value uplift could help to fund infrastructure. However, the potential for uplift differs dramatically across the country*." It sought views on: how the Section 106 and Community Infrastructure Levy regimes can be improved to capture land and property value uplift efficiently and help fund infrastructure. Some 66 respondents provided a response to question 11; this sub-section provides an overview of the comments received.

4.3.1 General Comments on Developer Contributions

Respondents were generally of the view that infrastructure spending is not sufficiently enabled by developer contributions from any source (be that Section 106 agreements or Community Infrastructure Levy (CIL)). There were mixed views about the way forward for Section 106 agreements and CIL, which included:

- Government should carry out its review of Section 106 agreements and CIL and/or respond to the CIL review.
- Any reform to CIL and/or Section 106 agreements must be in the context of a simpler, stable, long-term approach.
- There is need for a period of stability for infrastructure providers to provide the opportunity to use CIL and Section 106 agreement receipts for delivery of infrastructure.
- CIL and Section 106 agreement obligations should fall to whoever owns the land at time of planning consent being granted and should be non-negotiable.
- Wholesale reform to the developer contributions regime is required.
- Exemptions to Section 106 agreements and CIL should be re-considered including for small sites and starter homes.

Some respondents also provided commentary on what Section 106 agreements and CIL should be used for, including: (along with Allowable Solutions Funds) improving energy efficiency of existing homes; public and sustainable transport infrastructure and enhancements; and measures that might be needed to protect/safeguard existing land uses (including mineral product handling wharves and depots). It was also noted that the combination of Section 106 agreements,

CIL and net environmental gain tariff should not undermine delivery of housing and other development.

4.3.2 Section 106 Agreements

There was concern that the NIC misunderstood the purpose of Section 106 agreements: they are not designed to capture land value uplift but to mitigate for the impact of development.

There was support for the current Section 106 agreement pooling restriction being removed in its entirety and/or the limit on the number of schemes increased to enable infrastructure delivery from the monies collected.

A range of comments were made in relation to viability assessments, their relationship with Section 106 agreements and associated improvements to the process, which included:

- Government should implement a standard methodology and template for viability testing and negotiations.
- A dedicated resource or access to centralised resource should be provided for local authorities undertaking land valuation and viability assessments given the lack of in-house skills in this area. It was also noted that Section 106 agreements are time/resource intensive for local authorities both in their preparation and monitoring.
- The current approach to viability as set out in the National Planning Policy Framework should be amended so that it is no longer possible to reduce or remove Section 106 contributions on viability grounds.
- Support for Government's proposed reforms to viability assessments. This included a request for guidance to be produced on viability testing to support plan-making.
- Local planning authorities should be firm on the minimum number of affordable homes intended on a site and not negotiate on this.
- All developments regardless of size should be eligible for affordable housing contributions.
- There is a need to balance Section 106 contributions against the delivery of homes.
- Planning policy and guidance should be changed to make it clear that viability arguments will be restricted at the planning application stage.

Other improvements to Section 106 agreements were suggested. These included:

- Improved strategic planning will assist in prioritising investment based on local needs and reduce the need for off-setting.
- Section 106 agreements fail to capture the longer-term benefits of development; assessment of longer-term benefits should be encouraged and then reflected in Section 106 agreements.
- A lifecycle approach should be adopted which focuses on delivery of infrastructure. This would make community development a core part of Section 106 agreements.

- The restrictions on the requirements for Section 106 agreements/what they can cover are unduly restrictive.
- There should be consistency across local planning authorities regarding the application of Section 106 agreements.
- There is a need for greater co-ordination between upper and lower tier local authorities to collect Section 106 monies in order to deliver infrastructure.
- The process of negotiation (in terms of time elapsed) and uncertainty on costs payable can cause delays/make it difficult for developers/promoters to factor Section 106 costs into project viability assessments.

4.3.3 Community Infrastructure Levy

Respondents provided a range of comments on the limitations of the current CIL system. These included:

- The levels of income derived by CIL are low/not as much as was envisaged and/or there is patchy take-up of CIL across the country.
- There is no obligation to spend funding/it's unclear how funds are being spent.
- There is a need for local planning authorities to co-operate with all infrastructure providers to ensure a transparent approach to allocating CIL income that includes the breadth of infrastructure requirements.
- There are issues applying CIL when developments are marginal.
- CIL should not be applied to farm buildings and agricultural operations.
- The existing CIL regulations are considered complex.
- CIL does not capture land value uplift and indeed may suppress land value and discourage submission of planning applications.
- The timing of CIL receipts means that it is not possible to use the monies to advance fund infrastructure.

Suggestions were made by respondents on potential improvements to the CIL regime, which included:

- There should be a nationally consistent approach to CIL, including a standard methodology for calculating it; this could include a central balancing element to assist areas with lower development viability.
- The process for setting up and revising CIL should be streamlined with national exemptions from CIL removed.
- Qualified support for the proposal in the Autumn Budget to provide an alternative CIL charge for changes in land use and to set CIL charges to reflect the potential uplift in land value.
- Significant development proposals should be accompanied by impact assessments including estimated costs for new or improved infrastructure to enable appropriate CIL contributions to be sought.
- CIL should be used to collect contributions from small scale developments which are exempt from Section 106 agreements.
- Smaller housing developments in rural areas including those on farms should provide their own infrastructure but should not incur additional costs through CIL; any funds raised should be spent on rural infrastructure improvements.

It was noted that local planning authorities need to ensure that Local Plans and supporting infrastructure plans properly reflect infrastructure needs to enable CIL receipts to be spent appropriately. Local authorities should also be able to retain a proportion of CIL receipts to enable them to fund interest repayments on loans taken out.

4.3.4 Alternative Mechanisms

There was support for the introduction of additional mechanisms to support delivery of infrastructure. Specific suggestions included introduction of the following measures:

- Local Infrastructure Tariff.
- Land value capture including specifically the Development Rights Auction Model.
- Tax increment financing.
- Use of revolving loans.
- Enabling local authorities to issue municipal bonds.
- Strategic Infrastructure Tariff overseen by combined authorities/joint planning committees/county councils.
- Enabling local authorities to borrow against future business rate incomes or Section 106 agreement/CIL receipts.
- Reform the compulsory purchase process or introduce a more proactive approach to public sector land assembly.
- Enable local authorities to introduce/retain receipts from land and property taxes, council tax or national non-domestic rates or business rate supplements.
- Introduce local authority retention of first time sale stamp duty.
- Property value uplift.
- Charges to developers per additional dwelling based on local requirements for infrastructure.
- (Greater) use of powers pursuant to Section 278 of Highways Act (1980).
- Innovative financial vehicles where key infrastructure is delivered to unlock sites and costs are then paid back once occupied.
- Introduce a tariff that is derived from the cost of delivering infrastructure within a strategic area and banded based on the level of value uplift.

Concerns were raised about the principle of land value capture to fund infrastructure delivery. Particular comments received included:

- Land value capture uplift will only work/work more successfully in areas where there is strong demand.
- New mechanisms are required in areas where land values are lower and development viability is marginal.
- Land value capture should not be relied upon to fund infrastructure.
- The potential to capture more value beyond CIL and Section 106 agreements is being overstated. Consideration must be given to existing contributions already being made through planning and taxation regimes as well as other policy objectives before introducing further mechanisms.

- Planning gain often happens before infrastructure funding is found. Therefore, landowners benefit with the public sector and developers paying for infrastructure (since the costs of infrastructure are not reflected in land values).

The NIC should ensure it has learned from Britain's past experiences of land value capture and the experience of other major cities outside the UK.

Some respondents considered that a toolkit of potentially appropriate approaches should be identified (as opposed to favoured mechanism(s)), which links planning with a range of other policy and fiscal measures. This reflected other views that there is a need for an integrated system, which can utilise funding held for infrastructure across a spatial area and prioritise spend to meet local needs.

Before making a decision on additional mechanisms, some respondents considered that the NIC needed to undertake further analysis, which included:

- Set up an NIC sponsored and overseen group of professionals to develop the revised system.
- The NIC should seek inputs from relevant stakeholders and consult on its findings before forming an opinion and concluding its recommendations.
- That further clarification is required from Government on the relationship between infrastructure expectations from planning gain and infrastructure provided through general taxation. Linked to this, the NIA should include further detail on the availability of finance to support infrastructure investment and the balance between public and private finance.
- The NIC should explore the catalytic role that regeneration and new developments have on infrastructure provision over a wider area and understand the complexity and challenge that new levies and taxation will have on the property and construction industries.
- The NIC should explore the lifecycle of land and property including the variety of roles within the land and property sector to ensure impact of any mechanism is understood on the various parties.
- The NIC should take into account the role, viability and risks involved in developments that support or bring forward infrastructure schemes that otherwise would not be delivered.
- Any new mechanisms should address proximity and accessibility to new and existing infrastructure (including social infrastructure).

4.4 Other Comments

A range of comments were received on Chapter 2 which did not directly relate to the questions posed; these are summarised below.

4.4.1 Land Use and Spatial Planning

Respondents considered that the NIA should adopt a policy position on land use planning given the linkages between land use planning and the operation of infrastructure. The NIC could therefore shape planning policies to: help direct development to appropriate locations; identify that where new transport infrastructure is needed to support new homes that such infrastructure should be

multi-modal; emphasise low carbon transport and the need to follow the sustainable transport hierarchy; and integrate developments with public transport and active travel modes.

A range of other comments were received on the existing planning system, which included:

- The spatial planning system offers a pre-emptive and integrated means of addressing climate change. Local planning authorities are struggling to deliver this given resource and skill constraints. The NIC should give this greater focus in creating liveable cities.
- The NIC should support use of Government's standardised methodology for calculating housing need in the preparation of Local Plans.
- Office to residential permitted development rights are affecting the ability of the planning system to maintain and foster a sustainable mix of land uses.
- Consideration of major infrastructure projects should inform Mineral Local Plans and Local Aggregates Assessment to ensure timely delivery of raw materials.
- There is support for the Managed Aggregate Supply System to ensure minerals products are available to support development projects.
- Concerns were raised that there is insufficient supply of aggregates to meet permitted and planned development and that there is a need for Government to support the role of regional aggregates working parties in planning an adequate supply of aggregates.

4.4.2 Transport Schemes

A range of comments were made on transport proposals. Comments on strategic policy issues included: support for road-based trams and bus rapid transit/dedicated bus lanes over new light rail networks; emphasising improving public transport connectivity to city centres over new orbital roads or bypasses; the need to prioritise public transport accessibility to train stations; support for rail electrification upgrade programme; support for smart systems to relieve congestion; support for integrated and smart ticketing and fare regulation to make public transport more attractive and affordable; support for national cycle network; and support for improvements to orbital routes (to complement radial links).

A respondent noted that research indicates that new road infrastructure may not lead to increased economic growth and that investment programmes are not addressing congestion issues and in some cases, are only providing a short-medium term fix. They also suggested that the NIC should recognise the role that rural rail services play in ensuring accessibility and supporting local economies.

The need for a national transport network between urban centres, regions and transport hubs was identified. High speed rail should form part of this network and was considered to provide a vital role in stimulating economic growth; the NIC should co-ordinate the development of minimum standards for high speed rail connectivity and define the future network map. Also, the strategic road

network must be developed in a way that integrates with local transport infrastructure plans and strategies and enable increased travel choice.

A range of positive and negative comments were also received in relation to specific infrastructure projects, studies or proposed interventions for which NIC support was sought. This included projects identified in the Consultation Report such as High Speed 2 or locally identified priority projects.

4.4.3 Freight and Logistics

Concerns were raised about the NIC's analysis of freight including that the analysis of the sector did not reflect recent trends, reflect the wealth of information available on the relevant performance of different modes of transport or that freight end-users prefer the transport mode which offers the best value-for-money and meets their requirements (as opposed to a preference for road transport).

Some respondents therefore considered that the NIC should support expansion of rail freight recognising the benefits that this could bring including avoiding an increase in road congestion, providing socio-economic benefits, contributing to combatting climate change and improving air quality. Respondents also noted that:

- There are technical solutions to addressing constraints on railways that the NIC needs to take account of.
- The use of 'platooned' lorries is at its infancy and therefore the potential benefits of this solution are overstated and/or technical issues have yet to be resolved.
- The NIC's approach to rail freight conflicts with a range of Government policy including, for example, the Rail Freight Strategy and Clean Growth Strategy.
- Rail freight of aggregates and other mineral products is critical to construction supply chains.
- There is a need for more rigorous analysis of current infrastructure and future needs and opportunities, including how the introduction of other infrastructure schemes could result in additional future capacity on the railway network.
- It was considered that the NIA should inform and complement rail industry planning processes rather than duplicating or cutting across them.

There was support for the NIC undertaking a study on future of freight with suggestions made on its content. Respondents also considered that the findings of the freight study should be reflected in the NIA or a holding position included if the NIA is published beforehand.

Respondents also considered that the NIC needs to place a greater emphasis on freight logistics system and its future requirements including road and rail infrastructure, intermodal facilities and road parking facilities. Linked to this, the NIC should recognise the importance of rail depots, wharves, other freight facilities, mineral deposits and minerals infrastructure being appropriately safeguarded to ensure efficient operation.

Other comments received in relation to freight and logistics included:

- Further clarity is needed on policies and investment affecting international and domestic shipping/ports.
- There should be greater focus on the use of waterways for freight logistics to address congestion.
- Welcome Government commitment to continued investment in the rail freight industry.
- The new deal for Freight Operating Companies should recognise rail freights' environmental and air quality benefits.
- There is a need to promote careers in the rail freight sector including increasing the diversity of the workforce and re-skilling existing employees. The NIA should bolster support for the Government's plan to address skills shortages within the logistics industry by investing in technical colleges.

4.4.4 Airports

A range of comments were received in relation to airports. Some respondents were not supportive of airport expansion while others suggested that the NIC should explore alternatives to a third runway at Heathrow including evaluating the scope for shifts of travel to other airports, the scope for further growth of Channel Tunnel rail services and the assumptions relating to short distance air travel if patronage on high speed trains increases including on High Speed 2.

Support was expressed for the NIC's resolve to press Government for swift resolution on a decision about expansion at Heathrow and ensure that resources are provided to address the impacts on neighbouring areas. It was also considered that the NIC should take an active role in the development of Government's new Aviation Strategy and that the NIC should consider the UK's aviation infrastructure post 2030.

More generally, respondents considered greater priority is required for raising the proportion of travel to airports by public transport and that there is a need for improved planning guidance on land uses surrounding airports to minimise the number of people affected by noise.

5 Infrastructure to Support Housing

5 Infrastructure to Support Housing

This section addresses feedback received on Chapter 3 including the responses to question 12.

5.1 Question 12

The Consultation Report identified that "*currently, infrastructure and housing are often not financed, designed, timed or delivered compatibly, which leads to infrastructure delaying housing delivery*". It sought views on: what mechanisms are needed to deliver infrastructure on time to facilitate the provision of good quality new housing. Some 75 respondents provided a response to question 12; this sub-section provides an overview of the comments received.

5.1.1 Alignment of Housing and Infrastructure Planning

A number of the respondents recognised that there is an opportunity for greater alignment between housing and infrastructure planning and the associated decision-making processes. This included up to date housing and economic projections being used, along with future-proofing technology to ensure forward planning against the most relevant information. Opportunities for improved alignment of the respective timeframes for plan-making were highlighted to facilitate a coordinated approach that would achieve greater certainty for different stakeholders, and could also better manage funding. The need for better engagement in the plan-making processes was raised with suggestions that it should be mandatory for infrastructure providers to participate in the planning process and for the introduction of flexibility from regulators to allow changes to accommodate housing growth

Better data sharing was identified by respondents as a mechanism that could improve alignment of plan-making processes. There was support for data to be provided in a spatial format and for a digital framework.

There was some support for a national infrastructure plan with a spatial dimension. There were two aspects to these responses, one related to providing greater certainty to infrastructure projects and their funding, and the other to identifying the location of housing (and therefore infrastructure).

In addition to respondent comments on our aging utility network and associated capacity challenges, a number of operators, service providers and representative industry bodies highlighted areas where more infrastructure investment is needed to unlock housing opportunities. Some respondents highlighted the issue of good infrastructure maintenance programmes to manage future costs.

Some respondents raised concerns in respect of the existing approach to procuring infrastructure works and made suggestions as to how this might be improved to increase certainty of delivery, minimise stranded capacity, secure time saving and lower costs.

5.1.2 Planning System Mechanisms

A range of responses were received in relation to the mechanisms associated with the planning system:

- In relation to plan-making the need for there to be up to date plans in place; that plan-making should drive the location of housing growth rather than available infrastructure; and the need for appropriate evidence to support the process.
- Green Belt was raised, with a range of views about how designated land could be used for exception development and how it could be used to tie delivery of infrastructure and housing.
- Responses on the development management process highlighted mechanisms including: better monitoring of applications and housing completions; the use of planning performance agreements, conditions, planning gain, (reformed) compulsory purchase, permission in principle; fast tracking of applications and permitted development. Strong building regulations were also identified as a mechanism.
- More general responses included: streamlining and speeding up the planning system, with reference to the Welsh planning system; broadening its emphasis to better encompass infrastructure provision; maintaining effective public consultation and greater co-ordination between planning bodies and developers. There were suggestions for powers to promote implementation of unused permissions and use of the development corporation model to capture land value increase to support implementation.
- Adequate resourcing of the planning system was raised in the responses to manage and monitor sustainable growth.

5.1.3 Other Mechanisms

Within the responses, suggestions were made for existing and new housing design standards and how these should plan for resilience and longer-term strategic needs associated with infrastructure.

Ensuring the appropriate skills are available to support delivery of infrastructure to support housing was identified in the responses, with recognition that the right combination of skills contributes to improved outcomes. A skills assessment was suggested, as was a need to address the construction skills gap. Strong leadership and governance in all stages was also raised as an important factor.

Other mechanisms that were identified include: cross-boundary working to enhance co-ordination; managing and communicating risk; and timing infrastructure delivery to avoid redundant assets. Larger-scale housing was identified as having more complex challenges but equally large-scale infrastructure projects were identified as being capable of being planned more effectively than piecemeal development.

There was support for a number of existing funding mechanisms and some concerns regarding funding gaps, and predicting cost and viability. The responses included suggestions for financing or funding mechanisms, such as: a strategic infrastructure tariff, regional investment backs funded by Treasury, greater private

investment with a simplified regulatory framework, public sector borrowing, relaxed caps on borrowing under Housing Revenue Account rules and value capture. Additionally, respondents raised the opportunity for simplified funding criteria, innovative funding, investment better aligned with housing growth locations, clarification of the role of the state in delivery, managing funding gaps where high upfront costs, and review of the UK Shared Prosperity Fund. The need for additional funding to support infrastructure delivery was also raised. Responses were also received on specific funding measures to deliver housing.

6 Eliminating Carbon Emissions from Energy and Waste

6 Eliminating Carbon Emissions from Energy and Waste

This section addresses feedback received on Chapter 4 including the responses to questions 13 to 19.

6.1 Question 13

The Consultation Report identified that "*the UK has an established and mature gas grid, which provides a reliable supply of gas for heating. However, the continued burning of natural gas for heating is not sustainable as the UK progresses towards a low carbon energy system. This brings into question the future role of the gas grid*." It sought views on: what the critical decision factors will be for determining the future of the gas grid, what the process for deciding its future role should be and when decisions need to be made. Some 70 respondents provided a response to question 13; this sub-section provides an overview of the comments received.

6.1.1 Critical Decision Factors

Many respondents conveyed their views on what the future of the gas grid should be, rather than outlining the critical decision factors for its future. There was general agreement that the use of natural gas is not sustainable, and that either electrification of heat, or introduction of hydrogen and/or green gases will be required.

Where decision factors that will determine the future of the gas grid were provided, these were generally focussed around those which influence the potential of hydrogen/green gases, as well as the electrification of heat:

- Whether hydrogen/green gases can be delivered to the same extent as natural gas – most respondents referred to hydrogen as having the most potential, but cited its commercial scalability as well as the adoption of ancillary infrastructure as a critical decision factor. Whether the existing gas grid can be adapted to carry hydrogen/green gases was seen as significant to its potential expansion, as well as the impact of off-grid areas and the ability for the grid to store energy (power to gas). It was cited that partial decommissioning of the gas grid would be required if low carbon gas cannot be deployed at scale.
- Whether hydrogen/green gases can be cost-effective – respondents highlighted the cost of hydrogen/green gases compared to other technologies as a key decision factor. They also referred to the available funding and carbon factors as having importance.
- Whether customers would be willing to pay for alternative heat sources – this relates to the possible price increases as well as the perception of safety of alternative fuels such as hydrogen and green gases.
- Whether electrification of heat can meet peaks in demand – respondents generally reported this could be a restraining factor for widespread electrification of heat.

Other critical decision factors included:

- The rate and uptake of energy efficiency across the built environment and industrial processes, and its impact on gas demand.
- The level of security of gas supplies and the requirements for the storage of national strategic gas reserves.
- The economically extractable volumes, environmental impact and carbon intensity of gas derived from UK national gas fields and shale gas
- The magnitude of emissions reductions that the UK must achieve, including through science based assessments, advice from the Committee on Climate Change and international commitments made.
- Potential fluctuations in the wholesale gas prices and consideration of the infrastructure necessary for gas imports.
- The rate and level of uptake of low-carbon heat networks in heat-dense areas.
- Safety and emissions associated with the various options.
- The outcome of Government policies and strategies, timing and resolve.

6.1.2 Process and Timeline for Deciding its Future

Many respondents provided clear answers on the process for deciding the future of the gas grid. While there were mixed responses, respondents most commonly expressed the need for:

- Further research and investment – the need to further understand the best options for decarbonisation of the gas grid, including through trials, innovation and supporting ongoing research programmes.
- Government policy – a number of actions and policies which the government should follow, including making decisions that reflect key milestones in existing policy, advice from the Committee on Climate Change and RIIO-GD2. The need to decide on the preferred option for heat decarbonisation and the role of bio-energy were identified, with some wanting policy to directly support the continued growth of green gases. Clear and early government direction is required.
- Government incentives – identified the need to incentivise and stimulate alternative technologies through renewable heat incentive (RHI) reforms and regulatory change to lower barriers to low carbon gas as well as equalising the burden.
- Public engagement and communication – the need to engage customers early regarding the options available, with the process for deciding the role of the gas grid being led by customers and markets. It was stated that as options are considered it is vital to focus on customers in terms of costs, acceptability and disruption, in particular for vulnerable customers. Public communication was seen as central to switching to hydrogen.
- Collaboration – the need for a collaborative process between Government, network companies, regulators and customers to decide the right approach.

There was a mix of views regarding when decisions should be made on the future of the gas grid; some respondents agreed that decisions should be made no later than the mid 2020's, others considered that decisions should be made now or as soon as possible, while others stated that decisions should be made by 2030. Other

respondents went further and stated that the UK should be rolling out new infrastructure within five years, or that the cheapest and most efficient systems must be deployed by 2020. On the other hand, some suggested that the move to decarbonise heat should start in the mid-2030s, gathering pace in the 2040s.

6.1.3 Other Comments

The remaining responses related to the respondents' views on what the future of the gas grid should be. Most respondents indicated that hydrogen or green gases should be introduced in preference to electrification, citing the potential for hydrogen to meet demands, minimal changes to existing infrastructure and behaviour and the reduction of emissions as some of the advantages. Those that supported electrification, stated the fact that it is more of a proven technology, could present a successful alternative to gas and could play an important role in the use of heat pumps and improving energy efficiency.

Some respondents were supportive of heat networks particularly for dense urban areas. These respondents referred to them as a low cost 'no regrets' decision, able to cater for peaks in demand and distribute heat from any form of energy. A number of respondents saw the gas network as important to provide backup energy and to act as an enabler to a low carbon future. Other respondents went further suggesting gas should play a major role in supplying energy to the UK and can still be used when meeting the UK's 2050 climate change obligations. A number of respondents thought that a mix of energy solutions is required, rather than just selecting one.

The need to retrofit inefficient homes to reduce heating demand was referenced. Finally, some respondents expressed the need for a mix of technologies, involving a devolved approach recognising the different characteristics of regions and their natural resources.

6.2 Question 14

The Consultation Report identified that "*the UK has a relatively old and energy inefficient building stock, which results in higher energy consumption. Upgrading the energy efficiency of buildings will enable consumers to save money in the short and longer-term as the UK switches to low carbon heat infrastructure. Building refurbishment could be integrated with other enhancements, such as installing solar panels or alternative forms of heating.*" It sought views on: what the ambition and timeline for greater energy efficiency in buildings should be and what combination of funding, incentives and regulation will be most effective for delivering this ambition. Some 81 respondents provided a response to question 14; this sub-section provides an overview of the comments received.

6.2.1 Ambitions and Timeline for Greater Efficiency

There was strong support from respondents for NIC's commitment to energy efficiency in homes and buildings as a key infrastructure investment priority to meet carbon reduction targets. Many respondents called for the NIC to make this explicit in the final NIA and to make clear that this commitment is UK-wide. The

wider benefits of energy efficient buildings, beyond reduced carbon emissions, were stressed by a number of respondents, including positive impacts on health and wellbeing, as well as cost efficiencies for customers and local employment creation resulting from installation requirements. It was suggested that these wider benefits should be explored further by NIC.

A number of respondents highlighted a concern that the UK currently lags behind other countries in energy efficiency performance, and that there is not sufficient market traction for energy efficiency measures at present. A variety of barriers to the investment in and adoption of energy efficiency measures in the UK were identified, including:

- Low awareness and lack of update to homeowners on the benefits of energy efficiency improvements.
- High upfront installation costs.
- Natural consumer tendencies of discounting future benefits and using defaults.
- Lack of sustained demand for investments.
- Lack of easy to access financial support measures.
- Lack of trust in quality and advice.
- Concern that measures would detract from the appearance of buildings.
- Skills gaps in technical expertise.
- A historic lack of policy direction.

There was substantial support for the Government's Clean Growth Strategy targets for achieving Energy Performance Certificate (EPC) C by 2030 in rented housing and fuel poor homes and by 2035 in all homes. There was also some support for completion of the National Retrofitting Programme by 2030. Some respondents asked NIC to explicitly support these targets, and in some cases called for them to be made binding requirements and integrated into policy across the UK. Others requested more information from Government as to how they propose to meet these targets. Some respondents flagged that energy efficiency ambitions and timelines should be aligned with plans from the Committee on Climate Change and other non-departmental bodies, and that the final NIA should take explicit account of these.

It was also suggested that these targets could be reinforced by a set of shorter-term milestones to aid transition, and that thought should be given to raising standards post 2030/2035 and the pathway to achieving this. Many respondents called for a defined and ambitious timeline for implementing energy efficiencies to be put in place within the current parliament, to enable action by 2020.

The Government's decision to halt the Zero Carbon Homes legislation was queried by some respondents, who thought this has impacted upon the quality of new housing stock. Some respondents suggested a new, similar standard should be introduced to align with targets for all homes to be zero carbon by 2050, while others called for the reinstatement of the previous legislation. It was suggested that if Government are to reintroduce a zero-carbon target, they will need to define a technically feasible way for this to be done, and set out how it will be achieved. A ministerial statement stating support for carbon neutral (if not negative) homes was supported by others. It was suggested that a timeline needs

to be set that allows the UK to meet these targets while not encourage significant costs, particularly associated with retrofit of existing buildings.

The concern that leaving the EU will leave a policy vacuum for energy efficiency was raised by a small number of respondents. It was suggested that Government needs to ensure 2030 Energy Saving Targets and all related EU energy efficiency requirements should be transposed to the UK. A call was also made for Government to further explore the impact and opportunities of Brexit for the sector.

6.2.2 The Right Technology

Respondents proposed a range of measures and technologies to support improved energy efficiencies across the UK, including a focus on high quality durable materials, prioritisation of insulation and waste heat reduction, regulation of heating systems, use of energy efficient appliances, demand reduction approaches, and smart monitoring of energy use. It was generally agreed that a combination of approaches, including both new and existing, would be most effective. A whole house approach was supported by some stakeholders, rather than piecemeal implementation of energy efficiencies. Some respondents suggested the need for continued support for low carbon technologies, alongside energy efficiency measures, with the focus on making homes ready to integrate and respond to these.

The different needs of types of building, and the measures that might be appropriate were noted by a number of respondents. In particular, the importance of energy efficiency in all homes (new and existing) as well as commercial and industrial buildings and assets was emphasised. Respondents emphasised the importance of building retrofit, and the need for more to be done as energy efficiency average ratings remain low. Extending new build policy and legal frameworks to existing buildings was proposed by some respondents. The need to acknowledge that historic buildings perform differently to modern buildings and that the balance should be struck between energy efficiency and harm to historic assets was also noted by a few respondents.

There was general support among respondents for a holistic and long-term approach to identifying the right measures for improving energy efficiency. A lot of respondents expressed support for an open, competitive and technology neutral approach to identifying the right measures. Assessment of cost-effectiveness that takes account of whole life performance of an asset, and using the ‘energy trilemma’ of supply, cost and targets were also supported. One respondent proposed using a standard primary energy savings measure that enables a fair comparison of the cost-effectiveness of supply and demand options.

6.2.3 Approaches to Regulation, Funding and Incentives

Generally, respondents supported the NIC’s approach of combining a range of approaches to encouraging energy efficiency in buildings, through funding, policy, regulation, behavioural change and incentives. Some respondents suggested that NIC should commission further research to explore energy

efficiency further and how an ambitious programme will operate, which should be published to inform the NIA. Others noted that while research will be important, it is important that standards and incentives are put into practice alongside this to ensure real impact.

Policy and Regulation

A range of views were expressed on the role of policy and regulation in encouraging greater energy efficiency in buildings. These included:

- Existing regulation and policy was sufficient, with no changes required to support increased energy efficiency. It was suggested that new regulations would not be cost-effective.
- Regulations and planning have already been watered down too much to meet energy efficient technologies.
- Policy and regulation were considered to play a strong role in encouraging energy efficiency. Support was expressed for Frontier Economics' Affordable Warmth, Clean Growth Report and the detailed planning, testing and implementation of the recommendations of this report. There was particular enthusiasm for establishment of a Building Energy Infrastructure Programme – a dedicated agency for delivery of energy efficiencies.

Reference was made to existing programmes, in the UK and internationally, which could help to inform the right mix of measures in UK, (for example, Scotland's Warmer Homes programme, the Renewable Heat Incentive (RHI), CERT, Feed in Tariffs and the Green Deal). There were some concerns that the Green Deal model in particular was not effective.

A number of new or amended regulatory approaches to ensuring energy efficiency were suggested, including:

- Review and amendment of existing programmes or standards (for example, Green Deal, RHI), or reinstatement of past programmes (for example, code for sustainable homes).
- Development of standards for installation and quality control, including implementation of the recommendations of the Each Home Counts Review.
- More rigorous enforcement of regulations and areas of non-compliance, possibly funded by house builders.
- Requirements on organisations to demonstrate progress in energy efficiency and consumption, possibly through review of carbon report legislation, and particularly the proposals for Streamlined Energy and Carbon Reporting.
- Programmes and policies to increase awareness for consumers of their homes' energy efficiency, and opportunities to improve.
- Improved training and education to enable contractors and designers to recommend and implement high quality energy efficiency improvements.
- Amending/tightening building regulations, in a number of ways, including: more regular updates; replacing part L with detailed standards for appropriate technologies; standardisation of building regulations to avoid deviation; and incorporating higher energy efficiency standards.

- Policies that require standards of energy efficiency in public sector buildings or those supported by public funding, to act as exemplar for wider change.
- Policies to restrict or encourage the restriction of energy use, and encourage the use of more efficient appliances and technologies.
- Encouraging retrofit of energy efficiency measures, for example, through making retrofit a condition of custom splitting homes or identifying trigger points for energy efficiency improvements, tying in with repair and maintenance markets.
- Carbon targets (for example, a carbon intensity standard) for energy suppliers.

A large number of respondents suggested that a long-term action plan is required setting out a stable legal, policy and regulatory framework, which identifies incentives and finance mechanisms to stimulate investment in infrastructure and reach Clean Growth Strategy targets, to drive consumer and investor confidence.

Funding and Incentives

There were mixed views between respondents as to the role of Government in funding and incentivising energy efficiency measures. Some respondents considered direct Government funding, grant and loans to be required to boost investor confidence, generate innovation and growth and cover upfront costs to ensure energy efficiencies are delivered on programme. These respondents called for the NIC to encourage Government to reintroduce central investment in energy efficiency. Some respondents proposed a long-term funding programme be developed, providing confidence that energy efficiency is an investment priority area.

For other respondents, conversely, availability of finance was not considered sufficient to stimulate the market, and they highlighted the need for alternative incentives to be found to encourage the market in a competitive manner. The extent of demand for energy efficiency means that funding outside of Government programmes is a major opportunity area. For some these incentives were considered to sit alongside Government funding packages, while for others, they were suggested as an alternative to subsidy dependency, with no public funding required. The preferred direction of incentives varied across respondents, and included consumers, businesses, house builders, energy suppliers and the supply-chain. Some respondents expressed the view that incentives are most successful where solutions are simple and do not require complex knowledge. Within this, some respondents considered that full funding of measures is more successful than more indirect support.

A range of funding and incentive models were proposed, including:

- Encouraging innovation and good practice across the supply chain to overcome barriers to investment.
- Incentives for the supply chain and producers to encourage research and development in innovative technologies, for example reduced VAT rates.
- Incentives to reward uptake of energy efficiency measures in specific industries, for example agriculture.

- The use of taxation to fund energy efficiencies, including through general taxation (noting this would require competition with other centrally funded resources); and through explicit carbon taxation.
- Loans for investment in energy efficiency measures, including: low or zero interest loans, equity loans (repaid upon sale of the property), conditional or green mortgages, and cash back schemes.
- Tax-based incentives for consumers, including: variable stamp duty (paid according to efficiency rating), Council Tax rebates, and Business Rates relief.
- Linking energy efficiency to sale of property, for example, mirroring the existing private rented sector (PRS) minimum energy efficiency standards in the owner-occupier sector.
- Direct subsidy, grants and revolving funds/loans from Government for energy efficiency measures, including seed funding of examples.
- Use of collective purchasing to drive down cost.
- Salary sacrifice schemes that encourage the uptake of energy efficiency through incentive of tax savings on amounts dedicated from gross salary.
- Government funding of pilot and demonstrator projects to assess the benefits of different measures, and enable swift roll-out.
- The use of Section 106 and Community Infrastructure Levy to support energy efficiency initiatives.

Opportunities to tie energy efficiency to house prices were supported by some respondents as a means of encouraging consumers to invest in measures. However, other respondents expressed concerns that this would create a negative image of energy efficiency in the market.

There was support for energy efficiency improvements in the rental sector, through the tightening of regulations and targets. Noting that existing regulations are not sufficient, the consultation on amendments to The Energy Efficiency (Private Rented Property) (England and Wales) Regulations 2015 for domestic properties was welcomed. A range of measures were proposed by respondents, including:

- Adoption of the recommendations of the Fuel Poverty Commission's recommendations for landlord investment in energy efficiency.
- Review of the option for exemptions for landlords in the PRS.
- Reintroduction of the Landlord's Energy Saving Allowance.
- Inclusion of houses in multiple occupation (HMO) and social landlords in national standards for PRS.
- Development of a mandatory national licencing scheme for PRS landlords.
- Implementation of measures to ensure landlords do not increase rents to cover costs of energy efficiencies.

The Energy Company Obligation (ECO) was identified as the only national programme for installing energy efficiency measures. For some, the ECO has hindered the market for energy efficiency measures. A few respondents queried the position of suppliers as key funders of energy efficiency, given their role as vendors of energy as well. This conflict of interest, coupled with their tendency to implement efficiencies on a property by property basis (as they work in a

competitive market) called into question the suitability of their position as promoter of energy efficiency for these respondents

There was support for the ECO, and a call for continued Government investment in the area. However, concerns were raised that the initial success of the programme has slowed due to funding cuts and changes to the programme, and that the mechanism is not sufficiently geared towards catering for low-income and vulnerable households. Further, ECO costs are distributed among energy consumers regardless of their ability to pay. A number of amendments were proposed to ECO to allow its future success, including:

- Removal of the cap to funding measures under the local authority Flexible Eligibility element.
- Encouraging full ECO funding of measures by defaulting the value of carbon saving associated with the proportion of an efficiency measure not funded by ECO back to Government.
- Focussing funding only at the fuel poor.
- A dual approach combining ECO with direct subsidy to provide balanced and reliable support.

Focus on the Hard to Reach

Some respondents noted that there has been too much focus on the ‘easy win’ of targeting the ‘able to pay’ market. For many respondents, the ‘able to pay’ market should be the focus of regulation and policy while funding and incentives should focus on providing support for the fuel poor. The benefits of investing in meeting fuel poverty targets were outlined by a number of respondents, and include carbon emissions reduction, cost efficiencies and health benefits. Proposed interventions included:

- Use of Fuel Poverty (England Regulations) 2014 to require delivery of energy to fuel poor by 2030.
- Reinforcement of the statutory fuel poverty eradiation targets (as noted in the Clean Growth Strategy).
- A system of locational incentivise that focus on areas where energy efficiency harder to accommodate.
- Requiring social landlords to support private low-income households that have exercised their right to buy.
- Making targets for fuel poor households binding.

There was a concern expressed that many households fall just outside of the criteria for fuel poverty and therefore do not access funding etc. but still live in fuel poverty.

The Role of Collaboration in Implementing Energy Efficiencies

A key theme among many respondents was the importance of collaboration in ensuring the right framework and investment programme is in place to support energy efficiency improvements, and facilitating a joined-up approach to planning, installation and enforcement of energy efficiency approaches. There was support for better data sharing between different organisations, and respondents

suggested that Government should make data and factual information accessible to the whole energy efficient market, to support market growth.

The core role of the local authority in helping to deliver energy efficiency measures was also highlighted, in driving area-based solutions that are suitable for their locality. A local strategic energy planning system was proposed to help local authorities in this area. It was suggested that energy efficiency be embedded in English Devolution Deals, and that civic leaders and local authorities be supported and resourced to take action on energy efficiency. The possibility of local authorities controlling funds for energy efficiency measures at a local level was also raised by some respondents. The role of businesses in delivering energy efficiencies was also noted by a small number of respondents.

6.3 Question 15

The Consultation Report identified that "*keeping the cost of low carbon energy down is one of the most important inputs into a successful industrial strategy for the UK. Well-designed market mechanisms should ideally be open, competitive and technology neutral*." It sought views on: how existing mechanisms to ensure low carbon electricity is delivered at the lowest cost could be improved with reference to: being technology neutral as far as possible, avoiding the costs of being locked in to excessively long contracts, treating smaller and larger generators equally, participants paying the costs they impose on the system and bringing forward the highest value smart grid solutions. Some 106 respondents provided a response to question 15; this sub-section provides an overview of the comments received.

6.3.1 Technology Neutrality

There were mixed views regarding technology neutrality. Some respondents supported the concept and further suggested the Government should:

- Foster a competitive environment, with procurement on a competitive basis.
- Frame intervention terms of capability and security of supply rather than underlying technology.
- Treat new and existing assets in the same way.
- Revise the energy National Policy Statements to support a more level playing field for technologies.
- Focus future policy on correctly valuing local generation of energy, including its wider benefits to energy consumers.
- Provide clarity on the available capacity of each new technology of sufficient scale to create a competitive market capable of driving supply chain costs down over time.

Limitations of technology neutrality were identified as: difficulties internalising all the costs; and risk of encouraging sub-optimal short-term solutions.

Conversely it was also suggested that Government intervention is required to identify the preferred technology options, to avoid the distraction of focussing on multiple options; and to enable targeted support for technologies that can unlock

significant renewable capacity. Concerns were raised that intervention on technology type, impacts on competitiveness and risks increasing costs for consumers.

The Government's Helm Review was specifically mentioned as having identified a variety of explicit and hidden subsidies that distort the market and make technology neutrality difficult and that need to be addressed. It was suggested that achieving low prices through technology neutrality could be improved by strengthening penalties for non-delivery, which would help facilitate the emergence of a secondary trading market. Some respondents stated that the existing Contract for Difference (CfD) mechanism had led to the reduction in the costs of established technologies; however other respondents raised concerns and suggested that Government intervention should be reduced wherever possible and that support schemes such as CfD and FiT should be gradually phased out. A concern was articulated that it will be difficult to deliver genuine technology neutrality through an approach that relies on centrally administered auctions, and that rather greater flexibility and openness to new business models and technologies is required.

Various suggestions were made for revisions to the CfD auction process, including:

- Expand to other technologies to ensure continued technology neutrality. Although a point was raised that procurement will not be achieved by merely allowing technologies to compete in the same auction.
- Include intermittency costs within generation costs when assessing projects.
- Hold more regular auctions to expedite a continued and more fluid reduction in strike prices.
- Re-introduce a two 'pot' CfD, or another funding mechanism, to fund 'established' and 'less established' technologies to encourage greater uptake of established technologies and allow less established technologies to compete on a more level playing field.

A key theme was the need to invest in renewable energy sources, including wind, tidal, solar and geothermal power, within environmental limits. Renewable energy was identified as offering the lowest cost electricity and was thought to have a central role to play in the decarbonisation of energy; although additional research was suggested to determine which form(s) of renewable energy are cheapest. Government intervention was identified as essential to ensure that emerging technologies attract investment, achieve technological advances and scaling-up cost reductions. Further that once a technology is established, support mechanisms should not be suddenly withdrawn to avoid destabilising the industry. There was a call to accelerate trials into the range of renewable technologies, to speed up transition to these technologies.

A proposal was made that technology neutral obligations should be placed on energy service providers, to ensure that any services they sell in the UK meets defined decarbonisation targets.

6.3.2 Long Contracts

Long contracts were identified as necessary by most respondents, allowing a degree of certainty to underpin investment in infrastructure. An alternative view was expressed that the market should find its own way with regard to contract lengths. Whilst there was support for existing contract lengths, which were thought to be working well; an issue was raised regarding the current contract length and the fact that different parts of projects have different design lives.

A challenge was identified with long contracts and the need to ensure that they are set as low cost as possible. It was suggested that contracts should be awarded competitively where possible and the competition process designed to minimise the impact on the (future) energy costs. Furthermore that more robust implementation of the regulator's powers to control and limit contracts would assist in managing the impacts of long contracts on costs.

The need for flexibility was identified as a requirement for contracts, in particular to ensure changes to service delivery can be introduced where it will increase resource efficiency and to cope with changes in market structure.

6.3.3 Smaller and Larger Generators

There was recognition that small and large generators are not equal; however, there were mixed views as to whether they should be treated differently, with Government incentives structured to reflect the mix of generator sizes, or treated consistently. Larger generators were identified as likely to enjoy better cost control and economies of scale than smaller generators; although questions were raised as to whether the efficiencies of scale were lost in transition and process loss where there is no use for the waste heat. Whilst smaller generators were considered beneficial to reduce transmission losses; and if owned locally allow the value to be retained locally and a smarter grid enabling local balancing and consumption to allow further value capture. Respondents were divided as to the position of large and small generators within the markets; with some stating markets are currently skewed in favour of large generators and others that market arrangements have been over rewarding small generators. Regardless of whether small and large generators are treated equally, there was a call for Government to be transparent with regards to their approach to generators.

6.3.4 Participating Costs

Network charges applied to users and generators should reflect the costs they impose on the system. They should be fairly allocated and this should not distort competition. Specific suggestions were made on matters including legacy costs, network costs and charges (and their reform), how subsidy could be removed from consumer bills and how customers are vulnerable to energy cost risk. Concern was also highlighted regarding the viability of projects if they are to be fully funded by developers.

There was some concern that calculating the costs may be complex: they should be understandable, predictable, enduring, sustainable and consistent with Government energy policy.

6.3.5 Highest Value Smart Grid Solutions

There was support for the highest value smart grid solutions, where value is defined clearly and assessment takes account for the full costs. Smart grids should plan for future technologies, supported by modelling, testing and trials. Micro grids should be considered further, although it was recognised that alone they will not provide the generation capacity required.

Good visibility of future system needs and its value will support the development of accessible and open markets to provide the right services. It was recognised that Ofgem and Government should work together to deliver common goals for smart grids. Further local government should identify opportunities for smart grids and document these through spatial and/or local plans.

6.3.6 Electricity Market Reform

There are mixed responses regarding the current electricity market and the changes which need to be made. The majority of the respondents believed that the current Contract for Difference (CfD) auctions have helped with keeping the costs low.

6.3.7 Other Comments

In terms of other mechanisms, a range of comments were provided, including:

- A need for better forward planning and horizon scanning to identify how to meet demand. Whole-system consideration is required that considers both technology and delivery, and homes, transport, power and industry. There is also a requirement for clear, credible long-term policy that takes account of complex interdependencies. There was support for a national energy assessment, linked to the advent of new low-cost urban sources of energy storage.
- Reference was made to how the existing regulatory framework includes features which deliver low-carbon at lowest cost, including the sharing factor, cost efficiencies being reflected from one price control to the next, incentives to engage customers and stakeholders. Reference was also made to UKPNs Flexible Distributed Generation Scheme and forthcoming flexibility tenders; National Grid's System Needs and Productivity Strategy and System Operability Framework for procuring services; and delinking inflation of revenues in tidal lagoon facilities. It was suggested that open standards will bring the lowest costs in managing a stable and cost effective system.
- There was support for development of the grid through increased transmission charges or direct government investment, overseen by National Grid.
- Carbon price comments raised the issue of a predictable long-term price and an upward trajectory to incentivise low-carbon generation. Increases in flexibility were identified as being important to avoid unnecessary costs on consumers. In terms of reducing the costs, solutions should not be considered in isolation.
- Substantial investment is required in energy infrastructure, to support decarbonisation while maintaining security and reliability of supply.

- Splitting single meter data between multiple supplies may not be practical and would require variation to the Electricity Act and discussion with Ofgem and industry.
- Interconnection with other countries was suggested to diversify energy sources and ensure flexibility, although recognising the need for a comparable service.
- Cooling of computer equipment may be best located in rural area where natural cooling systems can be delivered more easily than in urban areas.

A broad range of general comments were provided on energy strategy, the majority of which focussed on the following:

- The need for a clear long-term policy trajectory to give the market confidence to provide for the future needs of the electricity grid.
- Understanding whole system costs associated with low-carbon technologies
- A coordinated approach, across all Government departments and agencies, is required to meet the challenge of decarbonising the grid. This approach should consider addressing the challenges of decarbonising heat, power generation, waste and transport in an integrated and inter-connected manner.
- Recognising the importance of utilising the existing energy infrastructure already in place.

6.4 Question 16

The Consultation Report identified that "*nuclear power is an expensive form of generation and is unlikely to get built without Government intervention. However, if electricity is selected as the primary way to heat our buildings in the future, it is unlikely that renewables could generate sufficient electricity to meet total demand. It is also unclear whether system stability can be maintained with very high levels of renewables.*" It sought views on: what the critical decision factors are for determining the role of new nuclear plants in the UK in scenarios where electricity either does, or does not, play a major role in the decarbonisation of heat; what the most cost-effective way to bring forward new generation capacity would be; and how important it would be for cost-effectiveness to have a fleet of nuclear plants. Some 51 respondents provided a response to question 16; this sub-section provides an overview of the comments received.

6.4.1 Overall Positions on Nuclear Power

Respondents provided mixed views with regard to the general acceptability of nuclear power as a component of the UK's energy sector.

For some, the continued or increased use of nuclear plants for electricity in the UK was not supported due to a number of risks that nuclear power presents, including:

- Storage and disposal of nuclear waste.
- Financial risks associated with the significant upfront capital investment required and longer-term costs of electricity to consumers.
- The length of time taken for consent and construction.
- Concerns about the unsuitability of nuclear power to respond to the seasonal nature of energy demand.
- Problems and lack of transparency associated with existing projects.
- Concerns that pace of change and time to delivery are often slow, especially in an environment where other technologies evolve rapidly (due to safety regulations).
- Lack of evidence that nuclear is required.
- The view that nuclear is less cost-effective than alternative low carbon resources.

From other respondents, there were clear messages of support for the role of nuclear power in the energy mix. For some, nuclear represents the 'least worst' option for meeting the UK's energy demands in the mid- to long-term. While for many supporters of nuclear power, the NIC's position that "*the constraints of technologies mean it is difficult to envisage a secure and stable energy mix that does not contain nuclear*", was supported for a number of reasons, including:

- The role nuclear can play in the provision of a steady and consistent supply of power which can be expanded to cover energy demand, and provide system inertia.
- The lack of alternatives, and therefore need for nuclear in order to meet the baseload and ever-growing demand for electricity.

- The wider benefits of nuclear power that include local employment creation, as well as defence uses.
- The necessity of continuing to use nuclear, as failure to act until this point means there is no option but to continue the development of nuclear, as the critical decision point has passed.
- Evidence that nuclear is not expensive in the longer-term when assessed through a whole system approach.

Respondents highlighted a number of other technologies that should be considered as part of the energy mix for the UK, including low carbon heat solutions, renewable technologies (including micro-generation), carbon capture and storage, gas generation (in the short-term), interconnectors and Energy from Waste. For many, these represented alternatives to nuclear power, and to others they represented part of a package of measures that might sit alongside nuclear power. With regard to renewable energy in particular there were mixed views, with some respondents questioning the NIC's assertion that renewables cannot generate sufficient energy to meet current demand as unjustified, while others fully agreed with this statement.

6.4.2 Critical Decision Factors

Not all respondents provided critical decision factors for determining the role of nuclear. However, a number of key points were made, which included:

- A number of factors, including population increase and possible electrification of the heat network will require a significant increase in demand – respondents suggested that the level of demand will be a key determining factor in whether nuclear is required, as alternative measures will only provide a certain amount of low carbon capacity.
- While electrification will increase demand, a decision on nuclear should not necessarily be linked to decisions around the electrification of the heat network, as nuclear power may be required in advance of electrification.
- Financial and commercial risks and investment required will be a central decision-making factor, as the costs for nuclear are substantial, with upfront capital costs high, and long development periods meaning a long wait for revenue impacts. Costs of capital are also an important consideration. Weighing these costs against the benefits of nuclear will be important in decision-making.
- Timescales for design, construction and delivery will be important, as any low carbon source will need to respond to demand when it is required.
- Public perceptions were identified as a barrier to investment in nuclear by many stakeholders, and more should be done to change public perceptions in this area. Local authorities are well placed to explore issues around nuclear and other technologies with their communities.
- In the context of Brexit, security of supply will be an important factor in decision-making, and the transitional arrangements for exit from Euratom.
- The long-term impacts should be taken into account in decision-making, including decommissioning impacts and legacy.

- The decision as to whether to support nuclear will be political and therefore Government should take the lead in directly funding and driving investment in this area.
- The UK will need to have effective and sustainable strategies in place for the use and management of increased nuclear waste associated with more nuclear power plants. Consideration should be given to a geological disposal facility for permanent disposal of radioactive waste.
- The NIC should take into account individual areas and their own Energy Strategies to understand appetite and opportunity for nuclear and other energy sources.
- The price differential and scalability of nuclear generation, compared to other alternative technologies are key decision factors.

Cost effectiveness analysis, using an evidence-based approach was recommended by a number of stakeholders, to inform decision-making. It was suggested this should include whole system costs to properly assess the relative economics of different options, as well as cost of intermittency. This should include consideration of other costs alongside financial, including environmental and carbon. The need to update assumptions used for nuclear costs to be more realistic was flagged by one respondent.

6.4.3 Cost-effectiveness Measures

There were mixed views among respondents as to whether Government intervention is required to drive cost-effectiveness in nuclear power. Some respondents considered that no preferential support should be given to nuclear over other energy sources. The use of competitive forces using the existing Contract for Demand (CfD) auctions as a basis was supported by some respondents.

Conversely, some respondents were concerned by the contradiction between competitive mechanisms and explicit support for nuclear, which is currently procured through a managed approach. Concerns around unjustified concessions for nuclear were raised and it was also suggested that any explicit Government support for nuclear power should not impact on the fairness of CfD awards.

In addition, concerns were expressed by respondents that high upfront costs mean few developers have the ability to finance nuclear investment without third party support, which limits the role of CfD. For these respondents, alternative financing models that enable financial investors to participate should be sought. Models that allow access to the lower rates of Government borrowing were supported by some respondents as a means of reducing financing costs and commercial risks, bringing customers' value for money, and providing confidence to attract private investors. Direct funding for to reduce upfront costs was also proposed by some respondents for similar reasons. Further direct support from Government was also supported in provision of sites; provision of access to fuel; and taking on the decommissioning risk from small technology companies.

A number of other important mechanisms for reducing costs of nuclear power were suggested by respondents, which included:

- Implementation of the Nuclear Industry Council's Nuclear Sector Deal.
- A technology neutral framework, using a common market carbon price.
- A package of regulation, policy, funding and new technology investment.
- A regulatory and policy framework that is stable and fit-for-purpose.
- Gaining experience in new nuclear construction and learning from significant industry expertise.
- Research and innovation to revitalise the UK's global position in the industry.
- A focus on maximising benefits of nuclear investment to UK firms.
- Greater collaboration between Government and industry.
- Exploration of different models for financing nuclear power, for example that used for Thames Tideway Tunnel.
- Adoption of technologies which already have licensing.

Innovative technological approaches were supported by many respondents as a means of lower costs for nuclear power, including modular and off-site construction, and the use of advanced modular reactors. The role of small plants and small modular reactors (SMR), alongside other approaches, was supported by a number of respondents, as these are easier to finance and deliver, and can be factory built, resulting in cost savings. It was also proposed that SMRs could act as combined heat and power plants to provide low carbon heat to homes and businesses, as currently used outside of the UK. Although it was suggested that SMRs be avoided near cities, for safety reasons. Government support for companies looking to explore SMR in the UK was encouraged by a number of respondents, through: a policy framework that reduces the risk; making sites available; and enabling Generic Design Assessment (GDA) slots to be allocated.

6.4.4 Nuclear Plant Fleet

There were mixed views on the likely success and cost-effectiveness of a fleet approach to provision of nuclear plants. For some respondents, it was considered that having a fleet of nuclear plants would provide nuclear power at lower costs across the lifecycle of a project:

- At the planning stage as it avoids the need for costly design work (if using a design already approved through GDA process), and can build on learning from past experience of obtaining Nuclear Site Licenses and Development Consent Orders.
- During construction as it removes the costs involved in contract negotiation for equipment, materials and services required for 'first of kind' supply chain contracts; enables more accurate cost estimates based on the use of stabilised costed designs to allow competitive engagement with the supply chain competitively; and increases productivity in use of the same suppliers.
- During operation as it enables the sharing of learning, staff, resources for regulation etc. between plants. In addition, some respondents suggested that it was easier to supply a fleet with the same design, with the same components and systems than it is for individual plants.

Respondents also considered a fleet approach to be beneficial for a number of additional reasons, including:

- Greater resilience in a larger number of small nuclear plants.
- Improved capacity and capability in the supply chain, providing the incentive and confidence to commit to investments, which will support higher levels of UK content and exports in nuclear goods and services.

For some respondents, a fleet of large nuclear plants will be essential should heating systems move to a hydrogen-based model. Other respondents suggested it is unwise to rely on a small number of larger nuclear plant, with a preference for a fleet of smaller plants. Some respondents also highlighted that using the same reactor technology is central to reducing the costs of new fleet nuclear.

On the other hand, other respondents queried the likely success of the fleet approach due to: the small-scale of nuclear industry, suggesting the industry would need to be significantly bigger to achieve economies of scale; the lack of evidence and testing to support a fleet approach in the UK leading to lower costs; and concerns that replicating designs will result in the same risks on multiple sites and could cause simultaneous outages of a fleet of reactors. For some respondents, this distributed nuclear energy scenario will only be possible if both the public and private sector continue to invest in the area.

6.5 Question 17

The Consultation Report identified that "*carbon capture and storage has the potential to support the transition to a low carbon energy system in multiple ways, including enabling the creation of greener gases for heating, and reducing emissions for fossil fuel power stations and industry. However, it has had a difficult history in the UK. Internationally, it is predominantly used for enhanced oil recovery, rather than reducing carbon dioxide emissions*." It sought views on: what the critical decision factors are for determining the role of carbon capture and storage in the UK in scenarios where electricity either does, or does not, play a major role in the decarbonisation of heat and what the most cost-effective way to bring it forward would be. Some 52 respondents provided a response to question 17; this sub-section provides an overview of the comments received.

6.5.1 Critical Decision Factors

The feedback received tended to convey respondent views on what the future of Carbon Capture and Storage (CCS) should be, rather than outlining the critical decision factors. CCS could play a significant role in the decarbonisation of some industries, including steel and cement manufacturing and other high temperature industrial heat processes. The issue of how heating is delivered was also highlighted. Where respondents did provide decision factors, the role of CCS was identified as dependent on the future decarbonisation of heat, – CCS will play a greater role if low carbon gasses are introduced, particularly hydrogen. However, there was a lack of distinction in how the decision factors may vary depending on the two scenarios provided (where electricity either does, or does not, play a major role in the decarbonisation of heat). The most common decision factors were:

- Whether CCS will be cost competitive and commercially scalable.

- Whether carbon can be safely and effectively transported and stored.
- Whether sequestration is reliable and long-term.

Where electricity does play a role in the decarbonisation of heat, it was identified that the key decision factor is whether CCS with power generation is cost competitive with renewables, however few respondents expressed this.

6.5.2 Cost-effective Means

A range of views were provided on what would be the most cost-effective way to bring forward CCS, which included:

- Clear Government support through policy and funding – a clear policy framework is important to reduce uncertainty and provide a cost-effective means to proceed, develop incentives and mitigate the high upfront costs. Funding is important to support innovation.
- Research and trials – although related to above, research, trials and innovation were commonly supported to better understand the technology and demonstrate that CCS is deliverable at commercial scale.

Other feedback included:

- The polluter pays principle – pricing carbon at its social cost and asking all technologies to bear their system costs on an equitable basis. This way the businesses that produce carbon must pay, which may incentivise CCS.
- Collaboration – between other countries, Government, business and researchers to demonstrate full scale CC
- Use of existing infrastructure – the use of exiting oil and gas infrastructure, legacy pipelines and geological storage sites for the transportation and storage of carbon.
- Development of strategic clusters – to develop economies of scale.

6.5.3 Other Comments

As discussed, the remaining responses related to the respondent's views on what the future of CCS should be. There were roughly the same number of respondents who supported CCS compared to those who were against it. Those against it referred to reasons including: CCS being unproven and unlikely to be commercial in bulk form, encourages the use of unsustainable bio-energy, has a poor history if being used for enhanced oil recovery and risks locking the UK into fossil fuels.

Those that supported CCS generally identified that it will be required to address emissions, including from industrial processes, remains a valuable option for decarbonisation and can utilise existing storage reserves. It was generally agreed that CCS will play a greater role in facilitating hydrogen production or bio-energy, rather than power generation, due mainly to CCS being seen as an inherent part of hydrogen production in particular and being cost-effective. Those in favour of CCS for electricity generation cite its importance in decarbonising power stations during the transition phase to a decarbonised grid.

6.6 Question 18

The Consultation Report identified that "*waste can be a valuable fuel for the difficult-to-decarbonise sectors. New and established technologies could make a contribution to the heat and transport sectors*." It sought views on: how the residual waste stream should be separated and sorted amongst anaerobic digestion, energy from waste facilities and alternatives to maximise the benefits to society and minimise the environmental costs. Some 57 respondents provided a response to question 18; this sub-section provides an overview of the comments received.

6.6.1 Waste Reduction and Management

Reducing waste was identified as a priority along with following the waste hierarchy for waste management. In terms of collecting waste, concerns were set out about effective source segregation of materials, highlighting the limitations of extracting recyclates from residual waste. It was suggested that there should be more analysis where recyclable waste has been included in residual waste to prevent future inclusion. Front-ended recycling was also identified, with the need for products that are easier to reuse and recycle, with a programme of education and communications to reduce residual waste. There was also recognition that the waste and resources sector will continue to evolve and current models and volumes may not be applicable in the future.

The need for protection of existing waste management infrastructure and investment in and creation of new facilities was identified both in light of declining landfill and the opportunities associated with the circular economy.

Consistency of waste collection systems was raised to further source segregate materials, ensure parity of approach in different areas (and therefore breakdown consumer confusion) and increase recycling, with the suggestion of carbon metrics for recycling.

Improved waste data and its use was raised by a number of respondents, including a comprehensive waste data system, questions on the edoc system and its voluntary status, the need to collect Construction and Industry (C&I) data possibly through the existing waste carriers licence system, and use of EA and Defra collected data particularly as this would avoid duplication.

Responses identified an overreliance of export of waste and the need for clear Government guidance in light of landfill capacity, an unknown policy context post Brexit, to manage fly tipping, to create new opportunities and investment in line with the waste hierarchy, and creation of an office for resource management.

6.6.2 Energy from Waste

A mix of views were identified on energy from waste (EfW)/incineration with some respondents supportive of this form of waste treatment and energy generation, including as an alternative to landfill, and others opposed to its use in principle and as part of a move to the circular economy. The benefits of EfW were identified as including carbon savings, waste collection cost saving, opportunities

to provide heat, noting that the UK model is focussed in power generation rather than heat and that this would require a different offtake market to be established. The question of who is best placed to bring forward heat networks was raised, along with points on funding and expertise and the need to demonstrate local need. Concerns were raised as to how a focus on EfW would divert waste from other potential uses and lock in bad habits, the need for any new plants to integrate heat offtake, and for plants to be limited to residual waste only to incentivise pre-sorting, source segregation and incineration tax.

6.6.3 Anaerobic Digestion

Anaerobic digestion (AD) was identified as a form of waste management and energy generation that could effectively use food waste and other biomass, and result in a lower carbon impact. Separation of food waste was identified as an important requirement, as was the availability of feedstock in an area. The issue of subsidy for food waste collections was raised, to offset higher costs. On-farm AD was raised as an opportunity with its own benefits. Direct injection of gas arising from AD into the grid was identified as a measure that would make production more efficient and cost-effective. The market for AD digestate was also questioned.

6.6.4 Other Technologies

Gasification and pyrolysis were criticised in a number of responses. Issues were identified with tar content of the gas, overall CO_2 generation, lack of proven capability especially at a commercial scale, viability, the need for public subsidy and challenges associated with predicting/controlling mixed waste feedstock.

Other technologies were identified including chemical recycling of plastics, natural gas, and post treatment extraction of residues for recycling.

6.6.5 Other Comments

In determining future renewable locations best environmental information should inform decision-making to avoid areas of greatest sensitivity. There should also be ongoing monitoring to inform decision-making and design of renewable energy.

Respondents identified the need for incentives to support the sector, including: uptake and funding of separated collection schemes; the volume of waste generated, incineration tax, legislation changes to the planning process to support co-location with heat users; commercial support for new and emerging technologies.

The roles of the Government's Resources and Waste Strategy was identified as an opportunity, including how to link product and policy design, green procurement standards. It was also suggested that waste and recycling should be considered separately by the Commission.

6.7 Question 19

The Consultation Report identified that "*the first best option to reduce waste costs for households and businesses is to minimise the amount of waste produced. The packaging recovery note system places costs on the producers of packaging to account for the end-of-life impact.*" It sought views on: whether packaging regulations could be reformed to sharpen the incentives on producers to reduce packaging, without placing disproportionate costs on businesses or creating significant market distortions. Some 37 respondents provided a response to question 19; this sub-section provides an overview of the comments received.

6.7.1 Current Producer Responsibility Obligations

A range of responses were provided on the current producer responsibility obligations with concerns as to the contribution made by producers to the costs of management of waste arisings, particularly when compared to other countries. The implications of leaving the EU and the desired outcomes for packaging regulations need to be better understood.

6.7.2 Proposed Changes

The responses identified support for changes to the existing producer responsibility regulations, with positive outcomes identified as reduced resource consumption, more single material packaging, reduced separation costs, improved reuse and recycling, reduced waste generation and an opportunity to bolster domestic infrastructure provision and the sector. Suggestions included extending the regulations to products not currently covered, a carbon tax on packaging, managing price volatility in tradable recycling certificates, splitting incentives between producers and local authorities, modulated fees to promote recyclability, phasing out exporter Producing Responsibility Notes (PRNs), and support for the Environmental Audit Committee recommendations.

Some respondents identified a need for an entirely new system of producer responsibility regulations, while others identified concerns arising from the impacts of amended regulations on the sector.

Improved collaboration between local authorities and packaging producers was identified to improve shared understanding.

Respondents identified support for the use of consistent recyclable products and packaging, with incentivisation or regulation through a variety of mechanisms. Single use plastics and hard to recycle materials were raised as areas that could be changed, as was incentivisation of greater use of recycled content or to remove unnecessary packaging. A lifecycle approach should avoid disproportionate cost or market distortion, but new infrastructure will be required to support a revised approach. Additionally, certainty on the demand for secondary materials is important to help recycling.

A number of responses identified consumer behaviours as being an area that could influence packaging. Suggestions included regulation of labelling to make consumers more aware of sustainable packaging and how it can be reused or

recycled, along with better information and its communication to reduce consumer waste.

Some mechanisms were identified to address packaging including carbon metrics rather than recycling targets, pay as you throw, and financial and/or legislative measures to drive behavioural change.

Reference was made to Defra's 25 Year Environmental Plan and Waste and Resources Strategy as being relevant to the issue.

7 A Revolution in Road Transport

7 A Revolution in Road Transport

This section addresses feedback received on Chapter 5 including the responses to questions 20 to 22.

7.1 Question 20

The Consultation Report identified that "*after 100 years of incremental change in the design and operation of road vehicles, a new generation of connected and autonomous vehicles will offer higher quality and safer road travel. However, car manufacturers are mainly focusing on building future cars for existing roads, and relatively little work has been done on how the roads themselves should be adapted and used*." It sought views on: what changes would be needed to the design and use of the road to maximise the opportunities from connected and autonomous vehicles including on motorways and A roads outside cities and roads in urban areas. It also sought views on how should it be established which changes are socially acceptable and how could they be brought about. Some 87 respondents provided a response to question 20; this sub-section provides an overview of the comments received.

7.1.1 Motorways and A Road Design

There was support for the need to alter the design of motorways and A roads to accommodate Connected and Autonomous Vehicles (CAVs). More mixed views were expressed on the proposed approaches to design, although respondents generally supported the need for either:

- High quality infrastructure such as clear road markings, signage, noise barriers, grade separation and interactive signalling to facilitate the introduction of CAVs. Specific responses also included the need to ensure motorways are equipped with cooperative systems for stack metered traffic.
- Reconfiguration of road layout to maximise efficiency. A range of views were expressed on the detailed design of these configurations; however, there was a general emphasis on making the best use of limited capacity through flexible and dynamic lanes, multi-lane roads to accommodate different road users, and the need for regimented lane gain and drop to deal with tidal flow. Respondents provided mixed views on road width required for CAVs, with some advocating additional motorway space to enable lorries to assemble and rest, whilst others supported reduced lane widths, as 'wriggle room' associated with human drivers would not be required.
- Mechanisms to accommodate platooning vehicles – mixed views were provided, with some respondents supporting the removal of speed limits for autonomous Heavy Goods Vehicles, whilst others highlighted the need for hydrogen fuel infrastructure to support freight and long-distance journeys.
- Digital connectivity – some respondents identified the need to access appropriate data to facilitate real time responses, and the need for rapid maintenance services to support fixing digital and physical malfunctions. More broadly, it was noted that sufficient technology was required to support a range

of functions, such as pricing mechanisms across different times of day and improved user safety.

7.1.2 Urban Environment Road Design

There was support for the need to alter the design and layout of roads within the urban environment, to accommodate CAVs. Respondents made wide-ranging recommendations on approaches to improving the design of roads, proposing infrastructure interventions, alongside broader suggestions surrounding land use planning and governance.

Infrastructure Delivery

There was a strong focus on specific infrastructure interventions to facilitate CAVs in the urban environment, which can broadly be categorised as follows:

- High quality road infrastructure – there were mixed views on the role of supporting infrastructure, with some respondents in support of new infrastructure, whilst others advocated simpler and less cluttered urban roads to ensure ease of travel for CAVs. Specific infrastructure requirements included the need for clear signage, additional road markings, and altering traffic signals to accommodate platooning vehicles.
- City-wide digital infrastructure – respondents broadly supported the need for improved digital connectivity within urban environments to support accurate and reliable travel data. Some respondents showed support for the use of technology to develop apps and Variable Message Signs to inform drivers of travel conditions in urban environments. This included mechanisms such as connecting CAVs with parking supply in urban areas to improve efficiency of travel.
- Appropriate location of charging infrastructure – a number of respondents supported implementing charging facilities to accommodate the needs of residential, commercial and public premises. This included support for off-street charging facilities, and appropriate infrastructure at key transport hubs to support both CAVs and shared modes of transport.

Land Use

A number of respondents commented on ways to make the most efficient use of land within urban environments. These responses can broadly be categorised as follows:

- Zoning and segregation – a number of respondents supported further exploration into creating zones for specific vehicle types within cities. Other respondents proposed the use of multi-lanes to segregate active travel modes from CAVs and other vehicles, to improve user safety and promote active travel.
- Integrated approach to transport – respondents commented on the need to ensure CAVs formed part of a wider joined-up approach to overcoming transport challenges. Mixed views were expressed, including proposals for ‘first mile last mile’ transport solutions to help remove congestion from urban

centres. Other respondents proposed opportunities around using CAVs for waste management, along with the need to consider new and coordinated methods of dealing with accidents and breakdowns, including re-routing around blockages.

- Responsive built environment – a number of respondents supported the need for CAVs to remain sensitive to their surrounding environment. Respondents provided mixed views, including support for reviewing public realm and shared spaces within urban areas to maximise safety, lowering speed limits for CAVs within cities, and ensuring that supporting infrastructure remains sensitive to the geometry and layout of the built environment.

It was particularly noted for urban environments that the transition to CAVs was insufficient in isolation, and needed to form part of a wider narrative of modal shift, and ensuring appropriate infrastructure is in place for active transport modes.

7.1.3 Design of Roads (Unspecified)

A number of respondents identified design solutions for the highways network in general, without specifying between motorways or urban environments. Respondents were broadly in support of the NIC's view that technological advancements will play a significant role in transforming the road network, and their ambition to further explore how the network is used across different modes and temporal patterns. Respondents provided mixed views, which can broadly be grouped into the following key themes:

- Changes to the layout of roads – the need to reconfigure roads to accommodate the transition period associated with CAVs, whereby autonomous vehicles might require segregation with manual drivers. Specific responses included recalibrating the bends and camber of roads to ensure cars can drive at speed, along with reducing the need for roadside infrastructure in favour of virtual systems.
- Integrating with other road users – the need for CAV infrastructure to be designed in a way that integrates with other road users. Changes to highways infrastructure should not exclude other road users to a limited part of the network, and a combination of vehicle-based and satellite systems will be required.
- The need for digital infrastructure – improved data connectivity between vehicles the transmission of information between vehicles and surrounding infrastructure was supported. Some respondents also raised the issue of cyber security, and the need to standardise data systems and infrastructure to facilitate co-ordination across spatial scales.
- Approach to infrastructure upgrades and maintenance – as infrastructure becomes more sophisticated and automation increases there will be a requirement to maintain infrastructure to a higher standard. This will require specialist skills and will be a costly process. One respondent noted the need for the NIC to examine the risk to network resilience as a result of inadequate maintenance provision. There were more mixed views in terms of whether the emphasis should be on prioritising upgrading existing infrastructure, or investing heavily in new infrastructure to ensure it is suitably future-proofed.

One respondent raised that greater national investment is needed in the major road network, given the disparity between investment levels in these roads compared with the motorway and trunk road network. Respondents also supported the need for high quality, appropriately located charging infrastructure.

- Managing demand on roads and improving the efficiency of the network generated a mixed response. Measures suggested included: road charging mechanisms, promoting public transport, provision of information and alternative travel options.

It was also noted more broadly that there is a need for reliable and resilient infrastructure to underpin economic competitiveness.

7.1.4 Other Measures

Alongside specific design measures for roads, a number of additional measures were proposed to maximise opportunities around CAVs.

There was general support for joint working at the strategic planning level to maximise opportunities around CAVs. A number of respondents identified the need for an integrated approach to transport planning, infrastructure delivery, communication and data handling. The purpose of this was to improve environmental outcomes, standardise the quality of infrastructure and minimise long-term maintenance costs. Other respondents noted that CAVs should form part of a holistic, inclusive public transport and goods distribution network. It was suggested that there should be better communication between road and rail transport, and supporting road and line side infrastructure.

The need for efficient maintenance of infrastructure was noted. It was suggested that further exploration into more efficient approaches to highways maintenance and street works is undertaken, to limit the disruption and associated cost and traffic impacts. Some respondents also noted the importance of auditing existing infrastructure, and establishing ongoing monitoring of road use and travel behaviour to ensure approaches to CAVs are appropriate and responsive.

To coordinate and streamline infrastructure delivery, a number of respondents proposed adopting best practice guidance, particularly for road design and utilities infrastructure. Other respondents supported the integration of CAVs into the wider policy framework associated with electro-mobility and vehicle sharing. It was also suggested that the NIC produce guidance into the development of a national policy for Unmanned Aerial Vehicles.

In general, there was support for autonomous vehicles that cater for higher occupancy, such as buses and other forms of shared transport. The purpose of this was to maximise public benefit, discourage individual vehicle use and support large-scale modal shift. Specific responses suggested that the public sector should take an active role in supporting opportunities for CAVs, and should lead by example. It was also noted that CAVs should seek to deliver an intensity of car use to help transform personal transport.

A number of respondents disagreed with the NIC's phrasing of the question to only focus on urban environments and major roads. It was suggested by a number of respondents that opportunities to support CAVs in rural areas should also be considered, particularly as private vehicles remain a necessity in most rural areas. It was also noted that there was a need to ensure access to sustainable transport for rural areas.

Some respondents supported the need for changes to the law. Specific responses included changes surrounding jaywalking, and similar measures for cyclists, to prevent them from ignoring signal sequencing. Other responses included the need for a comprehensive national insurance framework to ensure those involved in collisions receive appropriate care and financial assistance.

A number of respondents also noted the importance of digital technology, in that the development of CAV infrastructure could be undertaken in conjunction with the digital agenda to clearly define infrastructure requirements. Other respondents noted that improvements in digital technology and connectivity will facilitate home working, which will reduce the need to travel overall.

7.1.5 Social Acceptability and Uncertainties

A number of uncertainties and issues relating to the social acceptability of CAVs were highlighted. These can broadly be categorised as follows:

Interaction between Driverless and Non-Driverless Vehicles

Many respondents highlighted the unknowns surrounding how CAVs would interact with surrounding vehicles, infrastructure and the environment more broadly. Key concerns raised included liability in the case of accidents, insurance frameworks and asset responsibility. Some respondents raised concerns around the capacity of CAVs to respond to changing environments, such as dense and busy urban centres, power shortages and unexpected events such as flooding and debris in the road.

It was also widely noted that the urban environment presents additional challenges for CAVs. Respondents provided mixed views, with some identifying challenges in terms of the fast paced and unpredictable nature of urban environments, whilst others focussed on the competing land uses, community objections and high levels of existing congestion.

Lorry Platooning

A number of respondents highlighted concerns around the impacts of lorry platooning. Specific responses included concerns that the practical implementation of platooning could have adverse impacts on health and safety, road infrastructure, congestion and the wider environment. The result of this could be increased road maintenance costs.

Behavioural Changes and Driver Control

A number of respondents highlighted uncertainties surrounding public perceptions and behavioural change as a result of CAVs. Respondents provided mixed views, however tended to include: uncertainties surrounding future changes to travel behaviour, confusion over the terminology of CAVs and their potential benefits. Some respondents also questioned the levels of control drivers would be willing to give up on certain parts of the road network. Specific responses included the requirement for emergency services to be able to take control of CAVs in an emergency situation.

Some respondents also noted that there are barriers facing the widespread implementation and uptake of CAVs, including purchase prices, battery longevity and replacement costs.

It was also widely noted that the use of location data and increased connectivity to surrounding vehicles and infrastructure could undermine consumer privacy. This included concerns over the involvement of third parties in data handling. Respondents also raised safety concerns over the introduction of CAVs. Specific responses included support for ongoing trials across a range of conditions, and clarity over the level of human competency required to take control of CAVs if required.

It was also noted that there are uncertainties surrounding the implication of higher speed limits, journey lengths and carbon emissions associated with CAVs.

Congestion and Land Availability

A number of respondents identified concerns surrounding how CAVs will impact on overall numbers of vehicles on the road, and concerns that the NIC does not fully address the problem of current and future congestion. Specific responses included concerns that changes in travel trends, consumer preferences and perceptions of risk could increase the attractiveness of car travel over shared models, resulting in greater levels of congestion. There were also mixed responses surrounding the impact of CAVs on land use, with some noting that the removal of parking could free up land for alternative uses, whilst others suggested that the requirement for charging facilities and ancillary infrastructure could increase pressure on scarce land resources.

Infrastructure Requirements and Role of Operators

It was also broadly noted that there remains considerable uncertainty around when CAVs might be introduced onto the roads. Some respondents thought it was therefore too early to determine appropriate infrastructure requirements, while others raised concerns that digital technology solutions alone are not sufficient to resolve existing transport problems. Uncertainties were identified surrounding the capital investment required to upgrade the road network to accommodate CAVs, and the reduced ability of local authorities to invest in road infrastructure. Some respondents raised uncertainties surrounding the implications on the network operators, particularly in terms of the changing needs and expectations of users.

Other respondents identified a lack of priority given to road maintenance, including a long-term strategy to address this infrastructure failure.

Impact of CAVs on the Electricity Network

A number of respondents noted that CAVs will place additional pressure on the energy sector, and the resulting need for capacity of electricity infrastructure to be substantially increased to support growing demands on the network. Some respondents supported mechanisms to manage demands on the electricity grid, such as the need for a road user charge across different modes on the network, and carefully controlling charging points.

7.2 Question 21

The Consultation Report identified that "*the impact of road transport on air quality is severe, and the Government's greenhouse gas emissions target means that nearly all vehicles on the road will need to run on low carbon power or fuels by 2050. Electric vehicles provide the most promising means of addressing these challenges, but unmanaged charging can put additional strain on the electricity distribution network, potentially requiring costly reinforcements*." It sought views on: what Government policies are needed to support the take-up of electric vehicles; what the role of Government is in ensuring a rapid rollout of charging infrastructure; and what the most cost-effective way of ensuring the electricity distribution network can cope. Some 81 respondents provided a response to question 21; this sub-section provides an overview of the comments received.

7.2.1 Electric Vehicles Uptake

The respondents showed general support for the proposal to end the sale of conventional petrol and diesel cars by 2040, and the movement towards zero emissions more broadly. A range of policies and approaches were identified to support the uptake of electric vehicles, including:

- Government subsidises – respondents provided mixed views surrounding the type of subsidies that should be used, including: to cover the costs of installing home charging facilities, to cover initial purchase costs, and grant innovation funding to support electric vehicle pilots and trials.
- Supporting behaviour changes – respondents provided mixed views however broadly included: communicating the risks and benefits of Connected and Autonomous Vehicles (CAVs) to the public, mechanisms to normalise electric vehicles within the market and change attitudes surrounding 'pioneering'.
- An integrated approach - specific responses included the role of Government in engaging with local authorities, communities and other organisations to support an integrated approach to smart and efficient transport agendas. Other respondents supported the need to clearly communicate a long-term strategy to support the delivery of infrastructure, along with the need for an integrated data platform to support the planning of future infrastructure.
- Incentivising electric vehicle use – respondents broadly supported that the Government should support high-quality, standardised infrastructure to facilitate the uptake of electric vehicles. Specific responses included

incentivising employers to install charging infrastructure, incentives to replace older and more polluting vehicles, and incentives for manufacturing to limit internal combustion engine production. A number of responses also proposed the public sector should lead by example and incorporate electric vehicles as part of their own fleet. Some respondents were also in support of placing bans on the sale of new fossil vehicles. Specific responses included a ban on fossil fuelled buses, coaches, other forms of public transport, along with motorbikes within two years, and a ban on all new fossil fuelled cars within four years.

7.2.2 Roll Out of Charging Infrastructure

A number of approaches were identified to facilitate the rolling out of charging infrastructure for electric vehicles. Responses were mixed, identifying the role of Government, and the private sector in infrastructure delivery. These included:

- Policy and legislation – many respondents agreed that Government has a key role to play through setting clear policy and regulatory frameworks to support infrastructure delivery. The approach and extent of these proposals were mixed, including: providing best practice guidance for local authorities, updating legislation to accommodate technological advancements, polices to manage the visual impact on the urban environment, collaborating with key stakeholders, incentivising efficient outcomes, promoting growth, establishing consistent baseline information and incentivising infrastructure in rural areas through grants. Clear targets for charging infrastructure should be incorporated into planning policy and Section 106 agreements.
- Strategic network of charging facilities – general agreement that a comprehensive strategic network of charging infrastructure was required, with the right charging facilities located in the right places. Respondents provided mixed views in terms of how to achieve this, particularly in terms of whether to prioritise filling gaps in existing infrastructure, or whether to expand and upgrade existing infrastructure to ensure it is future-proofed. A number of respondents supported charging facilities to accommodate a range of road users, and in strategic locations.
- Financing infrastructure – respondents provided mixed views, however broadly supported the role of the Government in leveraging private investment to deliver and maintain infrastructure in the long-term, along with facilitating competitive grants for local authorities, introducing tax incentives, and using public money efficiently to address market failures. Specific responses included the Government exploring options to reduce the costs of rapid charging facilities for users and suppliers, while others supported the expansion of the Clean Air Fund to increase capital and revenue funding available to deliver charging infrastructure.
- Support for standardised charging points, sockets and leads, both nationally and internationally, to facilitate rolling out charging infrastructure.

7.2.3 Distribution Network

There was a general consensus across the responses that there is a need to ensure sufficient generating capacity and security of electricity supply to meet increased

demands associated with electric vehicles. Comments received can be broadly grouped into supply-side issues, demand management, governance and research:

- Expanding capacity of the existing network – the requirement for costly upgrades to the distribution network, possibilities surrounding road user charging as a means to fund network upgrades, improvements to energy storage and encouraging market based solutions to address network constraints.
- Diversifying the supply of energy – alternative energy sources such as the increased use of renewables, low carbon options, maximising the value of the gas network, hydrogen fuel cell vehicles, and further exploration of the role of nuclear power. Respondents broadly supported the role of these alternative fuels in improving air quality and environmental outcomes.
- Managing demand – broad support for charging load only being taken at a time when the grid has adequate capacity. Respondents provided more mixed views on how this could be achieved. This included the use of a form of smart metering to regulate charging, and potentially exploring opportunities for vehicle-to-grid charge back during peak times. Other suggestions included Time of Use Tariffs, whereby price incentives are used to encourage off peak charging. Specific responses also included the need for cost reflective price signals to incentivise and reward effective load shifting. This would capture revenue streams from users of premium services to generate income. It was noted that the management of charging impact on the network should be managed through a combination of pricing signals and direct control from operators.
- Effective governance – the need for clear regulatory frameworks and an integrated approach to governance of the energy sector.
- Further research – further research is needed to inform appropriate solutions to network capacity. Specific responses included research into viability, public acceptability, cost-benefit analysis of need, demand management tools and their effectiveness in reducing pressure on the network, the potential of smart infrastructure, and the need to improve understanding of battery and storage technology.

A number of respondents were in support of a whole system approach being used to coordinate design, commercial and regulatory issues and identify clear lines of accountability.

7.2.4 Challenges and Uncertainties

A number of challenges and uncertainties were raised throughout the responses. There was a general agreement that there are barriers facing the widespread introduction of electric vehicles. The identified barriers included the anticipated demands placed on energy networks, and wider concerns over the potential for electric vehicles to disrupt revenue generation for operators due to its incompatibility with long-term spending plans. Specific responses also identified the insufficient charging infrastructure currently in place, with inconsistent costs across the network.

A number of respondents also noted potential barriers surrounding the large initial costs of electric vehicles in preventing mass uptake, along with uncertainties of

the timescales for technological and cultural changes, future patterns of vehicle use and consumer preference. Specific responses highlighted that there are public misperceptions about the practicality of owning and running and electric vehicles. It was also noted that the fast pace of technological change has created barriers for Government involvement with CAVs, and also poses the risk of 'locking in' inefficient infrastructure. There were mixed views, with some respondents supporting the need to set out a vision for how future travel is paid for, and clarify the role of the public in this process, with others supporting the withdrawal of state subsidises for CAVs.

Some respondents also raised concerns that opportunities for modal shift were not being fully explored. Although varied, there was a broad consensus amongst these responses that the electrification of the railways should be extended further, as it offered a more sustainable mode of transport. Specific responses raised concerns that there are uncertainties surrounding the impact of charging systems and access zones, and that these could restrict vehicular movement and divert traffic to different parts of the road network.

A number of responses also supported the role of other bodies and organisations in facilitating the roll out of electric vehicles and associated infrastructure. There were mixed views, with some respondents supporting the need for power, energy and public transport industries to be more proactive in advising the Government and automotive industry in decisions surrounding electric vehicles. Some respondents suggested that the private sector should take a leading role in funding new infrastructure, whilst others identified that market forces would determine the appropriate type and location of infrastructure, along with the most cost-effective approach to delivery.

7.3 Question 22

The Consultation Report identified that "*meeting the Government's greenhouse gas emissions target means that fuel duty revenue will have fallen towards zero by 2050. Traffic congestion is also a significant and increasing cost to society*." It sought views on: how the Government can best replace fuel duty and how any new system can be designed in a way that is fair. Some 52 respondents provided a response to question 22; this sub-section provides an overview of the comments received.

7.3.1 Replacing Fuel Duty

There was support for the need for a charging mechanism to help replace fuel duty, particularly one that is linked to congestion, and supports funding the road network. More mixed views were expressed on the proposed approaches to raising revenue, including:

- Distance based tax – a broad range of factors were suggested to calculate the rate of this tax, including the weight of vehicle, vehicle emissions, time of travel, fuel duty and route taken.
- Dynamic road pricing – a broad range of factors were suggested to calculate the rate of tax, including duration of travel, distance, vehicle emissions,

financial situation of driver and the potential for geo-fencing rural and urban areas.

- Charging specific to HGVs – the general consensus across respondents was to ensure larger vehicles fully covered the cost of associated road and environmental damage. A broad range of factors were suggested to calculate the rate of tax, including vehicle emissions, length of vehicle and distance travelled.
- Congestion charges – a number of respondents referenced the success of the London Congestion Charge. Respondents provided mixed views in their suggested application of the charge, with some supporting local charges set by relevant authorities, while other proposed national congestion charging schemes. A range of factors were suggested to calculate the charge, including forecast demand based on historical data, such as day of week, time of day, local status of road and the importance of the road segment for public transport and emergency services.
- Road user charging system for electric vehicles – a number of respondents supported introducing charges specifically for electric vehicles. Respondents provided mixed views, including a charge per kilowatt of energy required to 'fill-up' the battery, along with charges that take into account characteristics such as vehicle weight, time of day and distance travelled.
- Support for existing charging models – a number of respondents advocated the use of existing road charging models that are not currently implemented, such as the Clearways and Raccuja models.

Alongside road charging schemes, a number of other solutions were identified, to raise funds to replace fuel duty, including:

- Tax on non-domestic electricity use.
- Carbon tax to deter polluting vehicles - specific responses included road charges levied to nitrogen oxides and particulate emissions.
- Pricing determined by vehicles design, including volume and safety.
- Fixed annual administration for all vehicles.
- Increased level of vehicle licence duty for all vehicles.
- Flat rate charges in line with public transport accessibility levels.
- Tax on multiple car ownership.
- Increases in general taxation.
- Vehicle feed-in tariffs.
- Urban toll lanes.
- Collision costs.
- Local authorities charging for road works being carried out.
- Combination of pricing and selective expansion of road capacity.

There were further responses that focused on how the charging system should be implemented, as opposed to a specific charging mechanism. These included the consideration of any charging mechanism within the context of the wider digital society, drawing upon advances in mobile, location and traffic data to support behaviour change and the most appropriate outcomes. Some respondents supported the need to consider options based on national and international case studies.

There was support for taking into account additional levers such as Mobility-as-a-Service solutions and travel patterns within urban environments. A number of respondents identified the need to support modal shift away from peak travel times, and towards more sustainable modes. This included ensuring that charging mechanisms do not undermine incentives for the uptake of electric vehicles and other sustainable forms of transportation.

Changes to the law were proposed to support the enforcement of national charging systems, such as the legal requirement to have a smart meter and submit odometer readings.

7.3.2 Fair Charging System

In general, there was support for systems that strengthen the relationship between charges paid by road users, and the demands they place upon on road infrastructure and the surrounding environment. There were mixed views on how to implement a fair charging system, including:

- Exemptions and discounts – a number of respondents supported the need to protect vulnerable users, including those with limited access, older people, lower income groups, those living in rural areas, and those dependent on their vehicle for livelihood means. Respondents also supported the need to ensure that road users facing charges have a reasonable alternative.
- Consultation – a number of respondents supported a full consultation process to ensure any new system is transparent and accountable, and fully reflects public views. Respondents provided mixed views on the best way to achieve this, with specific responses including ongoing education, a public referendum and announcing any changes early to avoid pricing differentials.
- Data security – a number of respondents raised the issue of data security relating to location and journey information. Respondents provided mixed views on how to ensure privacy and data protection, with specific responses including having ‘authorised monitors’ to handle data, along with measures to anonymise data and discard it once analysed.
- Vehicle specific charges – a number of respondents supported varying charges for different types of vehicles, to ensure that less polluting vehicles such as motorcycles, were charged less. A number of respondents also supported the need for passenger and freight vehicles, along with public transport, to be exempt from any charging system.
- Cover the entire network – respondents provided mixed views, with some supporting that any charging mechanism should cover the entire road network, including urban, rural and suburban roads. This would allow for an equitable approach to charging, and rates could be calculated accordingly. Other respondents supported that road taxes should be used to incentivise greener vehicles to benefit air quality.
- Reinvesting revenue – a number of respondents supported that spending revenue from charges will need to be part of a transparent and accountable system, with some respondents supporting that a charging system should generate an overall level of income equivalent to the fuel duty income. Other respondents supported the proceeds of any charge being invested back into the transport system, particularly to support public transport and modals shift

towards sustainable transportation. Some respondents suggested revenue raised should be reinvested where the journeys took place.

7.3.3 Challenges and Uncertainties

A number of respondents did not have any detailed alternatives for replacing fuel duty, whilst others acknowledged that the Government has many options, and should explore a range of mechanisms. Many respondents referenced good examples of existing charging models, notably the London Congestion Charge.

Across the responses, a number of challenges and uncertainties were raised. These included the practical concerns around preserving data location and privacy, and the politically unpopular nature of road charging, particularly if road pricing would charge drivers more than fuel duty. Some respondents raised concerns that the pioneers of electric vehicles would see their initial savings in travel costs eroded by the new road pricing regime.

There were also concerns that road pricing would not be able to cover the backlog of maintenance required for highways infrastructure, particularly as the increased uptake of electric vehicles and Mobility-as-a-Service apps will result in fewer vehicles overall, and a reduction in vehicle excise duty. Specific responses noted that there are significant challenges in maintaining a safe and reliable highways network during a time of diminishing resources, ageing assets and growing backlogs. Other respondents supported the need for smart motorway and expressway programmes identified in Road Investment Strategy 2 to be designed to accommodate road user pricing.

Some respondents supported that road pricing needs to be considered as part of an overall restructuring of motor taxation, and could provide an opportunity to rebalance the costs of road based transportation. Specific responses identified that introducing a distance based tax for HGVs alone will not replace losses in fuel duty revenue.

Respondents also raised concerns surrounding the behavioural outcomes of charging schemes, and the potential for user exemptions to have unintended outcomes on the road system. In general, respondents were in support of intended behavioural outcomes being made clear, whilst others noted that an incremental approach would be appropriate. Specific responses relating to unintended outcomes included the potential for negative impacts on communities as a result of traffic diverted from main roads onto the local road network. A number of respondents also showed concern that electric vehicles make driving cheaper overall and therefore could increase congestion on the roads.

8 Reducing the Risks of Drought and Flooding

8 Reducing the Risks of Drought and Flooding

This section addresses feedback received on Chapter 6 including the responses to questions 23 to 26.

8.1 Question 23

The Consultation Report identified that "*given increasing pressures from climate change and population growth, and the need to safeguard the environment, it will be necessary to make better use of the water that is available. Metering can help identify leaks and encourage customers to use less water but will not be enough by itself.*" It sought views on: what should be done to reduce the demand for water and how quickly can this have effect. Some 54 respondents provided a response to question 23; this sub-section provides an overview of the comments received.

8.1.1 Water Demand Risks

The risk of decreasing water access was highlighted as a concern, and several pressed the point that this should not be underestimated. The concerns included:

- The consequences related to climate change, such as drought and potential impacts on health, the economy and particularly vulnerable industries.
- Population growth and influence on capacity (identified in areas with low water supply) and the need for a long-term plan to address this.
- A potential overestimation of the savings possible from smart metering, which could influence forecasts.

The respondents further provided a wide variety of suggestions as to how demand could be reduced. Very few addressed the timescale in a specific manner.

8.1.2 Planning Policy and Other Regulatory Measures

Many of those who identified planning policy emphasised the need to ensure that it regulated the need for efficient use of water in both new developments and existing homes. Some suggested that installing grey water systems should become a planning requirement for new development; others focused on local authorities' opportunity to better specify demand management requirements for new developments through the planning system. It was also suggested that water companies' Water Resource Management Plans should be better utilised and could be better integrated with regional and local plans.

Several propositions were made for other means of regulations, covering the need to enable interchange supply between water companies, reforming the abstraction licencing systems and the need to revise water stress destinations to allow companies to use domestic water meters. It was further suggested that new grades of water quality should be introduced to better allow for different usages, such as grey water for flushing and manufacturing. The need to encourage retrofitting of homes with more efficient equipment was also raised.

More collaborative and coordinated measures were suggested, through better links between policy for energy and water efficiency, the need for a national strategy to reduce water waste. Some also recommended that product-level standards should be encouraged in preference to building standards. This could build on existing Water Stewardship Standards, Waterwise Recommended Checkmarks and product-level standards in Scotland. Any product-level standards introduced should be monitored over time.

8.1.3 Building Regulations

In terms of building regulations, most respondents agreed that it was a useful and necessary tool to offset demand in new or existing buildings, and that there existed a potential to tighten them (or at least meet the 125 litres per day). Respondents also suggested that local authorities should tighten their building standards and technical standards through a nation-wide strategy.

Some respondents proposed that existing homes needed to be retrofitted to enable more efficient use of water resources, and that the use of financial incentives should incentivise developers to build more water-efficient new homes. A number of respondents also recommended that building regulations should be extended to also include non-residential buildings and existing buildings set for changes such as change of use, refurbishment or extensions. Lastly, the need to review the standards to reflect new technology was raised by some respondents.

8.1.4 Raising Awareness and Incentivising Efficiency Savings

The need for behavioural change for consumers, and the need for consumers to understand the complex issue of water access (resulting in behavioural change), was seen by most respondents as a requirement to reduce demand. Lack of awareness of the issues and of available incentives to reduce water use (which some thought there were too few of) was regarded as a fundamental reason for high consumption, although some thought awareness was rising, especially in the commercial sector.

The need for customer outreach was frequently recommended, either through education, national campaigns or multi-stakeholder initiatives. The need to better understand the consumer to enable better targeting through means such as language and timing was also pointed out by a few respondents.

Fiscal measures suggested to improve consumer management/awareness included pricing direct water use, better tariffs informed by smart meter data, or Governmental focus on hot water and bill reduction incentives by aligning with energy efficiency schemes. Many suggested labelling mechanisms (some emphasised it should be issued by Government), like the energy savings labels or European water labelling, to inform customers at the point of purchase.

Several respondents suggested learning from piloted programmes, existing strategies or methodologies or markets, such as Spain and Copenhagen, which have both utilised campaigns to successfully reduce demand. Other examples included:

- Pilot providing financial incentives or fees to developers to achieve more efficient homes.
- Home visits to areas with low-supply.
- Smart metering and water saving devices.
- Single-district meter pilot.
- Stakeholder involvement in the development of new schemes.

8.1.5 Leakage Reductions

Respondents identified leakage reduction as an area with great potential to reduce demand, and emphasised that leakages, if not properly addressed, undermined other initiatives to reduce water management. The NIC was urged to continue to address leakages in forthcoming assessments, and recommend Ofwat to take action on this point.

Water companies naturally had a big role to play in many responses, as they are key to reducing leakages. Suggestions varied from setting more challenging leakage targets to water companies, reviewing companies' business plans to ensure that they planned for more efficient water use, and better management of pipe pressure, or use of technology (for example smart meter data) to drive better maintenance and repairs. Some respondents further suggested more active management of pressure in pipes, and new technologies, better maintenance, analysis and repairs due to mutual benefits for all actors involved.

There was encouragement for considering water companies' commitments (or incentivise them) to show a robust evidence base of leakage commitment to customers, as they can be influenced by their behaviour. Water companies need to 'do their bit' to encourage customers willingness to save. Some respondents suggested water companies should have compulsory ownership of pipes to help identify leakages, as some cannot be monitored within properties where pipes are owned by others. This should also be addressed by policy.

Some respondents raised the issue of coordination, or the lack of it, exemplified by a suggested approach to improve coordination with other utility providers (such as energy and sewerage) who frequently conduct repairs to pipes and/or cables causing public disruption. Sharing information between them, and ensuring utilities are collocated (particularly in new developments) could reduce this disruption. The Greater London Authority is investigating the possibility of establishing an infrastructure development coordination unit to make this easier in the future.

Some respondents identified the issue of ageing infrastructure as more prone to leakage, and the difficulty in raising private finance to cover this. Ofwat demands (such as the sustainable economic level of leakage) were seen by many as too high, and several suggested they move away from it to better incentivise leakage repairs. The NIC is urged by some respondents to address leakage in the forthcoming assessment, and to consider revising leakages and consumption assumptions in modelling for future drought, to mirror Government ambitions and companies water management plans.

8.1.6 Smart Metering

Most respondents suggested smart metering in various ways, primarily encouraging further use and rapid roll-out, some respondents suggested this should also be complemented with more efficient products. Some respondents warned that compulsory roll-out would not represent a 'silver bullet' to addressing water scarcity and behavioural change, and that it would not compensate for new infrastructure development. Several respondents mention that the roll-out percentage is what differs water consumption numbers with other European countries.

Suggestions for improving roll-out range from removing legislative barriers, requirements for new developments, and expanding the ability of water companies to undertake metering programmes, or providing financial incentives to increase the usage. Another proposal was to take a holistic approach to smart meter use which would include leakages, grey water use and recycling measures and water resource development. On the customer side, some respondents recommended smart metering to be sensitive to price, some suggested financial incentives to increase use coupled with better outreach concerning the benefits.

8.1.7 Innovation

Innovation was identified as a mechanism to reduce demand. Examples identified included:

- Smart rainwater harvesting systems.
- Increasing use of smart technology and water efficient appliances.
- Drip irrigation in agriculture.
- Smarter use of existing supply such as water retention methods.
- Removal of barriers to re-distribution of supply across areas.

Some respondents suggested that Ofwat should have a clear role in driving innovation to reduce demand of water, and that more research would be required to further understand barriers and enablers of future demand management.

8.1.8 Other Comments Related to Demand Management

Some respondents felt that demand management was only part of the solution, and that it should not offset new investment. Some respondents claim new infrastructure is more cost-effective than reducing demand, and highlight that the state of ground water reduction should incentivise new infrastructure. It is also noted by some respondents that the value of water needs to reflect demand management. Some respondents further mentioned that new infrastructure is required to deal with population growth and effects of climate change, increased drought resilience and green infrastructure with long-term funding. Other respondents raised that water companies should maximise efforts to increase productivity and asset use of existing infrastructure.

Respondents from dissimilar industries naturally responded differently, and some respondent raised that each stakeholder must be recognised to avoid unfair disadvantages or limited sectoral views. While some respondents mentioned the

need to better regulate agriculture, agriculture respondents requested not to be unfairly treated. The energy sector sought a focus on 'optimal use' instead of solely reduction, as their water consumption also influence energy prices through cooling systems.

Increased use of grey water, rainwater and other means of recycling and catchment methods by businesses was frequently suggested by respondents, as was the need for more integrated water management systems to reduce demand. Suggestions included more integrated water systems and incentives to relevant actors to increase the use of rain water, black or grey water. Some respondents further emphasised the need to assess opportunities for reallocation of water resources between areas.

Water as driver for economic development and growth: as the South East is an area with pressure on supply, several respondents suggest incentivising growth in other regions, closer to water sources. Some respondents also questioned whether growth should be concentrated to avoid areas with low water supply, and that new developments must be considered in combination with pressure on demand for water. Other respondents raised that the current demand management in local plans and strategic economic plans' is not sufficient to deal with future growth, and should be addressed.

Government, water companies and the regulator's delivery of long-term water security was raised as an important point by many respondents. Some respondents raised that incentives to reduce demand should be better aligned across the public and private sector, while other respondents raised their concern related to the Industrial Strategy and its unlikeliness to enable further reductions.

8.2 Question 24

The Consultation Report identified that "*reducing demand is unlikely to be enough to secure resilient water supplies. Some major new water supply infrastructure is likely to be needed well within the next 30 years*." It sought views on: what the key factors are that should be considered in taking decisions on new water supply infrastructure. Some 56 respondents provided a response to question 24; this sub-section provides an overview of the comments received.

8.2.1 National Planning

A number of respondents referenced the Defra National Policy Statement, some expressed support for the long-term aspirations, others do not consider it to be needed at the current time, and that decisions on infrastructure should be taken locally. There was support for the opportunity to reduce thresholds for infrastructure projects to be considered as NSIP and the associated certainty around consenting timescales, with the need for relevant stakeholders to be included from the early stage of the process.

In respect of national planning of potable water, there was support for a stronger steer to Ofwat and the Environment Agency on regional, multi-sector water resources planning with co-ordination to deliver the right solutions. Other suggestions included: a water cycle champion to identify the optimum solution for

the UK; a national level adaptive plan looking ahead to 2045-60; and additional Environment Agency resources.

New infrastructure should be as adaptable as possible for a wide range of scenarios, be considered holistically, be efficient in all stages, ensure sufficient storage supply, be delivered before water resources go into deficit, take into account operation and maintenance and align flood risk and water supply to spread the cost of infrastructure across funding streams.

8.2.2 Supply and Demand Management

Supply and demand should be considered in parallel, and supply should only be considered once demand has been optimised to support resilient water supplies.

Drought resilience should be a key factor in planning supply to address climate change, population growth, industrial and agricultural demand, environmental protection and sustainable abstraction.

A range of suggestions for water supply were identified in the responses including: raw water transfer between regions, desalination, reservoirs, quarries, abstractions, capture and treatment. Related measures included metering, demand management programmes, catchment interventions, reducing leakage, precision agriculture, winter storage, rainwater harvesting, water efficiency, treated waste water, SuDS to promote natural aquifer recharge, wetland and habitat creation, aquifer storage and recovery.

In considering proposals, a range of factors were identified for consideration, including: environmental impact, cost, best value, deliverability, intergenerational fairness, customer views, Government policy, reliability and resilience, growth plans and phasing and associated water demand and shortage, meeting regional needs, water quality, site availability, impact on existing utilities, single scheme and cumulative impacts.

A number of the respondents noted the water resource management plan (WRMP) framework as a tool for planning, and highlighted the need for regional or national scale plans as a platform for larger infrastructure schemes and raw water transfer. The scale of planning reflects comments on the need to look at new supply infrastructure for the first time in a number of years. Suggestions were also set out for additional aspects to be considered in the WRMP process including least environmental risk options.

8.2.3 Funding

Mixed views were given on funding. Some respondents suggested that water companies should carry funding and delivery risk. Points were raised on who pays for what, measures to protect water customers from poor financing decisions, smoothing of bill impacts, the need for clear governance on funding and cost recovery and phasing of investment. Additionally, separate financing of significant infrastructure was identified as positive for transparency as was the legitimacy of investment in sustaining investor confidence.

8.2.4 Other Comments

A range of other views were provided on water supply, including comments on: on-farm reservoirs, environmental management practices to reduce costs and improve reliability of water treatment, support for the NIC new technology study and capital investment for water supply and maintenance, developer charging reforms to deliver a more proactive approach to planning upgrades.

8.3 Question 25

The Consultation Report identified that "*there is limited understanding of current drainage and sewerage capacity. Although pressures are increasing, there is little long-term planning*." It sought views on: how long-term plans can for drainage and sewerage be put in place and what other priorities should be considered. Some 52 respondents provided a response to question 25; this sub-section provides an overview of the comments received.

8.3.1 Long-term Planning for Drainage and Sewerage

There was general support from respondents for a long-term approach to planning drainage and wastewater in the UK to build resilience in the current and future system. A number of benefits to long-term planning were identified, including supporting economic development and public health: helping water companies to better understand risks and long-term pressures, and identifying the most efficient and necessary areas for investment to bring long-term value for money to consumers and others. The challenges of identifying the right scale for planning was raised by a number of respondents, and suggestions included: national, regional, local authority, water company and catchment area plans. Where water companies are responsible for water planning, the challenge of whether to have one plan per company, plans for individual catchments, or plans for groups of catchments was raised.

While some respondents noted the benefits of the flexibility in the current system in enabling water companies to develop plans that reflect local context, there was general support for the recommendations within Water UK's 21st Century Drainage Programme for a standardised approach for long-term Drainage and Waste Water Management Plans (DWMPs) and a consistent set of metrics and tools. Some respondents recommended that the standardised approach should build upon the existing Drainage Strategy Frameworks and any ongoing Government research, such as the work of Inter-Ministerial Group on Flood.

There were mixed views expressed regarding the status that this standardised framework should have. Some respondents suggesting it be made statutory, others were opposed to this idea whilst others favoured some degree of specification. Some respondents suggested a degree of mandating should be integrated into the framework to ensure parties – particularly Government Departments and bodies, as well as local authorities – are aware of, and enact their required roles. The opportunity for DWMPs to influence customer behaviours as part of risk management was also noted.

Further work to develop a consistent framework for DWMPs, in collaboration with a wide range of relevant stakeholders was recommended. There was some support among respondents for encouraging companies to produce long-term plans including that they should be approved by Ofwat as part of the Period Price Review Process and/or as part of Price Reviews PR19 and PR24.

Historic difficulties in coordination and planning of drainage and sewerage were identified as a possible barrier to future economic growth. Therefore, the need for collaboration more widely in planning for drainage and sewerage was also raised by a large number of respondents, with suggested stakeholders including the Environment Agency, lead local flood authorities, risk management authorities, water companies, sewerage companies, elected Council Members, local planning authorities, developers, industry groups, customers, third sector, local community, and Local Enterprise Partnerships. It was considered this would enable co-created solutions. There was some support for responsibility for drainage to be transferred to the local level; other respondents suggested this could be unsuccessful where there is a lack of local leadership, and could lead to a loss of expertise which is currently held by the Environment Agency.

The need for awareness raising initiatives to encourage local communities to develop their own small-scale solutions, alongside larger physical interventions was noted. Consultation was encouraged on long-term plans, as was ensuring that all stakeholders within a catchment area are treated equally in future planning.

The need for transparency between parties was highlighted, particularly utilities companies and local authorities to enable sharing of a range of data to support long-term planning. The need for better information sharing to map risks and opportunities was also stressed alongside the importance of increased knowledge of existing sewerage and drainage systems; this was seen as a vital first step for the implementation of long term plans. Respondents also noted the importance of data in an increased understanding of the state and risk of existing infrastructure, through a consistent database of drainage and sewerage assets, and how to make it fit-for-purpose/increase resilience.

In the context of a currently fragmented approach to management of water, drainage and flood, a number of respondents raised the importance of aligning long-term plans for drainage and sewerage with those for wider water cycle, including water supply and quality. Water companies were encouraged to align their business plans with long-term planning for drainage and sewerage.

Funding was another key topic for respondents, and it was suggested that management of drainage and associated flood risk is under risk due to lack of funding. More funding was called for and opportunities for co-funding of solutions to drainage and sewerage management were supported, alongside a flexible forward funding approach. It was encouraged that long-term plans consider funding availability, and how maintenance of assets in the future will be funded.

Respondents made a number of suggestions as to the approach that long-term drainage and sewerage plans and/or DWMPs should take when assessing the right approach to drainage and sewerage management, including:

- Adopting a whole systems approach.
- Planning drainage at a catchment scale.
- Assessing and communicating drivers of risk and quantifying likelihood and uncertainty of risks.
- Taking a risk-based approach, exploring all aspects of risk and opportunity associated with drainage and sewerage treatment, as well as wider network flooding and how future and current challenges will be met.
- Taking into account environmental and social benefits, as well as economic.
- Taking account of long-term costs to consumers.
- Providing a more nuanced set of design and testing rules to allow a balance to be struck between options, costs, risk and charges allocation.
- Including short, medium and long-term goals with relevant review milestones.

8.3.2 Other Priorities and Mechanisms

Alongside long-term planning, a number of additional priorities and mechanisms were recommended to support the implementation of a more holistic approach to drainage and sewerage. These included:

- Review and amend rights of discharge to watercourses, and roles in determining rate of discharge decisions.
- Investment in skills and capacity of lead local flood authorities to enable them to better respond to issues of drainage and sewerage.
- Reviewing design standards to take into account more extreme weather events and other future scenarios.
- Developing a standardised design methodology and minimum standards for drains and sewers in the UK.
- Enhancing powers of local planning authorities to enable infrastructure to be delivered, including site wide infrastructure strategies, and developer contributions.
- Improving mechanisms for developers to access third party land to undertake drainage works.
- Enabling regular liaison during planning and implementation so early information can be reviewed and regular interaction with developers.

A number of respondents highlighted the pivotal role of the Local Plan process in determining requirements for development related drainage and sewerage infrastructure investment and provision, and prioritising addressing capacity issues and agreeing drainage plans prior to development coming forward. The role of water companies in contributing proactively to Local Plans was raised by a number of respondents, with some respondents suggesting water companies be made statutory consultees for both Local Plans and planning applications.

The use of new technologies to improve treatment and management of wastewater was also supported, and further research and development on sewerage management was called for, including opportunities to explore different technologies used for sewerage treatment, and opportunities to optimise capacity within sewerage and drainage networks. Alongside this, pilot studies were promoted by a number of respondents to help with identification of the right

approaches to drainage and management, and to help share lessons learnt and best practice. Concerns that water companies were treated too favourably by Government were raised by a number of respondents, and that existing and proposed mechanisms do not provide equitable charging arrangements, and are not contributing to meeting infrastructure requirements.

8.3.3 Sustainable Drainage and Surface Water Management

Tackling surface water management, and the consequential impacts on sewer capacity was highlighted by a number of respondents as a major challenge, in the context of large numbers of combined sewerage systems that carry both rainfall and sewage. Respondents highlighted the historic flood (and consequent pollution and environmental health) events, which have been caused as a result of this system, where large amounts of surface water have overwhelmed the drainage systems. Investment in separating sewers to avoid such risks was suggested, alongside sharing of infrastructure between utility companies which would lead to better organisation of sewerage systems. Other respondents noted that separating systems would be exceptionally costly and alternative approaches, with a focus on surface water management and reduction should be found.

The integration of sustainable drainage systems (SuDS) into the drainage systems was therefore supported as a tool for increasing resilience to climate change and flood. It was suggested by some respondents that this could be encouraged through a sustainable drainage plan. Concerns were raised by respondents that the uptake of SuDS has not moved at sufficient pace, and they have not been widely integrated into new or existing developments. Respondent's identified different barriers to the uptake of SuDS in existing and new developments including:

- Existing development: Respondents flagged the challenges and high capital cost of retrofitting SuDS (although it was noted that demonstrator projects are taking place). Some respondents supported roll-out of a national SuDS retrofit programme, using financial and planning levers to encourage uptake.
- New developments: Concerns were raised that requirements for developers to consider SuDS are not widely used. Many respondents suggested that all new developments should be required to provide SuDS, rather than being subject to negotiation through the planning system. The requirement to incorporate SuDS into new developments was introduced as part of the Flood and Water Management Act 2010. Some respondents suggested this requirement has had limited impact and that it does not facilitate an understanding of the wider benefits of implementing SuDS. Respondents placed particular emphasis on the need to invest and support legal frameworks and expressed concern that Schedule 3 of the Flood and Water Management Act 2010 has not been (and should be) enacted.

The importance of effective town planning in ensuring SuDS are adopted in new development was raised. Some respondents called for more effective use of Section 106 agreements and planning conditions to secure on-site SuDS. A number of respondents also supported changes to SuDS policy, including strengthening of Planning Policy Guidance on SuDS, alongside the inclusion of specific text in the National Planning Policy Framework. A small number of other

respondents, suggested that the current policy guidance was adequate and any changes would cause unnecessary delays to implementation.

Other respondents suggested that provision of SuDS should be a condition of connection to the sewerage network, and the right to connect surface water to combined and surface water systems should be reviewed and only allowed if no alternatives are possible.

A number of respondents emphasised the need for clarity on roles and responsibilities with regard to SuDS. The cost of SuDS implementation and management for lead local flood authorities was raised, with concerns that Government estimates for the costs were significantly less than reality. The lack of clarity on long-term funding sources for maintenance was also noted. It was suggested that more could be done to engage and encourage take-up of SuDS from other parties, including developers, landowners and land managers, and the water industry. The lack of duty on the water industry to adopt SuDS was raised as a possible barrier to growth, as it places all the risk and cost on developers. A more collaborative, partnership approach to SuDS implementation was therefore encouraged. The opportunity to use Periodic Price Reviews as a mechanism for gaining support and funding for SuDS solutions was proposed.

A number of additional measures were identified by respondents to support greater integration of SuDS, including:

- Use of advanced planning techniques to ensure the most cost-effective SuDS solutions are identified and implemented.
- Development of a clear mechanism for raising funds for maintenance and eventual replacement of SuDS.
- Statutory new standards aimed at optimising opportunity to achieve amenity, biodiversity and water quality benefits alongside flood risk reduction.
- Area-based surface water charging, as recommended by Ofwat to act as a financial incentive to increased SuDS.
- NIC providing support for Water UK's revised sewer adoption manual which will includes SuDs for the first time.
- Incentives to particular industries or parties (for example farmers and developers).

8.4 Question 26

The Consultation Report identified that "*flood risk is increasing due to climate change and population growth. A range of actions are already being taken to manage risk, but the overall level of ambition is unclear*." It sought views on: what investment is needed to manage flood risk effectively over the next 10 to 30 years. Some 84 respondents provided a response to question 26; this sub-section provides an overview of the comments received.

8.4.1 Approaches to Flood Risk Management

A variety of flood risk management measures were proposed by different respondents. Many respondents supported the use of a package of measures,

incorporating both natural and more traditional infrastructure responses, with a desire to target more 'slow flow' techniques, which can provide a more flexible response to surface water runoff rates compared to hard infrastructure that can only protect from a fixed level. It was suggested that monitoring is required to understand its efficacy of different measures in reducing flood risk. A number of respondents suggested that the UK needs to better understand the cost-benefit analysis of different measures for flood risk management and mitigation. Using a multi-benefit approach, with improved integration of social and environmental benefits was supported by some respondents. Suggested measures for responding to flood risk included:

- New and upgrades to existing hard engineering solutions, for example flood barriers, coastal defences, sewer capacity.
- Natural flood management (NFM), for example (re)establishing flood plains, wetland creation, restoration of peatland, afforestation, planting of vegetation.
- Avoiding building in areas at risk of flood.
- Utilising flood water storage.
- Maintenance of existing surface water management systems.
- Sustainable Drainage Systems (SuDS).
- Use of green infrastructure (green walls, roofs, swales, rain gardens etc.).
- Property level protection (such as flood gates), floating or amphibious homes, sacrificial ground floors, under floor air vents, removable barriers at doors.
- Use of new construction methods suitable and adaptable for flood locations.
- Providing emergency access and egress.
- The use of permeable materials such as permeable concrete or asphalt.
- Mitigation measures, for example use of sacrificial spaces, or design of roads to allow them to be used as a channel for flood water.

While concerns around long timescales to restore natural processes, investment challenges, and negative impacts of poor implementation were noted, a significant proportion of respondents emphasised the role of NFM in managing flood risk effectively and encouraged investments in this area where it represents an appropriate response. The benefits of NFM included its low-cost impacts, particularly in responding to smaller scale flooding, alongside wider benefits beyond flood risk management (for example biodiversity and amenity value). Opportunities for NFM were particularly noted in coastal areas. It was suggested benefits would be best achieved through a partnership approach between sewerage companies, local authorities and other parties responsible for drainage. The need to establish evidence of the scale of opportunity NFM provides was identified, as well as investment in effective and robust monitoring of NFM to inform future decisions.

Despite support for natural and softer measures to flood risk management, a number of respondents highlighted that these can be of little benefit at times of large flood. They suggested that the importance of hard infrastructure and traditional infrastructure-led approaches to flood risk management should therefore not be underplayed. A number of existing projects were referenced by respondents asking for NIC support in promoting the need for investment in existing and pipeline projects to support flood risk management across the UK.

There were mixed views on the balance between prevention and mitigation approaches. For some respondents, there was a preference for prevention measures rather than dealing with the impacts of flood. However, other respondents noted the inevitability that flood risk cannot be eliminated entirely, and the possible negative impacts of flood protection measures on buildings and assets. It was also noted that there are properties at risk of sewer flooding where the solution required to protect them is too expensive but mitigation measures might be more cost-effective. As such, respondents suggested that focus should be on mitigation of the impacts of flood and how quickly communities can recover from flooding events, as well as the prevention of flood itself.

Concern was raised by one respondent with regard to the NIC's view that flood and coastal erosion risk management approaches can be set out as a hierarchy, with investment in protection preferred to investment in adaptation. They noted that it may be more appropriate to invest in making communities more resilient than investing the same money to make fewer properties safe from flood. A concern was also noted that the NIC did not consider flood risk from the sea in the interim NIA, while another respondent suggested that coastal protection and adaptation need to be more fully covered.

Opportunities to learn from international best practice examples (including China's Sponge Cities, the Active, Beautiful, Clean Waters Programme (Singapore) and Water Sensitive Urban Design (Australia) were raised by various respondents.

8.4.2 Strategic Long-Term Planning

There was overall support among respondents for a more open, joined-up, holistic and strategic approach to flood risk management, considering the full range of different approaches from the outset. This was particularly supported in the context of climate change and consequential sea level rise and extreme weather events. The current lack of a comprehensive, concise and coherent management plan for flood issues was raised as a concern. A timescale of 10 to 30 years was supported by some respondents, while other respondents considered planning should well beyond this period.

Reference was made to a number of documents, and there was support for their integration into the NIA when considering long-term planning for flood risk management, including the National Flood Resilience Review, the Climate Change Risk Assessment, and Defra’s 25 Year Environment Plan. It was proposed that Government should provide direction on the level of protection to be given to sites and services to enable water companies to determine the level of investment needed. There was also support for a framework from Government to enable industry to lead flood management and protection.

A catchment based, integrated approach to flood risk management was supported by some respondents as a means of delivering sustainability for both environment and communities at risk of flood. This approach was seen to be important in identifying and maximising synergies, to inform meaningful investment in both built infrastructure and natural capital. Some respondents called for NIC to acknowledge the importance of catchment management in the NIA.

It was also suggested that integrated regional plans should be developed which focus on different flood nature in different parts of the country. Some respondents also suggested that the Environment Agency (EA) needs to move away from a focus on regions and be re-configured to reflect the appropriate devolved governance structures now maturing across the country. The development of flood risk management strategies by metro mayors or combined authorities was also proposed.

The six year horizon for funding of current capital programmes received significant support from respondents, and there was support for the extension and evolution of this. However, some respondents noted a series of challenges in relation to the EA's rolling six year plan including inconsistencies and lack of compatibility with Lead Local Flood Authorities (LLFA) approaches, and a focus on particular types of flood infrastructure.

The importance of data, technology and research for understanding both flood patterns and assets at risk of flood was noted as important by a number of respondents. Some respondents called for the NIC to invest in further research in a range of areas, including: the role of forest management in managing flood risk, and the use of Green Infrastructure in cities and towns to reduce rainwater runoff.

On-going acquisition and analysis of data, and risk models was flagged as important to ensure an adequate and realistic base dataset is used. A central register of flood assets and infrastructure and a consistent approach to assessing their condition was called for, alongside climate change risk assessments and plans for all asset operators and support for NIC’s digital twin work. A comprehensive approach to building resilience in flood risk management infrastructure was supported, involving vulnerability and risk assessments. Use of linked weather forecast and risk models was also supported to provide more accurate, reliable and timely information about flood hazards. A number of specific new and innovative approaches to flood modelling were referenced.

There was also support for better sharing and knowledge building across infrastructure owners. This tied in with a wider view of respondents that allocation of responsibility in flood risk management is currently fragmented and therefore a more collaborative approach is needed to managing flood risk. This included specific calls for better integration between local authorities and water companies, as well as joint working with the EA and other responsible bodies. The bringing together of River Basin Management Panels and Regional Flood and Coastal Committees was suggested to maximise efficiency in (water quality and) flood risk planning. Integration of the work of central Government departments and agencies was also identified as important. It was suggested by respondents that regulated utilities, the EA and drainage authorities should be subject to a statutory duty to co-operate requirement as set out in the 2010 Flood and Water Management Act. A simplification of the currently fragmented approach to flood risk management was also suggested by one stakeholder, with water companies becoming LLFA.

8.4.3 Investment Approaches

For many respondents, it was considered essential that long-term funding is secured for a more proactive, ongoing programme of installation and maintenance of flood risk management assets, which prevents reliance upon funding only made available in response to major flood events. It was suggested that Government should invest in providing a set of strategic objectives for flood risk management, covering standards, protection and funding mechanisms to effectively manage future flood risk. For some respondents it was concerning that no mechanisms appear to be in place to ensure that new flood defences do not become a burden on the public purse.

It was suggested that funding the management of local flood risk duties under the Flood and Water Management Act (2010) has been greatly assisted by the five year revenue settlement. Respondents called for a commitment to similar revenue settlements for future years. A national resilience body was also suggested, that would help to coordinate levels of investment required. Some respondents referenced the success of partnership funding programmes, and called for partnership funding methods to be made simpler to access and administer.

Reference was made to the EA's Long-Term Investment Scenarios and their need to be updated to reflect growing understanding of responding to changing risk. Concerns were raised about the Long-Term Investment Scenarios, including assumptions regarding external partnership funding, maintenance of existing defences and flood risk management structures.

A large number of respondents highlighted the significant scale of investment required to support flood risk management in the UK, although it was noted this depends on a number of factors, including population growth. It was noted that investment is particularly needed in existing assets, noting the capacity of existing infrastructure and opportunities to integrate upgrades into existing asset replacement and upgrade cycles. A lack of financial support to appropriately upgrade existing infrastructure was raised. Spending little and often to maintain capacity in the flood and drainage infrastructure was supported. A 'total expenditure' approach to funding flood risk management was supported, which values investment in maintenance and is aligned with water company and other sector investment.

Some respondents considered that a combination of private and public sources of funding is required for flood risk management infrastructure delivery. For some respondents, a reliance on public sector contributions was seen as a risk to projects. Where water companies have responsibility for maintenance of existing flood risk assets, it was suggested that a levying scheme might be required, which increases costs for consumers but shares the burden.

More specifically, respondents raised a number of key points for consideration in determining the right investment approach, including:

- Support for existing Government commitments regarding flood management, including: requiring more efficiency in capital project delivery; improving flood insurance products; and placing the cost burden for investment on developers and landowners (rather than local sources).

- Evaluation of all current flood risk funding regimes, to align all schemes for the benefit of the public purse (reducing recirculation of funding).
- Use of new market approaches to support Government funding, for example payments for ecosystem services where those benefitting from the flood risk management services financially contribute.
- Use of managed adaptive approaches/adaptation pathways in the development of major infrastructure projects (for example, Thames Estuary 2100 plan approach).
- Clearer routes to gaining funding from outside sources.
- Expansion of the Flood Re programme to small businesses
- Building on the change in the Common Agricultural Policy as a result of Brexit to invest different and provide incentives for this.
- Building more flexibility into grant determination when resilience improvements are required to enable improvements to be made during maintenance and repair (rather than 'like for like' replacement).

Concerns were raised with regard to the Government's Grant-in-Aid for flood and coastal erosion risk management, including the provision of insufficient funds to provide high levels of protection, lack of focus on surface and groundwater risk management, and granting of funds on an annual basis (as opposed to the proposed six yearly basis). Respondents particularly challenged the scheme's focus upon the total number of properties protected from flooding, as a key measure of grant award. It was suggested that this makes it challenging for certain projects (including SuDS, Green Infrastructure, rural-based projects, small community-based projects and non-residential schemes) to gain access to funding, as well as ignoring the collective benefits that small local improvements can have. A review of the methodology was proposed to ensure the right infrastructure is in place, and it was suggested that more weight should be given to schemes which provide wider environmental benefits (for example, water quality, biodiversity, air quality, etc.). A small number of respondents suggested that current levels of funding for flood risk management, through the Grant-in-Aid programme are insufficient to provide high levels of flood risk protection.

There was also significant support for investment in resourcing and capacity at the EA, LLFAs and local authorities to help these bodies in their flood risk management roles through the local planning and development planning processes in particular.

8.4.4 Regulatory, Policy and Legal Changes

Beyond investment, respondents raised the importance of existing legislative and regulatory frameworks in minimising flood risk. A number of other approaches to improving flood risk management were suggested, which included:

- The introduction of flood management requirements into building regulations for new development.
- The re-establishment of a Cabinet Committee on Flooding.
- Updated national policy to drive local delivery of flood management measures.
- Updated Design Codes to respond to latest climate change projections.

- Better use of the development planning process to manage flood risk, ensure new development has negligible impact on flood risk, and prioritisation of contributions to flood risk management in Section 106 and Community Infrastructure Levy, over other planning contributions.
- Integrating flood risk management into local and neighbourhood planning, and economic and social development programmes.
- A review of how all land management subsidies interact to provide the best overall outcomes for farming, flooding and environment to address concerns that farm payments under the Common Agricultural Policy are not aligned with other water quality/funding objectives.
- Development of national policy that advises on how to engage with communities whose homes are at risk from sea-level rise and coastal erosion.
- Clearer milestones and responsibility for implementing Shoreline Management Plans.
- Raising awareness among homeowners if their home is at risk of flooding, for example, requiring flood mapping to be provided on sale.

9 Financing and Funding Infrastructure in Efficient Ways

9 Financing and Funding Infrastructure in Efficient Ways

This section addresses feedback received on Chapter 7 including the responses to questions 27 to 28.

9.1 Question 27

The Consultation Report identified that "*the European Investment Bank and the Green Investment Bank have played an important role in financing infrastructure, but this may change following Brexit and privatisation of the Green Infrastructure Bank. The UK will need to have continued access to a similar range of services and expertise*." It sought views on: what the most effective institutional means to fulfil the different functions currently undertaken by the European Investment Bank (EIB) would be if the UK loses access and whether a new institution is needed or could an expansion of existing programmes achieve the same objectives. Some 39 respondents provided a response to question 27; this sub-section provides an overview of the comments received.

9.1.1 Risks and Challenges

The importance of the EIBs contribution was acknowledged by respondents. Many chose to highlight the significant risks that will arise with potential loss of access to it. The main concerns were associated with loss of flexibility for UK recipients in access to finance, and increasing cost of finance as a result. The loss of the expertise, risk-willing capital and market stability provided by the EIB were common concerns.

Several respondents further chose to highlight the risk of losing access to other EU institutions important for infrastructure funding and research, for instance the EU Fund for Strategic Investment, the European Energy Programme for Recovery, the Trans-EU Network for Transport and Horizon 2020.

9.1.2 Most Effective Institutional Means

There was support for the UK remaining in the EIB, either through joining the European Free Trade Association or remaining as a shareholder through other means. This was by some seen as a probable opportunity, as the EIB provides support to non-EU countries already through a variety of circumstances.

However, it was acknowledged that remaining in the EIB would not necessarily be a viable option. The responses to the most effective means of replacing its functions broadly fell within two categories: the establishment of a new UK-based institution or the need for a new institution is limited.

New UK-based Institution

The establishment of a new UK-based institution was suggested by several respondents. Which services a new institution should include and its preferred

structure varied, although most underlined the importance of similar or improved support to the EIB's in terms of knowledge, procurement experience and capital provision. The importance of independence from the Government was also addressed, and some suggested that a similar function to the GIB should be established. It was also noted that an interim measure will be required whilst the new institution is being established.

A number of respondents mentioned a UK Infrastructure Bank (IB), as suggested by the LSE Growth Commission, with some further suggesting that such a Bank should have a wider role, with mandate to make project loans, conduct infrastructure appraisals and/or provide recommendations to the Government. Other suggestions from respondents related to the services that could be provided by the IB included:

- Crowd in private investment through Government guarantees and reinvestment of profits.
- Deliver more sustainable and environmentally beneficial infrastructure in a more efficient way than existing private financing models.
- Make infrastructure investment more consistent and less vulnerable to recession.
- Promote difficult cases or function as a last resort.

In terms of the form and focal points of a new institution, suggestions ranged from better utilisation of pension funds, a seeded fund with mostly private investors, to a centralised fund for projects in need of high capital expenditure, similar to the Green Investment Fund or a sovereign wealth fund. The need to learn from models used in other markets was also frequently suggested by respondents. Many respondents included the importance of a new institution avoiding crowding out other forms of funding including, for example, the use of regional banks drawing on Germany's experience. It was further suggested by some respondents that a new institution should issue a co-lending function, or collaborative financing models, while some suggested existing institutions which could constitute or be a part of the new institution.

No Need for a New UK-based Institution

The need for a new institution is limited, and establishing a UK alternative could prove to be challenging. Several respondents expressed concern that a new institution was not necessarily the right response in this situation.

Alternatives varied from more efficient Government regulations with predictable planning permission outcomes, to better coordination of existing functions such as banks, bodies, departments and funds. The cross-departmental approach used in the Thames Tideway Tunnel was an example model suggested by some respondents to follow; as was better utilisation of existing Private Finance Initiatives and Public Private Partnerships, which are currently conducted with no EIB support.

A few respondents expressed that, even without the EIB, there should be enough available investment capital in the UK, however, private providers of capital could be inexperienced.

It was additionally underlined by some that a new UK replacement institution would be difficult and time consuming to replicate, with a potential result of increasing bureaucracy.

9.1.3 Other Mitigating Means

Means of mitigation for the loss of the EIB were identified. The suggestions included financial incentives, such as reducing margins on a variety of public loans and the general cost of borrowing, reform of pension funds to allow for more active infrastructure funding, exploring the opportunity for a sovereign wealth fund which follows strict fiscal and ethical principles, and extending the UK Guarantee Scheme for a wider portfolio to target new investors.

Respondents had mixed views concerning the Government's approach and priorities. Some encouraged Government to change its foci from short-term return to more long-term investments. Other respondents suggested that the pipeline of infrastructure requires re-evaluation post-Brexit, and that smaller scale improvements should be prioritised over grand schemes. Some respondents further suggested that areas of most need should be prioritised, for example through exploring opportunities for bundling resources, and providing guarantees and advice, which could be done while preparing other institutional measures.

The need for predictability was in general agreed upon across respondents. Some also emphasised the need for commercialisation of certain contracts, and increased need of collaborative approaches between public and private contributors to funding and finance.

Environmental concerns were raised by many respondents. Suggestions included better utilisation and development of new models for green infrastructure which incorporate associated risks, and the establishment of a Natural Environmental Impact Fund, as suggested by the Government's 25 Year Environmental Plan, with green or natural infrastructure as a key part of its portfolio. Respondents also raised that the new institution should uphold the robust environmental safeguard standards currently held by the EIB.

9.1.4 Other Comments

Other comments raised by respondents included:

- Several funds have been established, without clear coordination, resulting in incoherent public investment.
- The use of private sector risk management could be undermined by Government's support mechanisms and that the history of debt guarantee tools should be kept in mind.
- Fiscal devolution of powers including taxation and land value capture is supported to enable investments to be aligned with local priorities.

9.2 Question 28

The Consultation Report identified that "*there is no widely accepted comparable data on the whole life costs and benefits of different financing models for publicly funded infrastructure. This may mean that opportunities are being missed to deliver projects more efficiently, at lower cost and sooner*." It sought views on: how a comprehensive analysis of the costs and benefits of private and public financing models for publicly funded infrastructure could be undertaken and where there might be new opportunities for privately financed models to improve delivery. Some 48 respondents provided a response to question 28; this sub-section provides an overview of the comments received.

9.2.1 Cost/Benefit Analysis of Financing Models

Most the respondents acknowledged the lack of a good cost-benefit analysis (CBA) or similar methodological approaches, and the need to develop one. A range of factors that should be included in the analysis of costs and benefits of private and public financing models were identified.

A suggestion proposed by many respondents, was that any analysis undertaken should be free of any ideologies concerning whether a public or private financing model was the best approach, and that a combination of CBA and a multi-criteria analysis should be examined to provide a balanced perspective. Other respondents focused on the need to include whole-life costs and benefits of investments, the consideration of cross-sector alignment (for example data sharing) in decision-making for new infrastructure, and the importance of CBA considering costs together with benefits.

Some respondents further emphasised that the traditional value-for-money approach should be at the core of the analysis, as well as variables such as cost of capital, end user costs, asset delivery matrix, asset conditions, health and safety key performance indicators and customer service levels. Other respondents addressed the importance of a wider analysis approach, including parameters such as costs and benefits to the social landscape, a more balanced approach to risk and reward acknowledging unquantifiable risks, and potential future costs and benefits to the environment.

Some respondents suggested including data from the entire lifecycle of a project in the CBA, from the perspective of the sub-surface phase, to completion and operation. Another important context to include in a CBA is the local context, as well as adopting a balanced approach to infrastructure development which unlocks economic and housing growth in wider geographical areas, including rural issues to facilitate a balanced economy. As infrastructure projects do not always operate in a single economic or geographical vacuum, it is not necessarily covered by a single suitable analysis or model. Further, some respondents suggested an analysis across consistent and different points in time to allow a full assessment of costs and benefits.

A few respondents focused on the Government's lack of understanding of the opportunities the private sector could provide, while others suggested that private finance models should be tested against wider variety of procurement routes, not

only public sector. Some respondents further recommended an approach addressing existing or ageing infrastructure over major investments, and the need for infrastructure development to be led by people's needs reflected in a high-level strategy.

Along with specific examples, such as the financing model used by Kent County Council for the Lower Thames Crossing, respondents also recommended learning from other markets and from lessons learned. Many suggested better utilisations of the existing HMT Green Book approach to evaluating a range of Business Cases through its five-case model, and the need to review it to ensure it reflects the reviews of shortcomings in Private Finance Initiatives (PFI) identified by the Audit Commission. Some respondents recommended the establishment of a task-force or commission to further investigate how to best conduct an analysis.

There were quite a few respondents who in various ways addressed the need for a robust evidence base as a foundation for the CBA. The use of current and previous projects was frequently suggested for such an evidence base. Others reflected upon the point that methods of evaluation were under-researched and not utilised enough. The difficulty of achieving evaluation criteria such as control groups was identified by a few respondents as a barrier.

Several respondents also focused on existing barriers to good CBA results. Many of the respondents mentioned barriers concerning data, either the lack of availability due to commercial constraints, or the more general lack of quality or source transparency necessary to enable cross-organisational usage. Other respondents raised the difficulty of aligning theoretical approaches with reality, and the challenges of measuring against a 'do nothing' option, which is highly subjective.

9.2.2 New Opportunities for Public and Private Financing Models

Some respondents identified sectors that could benefit from privately financed models such as rail and maintenance of the rail sector, the flood and coastal resilience sector, social care, water, port and energy infrastructure. Other respondents' suggestions were more overarching, such as projects that had been prioritised by the Government due to insufficient public funds. Some respondents also claimed that projects that fulfil certain requirements, (for example. low risk, clear deliverables and controllable performances), would remain attractive to public finance. A few respondents further suggested that a separate consultation should be held on potential funding streams.

Private financing was seen by some respondents as essential to UK infrastructure delivery, and some respondents supported privatisation of infrastructure in full. Several forms of privately financed models were suggested by respondents, including Private Public Partnerships (PPPs) (although these were also criticised), third-party involvement, asset leasing, collaborate models with risk-sharing, and more holistic ecosystem models. It was further suggested that benefits from using private financing models such as time, cost and quality should be better utilised in UK infrastructure planning. To avoid excluding such benefits, projects using

private financing models should take a more whole life, whole cycle approach and revisit the value-for-money analysis based on this.

Risk was a topic widely mentioned by respondents, often as a barrier, however, also with suggested solutions. Some respondents identified that the private sector can have low appetite for risk, especially in the early stages due to lack of previous experience and that a more thorough risk assessment by the private sector could raise the cost of private finance, which should be taken into account as it can disqualify certain projects from being delivered by private models if delivery is not secured or not fully guaranteed by the Government. Risk-sharing models in general, or a model with later involvement of the private sector when the risk is lower were both suggested by respondents, as was the importance of flexibility to change throughout a project lifecycle. Some respondents advised the use of different and robust procurement models, and ensure they managed risk thoroughly.

Suggestions to learn from other models both inside and outside of EU were also suggested. Specific examples such as the Dutch Road PPPs and or Ofgem's Electricity Transmission programme were both mentioned. Consideration of the Hansford Review was recommended by several respondents, as was third sector involvement from for example social enterprises and local authorities. Other respondents suggested that private finance could be remunerated through various means, such as fares and tolls, or the use of growth revenue to recoup investment either for public or private financing. It was also highlighted by some respondents that foreign involvement could be considered in critical infrastructure projects.

Many respondents looked to the public sector to take the lead on infrastructure investment and saw it as natural to favour public sector actions. Some respondents claimed that, as long as competent staff are hired, the public sector could be as efficient as the private sector in the context of infrastructure funding and delivery. While some suggested the Government should secure the entire stream of infrastructure funding to better manage risk, others suggested looking to local authorities through increasing their fiscally devolved powers and reviewing their existing models.

A long-term plan that secures funding for vital projects was recommended by some respondents, while other respondents suggested a simple national framework of upfront public funding which could be subject to 'clawback' from the private sector in the future. The need for public leadership and strategy concerning objectives to bring the private sector into for example rail projects was also raised, as was the importance of only presenting robust and pre-tested proposals to potential investors. Some respondents also raised the need to investigate how infrastructure can be funded at the local level, or replacing PPPs with a system of bonds of locally funded infrastructure.

A strategy for ownership and structure of infrastructure providers was suggested by some respondents to be developed, stating which projects should be private or public, and their relation, as well as a plan for public investment and a list of short-term projects which could be offered to the private sector. Some respondents argued that public sector borrowing always would be less expensive than private sector borrowing, which should result in a predisposition to public ownership of

the infrastructure. Others raised the need for better co-ordination between the public- and private-sectors in relation to funding and financing, for example through a public incentive to mitigate for risk perceived by the private sector, an amalgam between public networks and private suppliers, and comprehensive funding through an infrastructure bank lending to both private and public developers.

In terms of barriers to new models or opportunities, the need to address the lack of pipelines for suitable projects was mentioned, as was the difficulty of attracting private finance to ageing transport infrastructure. Some respondents raised concerns related to lack of a consistent framework when considering funding from Government and others, which risks delivery of for example rail projects, and that infrastructure funding too often is based on costly bid processes rewarding local authorities with sufficient expertise and resources rather than spending where it would be most effective. Other respondents acknowledged that funding and financing models could be difficult to sell politically. Some respondents were concerned that the revenue stream from Section 106 agreement and Community Infrastructure Levy are insufficient to provide for major developments, and that the pooling restrictions for Section 106 agreements should be removed.

Lastly, some of the respondents also addressed the Government's contribution to risk. While some claimed scepticism or a lack of will to defend privately financed infrastructure including that the private-sector is interested n=in providing infrastructure for public benefit, that the Government priorities were too focused on specific details, lack of realisation of civil servant's influence on risk and benefits to the private sector, and the difficulty of austerity measures. Others chose to address an unsuitable planning process which worked against the development of large infrastructure projects, causing unnecessary delays. A few respondents also claimed that private finance had been constrained by the lack of long-term planning, and that governance prioritises long-term investment over short-term income, hindering private investment in, for example, innovation

Mitigation was suggested, such as the need for more predictable planning outcomes, as well as the need for a simple approach to address changes in property values affected by infrastructure projects. The introduction of an environmental fee for developers that could mitigate delays related to environmental risks.

10 Other Comments

10 Other Comments

Comments were received which related to the future of infrastructure but did not specifically address the questions or analysis raised in the Consultation Report. This section provides an overview of the comments received.

10.1 Engagement and Knowledge Sharing

Respondents provided comments on the need for further engagement with the public on the need for infrastructure and improved knowledge sharing within the infrastructure industry, which included:

- Need for greater level of communication with and education of the public as to why infrastructure development decisions are important and the consequences if every area does not accept such development.
- The NIC should convene an expert round table to consider all environmental matters relating to infrastructure which might involve relevant Government departments, statutory environmental bodies and other key bodies/organisations.
- The NIA should make reference to the recently created UK Collaboration for Research on Infrastructure and Cities which seeks to undertake trials and collect data to allow policies, regulation, systems and capital investment to be made on the basis of evidence, analysis and innovation.
- Need for resilient, learning organisations and user communities that inform a much greater capability and application of systems engineering in how infrastructure decisions are made and how the interaction of systems is managed.
- There are opportunities for better integration across infrastructure types in specific areas, which could promote new ways of working and collaborating.

10.2 Other

Further comments, covering a range of topics were received, including:

- The relationship between the documents prepared by the NIC and the National Policy Statements should be clarified. The relationship should also be clarified between the NIC's recommendations in the NIA and specific studies and how these are translated into Government policy particularly given that the NIC was established on a non-statutory basis. The NIC's recommendations should not undermine delivery of existing projects.
- It is vital that the delivery of local infrastructure is coherent with national ambitions and delivered to a consistent high standard across the regions.
- A sector-wide target for infrastructure covering capital and operational carbon should be introduced. This could be achieved through updating the Green Construction Board's Low Carbon Routemap to include specific targets for the infrastructure sector, introducing a framework to support ongoing progress and establishing a joint Government and industry infrastructure task group.

- The NIA should seek to complement the Government's 25 Year Environment Plan and forthcoming resources and waste strategy. It should also take into account BEIS' Clean Growth Strategy and policies around energy from waste.
- Reforms should be made to the planning system to improve the functioning of it at local authority level across all infrastructure sectors.
- The NIA should focus on providing step-free access to public transport and role of active travel for disabled people.
- The NIA should acknowledge the contribution of open-trench utility installation to urban traffic disruption.
- Infrastructure should be explicitly designed to be sustainable, resilient and future-proof.
- The NIC's role in facilitating the delivery of housing infrastructure should be clarified.
- A programme for infrastructure improvement should ensure that infrastructure incorporates the latest technologies and efficiencies.
- Competitive tendering (through ideas such as Direct Procurement for Customers and those promoted in the Hansford Review) should be implemented across all UK infrastructure sectors funded, financed and regulated by the Government. This will lead to greater innovation, better value for money and provide a means for Government to fully compare the delivery of publicly financed vs privately financed infrastructure.
- Government should adopt the approach being trialled under Project 13 where it is the 'infrastructure owner'; the approach is value driven incorporates collaborative teams that can deliver investment programmes that secure the outcomes demanded by clients and the public (as opposed to the existing transactional, cost driven procurement of individual assets).
- When infrastructure is funded by the private sector and the costs of any recommendations are met by customers, the NIC should be required to provide a transparent assessment of the overall impact on bills.
- UK companies are not always involved in delivering infrastructure projects; we are therefore losing the profit, project management experience and intellectual property associated with these projects.
- The NIA should address specific development proposals including Hinkley C and fracking.

Appendix A
Respondent List

A1 Respondent List

NOTE: This list excludes all individual respondents.

ABB Limited
Allen & Overy LLP
Allderdale Borough Council
Anglian (Central) Regional Flood & Coastal Committee
Anglian Water Services Ltd
Airport Operators Association
Association for Consultancy and Engineering
The Association for Decentralised Energy
Association for Project Management
Association for the Conservation of Energy
Atlantic Gateway
Atlantic SuperConnection LLP
BAI Communications Ltd
Biffa
Biofuelwatch
British Motorcyclists Federation (Enterprises) Ltd
The British Ceramic Confederation
British Chambers of Commerce
British Glass
British Ports Association
The British Property Federation
The British Standards Institution
BT
Buckinghamshire Thames Valley Local Enterprise Partnership
Business in the Community
Cadent Gas Ltd
Campaign for Better Transport
Campaign to Protect Rural England
Carbon Capture & Storage Association
Cityfibre
Confederation of British Industry
The Chartered Institute of Transport and Logistics
The Chartered Institute of Building Service Engineers
Chartered Institute of Civil Engineering Surveyors
Chartered Institute of Highways and Transportation
Chartered Institution of Water and Environmental Management
Chartered Institution of Wastes Management
Cheshire and Warrington Local Enterprise Partnership
Country Land & Business Association Ltd
Climate Genocide Act Now
The Commission on Travel Demand
The Common Futures Network
Community R4C
Confederation of Paper Industries

Consumer Council for Water
Cornwall Council and the Cornwall & Isles of Scilly Local Enterprise Partnership
Cory Riverside Energy
Cumbria County Council
db symmetry
Design Commission for Wales Ltd
Design Council
Drax Group PLC
E.ON UK plc
E3G
EDF Energy
EEF Limited
Electricity North West Limited
ELEXON Limited
Energy Networks Association Limited
Energy & Utilities Alliance (EUA) Limited
Energy Systems Catapult Limited
Energy UK
EngineeringUK
Environment Agency
Environmental Services Association Limited
Essex County Council
The Ely Group of Internal Drainage Boards
First Group plc
Freight on Rail
Freight Transport Association
Freightliner Group Limited
Friends of the Earth England, Wales and Northern Ireland
Funding Group for River Thames Flood Alleviation Scheme, Surrey County Council
GB Railfreight Limited
Greater London Authority and Transport for London
Global Infrastructure Investor Association
Gloucestershire County Council
Greater Manchester Combined Authority
Green Alliance
Greenpeace
Hafren Power Limited
Hampshire County Council
Hastoe Housing Association and Sustainable Homes Ltd
Health and Safety Executive
Heart of the South West Local Enterprise Partnership
High Speed Rail Industry Leaders
Historic England
Home Builders Federation
Horizon Nuclear Power
Hull City Council
Hutchison 3G UK Limited
The Infrastructure Forum

InLinkUK
Institute of Asset Management
The Institute of Engineering and Technology
Integrated Transport Planning Limited
Jacobs Engineering Group Inc.
Kent County Council
Kilbride Rail
Kingspan Insulation Limited
Local Government Association Coastal Special Interests Group
Lincolnshire County Council
Liverpool City Region Mayoral Combined Authority
Local Government Association
The Local Government Technical Advisers Group
London Councils
Long Term Infrastructure Investors Association
Longbay Seapower Limited and Halcyon Tidal Power LLC
Luton Council
Mace
Manchester Airports Group
Met Office
Midlands Connect
Mineral Wool Insulation Manufacturers Association
Mineral Products Association Ltd
Mobile UK
Motorcycle Industry Association
Mott MacDonald
National Energy Action
National Farmers Union
National Grid
National Infrastructure Planning Association
Natural Energy Wyre
Natural England
Northern Ireland Fuel Poverty Coalition
Network Rail
North East Combined Authority
North West Business Leadership Team Limited
Northern Gas Networks Limited
Northumbrian Water Limited
Nuclear Industry Association
Ofgem
Ofwat
Openreach Limited
Ordnance Survey Limited
Peel Energy Limited
Peel Holdings (Land and Property) Limited
Pegasus Planning Group Limited
Pennon Group Plc
Pensions Infrastructure Platform Limited
The Pipe Jacking Association

Plymouth City Council
The RAC Foundation
RAC Limited
Radioactive Waste Management
The Rail Delivery Group
Rail Freight Group
Railway Industry Association
Recycling Technologies Limited
The Renewable Energy Association
The Road Haulage Association Limited
Rod Rainey & Associates Limited
Royal Academy of Engineering
Royal Institute of Chartered Surveyors
Royal Town Planning Institute
Royal Society for the Protection of Birds
RWE Generation UK
Scottish Association for Public Transport
Scottish Carbon Capture Storage
Scottish Power Limited
SGN
Sheffield City Region
Siemens Plc
Smarter Cambridge Transport
South East England Councils
South East Essex Action Group Alliance
Southern Water
SUEZ Recycling and Recovery UK Limited
Surrey County Council
Sustainable Energy Association
Sustrans
Swindon Borough Council
Tantalum Corporation
Tarmac
Thames Water Utilities Limited
The Law Society
The Society for Poole
Tidal Lagoon Plc
Transition Town Brixton
Transport for West Midlands
TravelWatch NorthWest
Trees and Design Action Group
UK Green Building Council
UK Power Networks
Uniper SE
United Kingdom Onshore Oil and Gas
United Kingdom Without Incineration Network
United Utilities
The University of Exeter Energy Policy Group
University of Sussex Science Policy Research Unit and Orbit Group Limited

Urban Transport Group
Valpak Limited
Vattenfall Wind Power Limited
Veolia
Virgin Media
Vodafone
Water Resources East
Water UK
West Yorkshire Combined Authority
Westinghouse Electric Company LLC
Wheels for Wellbeing
Wildlife and Countryside Link
Wiltshire Council
The Woodland Trust
WSP
WWF-UK
Yorkshire Water Services Limited

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