

National Infrastructure Assessment 2 – Baseline Report - Call for Evidence

Final Report

June 2022



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Executive Summary

Ove Arup and Partners (Arup) were commissioned by the NIC to review all the responses received from the Call for Evidence on the Baseline Report, analyse the response content, and playback the main issues and findings for each of the 17 questions set by the NIC. This will be used to inform the development of the NIA2 recommendations. A total of 102 responses were received to the Call for Evidence.

A summary of the key messages from each of the questions, aligned to the key challenges identified by the NIC, are set out below.

Question 1 asked **whether the nine challenges identified by the Commission cover the most pressing issues that economic infrastructure will face over the next 30 years and if not, what other challenges should be considered**. Most responses were in agreement that the nine challenges identified by the Commission cover the most pressing issues that infrastructure will face over the next 30 years. No one challenge was supported more than others. Additional challenges mentioned by responses included how biodiversity, embodied carbon, decarbonisation, behavioural change, rural connectivity, wellbeing and skills were represented. Responses requested greater collaborative thinking across the policy, governance and decision making for infrastructure and also across infrastructure sectors to successfully address the challenges.

Question 2 asked **what changes to funding policy would help address the Commission's nine challenges**. Most responses highlighted the need for changes to funding and financing policies for infrastructure. The main changes highlighted were the need to devolve funding policies from central government to regions and local authorities, and to move away from a ring-fenced, siloed approach to infrastructure funding to a more cross-sector holistic process. Other changes identified included the need for a longer-term perspective to funding policies and the use of private finance to complement public spending. A reoccurring theme was the need to look at the wind sector as best practice for funding and financing policy, especially the use of both public and private finance.

Question 3 asked **how better design, in line with the design principles for national infrastructure, could help solve any of the nine challenges for the next Assessment**. Most responses raised climate as being the most important of the four design principles. The remaining three design principles of 'people', 'place' and 'value' were raised in some responses. Many responses provided suggestions and/or examples of how better design could help solve the Commission's nine challenges, although some of these were general suggestions, and did not specifically pertain to one of the challenges.

Question 4 asked about **what interactions exist between the nine challenges and the government's target to halt biodiversity loss by 2030 and implement biodiversity net gain**. Most responses identified existing interactions between the Commission's challenges and the government's target to halt biodiversity loss and implement Biodiversity Net Gain (BNG). Many responses provided further suggestions of how to improve upon the existing interactions or proposed altogether new mechanisms for halting biodiversity loss and better implementation of BNG. The main themes highlighted by responses centred on the role of policies and requirements, how investment impacts the delivery of environmental benefits and the dual benefits of environmental initiatives such as nature-based solutions.

Question 5 asked **what the main governance, policy, regulation and market mechanisms opportunities that may solve the nine challenges, and the main barriers**. Most responses did not specifically make reference to opportunities in terms of governance, policy, regulation and market mechanisms. The need for devolution was a common theme amongst a few responses and this spans governance, policy, regulation and market mechanisms, however, this was not highlighted as an opportunity, but more of a necessity. Net zero was mentioned in many responses. Many of the responses focussed on the barriers rather than opportunities. The main barriers highlighted were the impact of climate change and the need to decarbonise different infrastructure sectors. Other barriers highlighted included funding and investment and the absence of policy, and where policy is present, its siloed approach.

Challenge 1: The digital transformation of infrastructure – the Commission will consider how the digital transformation of infrastructure could deliver higher quality, lower cost, infrastructure services.

Question 6 asked about **which of the Commission’s sectors (outside of digital) can digital services and technologies enabled by fixed and wireless communications networks deliver the biggest benefits and how much would this cost**. Most responses agreed that improvements in digital services were needed across several of the Commission’s sectors, in particular transport and energy. The benefits identified included the contribution to net zero targets, access and ease of use of services for the customer or end user, and the levelling up agenda. Examples of where industry had already begun the digitalisation process were identified, but there was a perception that significant work was needed. Most responses concentrated on identifying the sectors which would benefit most from improvements to digital services. Only one response provided a monetary figure as to how much a move to digital services and technologies would cost. However, it was also highlighted that the cost would be dependent on requirements or focused on benefits, such as cost efficiencies and income generation or economic benefits. The need for government funding and government financial support was also raised.

Question 7 asked about **what barriers exist that are preventing the widescale adoption and application of these new digital services and technologies to deliver better infrastructure services, and how might they be addressed**. The main barriers identified in responses included risk aversion by both service providers, customers and end user; technical constraints; skills gaps; and a lack of investment and financial barriers. These barriers could be addressed by collaborative working, joined-up thinking, and a more holistic approach to digital technology adoption by regulators, funders, and delivery organisations.

Challenge 2: Decarbonising electricity generation – the Commission will consider how a decarbonised, secure and flexible electricity system can be achieved by 2035 at low cost.

Question 8 asked **what the greatest risks to security of supply in a decarbonised power system are that meets government ambition for 2035 and what solutions exist to mitigate these risks**. The main issues raised in responses that would need to be considered in the future power system are, diversification of energy sources, adequate system capacity, balancing mechanisms, and appropriate and effective controls. Responses discussed how these, combined with effective governance could deliver system flexibility which would mitigate the perceived risks to the security of supply.

Challenge 3: Heat transition and energy efficiency – the Commission will identify a viable pathway for heat decarbonisation and set out recommendations for policies and funding to deliver net zero heat to all homes and businesses.

Question 9 asked for **evidence on the barriers to converting the existing gas grid to hydrogen, installing heat pumps in different types of properties, and/or rolling out low carbon heat networks, along with what the potential solutions are**. The main barriers highlighted in responses included: energy efficiency; the role of government policy; workforce availability and skills; and public acceptance. Other barriers of note were commercial viability of the technologies, funding support, and the technical viability of each option. A range of solutions were identified which included change to government policy and regulations, investment in the technologies and the provision of a skilled workforce.

Question 10 asked about **what evidence there is on the barriers and potential solutions to deploying energy efficiency in the English building stock**. The main barrier highlighted was funding and other barriers noted were the maturity of the supply chain and misaligned government and local policies which hinders the deployment of energy efficiency technologies. Many responses called for better alignment of policies; a clearer funding environment to allow stakeholders to plan ahead when retrofitting or improving energy efficiency of the building stock; better data on the existing housing stock; attractive incentives for both developers and consumers; clear energy advice to consumers; and a collaborative, holistic approach to decision-making and strategy development.

Challenge 4: Networks for hydrogen and carbon capture and storage - the Commission will assess the hydrogen and carbon capture and storage required across the economy, and the policy and funding frameworks needed to deliver it over the next 10-30 years.

Question 11 asked **what barriers exist to the long-term growth of the hydrogen sector beyond 2030 and how can they be overcome, including whether any parts of the value chain (production, storage, transportation) more challenging than others.** There was a wide variety of barriers highlighted in the responses. Common themes included pricing and competitiveness of hydrogen, concerns on the clarity and timescales of government policy, and hydrogen's place as a vector in the market. Several responses expressed support for steps taken to promote hydrogen, with many qualifying that there is further to go to achieve overarching policy commitments, chiefly net zero. There were also a number of responses that set out the need for significant actions now, in order to allow for the major growth in the hydrogen sector expected beyond 2030.

Question 12 asked about **the main barriers to delivering the carbon capture and storage (CCS) networks required to support the transition to a net zero economy, and the solutions to overcome them.** Overall, most responses believed that carbon capture and storage (CCS) will play an important role in the transition to a low carbon economy, particularly for hard to decarbonise sectors. Some responses were concerned that there was a focus on CCS rather than overall emissions reduction and expressed concern over the impact CCS could potentially have on the environment. Other responses focused on the barriers to delivering these networks including, the impact of this technology on the environment, industry regulations, achieving planning consent for projects, the financial cost and a lack of confidence in a relatively unproven technology. Solutions to overcoming these barriers were also identified by responses, including the need for longer term planning and a road map to reach targets, investment in the industry and a collaborative approach to working across the industry to share knowledge and develop solutions.

Challenge 5: Asset management and resilience – the Commission will consider how asset management can support resilience, barriers to investment, and the use of data and technology to improve the way assets are maintained.

Question 13 asked **what ways current asset management practice will need to improve to support better infrastructure resilience.** Many responses raised concerns around the current state of infrastructure networks, particularly around ageing infrastructure and its vulnerability to the increasing occurrence of extreme weather events. A range of suggestions were put forward on how to better support infrastructure resilience, and some common themes emerged around the role of governance, policy, economy and funding, as well as digital solutions for monitoring of assets.

Challenge 7: Waste and the circular economy – the Commission will examine the role of the waste sector in enabling the move towards a more circular economy.

Question 14 asked **what are the barriers to and solutions for expanding recycling capacity, both now and in the future to deliver environmental and net zero targets.** Overall, most responses highlighted that expanded recycling capacity within the United Kingdom was possible, but barriers such as a lack of investment and incentives to recycle, global competition, regulation and policy, product design, and public behaviour remain. The solutions were focussed on government policy which has been moving towards Extended Producer Responsibility (EPR) where producers are required to take greater responsibility for recycled goods; protection from competition from countries with lower regulatory standards; and higher targets for recycling. Some responses also pointed to the need to look beyond recycling and design to repair, reuse and remanufacturing as part of the circular economy.

Question 15 asked **what the likely environmental impact of waste streams from construction across economic infrastructure sectors are over the next 30 years, and what are the appropriate measures for addressing it.** Responses identified impacts including the whole life carbon cost of construction, the predominately rural locations of major recycling sites, the use of heavy goods vehicles (HGVs), and associated impacts on the environment for the transportation of waste. Most responses identified the need for the construction industry to move towards a circular economy and a holistic whole-life approach to address environmental impacts. The reuse, recycling and repurposing of materials, infrastructure and buildings were also highlighted as solutions, along with the need for structural and regulatory changes including the setting of standards and targets for the industry to minimise the environmental impacts of waste streams from construction.

Challenge 8: Urban mobility and congestion – the Commission will examine how the development of at scale mass transit systems can support productivity in cities and city regions and consider the role of congestion charging and other demand management measures.

Question 16 asked **what evidence is there of the effectiveness in reducing congestion of different approaches to demand management used in cities around the world, including, but not limited to, congestion charging, and what are the different approaches used to build public consensus for such measures.** Many responses agreed that some form of congestion charging can be an effective approach to demand management in cities. However, the overwhelming message was the importance of implementing such schemes as part of a wider suite of solutions to reduce congestion. A range of alternative and supplementary approaches to managing demand were put forward, many with a focus on encouraging a modal shift towards active travel and public transport. The role of governance and funding of schemes, as well as the need to approach demand management holistically with a view to create a single comprehensive transport system, featured in many responses.

Challenge 9: Interurban transport across modes – the Commission will consider relative priorities and long term investment needs, including the role of new technologies, as part of a strategic multimodal transport plan.

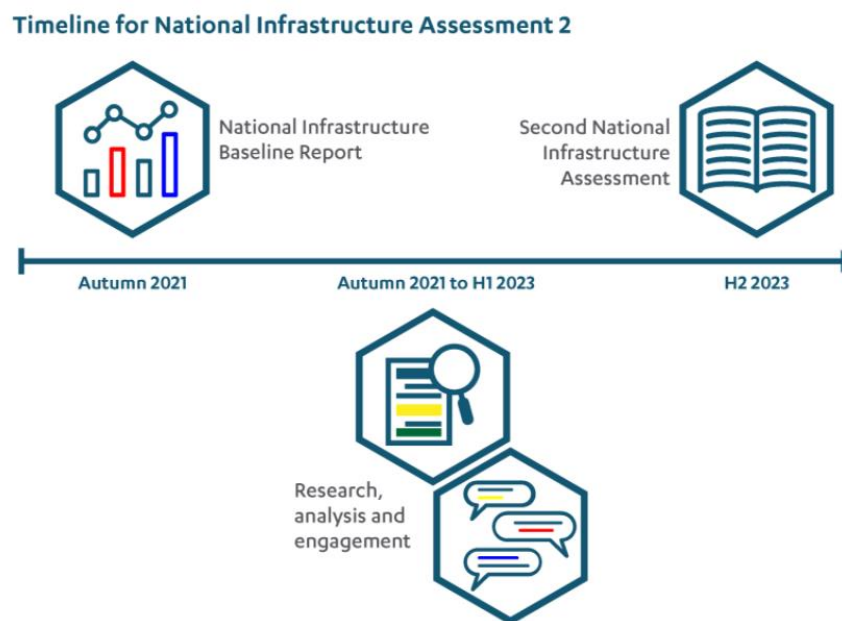
Question 17 asked about **the barriers to decision-making frameworks on interurban transport that reflect a balanced approach across different transport modes.** Most responses supported the emphasis on a balanced approach to decision-making across different transport modes. The main barriers and themes identified related to governance, policy, economics and funding and investment. A key barrier identified by many responses was that of planning and investment in modal silos and a need for better collaboration between stakeholders to overcome this. Overall, most responses suggested that any decision-making frameworks on interurban transport should support a shift away from private car use towards more sustainable modes.

Introduction

Overview of the report

Every five years, the National Infrastructure Commission (NIC) publishes a National Infrastructure Assessment (NIA). The NIA analyses the UK's long term economic infrastructure needs, outlining a strategic vision over the next thirty years and setting out recommendations for how identified needs should be met. The first-ever NIA in 2018 made a series of recommendations for how the identified infrastructure needs and priorities of the country should be addressed.

The NIC published a Baseline Report in November 2021 which summarised the current performance of key infrastructure sectors. The Second National Infrastructure Assessment (NIA2) report and recommendations to government will be published in autumn 2023.



Arup were commissioned by the NIC to review all the responses received from the Call for Evidence on the Baseline Report, analyse the response content, and playback the main issues and findings for each of the questions to inform the development of the NIA2 recommendations. Arup have not technically interpreted or commented on any of the content or topics raised, and have presented back the material provided in the responses in a structured way to support the NIC. Any detail on the statements made in the responses has been set out, where provided by the responses.

This report has been compiled by Arup to provide an independent and objective analysis of the Call for Evidence responses. Arup applied a rigorous and auditable protocol to the capture of the responses, analysis, and reporting of the findings by designing a response analysis framework that enabled opinions and priorities from responses to be recorded.

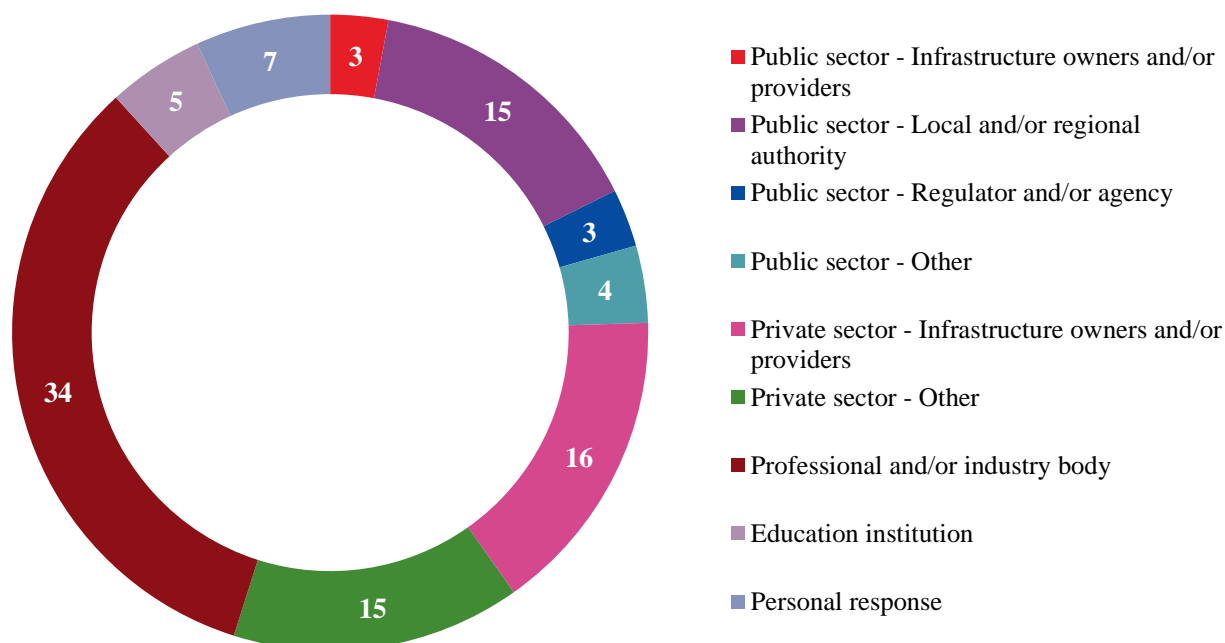
Call for evidence

The Call for Evidence initially ran from November 2021 until 4th February 2022. An extension for responses was granted by the NIC until 28th February 2022.

The NIC set a ten-page limit on response lengths (not including supplementary data files). Respondents were asked to email their responses to NIA2.CfE_Responses@nic.gov.uk. The NIC stated that they may publish any responses received. It was noted that if respondents believe there is a reason why their response or any part of it should be considered confidential, they should state this.

Overview of Responses

A total of 102 responses were received to the 17 questions set in the Call for Evidence. Responses were received from a range of organisations and individuals. A full list of responses is provided at Appendix A. The type of organisations that responded to the Call for Evidence is set out below:



Although most responses followed the questions set, it is always inevitable that some responses do not follow this guide; this accounted for a small number of responses received. We have broken down these responses and linked them to appropriate questions. In some cases, the responses did not directly address the question set, and we have highlighted this for the relevant question and provided content playback of what the responses said.

This report seeks to represent the range of viewpoints which are drawn directly from the Call for Evidence responses.

Approach to analysis

Responses submitted to the NIC were logged with a unique reference number. All responses were received digitally. Arup's approach applied the latest Government guidance, our own experience and relevant legal requirements such as the General Data Protection Regulation (GDPR).

Arup built a secure and scalable database platform to manage the response data and coding framework. The database acted as a centralised 'single source of truth' for the project, eliminating duplication through the unique identification of responses and codes, and keeping an audit history of all activity.

In order to consistently analyse the responses qualitatively, Arup developed a coding framework. Preparing the coding framework was a bespoke exercise carried out for the Call for Evidence to ensure robust, accurate and meaningful information is distilled from the consultation that can be used to inform design and decision making. The coding framework is a recognised method used to analyse text in order to establish a framework of thematic ideas; it is compiled of the points and concerns raised in the consultation feedback.

The coding framework was structured around

- **High level themes:** Overarching themes across all questions.
- **Detailed thematic codes:** A further breakdown of the themes and issues that are emerging related to specific high-level themes.

Through the coding approach Arup undertook, there were a number of themes where respondents provided a greater number of responses, and an associated greater amount of content in their responses. Throughout this

report, connections have been made and grouped from responses where themes align with the question set, and, where there are cross-cutting themes related to similar issues.

All responses have been coded and grouped based on issues raised. Where responses have raised multiple points, these are captured across a number of codes. Every new and different comment made was captured and no weight will be inferred to the frequency of a comment being made.

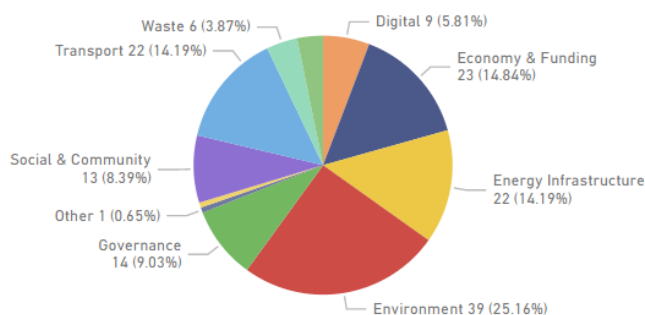
This report has been played back and analysed. The feedback provided followed the guide below to give an indication of the number of responses to specific themes and discussion topics:

- One - a singular response
- Few – a very small group of responses (approximately less than 5%)
- Some – a slightly larger group of responses (approximately less than 15%)
- Many – a significant minority of responses (approximately more than 25%)
- Most – a large majority of responses (approximately greater than 75%)

Question 1: Do the nine challenges identified by the Commission cover the most pressing issues that economic infrastructure will face over the next 30 years? If not, what other challenges should the Commission consider?

Overall, most responses were in agreement that the nine challenges identified by the Commission cover the most pressing issues that economic infrastructure will face over the next 30 years. No one challenge was supported more than others. Additional challenges mentioned by responses included how biodiversity, embodied carbon, decarbonisation, behavioural change, rural connectivity, wellbeing and skills were represented. Responses highlighted the need for joined up thinking across infrastructure sectors to successfully address the challenges. A move away from a silo mentality when it comes to national infrastructure is required and joined up, collaborative thinking, policy making and action is necessary.

There were 66 responses to Question 1. A breakdown of the high-level themes is set out below:



Many responses discussed how certain themes were more welcomed or more pertinent than others, including the themes relating to transport, climate resilience and net zero carbon. Responses tended to discuss the broad themes, which encapsulate the challenges, rather than generally picking out specific challenges.

Environment

A few responses indicated that the Baseline Report had not sufficiently acknowledged the negative impact that delivering national infrastructure can have on natural capital; it poses a threat to the Government's commitment to halt a decline in nature and protect a percentage of the UK's land and sea by 2030. A few responses noted that historic infrastructure and assets should also be prominent in the nine challenges.

Maintenance and construction materials

Maintenance of existing infrastructure was also cited as a missing challenge in a few responses, though it is noted that Challenge 5 and Question 13 cover asset management and resilience. The question was raised as to why new infrastructure was being built if existing infrastructure is not being adequately maintained. In addition, a few responses highlighted the need to reduce the embodied carbon in the materials of manufacture and construction for new infrastructure.

Transport

A few responses highlighted decarbonisation of the transport sector as a specific challenge due to the associated infrastructure needed to be in place to support this for all modes:

“Furthermore, transport decarbonisation will play a vital role in the transition to net zero. This includes the shift to zero emission vehicles” NIA-091

Rural mobility and connectivity were highlighted as important challenges in a few responses, as poor transport infrastructure, especially public transport infrastructure reduces accessibility to employment, education, and training, which has longer term impacts.

Societal Impacts

Some responses noted that a challenge which encapsulates the impact that future infrastructure can have on quality of life, health and wellbeing, inequality and fairness was missing. A few responses raised concern that there was no reference to water supply in the challenges.

Skills

Upskilling and the provision of a skilled workforce was considered to be a key challenge for a few responses which stated that without the skills, it will be difficult to address the challenges.

Geographic Disparities

One response suggested that the nine challenges do not adequately address the underinvestment in areas across the UK in infrastructure. A few responses identified the lack of powers that local authorities have to invest in and plan infrastructure for their areas, was also a challenge.

A holistic perspective of infrastructure

A move away from a silo-based mentality was raised in some responses as a way of overcoming some of the challenges that exist within and between infrastructure sectors. A few responses suggested how the challenges could be overcome by taking a holistic, cross-cutting systems-based approach:

“Outcomes cannot be addressed in silos – they need joined-up policies to improve them. For example, net zero offers the opportunity to create the necessary infrastructure to meet carbon reduction targets, but also has the potential to create internationally competitive industries that provide local employment at a large scale and thus help to address regional inequalities.” NIA-001

Funding

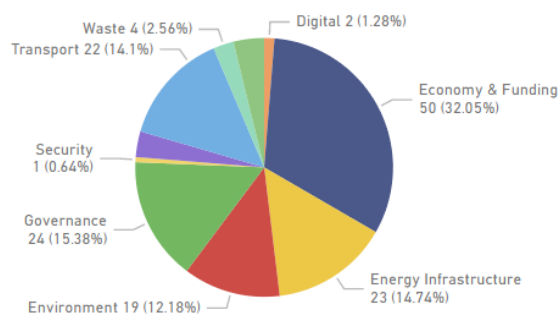
Another aspect that was raised by a few responses in terms of addressing the nine challenges was that of how to actually fund the transitions, skills required, technology and the new infrastructure.

A few responses highlighted the need for greater investment in the sectors, such as transport and energy, and a more collaborative, joined up investment plan for new technologies and new infrastructure that spans sectors rather than being just focused on one. This subject is dealt with in more detail in Question 2: What changes to funding policy help address the Commission's nine challenges and what evidence is there to support this.

Question 2: What changes to funding policy help address the Commission's nine challenges and what evidence is there to support this? Your response can cover any number of the Commission's challenges.

Many responses covered both funding and financing of infrastructure and so both are summarised here. Overall, most responses highlighted the need for changes to funding and financing policies for infrastructure. The suggested changes looked at infrastructure broadly, with little direct reference to the nine challenges or specific infrastructure sectors. The main changes highlighted were the need to devolve funding policies from central government to regions and local authorities, and to move away from a ring-fenced, siloed approach to infrastructure funding to a more cross-sector holistic process. Other changes identified included the need for a longer-term perspective to funding policies and the use of private finance to complement public spending. A reoccurring theme was the need to look at the wind sector as best practice for funding and financing policy, especially the use of both public and private finance.

There were 58 responses to Question 2. A breakdown of the high-level themes is set out below:



Devolution

Many responses identified the need to move away from infrastructure funding policies that were developed and controlled by central Government. Either regionally controlled or locally controlled infrastructure funding was seen as the more preferred approach in many of the responses as this would allow infrastructure spending to be directed based on local needs that are clearer to regional organisations or local authorities than to central Government. Responses highlighted that regional organisations and local authorities would then have more power to decide how funding budgets should be spent, plan for the long term, and benefit from the returns generated to help fund future projects.

“Devolving funding and distributing funding could help address the Commission’s challenges. Funding is too centralised.” NIA-007

One response recognised that a devolved funding approach would need to be well considered. Another response highlighted that, as transport projects often span multiple local authorities, devolved funding could have implications for the success and effectiveness of projects.

Holistic and cross sector design

Many responses identified how funding policies need to move away from taking a ring-fenced approach based on specific sectors or areas to a more holistic, cross sectoral design. A few responses highlighted that the move to net zero will have multiple benefits spanning many sectors which means taking a siloed approach may not provide the most effective or efficient solution. Another response highlighted how taking a more holistic approach will help develop collaborative problem solving and consequently cross-sector solution development and knowledge sharing. A few responses highlighted that infrastructure funding policies should be based on outcomes concerning placemaking, which require joined up thinking and partnership working, rather than specific sector thinking.

Long term perspective

The short-term, piecemeal approach to infrastructure investment and funding was identified by some responses as needing to be changed. Some responses stated that having funding and financing policies that are broader and take a longer-term view will encourage investment, which is especially welcome for new and emerging technologies. According to a few responses, the current short termism of funding policies does not provide the confidence for investment in the new technologies required to reach the government's net zero target. A few responses also discussed the challenges of competitive funding from central government pots and how it hinders long term planning and requires skills and resources to develop bids, which may, in turn, bias funding towards larger local authorities.

Specific sectoral points

A few responses also identified **funding and financing policy changes** required for specific sectors:

- A few responses raised the subject of **Electric Vehicles (EVs)** and the role they will play in the decarbonisation of the transport sector. One response suggested the need for greater clarity on the funding and financing mechanisms for EVs infrastructure as the uncertainty hampers investment.
- A few responses focussed on the need to incorporate **user charging for new infrastructure** within the transport sector as a means of gaining reinvestment for maintenance and running costs. Passing on the cost to infrastructure users in general was cited a few times in responses, as was incorporating tax increment funding, localisation of national taxes, developer-related contributions and fees on new technologies into funding policies.
- A few responses discussed the need to encourage the front-loading of funding for **carbon, capture, utilisation and storage (CCUS)** projects to help increase confidence and therefore investment, speed up the deployment of technologies, reduce risk and accelerate future cost reduction in future projects.
- A few responses highlighted the needed to develop funding models for **larger scale hydrogen transport and storage** to help unlock private investment and help provide confidence for further investment in the development of this area.
- Another response explained how the Green Finance Strategy should outline a plan for financing the transition to net zero, which would provide clarity as to how the funding mechanisms will work for all infrastructure sectors. A few responses also highlighted the need for funding policies to incentivise investment in low carbon technologies in order to generate progress and market confidence.

Evidence to support changes

- Some responses provided evidence of how changes in funding policy can enhance infrastructure delivery, including: The Institution of Civil Engineers (ICE) producing a policy paper examining the practical, technological, social, political and regulatory challenges that exist in establishing a 'pay-as-you-go' (PAYG) model for the Strategic Road Network. The paper demonstrates public support for PAYG models as long as there are clear benefits such as road maintenance and no increased tax burdens.
- The City Regions Sustainable Transport Settlements allocating funding flexibly and on a local need's basis over five years. This approach was identified by a response as a possible future direction for transport investment.
- The RAC Foundation and the Institute of Fiscal Studies examination of the current system of motor taxation.
- Nottingham and Leicester as examples of successful workplace parking schemes that demonstrate the benefits of planned, consistent and certain investment.
- The Rapid Charging Fund helping to deliver both coordinated and future-proofed electricity network connections to support the uptake of EVs.
- The disparity between the East and West Midlands was cited as evidence by a few responses of the importance of devolving funding and focussing on local needs. The East Midlands has had low investment in transport infrastructure. However, the West Midlands has been successful in gaining

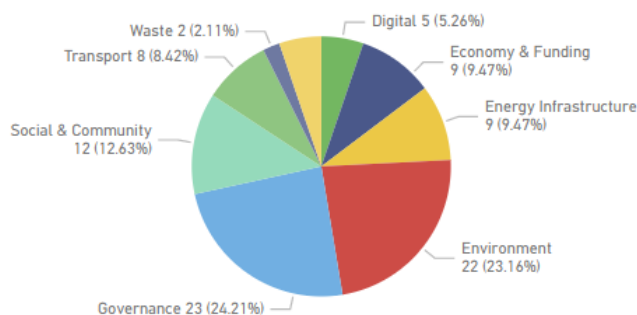
funding for significant transport infrastructure, due in part to the partnership that developed from the creation of the West Midlands Combined Authority.

- The £2m Innovate UK funded ‘Prospering from the Energy Revolution’ project called the West Midlands Regional Energy System Operator project, found partnership working and collaboration allowed links to be made to the network operator’s uncertainty mechanisms to unlock investment and could be funded in part, by the energy system, through allocations currently made to Distribution Network Operators (DNOs) to engage with local authorities.
- University of Strathclyde research found the current approach of passing the costs of upgrading the electricity distribution networks to consumer bills, will have sustained price and cost of living impacts over long time periods.
- The same piece of research by the University of Strathclyde highlighted that an ‘industry pays’ approach to funding new CO2 transport and storage infrastructure, could lead to negative economic outcomes. This research outlined that where industries take on additional costs to apply CCUS ahead of international competitors, the associated negative impacts may hit the sector, the associated supply chains and ultimately the wider economy. Additionally, the negative impacts may be particularly felt in the regions where jobs and economic prosperity are heavily dependent on key industries. This should be an important consideration for factors such as the ‘levelling up’ agenda.
- The Carbon Capture and Storage Association (CCSA) published a report in 2021 on the economics of UK CCUS which found that a funding framework is the largest gap in CCUS success compared to the offshore wind sector.
- Analysis from the Energy Efficiency Infrastructure Group (EEIG) in 2021 found that substantial public investment would be needed for domestic energy efficiency and heat pumps and even with current funding commitments, there would be a shortfall.
- UKERC research provides examples from other countries showing that the presence of a downstream carbon tax can help move households away from harmful fuels towards oil.
- Public First have produced research that shows moving policy costs to general taxes could reduce average energy bills.
- E3G has published a paper on the UK Infrastructure Bank and how it should be set up to effectively finance the transition to net zero.
- CBI (Confederation of British Industry) have produced a paper, ‘Investing in Infrastructure Paper’ which looks at how infrastructure could be financed along with barriers to funding including regulatory frameworks, political and funding model uncertainties and a perceived lack of clarity around the National Infrastructure pipeline.
- Project Reach provides models for private funding.
- Ofwat’s Direct Procurement for Customers (DPC) process demonstrates the benefits of third-party finance, amongst other aspects.
- IGNITION Project is a project that examines innovative financing solutions for investment in Greater Manchester’s natural environment. Learning from it could be applicable to the infrastructure sector.
- The Transforming Cities Fund, the Towns Fund and the Connected Cities fund demonstrate the benefits and success of devolution of funding and autonomy, while the failure of the Green Homes Grant, due partly to a lack of installers, demonstrates how using funding policy for specific sectors, in isolation, can lead to failure.

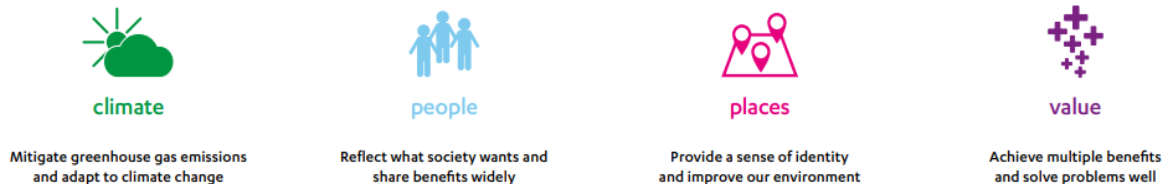
Question 3: How can better design, in line with the design principles for national infrastructure, help solve any of the Commission's nine challenges for the next Assessment and what evidence is there to support this? Your response can cover any number of the Commission's challenges.

Most responses raised 'climate' as being the most important of the four design principles. The remaining three design principles of 'people', 'place' and 'value' were raised in some responses. Many responses provided suggestions and/or examples of how better design could help solve the Commission's nine challenges, although some of these were general suggestions, and did not specifically pertain to one of the challenges.

There were 46 responses to this question. A breakdown of the high-level themes is set out below:



The design principles for national infrastructure are set out below:



Challenge 1: all sectors will need to take the opportunities of new digital technologies

A few responses identified ways in which digital technologies could support better design. Most of these suggestions related to the use of digital technologies to enable better asset management practices (ie. Challenge 5: good asset management).

Some responses raised digital twins as an opportunity, and primarily saw these contributing to the 'value' design principle. One response stated that design inputs need to ensure that asset maintenance and replacement strategies are compatible and traceable. Another response stated that a recurring issue raised by digital twin practitioners is that human factors, rather than technological factors, restrict adoption and application. These included:

- a lack of digital skills
- a lack of transformational leadership skills to encourage uptake of digital technologies
- poor data availability due to poor historical information management
- an ongoing lack of investment in digital technologies

One response highlighted how some services in detailed engineering design can be delivered remotely. The response did however identify a potential risk that outsourcing could lead to a long-term skill dilution in the UK. They stated that it is therefore in the UK's best interest to develop appropriate skills in feasibility study

and design of decarbonisation technologies to achieve net zero. In relation to the ‘value’ design principle, one response identified digital tools as an opportunity to enable design optimisation, reduce over-design and reduce life-cycle impacts of materials used in construction.

Challenge 2: the electricity system must decarbonise fast to meet the sixth Carbon Budget

A few responses identified ways in which better design could support the decarbonisation of the electricity system, with most of these suggestions aligned with the ‘climate’ design principle. Most responses pertaining to Challenge 2 also related to Challenge 3.

One response noted a potential constraint for the rapid decarbonisation of electricity systems is that planning consents and targets have been recently strengthened. Responses suggested that trade-offs may be required between:

- extensive engagement with communities at all projects phases and in all aspects of design
- more targeted engagement to ensure effective consultation and ensure progress with limited time and resources.

One response suggested that climate adaption policies and associated funding should support energy and climate resilience for new infrastructure as it is designed and built; potentially an easier approach than retrofitting.

One response identified offshore wind and hydropower opportunities for the UK to provide sustainable, renewable energy from natural resources. They noted that our numerous historic ports, harbours and mills could play a key role in enabling this, citing the following examples:

- Ørsted Energy maintain the Hornsea 1 and Hornsea 2 wind farms.
- Vattenfall maintain the London Array from the Royal Harbour, Ramsgate.
- River Thames Old Mills and Weirs - the first hydropower turbine on the Thames, reusing the Grade II listed waterpower mill on the river. This provides power to the Mapledurham Estate and the national grid.
- Osney Mill Oxford – hydroelectricity provided via the community-owned and crowdfunded Osney Lock Hydro Scheme.

Challenge 3: decarbonising heat will require major changes to the way people heat their homes

Most responses pertaining to Challenge 3 also related to Challenge 2.

One response noted that in order to achieve net zero, reducing energy consumption from future developments, particularly residential development, must be a priority. One response stated that new developments need to be built with ‘ultra-low’ levels of forecast energy use, and setting stringent standards for space heating demands, energy use intensity, and installation of renewable energy technology. The response also suggested that policy, and in particular Local Plans, could help support this change.

One response noted the potential of canals and rivers to provide opportunities for heat decarbonisation through water source heat pumps. Where waterways are adjacent to new residential development sites this offers the potential for district heating infrastructure.

Challenge 4: new networks will be needed for hydrogen and carbon capture and storage

Some responses made reference to this challenge, relating to investment and the other relating to planning processes. One response stated that the Government should take action to remove barriers to investment to ensure infrastructure, such as hydrogen networks. Another response noted that insulation, energy capture and storage and decarbonisation needs to be embedded in every planning decision.

Challenge 5: good asset management will be crucial as the effects of climate change increase

One response raised a need for more long-term stable funding to support asset maintenance. They stated that this would enable councils to plan a long term maintenance programme of preventative repairs. They further stated that future capital allocations should consider the significant inflation rates in construction and maintenance.

In relation to the ‘place’ and ‘value’ design principles, some responses identified opportunities to use historic infrastructure to support good asset management. A response cited an example from the mid-1990s, whereby British Waterways (now the Canal and River Trust) allowed for new fibreoptic cabling to be laid beneath canal towpaths. The response noted that using these routes saved significant costs and time compared to laying cables along roads, where other infrastructure could have been disturbed. In return, the Canal and River Trust received annual funding to help maintain the canal and towpath network as a valuable place for communities.

Another response noted how church towers are now a recognised option for hosting 5G antennas, creating another use for historic buildings. They stated that using the existing highpoints has avoided the need for intrusive masts in historic locations, as well as providing a rental income that helps support the maintenance of the buildings.

Challenge 6: action is needed to improve surface water management as flood risk increases

A few responses identified a need for enhanced infrastructure to ensure resilience against the increasing risks from extreme weather events.

One response cited interchanges in Greater Manchester as an example of how better design by integrating sustainable drainage systems and soft landscaping into new transport infrastructure. The response stated that this approach should be supported by agreed standards and better co-ordination of water management at a national level.

One response flagged that little work has been conducted in the UK to understand the infrastructure impacts and arrangements for drought that lie beyond the responsibility or capability of the water industry. Impacts include an inability to operate critical regional infrastructure due to low water pressure. The response suggested that a step change in water demand management is required to address this.

Planning, guidance and standards

A few responses identified a need for guidance and standards to support surface water management. One response stated a need for a more consistent approach to design standards that can be embedded across different authorities and risk holders, for example, sectors using an agreed, consistent set of climate projection scenarios to inform standards and project design. They also stated that restrictions on land take can limit opportunities for more innovative, sustainable flood risk management measures, particularly those based on green infrastructure.

One response referenced ‘The Environmental Benefits from Nature Tool’. The tool has been produced to expand net gain approaches to include wider natural capital benefits such as flood protection, recreation and improved water and air quality. This could improve the understanding of the natural capital impacts of development at an early stage.

Community outcomes

One response gave three examples of how flood risk prevention schemes have the potential to provide wider community benefits, in line with the ‘people’ and ‘place’ design principles, as follows:

- Boston Barrier, Lincolnshire – The United Nations Sustainable Development Goals were used in the development of this tidal flood defence scheme, to unlock wider project benefits. This approach supported greater economic, health and wellbeing outcomes for the local community.
- Grade II listed packhorse bridge, Pooley Bridge – This scheme involved extensive stakeholder engagement to provide a design with local identity and in keeping with the Lakeland-setting. The scheme also considered whole life cost and carbon and utilised 100% recyclable material.
- Fens Reservoir - The main purpose of this scheme is to provide 1:500 year drought resilience, but the project team has identified wider opportunities for environmental enhancement, such as reduction of abstraction in chalk streams, contributing to the alleviation of flood risk, positive social outcomes, improved climate resilience, and realisation of low carbon targets. The scheme could support the local economy by offering water for irrigation and improving the attractiveness of the area as a tourism destination.

Challenge 7: the waste sector must support the move to a circular economy

Some responses welcomed that the ‘Climate’ design principle considers whole-life impacts. Responses stated that:

- Many carbon management tools used to assess projects rely on carbon footprints of materials and installation equipment, rather than considering whole-life impacts.
- Resilience and carbon reduction are not primary drivers, and design solutions are therefore not optimised to reduce waste. A targeted programme to improve capture and calculation of carbon costs/benefits, define targets for resilience and develop standard designs based on full lifecycle analysis would contribute to achieving these objectives.
- Construction materials must be considered in terms of their contribution to the natural environment, as well as to ensure infrastructure can be easily dismantled for reuse.
- The reuse and repurposing of buildings should become a priority to reduce carbon emissions from construction and transport.
- Research undertaken identified that designing with lighter weight construction materials could accelerate the move towards a more circular economy, including flexible forming technologies and digital tools to enable design optimisation and reduce life cycle impacts.

Challenge 8: improved urban mobility and reduced congestion can boost urban productivity *and* Challenge 9: a multimodal interurban transport strategy can support regional growth.

A few responses included comments relating to both Challenges 8 and 9. A common theme across responses was the role that a people-centric approach can play in the ongoing development and design of the transport network.

One response stated that infrastructure design must go together with place-making. As an example for transport, they highlighted the concept of 15-minute neighbourhoods, where a range of amenities can be accessed by “walking or wheeling” in a round trip of 15 minutes or less. The response stated that 15-minute neighbourhoods could help to support place-making as part of the future development of the transport network, providing significant health and wellbeing, accessibility and environmental benefits to local communities.

Another response stated more people-centric approach to identifying, understanding, and responding to transport issues. They suggested that people-focused modelling and data collection could help to provide a better understanding of why and how people travel.

One response suggested that a new approach should be taken to business case development to ensure that the benefits of good design principles are fully accounted for within future NIC assessments.

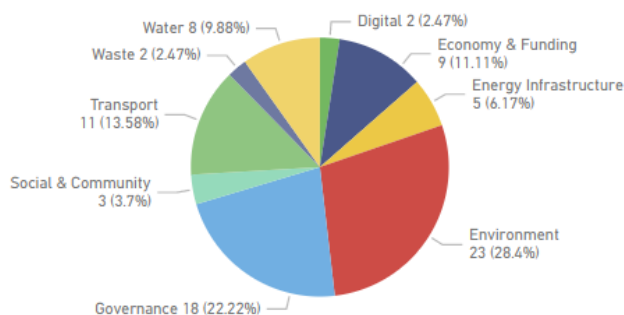
One response identified rail infrastructure as aligning well with the four design principles. They highlighted the key benefits as:

- Growth – rail projects generate significant investment.
- Geography – rail projects support the ‘levelling up’ agenda by supporting local jobs and productivity in all regions of the UK, including areas of social deprivation.
- Green – rail is a sustainable mode and will help to support environmental benefits alongside economic growth.
- Global - UK rail exports large amounts of goods and services each year and could deliver even more with further support.

Question 4: What interactions exist between addressing the Commission's nine challenges for the next Assessment and the government's target to halt biodiversity loss by 2030 and implement biodiversity net gain? Your response can cover any number of the Commission's challenges.

Most responses identified existing interactions between the Commission's challenges and the government's target to halt biodiversity loss and implement Biodiversity Net Gain (BNG). Many responses provided further suggestions of how to improve upon the existing interactions or proposed altogether new mechanisms for halting biodiversity loss and better implementation of BNG. The main themes highlighted by responses centred on the role of policies and requirements, how investment impacts the delivery of environmental benefits and the dual benefits of environmental initiatives such as nature-based solutions.

Question 4 received a total of 46 responses. A breakdown of the high-level themes is set out below:



Current challenges

Some responses noted that there are already policies in place targeted at having a positive impact towards halting the loss of biodiversity, including requirements in some Local Planning Authorities' (LPA) Local Plans that require developers to provide Biodiversity Net Gain (BNG). Some responses noted examples where this has been effectively implemented for example, where a minimum of 10% BNG has been achieved on the Humber Link Road and Able Marine Park.

Some responses stated their view that investment decisions are currently largely based upon economic benefits and/or if there is an infrastructure need. It was suggested the same weighting should also be given to natural capital when reviewing investment decisions for projects.

A concern amongst a few of the responses was that without a joined-up strategic approach to tackling environmental issues, there will be a failure to deliver what is needed.

A few responses were critical of the 10% commitment for BNG, citing experiences of attempting to secure BNG commitments from projects and the fact that these were unlikely to go far enough in tackling or preventing further loss of biodiversity. No specific examples were provided.

Some responses stated there should be more ambitious targets set for BNG. A few responses challenged that larger-scale developments, such as Nationally Significant Infrastructure Projects (NSIP), are currently not adequately mitigated or do not provide sufficient compensation for the adverse impacts they are generating from their development.

One response suggested a cautious approach to rolling out more obligations for developers to meet environmental targets, citing concern around the increased levels of bureaucracy and cost. An example provided was for ports which currently fall under three BNG frameworks that are terrestrial, intertidal and marine. This response was concerned that further obligations would result in some developments becoming unviable.

A few responses discussed transport, and the benefits of active travel in particular, with investment required to support additional green urban initiatives and low-carbon/zero-emission transport.

Potential solutions

Some responses noted the benefits of standardising the approach to the implementation and monitoring of BNG. One response suggested that additional guidance from the NIC on the government target to halt biodiversity loss by 2030, drafted with other organisations such as Natural England, would be welcomed.

Responses noted that there should be a further commitment on current and forthcoming projects to tackle the issue of biodiversity loss. An example provided was issuing tenders that require companies to submit how they will deliver BNG on their projects.

Some responses suggested there should be a greater focus on the re-using and maximising of existing assets and infrastructure. As all developments carry embodied carbon, responses suggested a preference to require proposals to first review existing infrastructure to determine whether it can be retrofitted to meet new requirements before the construction of new infrastructure.

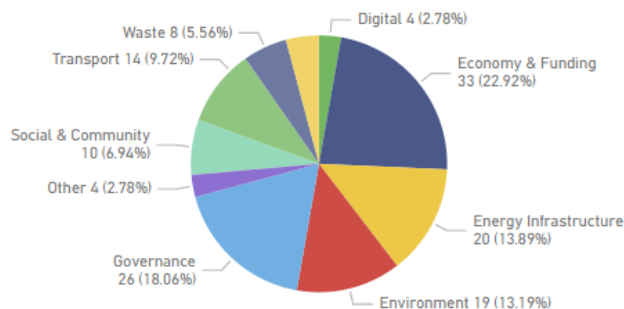
Many responses suggested nature-based solutions, that are strategically placed, to provide long-term positive environmental interventions. Examples included the creation of wetland habitats which can also be used to reduce the impacts of flooding and support carbon capture. A few responses noted the potential to deliver BNG on sites with renewable energy. An example provided was making use of land at the base of solar photovoltaics sites for habitat creation.

Responses suggested that strategic plans should be developed on a local and/or regional level to guide the location of interventions to deliver the greatest benefit. One response noted that requirements for both bioenergy and renewable energy sources require large amounts of land and may result in increased competition for available land which, if not approached strategically, could adversely impact biodiversity.

Question 5: What are the main opportunities in terms of governance, policy, regulation and market mechanisms that may help solve any of the Commission’s nine challenges for the Next Assessment? What are the main barriers? Your response can cover any number of the Commission’s challenges.

Most responses did not specifically make reference to opportunities in terms of governance, policy, regulation and market mechanisms. The need for devolution was a common theme amongst a few responses and this spans governance, policy, regulation and market mechanisms, however, this was not highlighted as an opportunity, but more of a necessity. Net zero was mentioned in many responses. Many of the responses focussed on the barriers rather than opportunities. The main barriers highlighted were the impact of climate change and the need to decarbonise different infrastructure sectors. Other barriers highlighted included funding and investment and the absence of policy, and where policy is present, its siloed approach.

Question 5 received 55 responses. A breakdown of the high-level themes is set out below:



Governance

Some responses suggested that siloed working and lack of aligned policy across sectors is a barrier to addressing the challenges set out by the Commission.

A few responses talked about the complexity of processes for decision-making and approvals required prior to delivery of infrastructure. Responses suggested that the volume and scale of new infrastructure required in the UK would be difficult to deliver within these current processes:

“Current processes are cumbersome, bureaucratic and mechanistic – ‘paralysis by analysis’” NIA-047

Some responses stated the need for a review of relevant processes, accountabilities and policies to allow for sectors and organisations to operate in a clearer, simpler environment.

Some responses emphasised the importance of devolution in delivering on the challenges, including levelling up, however one response stated limitations to devolved funding in relation to transport. Responses did not always identify devolution as a barrier or as an opportunity, but rather as a necessity. Some responses added that local decision-making was key to ensuring the right needs were addressed:

“We view ongoing devolution of funding as a key driver to take a place-based approach and reflect local needs. This will allow organisations to pick the best solution for the individual problem and maximise value for money for society.” NIA-018

One suggestion to address some of this perceived lack of coordination was for central government to set up a dedicated net zero unit with the ability to manage this policy area across departments and other organisations. Some responses stated that central government needed to provide more granular detail and coordinate across relevant sectors and stakeholders, as stated by one response:

“We support the government’s plans set out in the December 2020 Energy White Paper and the October 2021 Net Zero Strategy to drive the next stages of the net zero transition. [...] Much more needs to be done beyond these plans and the National Infrastructure Assessment can help to advise on these next steps” NIA-020

Policy

Decarbonisation was cited by some responses as a barrier, with some responses noting competing policy agendas for infrastructure investment leading to competing outcomes. An example provided in the responses was the ambition for levelling up and decarbonisation. Responses suggested this may significantly increase the amount of infrastructure required to be delivered.

Responses noted that decarbonisation may drive the need for adaptations to existing infrastructure, on top of any new infrastructure. For example, a response noted that the increase in major weather events could complicate surface water management and require more infrastructure to deal with this issue (noting this is a topic being considered separately by the NIC).

Some responses suggested that more detail is necessary in order to allow organisations to act effectively to meet the challenges. Responses suggested that the absence of sufficient policy detail was a barrier, with this also being covered in responses to other questions, including Question 11 'What barriers exist to the long-term growth of the hydrogen sector beyond 2030?'.

Funding and finance

Some responses acknowledged the pressure on funding availability for the major changes and additions to infrastructure that are anticipated as a result of policy. Some responses highlighted that significant funding is needed to meet these challenges, and that a strategic approach is necessary:

“Barriers to addressing these challenges can arise from the short-cycle approach to planning and investment that is currently common within sectors, which can limit long-term strategic planning” NIA-012

Some responses requested greater certainty of future targets and regulatory regimes to inform the investment decisions of relevant stakeholders.

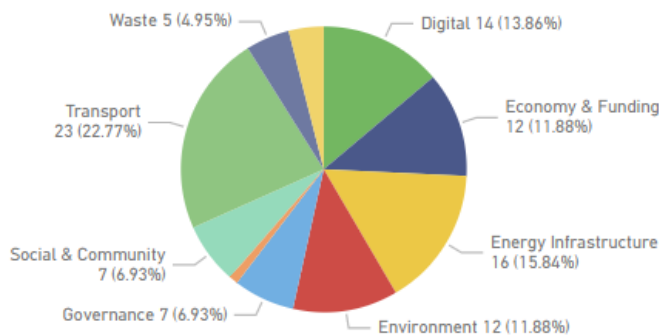
Further areas of focus

Many responses expressed a wide variety of areas where future changes would be required or desirable. Examples of this include the benefits of encouraging recycling of resources rather than further extraction, road pricing, interventions to behaviour change, fostering of innovation, the importance of nature-based solutions to water management, and benefits of retrofitting existing building stock.

Question 6: In which of the Commission's sectors (outside of digital) can digital services and technologies enabled by fixed and wireless communications networks deliver the biggest benefits and how much would this cost?

Most responses agreed that improvements in digital services were needed across several of the Commission's sectors, in particular transport and energy. The benefits identified included the contribution to net zero targets, access and ease of use of services for the customer or end user, and the levelling up agenda. Examples of where industry had already begun the digitalisation process were identified, but there was a common perception that significant work was needed. Most responses concentrated on identifying the sectors which would benefit most from improvements to digital services. Only one response provided a monetary figure as to how much a move to digital services and technologies would cost. However, it was highlighted that the cost would be dependent on requirements or focused on benefits such as cost efficiencies and income generation or economic benefits. The need for government funding and government financial support was also raised.

Question 6 received 41 responses. A breakdown of the high-level themes is set out below:



Transport

Transport was one area that many responses identified could benefit from digitalisation, both from a customer and supplier/service provider perspective.

Many responses stated that the rail network was as an area that could be improved through technology, such as digital signalling, intelligent infrastructure, and real-time data. Responses noted that the customer could also benefit from improved technology, with smart ticketing cited as an example.

On the road network, many responses noted asset and customer benefits from digitalisation, particularly where there is crossover between other sectors:

- One response noted that technology to monitor the condition of infrastructure assets would allow for timely and efficient maintenance interventions. An example of this is real-time monitoring of the performance of the road network to improve traffic management and improve congestion.
- Some responses identified that other road infrastructure and associated business practices would benefit from digital upgrades. These included sensors, telecommunications, and data.
- Sharing of data, it was suggested in some responses, could also support the development of apps and improvement of digital connectivity to enable use of and payment for EV charging points. It was noted that access to open data could help local authorities make informed decisions on where new infrastructure, such as electric vehicle charging points could be provided.
- One response noted that technology could have a detrimental effect on the road network, with digital navigation a case in point where diversion of traffic onto minor roads could present a risk. There was also an acceptance in some responses that there could be benefits from improved technology and

communications for digital navigation, as estimated time of arrival (ETA) data could mitigate journey time uncertainty and therefore improve congestion.

Some responses noted that technology could help customers change from one mode of transport to another, with one response providing detail on the concept of Mobility as a Service:

“These are services that enable people to plan, book and pay for mobility services through a digital interface (for example smartphone apps). The availability of these digital services has the potential to make it easier for users to interchange between modes and make use of non-car modes of transport (for example it can help users interchange between public transport and e-scooter).” NIA-031

Energy

Responses on energy covered both customers and supply issues. Across many responses, it was observed that various parts of the heating system, such as smart meters, heating and boiler systems, could be linked through wireless communications networks, improving energy generation and supply.

Housing was also identified in a few responses as a sector where digital technology can participate in achieving net zero targets and other environmental improvements:

“We feel that digital technologies will be an essential tool in achieving government's target of reaching Net Zero by 2050, with technology enabling a better understanding of energy usage as well as increasing efficiencies. Examples range from usage of smart meters in homes linked to demand management systems to AI-powered climate research and carbon capture facilities.” NIA-087

Some responses noted that improvements to infrastructure could improve efficiency and flexibility in delivering net zero. A few responses suggested this could be delivered is through the use of monitoring equipment and smarter grid infrastructure. This will however involve significant investment, which was acknowledged in a few responses. A medium-term concern in some responses was ageing housing stock and the challenges of retrofitting energy-efficient features

A few responses noted that the nuclear sector could benefit from improved digital technology, with regards to safety and efficiency. One response stated:

“Nuclear power generation across the region can be made safer and more efficient through the use of digital systems, robotics and other remote technologies which both keep humans safer and improve the efficiency of production.” NIA-007

The need for flexibility in the power grid system was also highlighted by a few responses, including one response that stated:

“To achieve flexibility and manage renewable energy, the power grids at both transmission and distribution levels will require further innovation to deliver a smarter grid infrastructure and therefore the largest allocation of infrastructure funding. National Grid has already invested £7bn up to 2026 to reach carbon zero by 2025” NIA-007

It was suggested that this could also create opportunities for supporting net zero, the circular economy, efficiency, and the customer experience.

Environment

One area responses suggested could gain from improvements in technology is flood resilience, specifically in terms of communicating flood risk:

- A few responses stated there is potential for digital services to play a central function in supporting the communication of risk to infrastructure in the lead up to, during, and recovery from, an environmental incident such as flooding.
- Evidence was presented from research commissioned by Waterwise and Arqiva that found smart water meter rollout could deliver up to 0.5% total greenhouse gas reductions, an overall £2bn net benefit to society, and result in lower average household bills.

- One response highlighted that digital assets can also be vulnerable to natural events. It was also observed that there was need for integration between digitalisation and government policy. One response stated:

“A number of steps are needed to ensure effective deployment of these solutions, including: ensuring government sets a requirement for digital adoption to prioritise environmental outcomes, while also supporting opportunities for digitalisation and data to policy aimed at environmental improvement; ensuring there are the policy drivers for data gathering and utilisation for environmental improvements in key sectors such as transport, manufacturing, construction and land use; strengthening digital skills; tackling the environmental footprint of digital infrastructure itself.” NIA-013

Skills

One response noted that workforce and skills shortage could be a challenge for digital innovation. Responses suggested that improved use of digital innovations can help address short-medium term challenges by increasing capacity and capability of the existing workforce, as well as attracting talent to the sector in the long-term.

A few responses noted that investment should be channelled into training on digital technologies, along with closer collaboration with developers, specifically in relation to decarbonisation.

Funding and financing

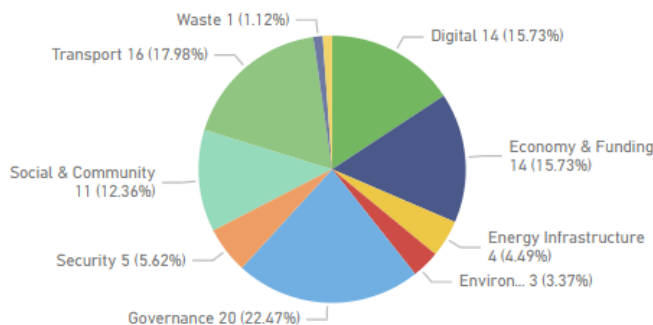
It was broadly agreed that the funding of digital infrastructure was required. One response stated:

“If the private sector anticipates strong demand for its services and that these services can be delivered profitably then government financial support may not be needed. But where there is uncertainty about future demand or large upfront expenditure then the private sector may seek government support if they are to go ahead with investment in new infrastructure, for example when running train routes in certain areas where people need trains but there may be limited passenger numbers or when building new energy infrastructure with uncertain or variable income flows.” NIA-062

Question 7: What barriers exist that are preventing the widescale adoption and application of these new digital services and technologies to deliver better infrastructure services? And how might they be addressed? Your response can cover any number of the Commission's sectors outside digital (energy, water, flood resilience, waste, transport).

The main barriers identified that would prevent adoption and application of new technologies included risk aversion by both service providers, customers and end user; technical constraints; skills gaps; and a lack of investment and financial barriers. These barriers could be addressed by collaborative working, joined-up thinking, and a more holistic approach to digital technology adoption by regulators, funders, and delivery organisations.

There were 46 responses to this question. A breakdown of the high-level themes is set out below:



Technical barriers and challenges

Mobile phone network coverage (both 4G and 5G) was noted as an area of concern, especially for rural communities where fibre links are problematic. One response suggested that investment in satellite-based communications could be a solution. One response noted that there is often a disconnect between the level of coverage that the operators claim to provide and the real-life experience of their customers.

Another response suggested that digitalisation of physical infrastructure assets and services would require the streaming of significant amounts of data, which would necessitate adequate network coverage and energy. They did not offer a solution to this challenge.

Other points covered included the shortage of comprehensive software, a lack of high capacity for the processing of infrastructure services, legacy IT infrastructure, and layering technology into an already complex and interconnected system.

One response raised the issue of cyber security as a risk, stating:

“The National Cyber Security Centre (NCSC) currently do not produce standards for enterprise Internet of Things (IOT) despite this being in use widely, across critical national infrastructure sectors.” NIA-012

Collaboration

A common point raised in many responses was the need for a collaborative approach. Responses encouraged regulators, funders, and delivery organisations to work together. One response noted:

“Cultural change is needed to address the ‘not invented here’ mindsets that can still exist in some companies. Systems thinking and learning networks can help tackle this challenge.” NIA-094

This sentiment was echoed in one response, which observed that there was plenty of ideas, but many of these can stall at the prototype stage due to the requirement of co-ordination between different industry parties, which hinder implementation. One suggested solution was an example of the Greater Manchester Infrastructure Board that has convened all providers on a regular basis to share investment plans and challenges for the past five years.

Fear of new technology and a risk-averse culture

Fear of the unknown was identified as a key issue in some responses when attempting to roll out new technology. One response noted that an aging workforce in some sectors can sometimes accentuate this problem. A suggested solution in some responses was greater diversity in recruitment, including not only younger people but also those with different skill sets and ways of thinking:

“Very few of the barriers to widescale adoption and application of digital services and technologies are technical in nature. Instead, the barriers are sociotechnical, meaning that human and organisational factors are the biggest obstacles to adoption.” NIA-001

On the point of socio-technical barriers to the uptake of digital technology, it was identified by many responses that this issue is not only for service providers, but it is a challenge shared by the customer or end users. One response explained that for example 30 per cent of people in the East and West Midlands have very low digital engagement, illustrating that improving digital skills along with rolling out 5G and broader connectivity will be essential to continue to deliver better digitally enabled infrastructure and services.

Digital skills and training

Some responses also noted that there remains a data skills gap, for both the industry and their customers, that will need to be addressed. For customers, one response stated that:

“A Government strategy including financial support to vulnerable customers who don’t have access to the digital connectivity, devices or skills they need including support for upgrading those still using 3G devices as the industry moves to sunset this older technology.” NIA-023

A skills gap in certain industries has been highlighted at an operational and management level. One response stated that much of the existing engineering and construction industry workforce do not have the digital skills to work with big data and emerging technologies. One response also stated in their view that management skills were lacking at senior level to project manage and implement large-scale digital transformation programmes. Another response highlighted:

“There is also the perennial issue of skills – our sense being 5G / wireless skills are in relatively short supply across the economy, let alone in the logistics sectors.” NIA-100

Investment

Investment, both by both the private and public sector (local, central and non-departmental government bodies), was stated in many responses as a key barrier to a successful adoption of new technology. It was mentioned in one response that the UK mobile industry needs help in delivering on the Government’s 5G ambitions with funding from central government. In certain sectors, responses noted that there was an overreliance on private sector investment, such as e-scooters, e-bikes and ride sharing apps. Some responses noted a lack of appetite for investment in these initiatives by local authorities. One response emphasised:

“A further barrier is lack of local council funding to invest in smart technology to benefit residents. The utilisation of smart technology would allow local authorities to interact directly with both community and local town infrastructure to monitor how towns and local areas are evolving.” NIA-094

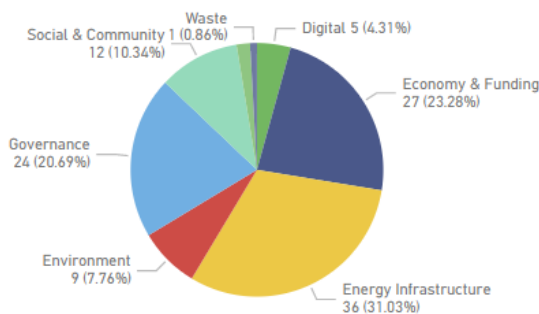
Government support

Some responses identified that other forms of support, such as the introduction and revision of legislation, would strengthen the achievement of this objective. It was acknowledged that there had been some success, including the introduction of Project Gigabit. However, some responses felt that more could be done to expediate this. One response suggested the introduction of compulsory metering and for government to set out a requirement for digital adoption, to prioritise environmental outcomes.

Question 8: What are the greatest risks to security of supply in a decarbonised power system that meets government ambition for 2035 and what solutions exist to mitigate these risks?

The main issues that would need to be considered in the future power system are diversification of energy sources, adequate system capacity, balancing mechanisms, and appropriate and effective controls. Responses discussed how these, combined with effective governance would combine to deliver a system flexibility which would mitigate the perceived risks to the security of supply.

There were 49 responses to Question 8. A breakdown of the high-level themes is set out below:



Generation and grid stability

Most responses agreed that electricity will be generated from a wide variety of energy sources in the future, although the exact make-up is currently unknown. Responses identified that they expect a significant increase in generation from intermittent renewables, coupled with a decrease in high-carbon baseload and backup generation.

Most responses agreed that there will need to be a diverse and balanced generation mix across the system, with some form of low-carbon, flexible power options to balance the system during peak demand or when the output of intermittent renewables is low. Responses highlighted the risks to security of supply which would result. One response stated that:

“An increasing reliance on ‘intermittent’ renewables, however, poses a significant supply security risk” NIA-070

Several responses highlighted there could be insufficient capacity to meet future demand. Electrification of heat and transport were given as examples of increased future demand, but the pace of change is unknown. Responses indicated that this makes it more challenging to plan the timely delivery of new supply capacity and supporting infrastructure.

A few responses further highlighted that the gradual removal of inertia-based generation will create lower grid stability, which is an additional risk.

Regarding nuclear power being used to provide stability, some responses were in favour stating as a preference to either further renewable capacity, and/or gas generation paired with carbon capture, usage and storage (CCUS).

Energy independence and security

A few responses discussed greater energy independence, which would then provide resilience to market fluctuations and external geopolitical drivers. No responses suggested this should be total energy independence. Some responses highlighted that there will be a need to continue to rely on imports (for example, the use of interconnectors or hydrogen) to mitigate certain risks such as capacity, baseload and peaking power.

A few responses made direct comments about national security in relation to current reliance on electricity generation from imported energy sources. One response highlighted:

“...it is important to differentiate between, security at a nation state level and security at the home/business user level.” NIA-019

Delivering the supply-side changes

Some responses discussed how the system changes could be delivered, and the pace required to meet government ambition. The lack of labour, both now and in the future, was raised as a risk:

“Potential workforce shortages ... pose a threat to the decarbonisation agenda. ... Employers, industry bodies, government and unions should work together to ensure the adult skills system is ready for the transition to net zero and to tackle barriers to retraining and upskilling” NIA-076

Responses recognised that the required changes could provide many economic opportunities, including significant job creation, inward investment, and the possibility of ‘levelling up’ deprived areas, although no examples or areas were specifically mentioned.

Some responses, although recognising that investment in low carbon electricity generation is required, highlighted the risk of overinvestment in any one single source.

Electricity demand

Many responses highlighted the future increased demand for electricity through electrification of heat and transport. It was recognised that that this exacerbates risks in relation to supply and grid capacity.

Energy efficiency

The theme of energy efficiency was raised by most responses. Many agreed that action to reduce the amount of energy consumed should be a priority, and would bring significant benefits to the wider system, reducing the level of investment required in other areas:

“...the fabric of our homes and buildings can play a role in demand side flexibility that could be very valuable as the imbalance between energy demand and renewable energy generation grows.” NIA-027

Most responses stated that demand reduction through energy efficiency has not yet been addressed well, and that many system risks could be minimised with a better approach. Most responses agreed that measures should be deployed at greater scale and at pace than current government policy. Additional benefits would include: job creation; supply chain investment; and a reduction in the impact of energy price rises for households and businesses.

Behaviour change

A few responses stated that another method of demand reduction could come via behaviour change, but that this has not yet been adequately addressed. There is inconsistent messaging and insufficient action taken to meet required targets. One response highlighted how network planning assumptions are based on overly optimistic demand-side solutions that rely on large-scale behavioural change, which is not currently taking place.

System flexibility

Many responses referred to the importance of having a flexible, demand-responsive, renewable system in the future. Responses noted that system flexibility would be important to enable grid balancing and to meet demand:

“As power system decarbonisation progresses, we will see larger and more prolonged periods of excess demand and excess generation... sufficient supply and demand-side measures will need to be in place to maintain security of supply” NIA-038

Options to increase supply-side flexibility included:

- Interconnection capacity

- Vehicle to grid
- Diverse generation sources
- The increased use of hydrogen
- Energy storage
- Varying demand to match supply
- Demand shifting across residential, industrial, commercial or transport sectors.

One response made a link to the national investment in smart meters to enable incentivisation of demand side response from domestic properties. Another response commented that embedded flexibility would improve system resilience to extreme weather events.

Most responses agreed that storage will form a large part of the future energy system to ensure security of supply. Responses advocated different pathways including hydrogen, batteries and Large Scale and Long Duration Storage. One response stated that different storage durations would provide different system benefits, and that provision should be made to both support grid stability and maintain the system over longer durations.

Some responses suggested other approaches to alleviate local grid constraints, such as targeted hydrogen deployment and demand management from the transport sector. Centralised strategies from government could help facilitate these.

Transmission and distribution

Most responses agreed that the move to decarbonisation will cause risks to supply due to grid capacity and an increased reliance on the distribution infrastructure. Many responses discussed the increased capacity required due to the electrification of heat and transport, and that this in turn would mean more end users and systems would be at risk of supply failures.

A few responses suggested that capacity constraints will create wider network resilience issues. Some responses mentioned the pace at which network reinforcement needs to take place.

Distribution infrastructure

Many responses referenced the geographically dependent nature of future demand and the impact it will place on national distribution infrastructure, requiring better connectivity to transfer energy to areas of high demand. Significant investment in transmission infrastructure is requested to connect the scale generation proposed by 2030 and deliver it to where needed. A strategic, coordinated approach to both onshore and offshore network infrastructure was suggested by one response.

One response recommended collaboration between government, regulators, and industry to secure investment in High Voltage Direct Current (HVDC) technology to enable the level of deployment required in the UK. This relates to the regulatory and governance changes, suggested by some responses, required to unlock investment and avoid future grid constraints becoming a barrier to renewable developments. This was considered by one response to be the single biggest barrier to achieving government ambitions.

Network management

A few responses mentioned that the increasing complexity of the UK energy system will need a different approach to network management. One response stated that the interdependencies between multi-vector supply solutions are not recognised or well understood, and that this will need careful management to enable efficient operation and consistency of supply.

One response recommended that the respective responsibilities of BEIS, Ofgem and the system operator should be clearly set out. Another response referred to the challenge of managing intermittent generation, stating that:

“... this can be mitigated by more active network management at the distribution level and greater use of flexible demand and storage.” NIA-085

Central government coordination

Many responses discussed the overall energy strategy from central Government, concluding that there was a lack of coordination and clear direction, making it challenging to meet net zero targets. One response stated that there had been:

“Conflicting UK policies arising from an over-centralised administrative system where priorities and action are fragmented and where departmental initiatives do not always cohere or reinforce one another” NIA-063

Many responses stated that infrastructure needed to be planned and delivered in a coordinated manner, regardless of who owned the strategy. Some responses advocated a strategy that is owned and executed by central Government, rather than a completely market-led approach. However, many responses preferred a decentralised approach with planning and implementation led by local authorities, who in turn are supported by central government, with greater devolved powers being given to local authorities. A few responses discussed that there is no clear strategy for the deep decarbonisation of the power sector, and one response stated the risk that without centralised coordination, interdependencies will not be adequately addressed.

Policy and regulation were raised in many responses, with issues around the pace of change of regulation and legislation, and the consistency of message to enable implementation of climate policy.

Decentralised energy

A key theme mentioned throughout the responses was decentralisation, including distribution infrastructure required to support local generation. Prioritising decentralised energy generation to increase resilience and enable energy to be generated closer to point of use is widely recommended by most responses. Some responses discussed the benefits this would have on reducing the amount of energy lost through transmission.

Most responses agreed that a national framework for Local Area Energy Planning should be put in place, so that local and regional authorities could be empowered to develop balanced local energy systems. This would involve multi-vector planning to enable the local integration of heat, power, transport and storage, thus optimising efficiency and flexibility. Some responses recommended the National Planning Policy Framework (NPPF) be extended to ensure all local authorities have Net Zero Local Area Energy Plans, with partnerships facilitated to ensure infrastructure is not limited across local authority boundaries.

There was a consistent message from most responses that local authorities should be key stakeholders in the development of infrastructure plans and be able to determine the best solutions to decarbonisation and identify opportunities for low carbon heat and power in a local area.

“Locally-led approach to infrastructure can address many of the key challenges to decarbonising the system, by providing the evidence needed to target investment smartly and cost-effectively.” NIA-024

There is a consistent message from most responses that local authorities should be key stakeholders in the development of infrastructure plans and be able to determine the best solutions to decarbonisation and identify opportunities for low carbon heat and power in a local area.

Governance and funding

Most responses stated energy governance structure is dated and needs revising and updating to incentivise investment in recognition of the needs of the entire energy system. The need for the new system to be able to manage intermittent renewables effectively was cited as a reason to implement changes to system governance, which would acknowledge the new operational requirements.

Some responses recommended incentives to promote flexibility within the distribution and transmission networks. This need to adjust where and what level of flexibility is provided by different stakeholders is common across several responses.

Investment

One response described the greatest barrier to enhancement of energy infrastructure being the cashflow risk profile which is unattractive for investors under current market conditions. Updates to the wholesale market

and ancillary services market were recommended to provide stability and reduce volatility for investors over typically long-term return periods.

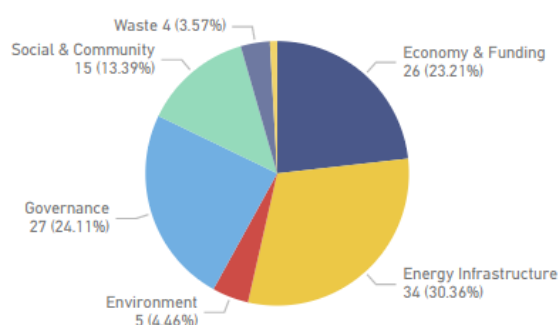
Another response suggested a review of market access to allow participation from both decentralised smart asset owners and smaller assets. This aligns with other responses which recommended using price signals to help reduce demand.

A few responses stated that the lack of clarity in providing signals to the market, due to inconsistent policy making, presented a risk to the achievement of government ambition. Some other responses raised issues with funding mechanisms, which they felt should be revised to promote the attributes of a resilient future energy system in order to incentivise optimal system investment. Many responses thought that grid and planning constraints were slowing investment in renewables, and that local authorities were being asked to implement local change while being under-resourced and without appropriate powers.

Question 9: What evidence do you have on the barriers to converting the existing gas grid to hydrogen, installing heat pumps in different types of properties, or rolling out low carbon heat networks? What are the potential solutions to these barriers?

The main barriers highlighted to these three alternatives to the gas grid included: energy efficiency; the role of government policy; workforce availability and skills; and public acceptance. Other barriers of note were commercial viability of the technologies, funding support, and the technical viability of each option. A range of solutions were identified with a change to government policy and regulations, investment in the technologies and the provision of a skilled workforce.

There were 47 responses to Question 9. A breakdown of the high-level themes is set out below:



Energy efficiency

Most responses highlighted the need to consider efficiency and demand reduction together. Updates to building regulations and building standards for energy efficiency was raised as a solution to this for new housing stock, but the responses do not refer to the new regulation planned for 2025.

“...energy efficiency and heat decarbonisation together, as a joint-up approach is the most efficient way to decarbonise homes” NIA-054

Central government policy

Responses noted that there were inconsistent messaging and policy on energy, which was raised as a barrier to meeting targets. This has an affect on all three alternatives to the gas grid through delays across the supply chain and obscuring a clear trajectory for investment. Many responses suggested that current government policy and regulation is not sufficient to achieve the targets the government has set. Some responses requested energy tariff structures which promote the use of clean energy. Many responses stated that a broad energy plan which encompasses all scales of infrastructure, including energy demand reduction and energy efficiency schemes, would be beneficial and these actions would help meet decarbonisation targets.

Workforce

Many responses raised the need to have a sufficient workforce capability to undertake the scale of the work required. A collection of solutions in responses included:

- Government support for any companies requiring a transition throughout this transition period.
- A well-planned programme of upskilling and training for existing installers and engineers.
- To mainstream and roll-out access to training opportunities, which are delivered through approved routes to ensure quality across the value chain.

Public acceptability

One significant barrier raised was public acceptance of these three alternatives to the gas grid in the face of rising energy bills. There was wide agreement that the transition will come at high cost, and many of the suggestions to achieve commercial viability for the transition may impact the end user. Responses noted concern about the rising cost of living creating a barrier to accepting new higher cost heating systems. One response noted that:

“Most consumers will be concerned about having sufficient means to maintain their current energy needs without being asked to consider these new initiatives.” NIA-001

Some responses suggested increased government transparency on the costs and payback period; financial support and grants; and incentives, such as feed in tariffs, could be provided to respond to this challenge.

Other responses included consumer disruption and technology familiarity as a barrier to installation in properties. Responses advised nationwide engagement and a communications drive, and a focus on ensuring high-quality installations and performance of all home retrofit measures.

One response raised trust in energy companies undertaking the work as a barrier, and recommended a more robust approach to consumer protections, in order to build this trust to facilitate the rollout.

How benefits are passed on to consumers was raised in a few responses, in particular how investment will support the levelling up agenda and how social and regional inequalities can be addressed. A suggested solution by one response is for extra support to be provided for rural areas which they state have been left out of the decarbonisation focus.

Hydrogen production and generation capacity

Many responses suggested the volume of hydrogen needed to supply the gas grid far outstrips production capacity, and evidence of production at scale was yet to be seen. A solution suggested in a few responses was an increase in UK hydrogen production ambitions in line with the demand forecasted by the Committee on Climate Change.

One response noted that hydrogen production and storage is expected to be location dependent, and as such it may be geographically impractical to convert the entire gas grid to hydrogen. It was therefore noted that a solution was required for the development of hydrogen transmission infrastructure.

Some responses raised the issue of a focus on blue hydrogen and viability of carbon capture and storage (CCS), fugitive CO₂ and methane emissions, and suggestions that blending hydrogen may drive up consumer costs for low additional climate value. No solutions were directly proposed; however, responses suggest an increase in capacity of green hydrogen, or technical advancements and capacity of CCS would mitigate this issue.

Many responses disputed that hydrogen should be prioritised for domestic consumption. Most responses felt that low carbon hydrogen should be directed towards sectors where fewer alternative decarbonisation options exist for example to displace operational carbon of industry and heavy transport. Responses highlighted that using it for low grade heating of buildings would be an inefficient use of the resource.

Commercial viability

Most responses raised concerns that large-scale hydrogen production does not yet work commercially. There is a need for policy interventions which scale up the hydrogen value chain to reach the minimum economies of scale required for market penetration. Some responses were positive on the outlook for commercial viability and technical viability of hydrogen if production facilities were developed in geographically optimal areas. A few responses noted that this may not address the commercial viability issues from low system efficiency which were inherent in the process.

Technical viability

Technical viability of hydrogen through the gas network was raised, however the majority of responses discussing this issue agreed that sufficient research, for example Hy4Heat, was being undertaken and was mature enough that no fundamental engineering barriers would materialise across the distribution system.

Regulation

Regulation and incentivisation to change were highlighted as a barrier, including a lack of clarity from the regulatory regime. Some responses wanted regulatory incentives or processes to spur the necessary network action for net zero. One of the key regulation reforms discussed for the gas (and in future hydrogen) network was the introduction and integration with Local Area Energy Planning (LAEP), with locally led decision making, accounting for local priorities and opportunities.

Safety

Safety was raised both as an impact on public perception and from a technical perspective, although does not appear to be an evidenced barrier for all but one response. Many responses consistently use the Hy4Heat programme as demonstration of safe design and operation of hydrogen distribution and consumption. The general message is that the safety case is being proved although one response suggested a review of relevant technical and safety standards is still outstanding.

Installing heat pumps in different types of properties

Technical barriers

Technical barriers to installation included wider household retrofits, complex installation processes, space constraints, lower system temperature requirements, complementary fabric upgrades and insulation, and disruption. A few responses suggested that heat pumps will not be suitable in many properties for a range of reasons, so alternatives will need to be sought. A proposed solution by one response was the development of heat zones which prioritise other decarbonisation pathways and their corresponding infrastructure solutions.

However, some responses evidenced the recent findings from the Energy Systems Catapult which demonstrated that heat pumps have the potential to be installed across the breadth of the UK's housing stock. This indicates that the technical barriers are not showstoppers. Improving commercial viability, complimentary energy efficiency measures, and the prioritisation and communication of a nationwide roll out are all required steps to mitigate the existing barriers.

Most responses agreed that energy efficiency measures were required in parallel to achieve economic performance of heat pumps, and therefore minimising the impact on the electricity network. Installing heat pumps without ensuring that buildings can retain the lower-grade heat was noted in many responses as causing further issues across the wider energy infrastructure. Timing of regulatory and funding approaches with the right building typologies through the transition was recommended to mitigate this:

“The challenge remains aligning regulatory and funding approaches with the best building typologies at the right time, rather than trying to squeeze square policy pegs into round holes” NIA-004

Planning policy

Planning policy was also discussed in some responses, with a reduction in planning timeframes required for heat pumps to bring them in line with other renewables, such as rooftop solar, which could enable faster installation and help maintain momentum throughout a project. One response proposed providing standard guidance to Planning and Environmental Health Officers to help support this.

Commercial viability

Some responses suggested higher up-front costs of heat pumps can be reduced over time through growing the size of the UK market, although this may require significant investment. Longer-term up-front grant incentives, green financing schemes, and supporting industry initiatives to achieve cost reduction through technological learning were all proposed as methods to accelerate this growth.

Operational cost barriers could be addressed through reviewing the difference in policy, environmental taxation and carbon cost charging between electricity and gas.

Electricity network capacity

Some responses highlighted that electrification of heat through heat pumps will create significant issues due to capacity and the required reinforcement of the distribution network. A proposed solution put forward in a

response was to update network regulation to allow for investment at a distribution level to support the connection of heat pumps.

Other responses were positive regarding a future smart network which could use heat pumps to optimise the grid operation through advanced flexibility, taking advantage of local storage and smart technology. However, it was recognised by many responses that this would still require significant network upgrades and consumer behaviour would be an important factor in the development of network solutions. This links strongly with the need for consistent messaging and public acceptance and understanding of initiatives that some responses set out:

“The primary constraints of at scale heat pump deployment are consumer acceptability, network upgrades (including storage) and end user disruption/capital cost.” NIA-070

Funding mechanism and incentives

A few responses suggested funding mechanisms and incentives are not effective, and lessons could be learnt from previous attempts such as the Green Homes Grant. Responses discussed how the aim should be to incentivise high quality installation and build confidence in the market and technology, whilst catalysing action in the market.

Rolling out low carbon heat networks

Commercial viability and capital costs

A few responses raised issues around investing in infrastructure with long payback periods, and the cost competitiveness of these networks when compared to alternatives. A few responses stated that heat networks will require high initial investment, coupled with uncertainty around connections, creating an environment where investment and commercial viability is difficult to achieve.

Other ideas set out in responses to improve commercial viability included giving scheme developers access to low-cost borrowing or underwriting some of the demand risks. One response suggested a model providing government guarantees which under-write investment risk for heat networks.

Funding and grants

Many responses noted that to unlock heat networks, government grants and funding are required to both build up the supply chain, and to catalyse network development, specifically with zero carbon heat networks costing more than gas driven networks.

From the end user perspective, a few responses question the current incentive to connect to a network, given the high costs required and the lack of policy requiring them to decarbonise. They suggested interventions mandating connection and funding mechanisms to support this could help stimulate end user demand:

“[it will be] very difficult for them to make this economically viable without more support from government.” NIA-024

Further proposals include funding enabling infrastructure prior to network development to align the installation of key infrastructure, such as heating pipes or grid reinforcement, with other civil infrastructure redevelopment. Such actions and guarantees could help provide longer term market assurance in investment.

The price of electricity relative to natural gas is also raised as vital for making heat networks economically competitive compared to natural gas boilers.

“Grants to cover a higher percentage of the capital costs should be considered for more innovative schemes that have the potential to deliver greater efficiency and carbon savings.” NIA-059

Planning and stakeholder coordination

Stakeholder buy in and coordination were identified as critical to the success of low carbon heat networks in some responses. Most responses stated that high development costs, the challenge of aligning the supply and demand for heat networks, and long development times, can lead to lost momentum in projects. A common solution proposed across the responses was for strategic intervention by government by giving local

authorities powers to coordinate the delivery of zoning, enabling mandated connections or technologies within a zone, and thus creating the high heat demand density critical to justify investment.

It was also suggested in some responses that removing the uncertainty over the extent and timing of connections would reduce risks to investment and cash flow, and in turn improve the commercial viability of heat networks.

One response raised concern that mandated connections within heat network zones coupled with decarbonisation regulation could create a situation in which some buildings in zones will disproportionately face decarbonisation costs when compared to those beyond. However, most responses agree that identifying locations and zones optimal for heat networks is not straightforward and the government should facilitate the implementation of Local Area Energy Plans and support local authorities with capacity to undertake this work, although no examples were provided.

One response provided an example of how it is possible to co-ordinate needs across stakeholders:

"We have developed Local Area Energy Planning (LAEP), a process which gathers stakeholders, led by local government, to interrogate different energy futures for an area and to develop the most promising, cost-effective options for decarbonisation. It considers costs across the whole system, including gas network and electricity network costs, whilst considering the values in the local area." NIA-099

Further local authority powers proposed in responses include National Planning Policy Framework clarification that local energy efficiency standards could be set more rigorously than national standards, further improving the case for net zero energy options such as heat networks.

One response suggested that apportioning the carbon saved between the different organisations that make up the low-carbon heat network value chain would incentivise engagement from a wider section of the commercial sector. It stated that the economic value of providing low carbon heat is very low, especially when compared to the development, monitoring and administration costs, and being able to attribute carbon savings to the company could provide a better incentive.

Regulation and standards

Most responses noted the absence of consumer protection regulations and/or technical standards as a barrier to the growth of the heat network market, and that standardising technical and commercial procedures will increase the confidence of all stakeholders. Satisfying the varied objectives and needs of stakeholders in the design of any regulation is required to remove this barrier.

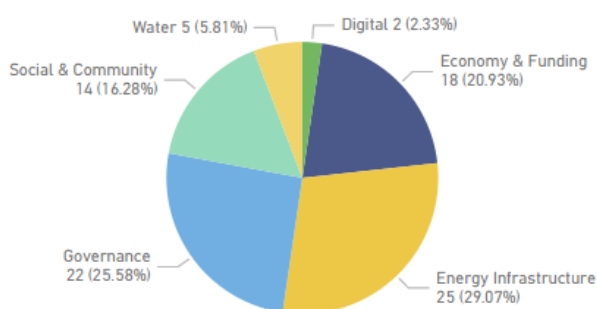
One response referred to the UK Government's Heat Network Market Framework as evidence of a potential solution and how consumer protections, and the technical standards, are being introduced and progressed. However, it was noted that this may need further policy support around quality assurance and enforcement in one response:

"...clear policy, funding and market framework is needed; from regulation to protect consumers, to 'zoning' and new funding programmes that will enable the expansion, growth and decarbonisation of these networks" NIA-085

Question 10: What evidence do you have of the barriers and potential solutions to deploying energy efficiency in the English building stock?

The main barrier highlighted was funding, with other barriers including the maturity of the supply chain and misaligned government and local policies which hinders the deployment of energy efficiency technologies highlighted. Many responses called for better alignment of policies; a clearer funding environment to allow stakeholders to plan ahead when retrofitting or improving energy efficiency of the building stock; better data on the existing housing stock; attractive incentives for both developers and consumers; clear energy advice to consumers; and a collaborative, holistic approach to decision-making and strategy development.

Question 10 received 45 responses. A breakdown of the high-level themes is set out below:



Funding

This was the most common barrier mentioned and referred to the amount, structure and certainty of funding available to give stakeholders confidence to invest. In addition, one response highlighted that the size and complexity of public sector (health and education) estates requires specific funding and incentivisation models.

Several solutions were suggested to overcome the challenges of funding:

- Existing government funding commitments to be clarified and implemented.
- The Energy Company Obligation (ECO) has been effective and should be expanded.
- Better data on existing housing stock could allow for more effective targeting of available funding.
- Changing how funding is allocated to allow for multi-measure interventions within a geographic area, allowing for economies of scale.
- Introducing attractive incentives that spur action and investment including an Energy Saving Stamp Duty incentive.
- An auction for the delivery of energy efficiency upgrades could facilitate cost-effective delivery and innovation through a competitive auctioning process that would bring new entrants into the market.

Maturity of Supply Chain

The maturity of the supply chain was sighted as a significant barrier in responses and there are significant gaps in knowledge. The impact of an immature supply chain on the delivery of improved energy efficiency of the English building stock suggested by responses is threefold:

- It will make it challenging to deliver the scale and scope of work implied by policy.
- It will make delivering multi-disciplinary retrofits of buildings that would lead to greatest energy efficiency gains challenging.

- Both of the above compound to produce the final impact – the high costs associated with individual interventions.

Some suggested solutions included provision of training to allow people to upskill in relevant disciplines alongside long-term funding to allow the supply chain to grow and mature.

Alignment of Policies and Strategies

Some responses cited barriers posed by local planning authorities' differing approaches to application of relevant policies. In particular, a few responses noted examples of considerations of aesthetics and heritage taking priority over energy efficiency measures. This was said to be incompatible with the wider need to improve energy efficiency given the scale of change required.

Some responses mentioned the need to ensure that certain sectors did not remain the sole focus of policy given the importance of all sectors in delivering overall energy efficiency improvements. Within the residential sector, some responses agreed with the benefits of targeting those on lower incomes first, but also called for policy to support those generally able to pay for their own efficiency measures. A few responses noted:

“The long-standing gap in policy and support for the non-domestic sector needs to be resolved, with a timeline for introducing regulation.” NIA-093

A common solution suggested was the need for a more comprehensive, joined up policy encompassing longer term funding commitments, governance for decision making, strategy and relevant local standards.

Specific additional suggestions from responses included:

- Creation of an appropriately empowered body with the sole task of delivering on this policy area.
- Minimum requirements for properties in order to allow them to be sold or rented.
- Updates to EPCs (Energy Performance Certificate) to better reflect overall energy efficiency.

Devolution

Also highlighted was the need to consider the type and depth of devolution of decision-making required to improve the energy efficiency of the English building stock. One response suggested that whilst it is understood that many decisions must be taken at a local or regional level, there is a need for central government to coordinate this if there is to be rapid progress towards the desired outcome.

“Like it or not, there are going to be decisions made at a local level that affect decarbonisation, and therefore why not try and formalise this into a process and integrate this as LAEP or similar rather than just leaving it to be chaotic.” NIA-018

Public Information

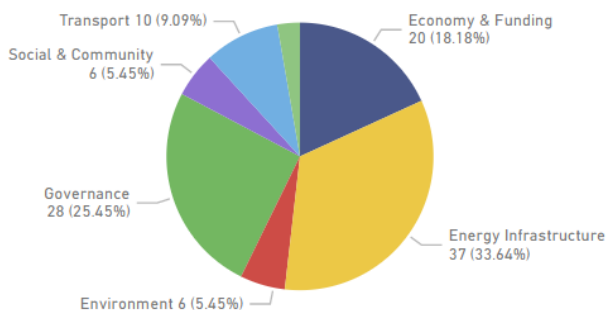
A few responses discussed the difficulties caused by lack of understanding of the options available to improve energy efficiency. A few responses also explained the work they already do to help their customers understand these options, suggesting that these could be expanded to help remove this barrier:

One response suggested a tool that would better evaluate the upfront costs of inclusion of energy efficiency measures in new developments versus the impact on running costs. This would give developers reason to build to higher standards, as they would be able to advertise these savings to potential buyers. This is relevant as some mortgage companies have started to consider this when calculating borrowing limits.

Question 11: What barriers exist to the long-term growth of the hydrogen sector beyond 2030 and how can they be overcome? Are any parts of the value chain (production, storage, transportation) more challenging than others and if so why?

There are a wide variety of barriers highlighted in the responses. Common themes included discussions of pricing and competitiveness of hydrogen, concerns on the clarity and timescales of government policy, and hydrogen's place as a vector in the market. Several responses expressed support for steps taken to promote hydrogen, with many qualifying that there is further to go to achieve overarching policy commitments, chiefly net zero. There were also a number of responses that set out the need for significant actions now in order to allow for the major growth in the hydrogen sector expected beyond 2030.

There were 48 responses to this question. A breakdown of the high-level themes is set out below:



Lack of a clear policy direction

A lack of clear policy direction was cited as a significant barrier in some responses to the development of a robust hydrogen sector:

“The Government has postponed key decisions, including blending hydrogen into the fossil gas grid, and the role of hydrogen for heating, including a nationwide roll-out of hydrogen ready boilers.” NIA-054

This is critical to enable stakeholders to plan how and when various areas of the existing network could be adapted. A frequent theme for removal of this barrier was a clear policy setting out the government's intentions for the specific roles hydrogen would (and would not) play in the future energy market. A few responses suggested it would be beneficial to target hydrogen in the areas where it is the only feasible option to deliver wider policy goals.

Some responses cited the need for a robust and comprehensive regulatory structure to be established, as is the case for other utilities.

There was a clear view from some that in order to allow for growth beyond 2030, there was a need to act now to facilitate the initial development of the sector so that it is in a healthy place for further expansion in the medium to longer term.

Scale of investment needed

Many responses highlighted the significant investment needed in the coming years to allow for development and growth of the sector. Overall funding constraints were acknowledged in a few responses, noting that there would be competition for funding with other infrastructure required to meet net zero. One response stated that:

“Focus is now needed on unlocking private capital for investment in hydrogen by launching business models at the earliest opportunity to allow networks to play their role in early unlocking of the UK wide hydrogen market, promoting the confidence of early movers, to maintain the trajectory to the end state goal.” NIA-102

The majority of responses making the point on funding suggested government policy would be critical to overcoming this barrier. An example raised by some was the delay to publishing the business models, which has made it difficult for private partners to be confident of how much and where to invest. Private financing was acknowledged as a key part of the funding picture for the future of the sector by some responses, with this being dependent on funding certainty such as that arising from publishing the business models.

Production

Production was raised as a challenge by some responses, but this was not explicitly stated to be more or less challenging than the other parts of the value chain specified in the question (storage and transport).

“While blue hydrogen might play a role in reducing the UK’s emissions in the near term ... the UK should aim to transition entirely to green hydrogen production by 2050.” NIA-013

Some responses drew out the need for a balance between blue hydrogen and green hydrogen production. The responses understood the need for blue hydrogen in the short and medium term but placed great importance on the need for a swift transition. A few responses cited the more general need to ensure there was sufficient clean electricity to allow for hydrogen production.

A few responses also cited that water availability should be considered when selecting sites for hydrogen production, given the volume of water it is expected to require.

One response noted that production of hydrogen from biomass with carbon capture storage (BECCS) could make this a carbon negative energy source which could be a particular advantage when targeting net zero.

There was some disagreement amongst responses on how best to promote growth in production in the short term. A few suggested mixing hydrogens into the existing natural gas supply to create a baseline level of demand and thus a degree of confidence to invest, while one response stated that doing so would take hydrogen away from the purposes for which it is most suited at a time when supply is limited.

Storage

Storage was seen as a barrier in some responses, with suggestions that the capacity envisaged by policy would be difficult to achieve. A few responses suggested the use of existing spaces, such as salt caverns, would allow for the volume of storage required. One response questioned whether salt caverns would store hydrogen effectively given how small hydrogen molecules are compared to carbon. Relatedly, another suggested that hydrogen was a relatively inefficient way to store energy and so should only be used where necessary, with compressed air being a more effective medium for general energy storage.

Distribution

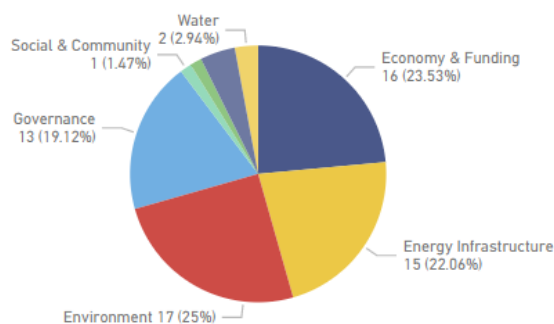
There was some disagreement between responses of the suitability of the existing natural gas network for adaptation for hydrogen distribution. A few responses linked this to the need for careful consideration of the spatial distribution of the hydrogen network, for example whether it should be in and around key industrial clusters and adjacent residential areas, effectively replacing natural gas.

It was noted by a few responses that transportation outside of a piped network would be a major cost factor that could count against hydrogen compared to other energy sectors.

Question 12: What are the main barriers to delivering the carbon capture and storage (CCS) networks required to support the transition to a net zero economy? What are the solutions to overcoming these barriers?

Overall, most responses believed that carbon capture and storage (CCS) will play an important role in the transition to a low carbon economy, particularly for hard to decarbonise sectors. Some responses were concerned that there was a focus on CCS rather than overall emissions reduction and expressed concern over the impact CCS could potentially have on the environment. However, a number of barriers to delivering these networks were identified including the impact of this technology on the environment, industry regulations, achieving planning consent for projects, the financial cost and a lack of confidence in a relatively unproven technology. Solutions to overcoming these barriers were also identified by responses including the need for longer term planning and a road map to reach targets, investment in the industry and a collaborative approach to working across the industry to share knowledge and develop solutions.

There were 41 responses to Question 12. A breakdown of the high-level themes is set out below:



Policy and financial barriers

Many responses suggested that the current deployment pathways for CCS were not significant enough to deliver the volume of CCS required to achieve government targets for 2030 and 2035 and that further policy support is needed. However, some responses acknowledged that the government is looking to provide revenue support to its proposed business models and supported its role in developing the cluster programme approach which would support the growth of the sector.

“BEIS announced the Track-1 CCUS clusters in 2021, however, to ensure the industry can deploy at scale, a strong pipeline of both capture and storage projects will be needed in the 2020s which will expand from 2030. What is now required is a comprehensive 10–20-year funding and policy framework which can deliver CCUS cluster projects at pace in the 2020s.” NIA-023

It was also made clear in some responses that there was a need for commitment to funding to support the sector and a long-term plan. Current proposals as part of the cluster sequencing process were not seen as enough to meet increased 2030 targets and the government should set out a road map which matches its own targets.

“The CCUS industry requires support by a long-term funding framework, detailing future allocation rounds, through the business models. Without a proportionate framework in place, a strong pipeline of projects would not materialise.” NIA-070

In order to support the development of policy it was suggested that a single department in government was created which could coordinate the government’s plans.

Responses highlighted the challenge of introducing increased capital requirements and the subsequent impact that this could have on the cost it would introduce on domestic businesses compared to international competitors. It was highlighted that in order to maintain the viability of businesses, any such regulation would need to be matched with financial support to chemical producers.

Regulation

Responses were clear on the role that regulation would have on the speed of development of the sector and some frustration at the current pace of development of this framework. The sector's regulation framework is under development with Ofgem, and responses were clear about the requirement for this to be established successfully and rapidly. The current option of utilising a regulated asset base (RAB) for the transport and storage infrastructure was supported, but responses were clear on the need for further detail on how this will be applied and developed into an investible product.

“The regulatory structure for CO2 networks is emerging, there are however many items relating to the development of the RAB which will need to be progressed at pace in order for companies to take investment decisions and understand the network code – governing the relationship between asset owners, operators and users.” NIA-025

It was also suggested that the number of processes and multi-user nature of CCS will require new network codes which govern the relationship between the CCS and users, presenting a challenge for regulators:

“The complex landscape of legal agreements, commercial arrangements, code structures and underlying government supported CO2 capture business models will need to be resolved.” NIA-025

Planning Consents

The challenge of achieving planning consent for large scale projects such as CCS was identified as a major barrier to delivery, with policies such as biodiversity net gain adding further costs onto projects. There is a need for government to take a more realistic approach to delivering nationally important schemes which have wider benefits. Accelerating the Development Consent Order (DCO) process would support earlier and lower cost deployment of CCS. Early identification and appraisals of sites was identified as key to the further growth of CCS as the sector expands.

Technical

There was a range of opinions on the technical challenges for carbon capture. Some responses felt that most companies in this sector had the technical ability to deliver projects. However, within the sector there will be benefits which can be achieved by sharing knowledge which will be key to overcoming challenges as the sector grows.

“There are benefits to be achieved in the cluster projects collaborating on issues such as CO2 compositional specification and approach to quantitative risk assessment. This will allow best practice to be shared, and for the sector to move away from the competitive environment of Cluster Sequencing to one of collaboration.” NIA-070

However, for those outside the sector there was greater concern in relation to the early stage of technical development of CCS and that this remained a barrier to relying on this process to deliver cost effective decarbonisation. As one response stated:

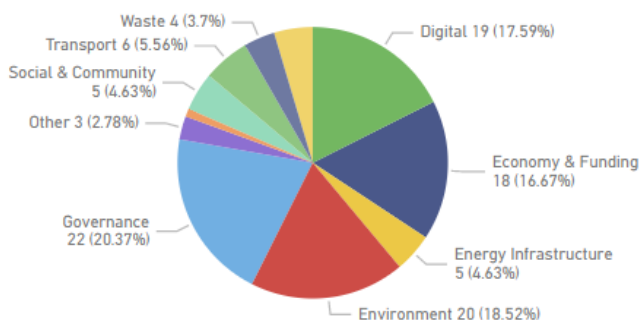
“The main barrier to CCS is that it remains a largely unproven tech, bar select emergent pilot projects at the early stages of development. This means that there is significant long-term uncertainty about the viability of the technology as a scaled decarbonisation solution. The urgency to deliver Net Zero means that even with the scale of planned government financial commitment to the technology, the real mitigation gains seen from CCS are still decades away.” NIA-024

A key challenge identified from responses was the interaction between offshore wind and the carbon storage sectors, as both sectors have similar requirements for stable areas of seabed. There will need to be co-ordination to ensure sectors are given permits which can be achieved by delivering an overarching net zero marine strategy that considers the needs, deployment pathways and locations of both offshore wind and CCS.

Question 13: In what ways will current asset management practice need to improve to support better infrastructure resilience? Your response can cover any number of the Commission's sectors.

Many responses raised concerns around the current state of infrastructure networks, particularly around ageing infrastructure and its vulnerability to the increasing occurrence of extreme weather events. A range of suggestions were put forward on how to better support infrastructure resilience, and some common themes emerged around the role of governance, policy, economy and funding, as well as digital solutions for monitoring of assets.

There were 42 responses to this question. A breakdown of the high-level themes is set out below:



Environment Resilience

Improving the resilience of our infrastructure networks to the impacts of climate change and increasing occurrence of extreme weather events was a key priority in most responses. The increasing occurrence of extreme weather events, increasing the likelihood of asset failure and acute challenges, such as management of flooding hotspots, was highlighted as a particular concern. The issue of ageing infrastructure also featured in some responses. Most responses agreed that asset management will need to change substantially in response to these challenges to ensure future resilience.

Nature-based solutions and climate change

The role of nature-based solutions in asset management featured in some responses:

“The NIA should consider where large-scale investment is needed in new natural infrastructure to deliver nature-based solutions. Where nature-based solutions can be used to help reduce risk to infrastructure assets from climate change, this would deliver multiple benefits and provide significant value for money.” NIA-077

Some responses stated that it is clear that natural infrastructure, such as sustainable drainage features and natural flood management installations, are expected to play a key role in asset management - both in delivering a service in its own right, and in easing pressures on traditional ‘hard’ infrastructure, thereby aiding resilience. A few responses identified catchment management as being key to delivering infrastructure resilience and environmental resilience in tandem, but did not define what is classed as a catchment.

Many responses noted that asset management and maintenance activities will need to be considerate of climate change. For example, one response cited how until recently, trackside green infrastructure has primarily been maintained for safety purposes only. These responses noted that going forward, consideration will need to be given to how more environmental benefits can be derived from such assets. Maintenance activities will also need to encompass management of new types of green infrastructure as they are introduced, as set out in the following response:

“Infrastructure resilience is partly dependent upon environmental resilience. Natural capital, green infrastructure and net environmental gain can increase the resilience of more traditional ‘hard’ infrastructure to hazards and reduce the need for infrastructure asset investment and running costs if it is designed in from the outset. The challenge is therefore not to protect infrastructure from the environment but to understand that environmental resilience is integral to infrastructure resilience and improved asset management, and indeed enables it.” NIA-086

A few responses related to better modelling and monitoring of climate change. Responses stated to not only look at historical data, but to also adopt leading indicators, for example, climate hazard projections, which could help better understand and plan for future asset vulnerability to extreme weather events.

The need for whole life carbon assessment in the delivery and management of infrastructure was suggested in some responses, including a need for better modelling of through-life carbon impacts. Some suggested that the delivery of new infrastructure is too carbon-intensive and retrofitting and optimisation of existing infrastructure should be a priority.

A few responses highlighted concerns around the maintenance of much of the existing basic infrastructure, particularly drainage and surface water management. They advised that a concerted effort must first be made to maintain and bring existing infrastructure up to a certain standard before delivering more.

Data and Digital

Many responses supported the NIC’s focus on data and digital technology to optimise asset management. A few responses suggested that the asset management that currently takes place on digital platforms is simply digitalised versions of traditional analogue processes and records. In the future, some responses suggested that it is likely that there will be ever increasing pressures on the resource and financial costs of asset management, and this is expected to require increased reliance upon new technologies and digital services.

Some responses called for digital engineering to be embraced for new assets, and retrospectively with existing assets. For example, one response noted that Building Information Modelling (BIM) is currently driving change with new assets, however, there is little driving it for existing assets. They identified the volume of existing assets, and the significant time and financial resources required to move these across to digitally engineered asset management as key issues.

Many responses highlighted availability and quality of data to be an issue for current asset management practices:

“Asset data is not generally trusted by owner organisations and as result, is not used widely as the basis for decision support.” NIA-014

Responses noted the importance of quality data in supporting asset managers in prioritising operational maintenance and capital programmes. Automation and technology enhancements were seen as an opportunity to transition to a more data-led approach to asset management in some responses. Adoption of data standards was also flagged in a few responses as necessary to ensure consistency within sectors.

A few responses identified a need for access to asset data from multiple infrastructure systems, rather than the current siloed approach. Having a standard external view of data about each infrastructure system and interoperability between the data sets would enable regular simulation of extreme events to understand where better resilience is needed across asset networks.

The role of digital technology in monitoring assets appeared in many responses, with more targeted monitoring and better use of predictive analytics thought to provide significant benefits. A few responses gave examples of monitoring devices that could help with routine monitoring of assets, as well as raising urgent warnings during acute events (for example extreme weather). These include:

- Sensor technologies, spatial analysis and pressure management for the water sector.
- Smart meters to reduce water consumption and detect leaks.
- Automated Intelligent Video Review, which makes video data rapidly accessible securely online, thus enabling remote condition monitoring of assets and environment.

- Atkins Rail Signalling Method, which integrates remote condition monitoring and other associated products on one platform.
- Sewer depth monitors that enable a smarter wastewater network and to detect blockages before customers' services or the environment are affected.

Some responses noted that digital technology and devices can reduce required maintenance, frequency of site visits, and avoid the sweating of assets, therefore offering efficiency gains. They also stated that it could enable more timely and cost-effective maintenance and management, therefore providing long-term cost savings.

Some responses identified the use of 'digital twins' as a way to improve current asset management practice and ensure better infrastructure resilience. They stated that digital twins have the capability to work with live data to provide a real time assessment of infrastructure systems to inform a real time response to damage and extreme weather events.

Governance

Many responses raised the different approaches to governance of asset management practices, noting how national and regional organisation structures impact on the pace of change adoption. Some responses acknowledged the need for national decisions in relation to asset management, and infrastructure planning, financing and design in general. Examples of national strategic guidance such as the 'National Infrastructure Strategy' and 'The Grand Challenges' were cited in one response as being beneficial in providing Local Authorities with a consistent framework through which to make decisions. Most responses agreed that these decisions and investments are most effective if co-determined between national and local government, with local control of scheme particulars to ensure maximum benefits.

A few responses suggested that the privatisation of asset management and maintenance can provide improvements to customer service levels and more resilient services with better environmental outcomes. One response noted that the Government should consider what policy steps are needed to ensure private investment is driving infrastructure resilience.

One response suggested exploring the establishment of an independent asset health agency. This agency would be required to independently assess the asset health and resilience of organisations and providers, learning from the model of the independent rating agencies in assessing financial resilience. The response stated that this could help to hold companies accountable for the management and maintenance of their assets.

Policy, Regulation and Standards

One response suggested that in more heavily prescribed industries, influenced by regulation and compliance, companies demonstrate more mature asset management capabilities. These capabilities included a desire to improve contingency planning and emergency response; established strategic planning frameworks; audit, compliance and need for continuous improvement; and reporting of performance commitments and outcome delivery incentives.

Some responses acknowledged that policy is already shifting away from the presumption that infrastructure solutions require the building of new assets. One response gave the example of the Scottish Government's Investment Hierarchy, which forms part of the Draft Infrastructure Investment Plan. The Investment Hierarchy 'prioritises enhancing and maintaining assets over new build', therefore seeking to maximise the use of extant infrastructure assets in line with future need.

A few responses highlighted the need for statutory and regulatory frameworks to be strengthened to ensure major planning and investment decisions drive sustainable future outcomes, and support ambitions such as net zero, implementation of nature-based solutions and ensuring infrastructure meets the standards required for climate change adaptation.

One response suggested that resilience assessments should be made a statutory requirement for all asset owners to identify vulnerabilities. They called for a central fund to be established to support the mitigation of vulnerabilities within systems to ensure system-wide resilience. Another response suggested a statutory requirement for every asset owner to embed monitoring into every aspect of asset management. Another

response suggested that clear frameworks to assess assets would enable organisations to identify opportunities, risks and constraints of their assets more effectively.

A few responses stated that oversight and engagement on risk management could be improved to ensure more effective planning and monitoring of assets. One response advocated for the use of an enterprise asset risk management framework as this would allow organisations to manage and maintain their physical assets throughout the entire asset lifecycle against a set of key strategic objectives.

Some responses identified a need for new or updated asset management resilience standards. This would make current and future resilience planning the default, rather than an add on. It would also help to drive systemic and aligned improvements over time to secure desired minimum levels of resilience in essential public infrastructure and services, ensuring more consistent services. One response noted that the NIC has already set out a concept for how infrastructure resilience standards could work.

Another response suggested that in response to climate change, international standards for infrastructure could be adopted in the UK to ensure assets are designed to operate safely in a wider maximum and minimum temperature range, thus future proofing their resilience.

Ongoing investment

Some responses flagged ongoing under investment as a key issue within asset management. A few responses noted that for long-life assets (for example wastewater assets), investment needs to focus on maintenance and upgrades, more so than new design. They suggested that adequate funding from economic regulators is key to this, and that the negative impacts of under-investment now will be realised in coming decades, for example, in pollution incidents and prosecution. Another response stated that the focus on capital investment rather than revenue expenditure dissuades the use of natural infrastructure, which is often low cost, but with ongoing (low) maintenance requirements.

Funding cycles

Many responses focused on a need for more long-term strategic investment to increase the resilience of assets to future stressors such as climate change and demographic shifts. One response suggested that the sheer scale of investment in resilience works requires a long-term approach to make this investment feasible, and that this will inevitably displace some of the ongoing expenditure on enhancement works.

Some responses specifically identified inefficiencies with the current short-term investment cycles for funding of infrastructure. Suggested benefits of longer-term investment cycles included:

- Avoiding costly inefficiencies in ramping up and winding down programmes at the start and end of each investment cycle.
- Supporting the development of skills and jobs in infrastructure providers and their wider supply chains.
- More opportunities to innovate in the knowledge that risks and potential benefits are weighed against more significant opportunities and give greater certainty for investors.
- More realistic timescales for planning and delivery of projects.

Regulatory incentives

Some responses suggested that regulatory incentives could help encourage asset managers to be more proactive in ongoing maintenance and management of their assets. As one response noted, when assets are healthy and not yet of concern, it is difficult for asset managers to prioritise them and justify the costs of upgrades or improvements. They stated that this approach can result in costly and disruptive issues in future. Some responses suggested that this could be rectified by incentivising asset managers to balance proportionate risks in maintaining their network and reliability at a reasonable level, whilst not gold-plating the network.

Wider value and benefits

A few responses flagged that the investment mechanisms for infrastructure fail to properly account for the wider value and benefits that could be realised. One response stated the following:

“Improving how processes select nature-based solution options is critical. Using natural capital, social capital and carbon values alongside financial costs is a key change that should happen. The regulatory framework for the water sector should ensure nature-based solutions are the preferred solutions wherever this is feasible and economic.” NIA-088

Other responses noted environmental and social/community benefits but did not provide specific examples of what these may be.

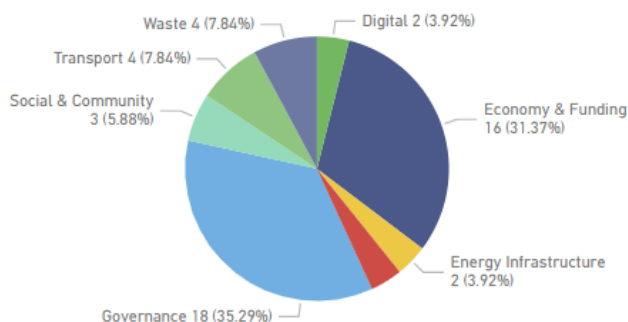
Private investment

A few responses mentioned the UK Green Taxonomy, which forms part of the government’s plans to improve the environment, accelerate the transition to net zero and create green jobs. It was suggested that this provides an opportunity to stimulate private investment in infrastructure resilience. This could be done by stipulating criteria, including adaptation and resilience measures, which specific economic activities need to meet in order to be considered sustainable. The responses suggested that the Government should consider what policy and/or investment is required to maximise the use of the UK Green Taxonomy for adaption, to ensure private investment is driving infrastructure resilience.

Question 14: What are the barriers to and solutions for expanding recycling capacity, both now and in the future to deliver environmental and net zero targets?

Overall, most responses highlighted that expanded recycling capacity within the United Kingdom was possible, but barriers such as a lack of investment and incentives to recycle, global competition, regulation and policy, product design, and public behaviour remain. The solutions were focussed on government policy which has been moving towards Extended Producer Responsibility (EPR) where producers are required to take greater responsibility for recycled goods; protection from competition from countries with lower regulatory standards; and higher targets for recycling. Some responses also pointed to the need to look beyond recycling and design to repair, reuse and remanufacturing as part of the circular economy.

There were 35 responses to this question. A breakdown of the high-level themes is set out below:



Limited investment

Many responses pointed to the low margins from recycling activities, which act as a disincentive for further investment. This is linked to the price of recycled materials compared to virgin materials. One response highlighted that policy measures did not necessarily lead to the financing needed to deliver additional infrastructure.

“There is a lack of required infrastructure to meet the targets and no evidence that currently, policy measures from DEFRA will change the investment landscape to secure the financing needed to deliver the required infrastructure at scale.” NIA-023.

Global competition

Global competitors are able to achieve lower margins as they do not have to reach the equivalent conditions as domestic facilities. Policies such as EPR could be a solution to this as they favour domestic processing. Alternatively, export bans to countries without equivalent standards could create a more level playing field for domestic facilities.

An alternative suggestion in a response was the adoption of a National Recycling Framework, mandating the types of materials used and agreeing a singular approach to waste collection and management by waste authorities.

“There is unfair competition from exports which significantly contribute towards achieving recycling rates, but which do not need to meet equivalent conditions as domestic facilities, creating unfair advantage against UK-based processors. In its current format EPR doesn’t favour domestic reprocessing and as a possible rebound effect, it may continue to stimulate export markets, rather than towards domestic reprocessing.” NIA-044

Transport costs

One response explained that the recycling sector is also highly dependent on logistics and will depend on support from the government to achieve transport decarbonisation.

Aging assets

Many assets within the sector are aging and investment will be increasingly required to maintain existing capacity. There is potential for improved digital asset management to play a role in reducing costs and extending asset life.

Regulation and Policy

Some responses believed that improved Resources and Waste Strategy (RWS) policies have the opportunity to provide significant market stimulus to increase UK domestic recycling capacity and demand. An improved policy would be designed to level the playing field for industry, create lower risk investments and also ensure that funding is better distributed across the sector. Responses believe the plastic packaging tax and EPR will act as an important incentive, driving demand for recycled products.

“The planned EPR regime has the potential to drive improved design for recycling and increased recycled content in packaging if the EPR fees are set in a way that rewards the right outcomes through reduced compliance costs and penalises undesirable outcomes.” NIA 031

A few responses mentioned that obtaining appropriate permits from the Environment Agency can be an issue for new entrants to the market, and long lead times and uncertainty increases the risk for investors.

Many responses focused solely on the water recycling sector and expressed concern over the interpretation of Farming Rules for Water (FRfW) which regulate the application of biosolids on agricultural land. Changes to the interpretation of these rules have led to the loss of a key recycling market. Whilst aimed at protecting river water quality this will have impacts on the recycling process which may lead to increases in alternatives such as incineration.

A number of responses focused on the wide array of recycling levels and local policies concerning waste collection across the UK which can present confusion to users.

“Expanding recycling capacity is complicated by what the LGA has termed the “smorgasbord” of approaches to waste collection and management in the UK, with over 300 different collection systems currently in operation. This makes it difficult to plan for the types of waste that will need to be recycled. Additionally, as exporting waste is a commercially viable alternative to recycling, there is currently little incentive to expand recycling capacity.” NIA-043

One solution presented was for government to introduce time specified targets for areas to achieve a mandatory level of recycling which would force local government to seek higher levels of recycling and support development of further capacity.

“By raising and enforcing statutory recycling targets with deadlines for achieving targeted levels of recycling, the UK could stimulate a need for greater investment into waste prevention and waste management interventions. There is a lack of a strong national policy and legislative framework to drive action around circular economy. Nor is there enough strategic planning across the region to support large-scale circular processes.” NIA-007

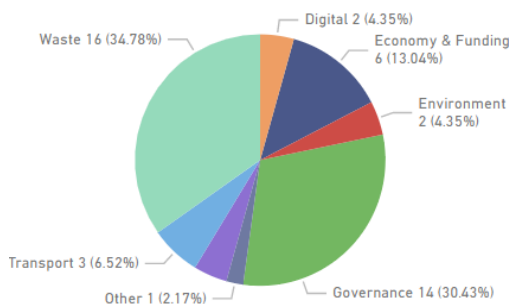
Labelling, product design and public behaviour

Some responses commented that there remains a significant challenge in recycling some products domestically. Incentives could be introduced for producers to phase out difficult-to-recycle formats, and clearer labelling on products could also make it easier for consumers to separate their recycling. Public participation remains key to delivering improved recycling rates and policies such as deposit return schemes and communication campaigns. Local authorities should retain or be given the tools to maximise participation, including the ability to determine recycling system design and residual waste collection frequency in their areas alongside appropriate enforcement powers.

Question 15: What is the likely environmental impact of waste streams from construction across economic infrastructure sectors, over the next 30 years, and what are the appropriate measures for addressing it?

Likely environmental impacts identified included the whole life carbon cost of construction, the predominately rural locations of major recycling sites, the use of heavy goods vehicles (HGVs), and associated impacts on the environment for the transportation of waste. Most responses identified the need for the construction industry to move towards a circular economy and a holistic whole-life approach to address environmental impacts. The reuse, recycling and repurposing of materials, infrastructure and buildings were also highlighted as solutions, along with the need for structural and regulatory changes including the setting of standards and targets for the industry to minimise the environmental impacts of waste streams from construction.

There were 30 responses to Question 15. A breakdown of the high-level themes is set out below:



Circular Economy

Most responses stated the need for the construction industry to move towards a circular economy, and a more holistic whole-life approach to construction, for example:

“NIC should consider the carbon impacts of new infrastructure to the same extent that fiscal and economic impacts are considered and emphasise the importance of infrastructure maintenance in meeting national goals, including net zero, resilience and addressing regional socio-economic inequalities.” NIA-001

Most responses agreed that in order to reduce environmental impacts, the reuse and repurposing of infrastructure and buildings must become the default position, rather than demolition and rebuilding. One response suggested that a greater emphasis on modular and advanced methods of construction now could help to support repurposing of buildings in future. Some responses flagged that more consideration needs to be given to the whole life carbon cost of all phases of construction. For example, a few responses suggested the increased use of rail to transport construction materials whilst another suggested the use of solar powered generators on site.

Reuse and recycling

The reuse and recycling of materials also featured heavily in responses as a way to increase circularity within the construction sector. Most responses agreed that in line with the waste hierarchy, avoiding the creation of waste should be a priority, but any waste that does arise should be recycled or reused.

Some responses suggested that a shift in the understanding of the concept of waste is needed to avoid the loss of valuable material. In future, waste management should lead to fewer products being considered as waste, due to a shift in how waste is viewed and valued within a circular economy. A few responses highlighted the benefits of reusing and recycling materials on site with examples from the highways sector.

A few responses supported a greater emphasis on recycling and identified a potential issue with a significant increase in recycling demand. They stated that historically some recycling facilities have been sited on agricultural land in rural areas, resulting in losses to residential and rural amenity. It was highlighted that if additional recycling facilities are created, they should be located on suitable land in appropriate industrial locations.

Construction Management

The need for better construction management and planning was raised in some responses. These responses stated that more careful planning of construction could prevent a large proportion of construction waste being generated in the first place. As one response stated:

“With approximately 13% of all materials delivered to site being sent to waste without use (according to data from the UKGBC), it is our materials management that poses the most significant risk.” NIA-018

One response agreed that waste management is still a major challenge on construction sites, with many still opting for mixed skips instead of separating waste on site. They identified space constraints and poor waste education and awareness as key causes of such practices. Another response suggested that improved material exchange mechanisms could help to increase reuse of materials and reduce haulage. In relation to this, one response suggested the building of data infrastructure around construction material flows, to facilitate the reuse of high value materials.

Soil Management and Excavation

A few responses raised the issue of poor management of soil waste from excavation during construction. As one response pointed out:

“Soil is the biggest terrestrial store of carbon and is a valuable bio-diversity resource. With 30% of the world’s soils in a degraded condition, soil is also a scarce resource.” NIA-014

Despite the recognised value of soil as a resource, these responses suggested that the majority of soil excavated in urban areas is disposed in landfill, and with it, the associated ecosystem services such as carbon sequestration, above and below ground biodiversity, and the water holding capacity of the ground. However, one response noted that the effective reuse of soils requires expert input and the response suggested that a national soil management culture and planning process that matches available soil to fill requirements would help facilitate greater reuse.

Research and Innovation

The role of research and innovation in reducing environmental impacts of construction was raised in a few responses. These responses suggested further research to improve or replace construction materials and products that are currently difficult to reuse or recycle, whilst another suggested further research to establish the value and or viability of recycling construction materials.

In contrast, one response warned of the potential implications of the growing volume of complex materials that have emerged due to the scale of research and innovation in the industry. They stated that this has resulted in an increase in hard-to-recycle materials, requiring either landfill disposal or complex incineration. They advised that NIA2 should take account of these developments within the construction waste stream.

Governance

Many responses suggested structural and regulatory changes to help reduce the environmental impacts of construction waste streams. Individual responses were as follows:

- A regulatory framework is needed within which environmentally sound design choices can be made.
- The vast bulk of construction waste is recoverable, mostly in the form of basic materials for reuse including fill and hardcore. If new build construction volumes fall over time, then the balance between waste material production and reuse may be altered. Regulatory intervention for inert waste disposal may provide a mechanism to manage these flows.

- Regulation of the Construction, Demolition and Excavation (CDE) waste stream is essential to prevent illegal deposits and misclassification of waste. Waste crime is a problematic area, and more regulation is needed to bring those operating illegally to account.
- Stronger application of Duty of Care for Tier 1 developers (at Board-level) is needed to incentivise them to monitor and self-regulate their supply chains.
- Introduction of building passports that capture all materials and highlight what can be reused or recycled and an assay of embedded carbon.
- Introduction of standards in line with established international standards, namely EN 15978 and RICS' 2017 professional statement.
- Targets and reporting requirements on embodied emissions to reduce environmental impacts of construction.

Economy and Finance

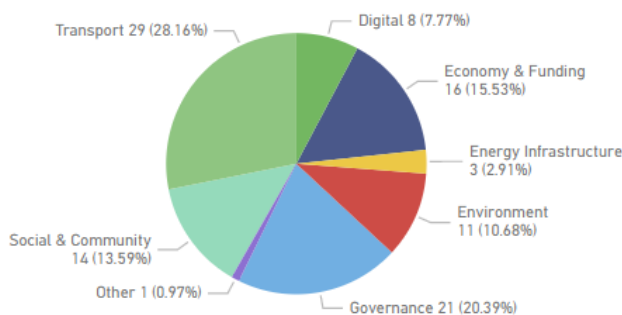
Some responses suggested that much of the waste currently generated by the construction sector is due to demolition, and disposal is often the cheapest or simplest option. Many responses agreed that financial incentives could help discourage these practices and see a shift towards more sustainable waste streams, though few responses gave specific example or suggestions. Some individual suggestions provided included:

- Cutting VAT on refurbishment to incentivise it over new build.
- Provide more funding to incentives adoption of emerging construction methods such as modular and off-site design and increased reuse of building components.
- Make it more costly to send demolition waste to landfill.
- Use of carbon and materials taxes.

Question 16: What evidence is there of the effectiveness in reducing congestion of different approaches to demand management used in cities around the world, including, but not limited to, congestion charging, and what are the different approaches used to build public consensus for such measures?

Many responses agreed that some form of congestion charging can be an effective approach to demand management in cities. However, the overwhelming message was the importance of implementing such schemes as part of a wider suite of solutions to reduce congestion. A range of alternative and supplementary approaches to managing demand were put forward, many with a focus on encouraging a modal shift towards active travel and public transport. The role of governance and funding of schemes, as well as the need to approach demand management holistically with a view to create a single comprehensive transport system, featured in many responses.

There were 44 responses to Question 16. A breakdown of the high-level themes is set out below:



Approaches to demand management

Many responses were in support of some form of congestion charging as an effective way to manage demand, although it was often highlighted that these schemes can be regarded as contentious. A few responses identified Stockholm as a successful example of a large-scale congestion charging scheme. Similarly, some responses identified Transport for London's (TfL) congestion charge as one of the most prominent examples of a congestion charging scheme, with evidence of the scheme having a significant and rapid positive impact on modal shift, traffic volumes, journey times, congestion and air quality. Revenue generated as a result of the congestion charge contributed to investments in active and public transport, including payment options.

However, some potential issues with TfL's congestion charge, both in itself and as a model for other cities, were raised. Firstly, a few responses noted that it is unclear whether the success of London could be replicated in cities where alternative transport options, and particularly public transport, are less comprehensive. Secondly, a few responses noted that although the initial impacts of the congestion charge were significant, the overall impact has appeared to plateau over time due to a variety of factors such as normalisation of charges, increasing number of exemptions and a practical limit on the charge amount (e.g., due to political deliverability).

A few responses flagged the electronic road pricing scheme in Singapore as a politically and practically feasible approach to road pricing schemes. One of the key success factors of the scheme appears to be that road user charging is not seen as a revenue-generating exercise but understood by the public to deliver benefits of reduced congestion and improved air quality. One response pointed to the Oslo Ring Road Toll which uses a dynamic pricing model by time period.

Most responses raised the importance of delivering a congestion charge or similar schemes with accompanying investment in order to make alternative modes a feasible option, encourage modal shift and ensure accessibility for all. Significant improvements to public transport, payment options and active travel modes should be delivered in advance of a scheme being implemented. As one response noted:

“There is clearly no silver bullet for dealing with congestion, and interventions need to be part of a well thought through set of measures that together form an integrated system.” NIA-029

Many responses identified Clean Air Zones or Low and Zero Emission Zones as an effective approach to demand management. However, a few responses raised public and political acceptability of CAZs as a potential issue, with people often conflating them with congestion charges.

Potential issues with encouraging uptake of electric vehicles were raised in a few responses including the slow roll-out of EV charging infrastructure, lack of affordable EV options and limited funding (for example the Plug-in Car Grant ends March 2023).

Parking

Many responses included suggestions on how parking restrictions and charges can assist in demand management. Workplace parking levies, retail parking charging, and limiting parking provision (or reallocating parking spaces for other modes) were noted as useful tools to encourage modal shift. A few responses also raised that parking was often overlooked by strategic policy and only seen as an operational issue.

The Workplace Parking Levy (WPL) implemented in Nottingham was highlighted in some responses as a successful method of demand management. Though not incremental and requiring political will, responses noted that WPLs are generally regarded as one of the less contentious approaches to demand management, delivering significant financial and operational benefits locally. For example, responses noted that on implementation of the Nottingham WPL, employer grants were made available to improve cycle facilities and funding was ringfenced for re-investment into transport initiatives.

Bus

Most responses emphasised the role of improved public transport services in effective demand management. Some responses raised the untapped potential of buses to support demand management, noting how they are often overlooked within policy and funding. As one response flagged, the National Bus Strategy and subsequent Bus Service Improvement Plans are a step in the right direction, but without sufficient available funding, the ambitions of these plans will not be realised.

Investment in bus infrastructure, including installation of more bus lanes and bus fleet electrification, will improve the speed and reliability of buses, making them a more attractive option. Inconsistent planning and delivery of bus services was raised as an issue, for example providing regular frequent services, ensuring routes serve the needs of customers, and effective cross-subsidies for routes that are not commercially viable to ensure that public transport is an accessible option for all communities.

“With a few notable exceptions, we have seen significant reductions in the extent of traditional bus routes particularly those serving more rural and less densely populated areas: a reflection of how the business model used to deliver such services is long overdue.” NIA-016

Rail

A few responses noted that there is also a strategic case for rail in managing demand, as long as there is improved access to rail gateways and services, which can be provided at a reasonable cost with sufficient patronage. Additional and improved Park and Ride facilities was also raised in a few responses.

Fares

Changes to fares and ticketing were mentioned in most responses as a key component to encouraging a shift towards public transport. Transferable tickets eligible for use on services run by different operators, or between different modes would support seamless and more affordable journeys. Widespread adoption of mobile/contactless ticketing would help facilitate this. The potential role of congestion charges in order to fund subsidised and/or capped public transport fares also featured in a few responses, as did reduced fares,

discounts, and incentives. One response noted a new climate ticket that has been launched in Austria, and free public transport offers in Luxembourg.

Active travel

Many responses emphasised the role of active travel in managing demand and reducing congestion. Most of these responses focused on cycling, such as the provision of additional and improved cycle lanes, cycle training, cycle hire schemes and cycle hubs.

Small scale measures were mentioned in some responses as local solutions to managing demand, including School Streets and pop-up cycle lanes during the COVID-19 pandemic. Low Traffic Neighbourhoods (LTNs) featured in a few responses, with Waltham Forest given as a successful example. The Waltham Forest LTN reduced traffic volumes by over half within the residential area and this impact was also felt on surrounding roads outside of the LTN. The LTN also showed a positive correlation with an increased uptake in active travel. However, other responses noted the potential for LTNs to divert traffic into other areas, and highlighted that small-scale initiatives only see localised behaviour change.

Behaviour change

Many responses suggested that key to managing demand is encouraging and facilitating behaviour change. The concept of “reducing, remodelling and retiming” journeys appeared several times across responses. The increase in homeworking and subsequent temporary reduction in traffic levels as a result of the COVID-19 pandemic was given as an example of the effectiveness of reducing the need to travel.

One response did note, however, that retiming journeys is not always feasible. For example, offering off-peak public transport fares often has limited impact, as people’s travel times are generally dictated by employers’ working hours, school hours and other commitments. The increase in flexible and remote working post-pandemic may however see more uptake of off-peak fares as stated in the response.

Single-system approach

Some responses suggested that a more holistic or single-system approach to the UK transport network is required. At present, different modes are planned, funded and operated in silos, making the integration of modes and multi-modal journeys an expensive and unattractive option. A more integrated transport system would give people flexibility to use different modes to suit different needs, as suggested by some responses. Some responses noted how this approach would ensure more equity between geographies and prevent certain areas being disadvantaged if they are included or excluded from transport schemes and initiatives.

Governance and policy

Many responses identified governance as key to delivering effective demand management schemes. The scale of congestion charging, and road pricing schemes was discussed in some responses. Most responses favoured schemes being implemented at a national level and centrally governed in order to ensure equity and consistency in their application. Other responses noted that there needs to be leadership at a national level to ensure a joined-up approach across networks. However, a few responses favoured a more localised approach to managing demand:

“The idea of a national pay per mile road user charging scheme as a panacea for managing congestion is pervasive but potentially a dangerous gateway to procrastination. Congestion is not a national issue; it is predominantly an urban phenomenon and one that is also bounded in time. Whilst there would clearly be some advantages in a national approach vs a patchwork of local solutions, there are also clear disadvantages, particularly on the political side.” NIA-029

A balanced approach between national and local governance was suggested by a few responses, for example, a national road pricing scheme complemented by local measures implemented at a Local Authority level, such as city centre access restrictions, low traffic neighbourhoods, emission-based congestion zones and dynamic parking charges.

The need for bold policy changes featured in some responses, including new policies to support homeworking, and active travel playing a bigger role in policy. A few responses identified a need for changes to local planning policy and processes in order to facilitate more accessible and sustainable development, which seeks to minimise impacts on the transport network, for example:

“There is extensive evidence that housing developments across England have been poorly designed and locked people into car-based living. Low carbon transport must also be embedded into local planning decisions to improve convenience and therefore increase patronage. This includes setting requirements for housing developments to be built where low carbon transport options are available or can be supported, with a requirement for such options to be available day one of residency.” NIA-013

Freight

Some responses discussed the management of demand associated with freight and commercial operations, acknowledging the faster growth of road freight compared to car traffic as consumer demands increase.

Paris was noted as an example of a good land use strategy for logistics. This alternative approach would see a move towards a ‘containerisation’ of urban deliveries, involving a multimodal system based on swap bodies that can be transferred easily from rail to road and vice versa. This could significantly reduce the number of HGVs in towns and cities, according to the response, giving space back to people, reducing congestion and associated emissions.

One response raised the importance of rail and water in removing HGVs from the Strategic Road Network to retain capacity. Another suggested locating distribution centres on edges of cities near the SRN to support more efficient last mile deliveries.

Digital

Digital solutions featured in some responses, mainly in relation to the highway network, such as **real time** traffic management, variable speed controls, alternative routes, weather station and information and connected vehicles.

Approaches to building public consensus

A range of approaches to building public consensus for demand management measures were identified within the responses. Most responses acknowledged that demand management requires a change in public attitude and behaviour, and stakeholder engagement must therefore play a key role. Proactive and evidence-based engagement with those most affected early on and throughout the implementation of new schemes is considered essential, as is clearly outlining both the need for and benefits of the scheme. Each element of the scheme should be clearly defined and justified, for example, the scale and geographic extents, costs and exemptions. One response noted that depending on the scale and type of a scheme, a ‘champion’ could be appointed to act as a focal point and representative. A few responses suggested running pilots or trialling solutions before full implementation, which provides the opportunity to garner feedback and refine schemes.

A few responses also noted that demand management schemes should be politically led:

“As shown in Manchester and Edinburgh, local referenda have not proved an effective way to debate the merits of charging proposals. The experience in London is instructive. The Congestion Charge was a mayoral manifesto commitment. It was also subject to an 18-month long public consultation exercise, after which refinements were made to the scheme. This serves to illustrate that the way a proposal is politically-led, developed and consulted on, will be key determinants of likely success.” NIA - 049

Many responses identified the importance of transparency on any revenue will be used in order to prevent the public viewing it as a ‘money-making’ scheme, and to ensure better support and buy-in:

“The evidence available from around the world is that people are comfortable with road user charging provided they share the reasoning for it and it is judged to be fair. Most new highways globally are tolled. New, (relatively) uncongested, highways where there is a ‘free’ alternative – the older, slower, lower quality road – have widespread public acceptance.” NIA-082

An emphasis on broadcasting the benefits of demand management schemes came through in many of the responses as a successful strategy. For example, in Singapore, electronic road pricing is not seen as a revenue generating exercise; it is understood to reduce congestion and improve air quality. Similarly, TfL published an annual monitoring report for the first five years of the Congestion Charge and continues to publish annual information in its Travel in London reports, outlining the collective benefits of the scheme.

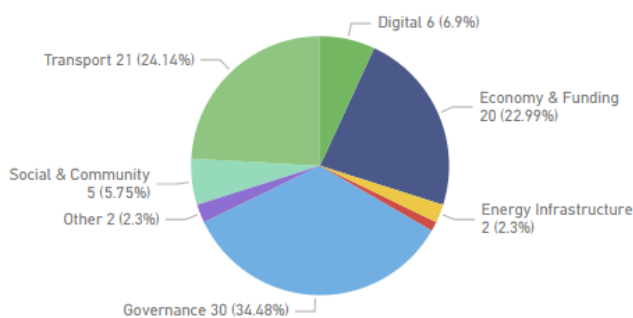
Some responses raised the importance of equity and inclusion throughout the design and implementation of demand management schemes. Responses suggested that scheme promoters must ensure that schemes do not disproportionately impact vulnerable or disadvantaged groups, and that any adverse impacts can be sufficiently mitigated. Engagement processes should be accessible and inclusive, through consideration of appropriate engagement methods, locations and times. One response gave the example of a travel buddying scheme, which could help the less able or those lacking confidence to make a modal shift.

Incentives, such as discounted public transport fares or cycle to work schemes, as a tool to achieve buy-in to demand management schemes, also appeared in many responses. One response spoke about the ‘Minder Hinder’ (which translates to ‘less nuisance’) approach taken in the Netherlands. ‘Spitsmijden’, or ‘rush hour avoidance’, is a key element of the approach based on positive incentives whereby drivers are rewarded if they change their behaviour to avoid peak periods on certain roads. Automatic Number Plate Recognition (ANPR) data is used to identify regular commuters who are then recruited into the programme as volunteers. An incentive payment is then awarded in response to any changes to travel behaviour such as rerouting or retiming a journey, changing to an alternative mode, or choosing not to travel. Spitsmijden has resulted in peak traffic levels reducing to those typically observed during holiday periods. Recorded benefits include time savings, travel distance reductions, improved journey reliability, better air quality and noise levels, improved safety and incentivised modal shift. This scheme found that the more freedom the driver is given to select options, the more successful the incentive is. Similarly, it was found that cash incentives are more effective than in-kind offers such as travel discounts.

Question 17: What are the barriers to a decision-making framework on interurban transport that reflects a balanced approach across different transport modes?

Most responses supported the emphasis on a balanced approach to decision-making across different transport modes. The main barriers and themes identified related to governance, policy, economics and funding and investment. A key barrier identified by many responses was that of planning and investment in modal silos and a need for better collaboration between stakeholders to overcome this. Overall, most responses suggested that any decision-making frameworks on interurban transport should support a shift away from private car use towards more sustainable modes.

There were 46 responses to Question 17. A breakdown of the high level themes is set out below:



Stakeholder coordination

Many responses identified poor stakeholder coordination as a key barrier, resulting in organisational barriers; either departmental, geographical and/or modal. For example, the DfT is largely organised along modal lines, as are its executive agencies (for example National Highways and Network Rail). Similarly, different modes of transport are often run by different private companies. As a few responses pointed out, the private control of bus and rail services means preparing and delivering a coherent transport plan can prove difficult.

A few responses noted that different stakeholders, such as residents, businesses, transport operators and local authorities all have different priorities, which must be appropriately balanced when making decisions on planning and funding of transport schemes. However, as one response noted, the differing views of each stakeholder often results in a compromise being agreed, which can result in the benefits of schemes being reduced, or significantly scaled back. The responses cited ‘a new cycle corridor might have gaps to ensure no reduction in highway capacity’ as an example of this.

One response suggested that an overarching strategy on interurban transport, that brings together the various streams of work and maps out the interdependencies would be useful to overcome barriers, both to provide guidance and ensure that stakeholders are working towards the same outcomes when planning and delivering transport schemes.

National vs regional approaches

A few responses noted the centralised nature of decision-making for infrastructure as a potential barrier. As one response noted, the same government department owns both the problem and solution to any issues with any given mode.

The benefits of nationally-led strategic thinking and maintaining a national perspective for strategic routes were, however, highlighted in a few responses. For example, enabling investments in high-speed lines providing effective interurban transport and creating more capacity for other modes of transportation. One response pointed out how any decision-making frameworks on transport must align with other aspects of ‘national networks’ strategy, such as the provision of energy to enable zero emission transport fuelling.

Overall, most responses suggested that a balance between national and local structures is needed. Some responses noted that devolution of decision-making powers offers many potential benefits, such as ensuring an effective focus on passengers and local priorities. A few responses suggested that local authorities understand the opportunities and constraints of their areas, and can use this insight to more effectively deliver sustainable transport solutions in the local context, rather than taking a blanket approach.

“Sub-national transport bodies offer a model to overcome fragmented decision-making. Through working with both constituent local authorities and government, sub-national transport bodies understand the needs of local places, but are still able to work at a scale which ensures a strategic approach.” NIA-016

As one response noted, devolved and sub-national transport bodies (for example TfL, TfWM, TfGM, TfW, TS, TfN) are distinguished by the democratic incentives on their political leaders (for example Mayors, First Ministers) to compile a manifesto. This often incentivises effective and swift delivery of transport improvements. The same incentives don't necessarily apply to organisations that span several jurisdictions, and, outside some form of English national or regional devolution, this may remain a barrier to a balanced decision-making framework.

Some responses suggested that local and regional authorities don't currently have sufficient powers (except those granted in specific devolution deals) to ensure that all transport modes are integrated. One response urged the Government to provide the powers required for local leaders to develop a London-style integrated, reliable, affordable and simple to use regional public transport service.

Policy

A few responses called for better land use planning policies and practices, to encourage growth and development in a way that allows for an integrated travel system to support it. A few responses raised concerns about how development continues to be permitted where it creates a car-dependent transport legacy, making decarbonisation and other objectives less achievable.

A few responses highlighted how the policy framework for placemaking has resulted in inconsistency across the country, such as gaps between Local Development Plans and Local Transport Plans. These plans need to share a common statutory framework for transport, that aligns with a wider strategic and statutory framework for placemaking, energy and other interfacing sectors. The need for the development of a National Transport Strategy to serve as a strategic framework was raised in a few responses, for example:

“The NIC could explore the need for an overarching transport strategy to resolve the tensions between competing aims and give guidance on how to address the right balance between intra and interurban trips.” NIA-043

Institutional barriers

As with governance, many responses identified institutional boundaries as a key barrier in relation to economy and funding, with schemes for different modes typically being subject to separate funding processes and sources. Many responses suggested that a closer relationship is needed between how interurban transport improvements are funded and how decisions are made to ensure that investment in different modes is balanced. Some responses stated that due to the lack of integration in the planning and funding for multi-modal transport, the development of area-based integrated approaches to interurban transport can be challenging to deliver.

Devolution

Many responses noted that funding is currently siloed between local and national levels, as well as between modes, creating a barrier to delivery. Many responses called for greater joined-up consideration and spend when developing and delivering schemes. Most responses were also supportive of devolution of funding in order to empower and entrust Local Authorities to deliver, using their local knowledge and context to plan the right schemes in the right places.

“[We] welcome the Commission's support for multi-year funding settlements for devolved Government transport bodies, in order to enable them to work with the supply chain to deliver local and integrated priorities effectively.” NIA-058

One response highlighted how STB transport strategies focus on strategic outcomes, taking a multi-modal approach to achieve these. As such, greater weight should be given to the outcomes and priorities in the unique STB transport strategies, and future funding streams given more flexibility to deliver solutions that transcend the existing modally specific funding pots.

Another response raised the practice of competitive bidding for funding, which can only be feasibly accessed by some Local Authorities. This has resulted in an unfair distribution of investment. Pooled and long-term funding was suggested as a preferred alternative approach, with funds being awarded on the development and merits of Local Transport Plans.

The timescales for funding were also highlighted as a barrier in some responses. The inability of transport authorities to control funding settlements beyond a single year is not seen as conducive to the development of coherently planned transport networks and services. One response commented that they would like to see multi-year funding settlements for STBs, with STBs being responsible for the development of the programme including prioritisation of what interventions are to be supported, as well as administration of the settlement over its life.

One response stated issues with the length of time taken to plan, design and build any major project, which can lead to funding uncertainty. They stated that a lack of funding certainty can create further issues, for example, providing improved bus services for a fixed period based on limited financial certainty can result in a lack of support from the industry, and frustration from the public when the services are pulled. One response stated that it is not reasonable to expect Local Transport Authorities to underwrite the risk associated with this approach to funding sustainable transport measures.

Approaches to Appraisal

The ways in which interurban transport schemes are assessed for investment was identified as a key barrier in many responses. Responses noted that the current approaches favour less sustainable modes and omit important criteria that should be considered.

“The approach developed by the NIC for valuing the benefits of packages of rail investments should be applied across the modes, including to the proposed RIS3 programme of road investments. If the outcome were to be that investment in new road capacity is unattractive for levelling up, compared to other kinds of investment, that would be an important conclusion.” NIA-080

A few responses suggested that the current business case methodology is a major barrier to implementing interurban transport. For example, dispersed populations in some regions make the financial viability of a mass transit approach challenging. A few responses voiced support for the HMT Green Book and DfT TAG, including recent updates. Some responses also included suggestions and areas for improvement:

- The orthodox approach to economic appraisal treats travel time saving as the main benefit, but this cannot be reconciled with the observed long run invariance of average travel time.
- The TAG process should be revised to increase the value assigned to traffic reduction, active travel and health impacts.
- The valuation methodologies in the Green Book should capture both user and non-user benefits of freight, putting them on a more comparable basis with passenger focused schemes.
- The benefits of the full ‘corridor’ in individual project assessments should be recognised so that the whole corridor is less impacted by an individually weak project business case.
- Decision-making frameworks need to consider factors other than just Value for Money. Decisions on interurban transport should balance an approach whereby they honour the principles of TAG and the Green Book, whilst highlighting more prominently to decision-makers the impact that they will have on other policy initiatives and criteria such as net-zero, safety, quality of life, housing delivery, economic growth post-Covid, and levelling up.
- Decision-making frameworks need to prioritise interurban public transport links over highway links. They also need to account for the relative cost and time it takes to deliver rail improvements in comparison with highway improvement schemes, which is a significant barrier to securing investment in rail.

Levelling Up

A few responses noted that existing approaches to appraisal may be contributing to increased barriers and regional inequalities, thus hindering the levelling up process. These responses emphasised how regional connectivity is a fundamental factor in facilitating growth that supports shared objectives on levelling up. They also called for increased funding priority for peripheral and disadvantaged areas, and more equitable approaches to appraisal and investment.

A few responses identified however, that improved connectivity does not always result in equally shared economic growth. New transport infrastructure inevitably attracts more new development, which can divert investment and resources away from the originally targeted areas.

One response suggested that levelling up needs to be appropriately balanced with other priorities:

“Levelling up is important, but we also need to deliver carbon savings as quickly as practicable and need therefore to accept that the biggest ‘bang for buck’ in terms of reducing emissions may be in areas of comparative advantage.” NIA-029

Single system approach

As previously identified in relation to governance, economy, and funding, a siloed approach to decision-making on interurban transport can have negative implications.

Many responses noted how planning and frameworks tend to be organised modally, with severe institutional silos preventing fuller and more holistic consideration of interurban transport infrastructure requirements. They also raised concerns about the number of mode-specific strategies and consultations ongoing, and their timing in relation to the NIA2 consultation. Examples cited included the GB Railways Whole Industry Strategic Plan, RIS3, and the local response to Bus Back Better. Whilst acknowledging that these are important conversations, responses emphasised the need to think beyond one specific mode when determining what the most appropriate solution may be for tackling transport challenges and developing an integrated transport system.

In line with the single system approach, mobility as a service (MaaS) was raised as a topic in a few responses, which advised that in order to be successful, MaaS systems will need to effectively incorporate all modes and ancillary services such as parking, vehicle charging and congestion payments. As different modes and services are operated by a range of competing service providers, the future development of MaaS offerings will need to be able to access these providers in order to be able to decision-support across the full range of criteria including total cost.

Many responses highlighted the potential benefits of a more holistic multi-modal approach to decision-making on interurban transport systems. An overall multi-modal strategy for long distance transport, as proposed by the NIC, was broadly supported by many responses.

“Good decision making should treat the transport network as an interrelated system, with different modes supporting the effectiveness of each other. The focus should be about how to encourage the ‘right journey on the right mode’.” NIA-003

Interurban vs Intraurban

A few responses argued that interurban transport cannot be considered in isolation, and decisions and investment in intraurban transport must complement those of interurban transport in order to reap maximum benefit. As well as transport modes, this should include the public realm within cities, and how well it lends itself to access by active modes.

“Although interurban trips are important, it is also vitally important to connect our rural locations with our towns and cities to ensure access to employment, healthcare, education and leisure activities are available to all. Not considering rural locations when looking at the transport network runs the risk of isolating those living and working there and increasing their car dependency.” NIA-043

One response highlighted that a key issue associated with considering interurban transport in isolation is that interurban schemes have the potential to change travel demand within the urban areas they serve. This response cited the example of HS2, an interurban scheme, resulting in a concentration of demand in specific

areas of London, creating more development opportunities in these areas and subsequently increasing the need for intraurban schemes such as Crossrail 2 to distribute passengers.

Some responses noted that longer trips tend to be associated with economic activity that is considered higher value in traditional appraisal methods, although these trips are more infrequent and less fundamental to the everyday lives and social and economic needs of the general population. Both trip types are strategically important for local, regional and national objectives. A few responses suggested that the NIC could explore the need for an overarching transport strategy to better align competing aims and provide guidance on how to effectively address the right balance between intra and interurban trips.

Data and Technology

Data collection and availability was raised as a barrier in some responses. This is perceived as an issue as data and modelling capabilities are needed to inform decision-making.

It was noted in some responses that traditionally transport data has been collected through ticket sales for interurban rail and air demand, or bespoke surveys of passengers and road users. However, these types of data do not capture end-to-end journeys and so do not provide any information on full multi-modal journeys or trip purposes.

Anonymised data, such as that collected from mobile phones, could provide a better understanding of some aspects of travel demand. However, as one response noted, there is still some way to go to having reliable methods that provide a systematic, comprehensive picture of interurban travel patterns. They noted that the constraints are partially technical, although the technology is constantly developing.

One response raised funding in relation to data as an issue, in that decision-support systems need to collate large volumes of data in advance of operation. Forward funding of development is therefore a further consideration.

Electric Vehicles (EV)

Related to the above, is uncertainty on the future of electric vehicles, which was raised in some responses. It was generally accepted that EVs will play a role in future interurban transport systems, although some potential barriers were raised:

- EV charging currently has an immature and uncertain business model.
- Unclear priorities of hydrogen vehicles vs. electric vehicles.
- Electric vehicles do not solve all problems associated with car travel (for example congestion will still occur and journey times are unlikely to improve).

A few responses noted that in order for EVs to be successfully integrated into future transport systems, Distribution Network Operators, Local Authorities and other key stakeholders will need to work collaboratively to ensure that EV infrastructure is being optimised and provided in the right locations. Another response suggested that a coherent plan for EV infrastructure rollout in the UK is needed.

Demand Forecasting

Demand uncertainty was raised as a barrier to decision-making on interurban transport in some responses. Of these responses, most made reference to the COVID-19 pandemic, which has driven changes in how people live and work, and has in turn impacted demand for infrastructure services and accelerated shifts in long-term demand. The increase in remote working has in particular impacted commuting patterns within and between urban centres.

A few responses voiced support for the NIC continuing to monitor the impacts of behaviour change as data emerges. They noted that a better understanding of demand will support more consistent decision making in terms of which modes take priority in different contexts.

Freight

The COVID-19 pandemic has also seen an increase in home deliveries, with commerce expected to shift further online. This will continue to introduce new demands on freight and logistics operations.

A few responses identified lack of understanding of freight needs as a barrier to decision-making on interurban transport. Better information and data about what goods will be moving around the country and by what modes would help inform decision-making going forward. One response identified the need for a coherent low-carbon freight strategy and another response highlighted the potential costs of decarbonising freight.

“As the Baseline Report notes, the best technology for decarbonising road freight is not yet clear. Even less clear is cost of decarbonisation; and to what extent, and by what mechanisms, those costs would be reflected in prices paid by users. Given the price-sensitivity of key parts of the rail freight market, such as container traffic, these uncertainties in prices imply substantial uncertainties in the scale of the future market for rail freight” NIA-008

Another response suggested that increasing the use of rail to transport freight could minimise the number of HGVs on the road network and reduce associated emissions. To achieve this, increased rail network capacity would be required, although this would need to be done without compromising the need of passenger services. This is an area where interurban and intraurban transport strategies intersect and responses highlighted the need for more coherent national, regional and local transport (and supporting) policy.

Appendix A – List of responses

ID	Organisation		
NIA-001	Institution of Civil Engineers	NIA-052	Enterprise M3 Local Enterprise Partnership's
NIA-002	Scottish Carbon Capture & Storage	NIA-053	University of Strathclyde
NIA-003	National Highways	NIA-054	E3G
NIA-004	Arup	NIA-055	Natural England
NIA-005	SSE	NIA-056	Ofwat
NIA-006	Local Government Association	NIA-057	Energy Networks Association
NIA-007	Midlands Engine	NIA-058	Railway Industry Association
NIA-008	Network Rail GBR Transition Team	NIA-059	Yorkshire Water
NIA-009	Lincolnshire County Council	NIA-060	Thames Water
NIA-010	Network Rail	NIA-061	Transport for the East Midlands
NIA-011	Associated British Ports	NIA-062	David Finlay
NIA-012	United Utilities	NIA-063	UK2070 Commission
NIA-013	Green Alliance	NIA-064	Independent Networks Association
NIA-014	Arcadis	NIA-065	Country Land and Business Association
NIA-015	Pollination		
NIA-016	England's Economic Heartland	NIA-066	Rolls-Royce SMR
NIA-017	London Cycling Campaign	NIA-067	Cumbria County Council
NIA-018	National Infrastructure Commission	NIA-068	C W Daws
	Young Professionals Panel	NIA-069	Transport Planning Society
NIA-019	Greater Manchester Combined Authority	NIA-070	Progressive Energy
NIA-020	EDF Energy	NIA-071	Centre for Digital Built Britain
NIA-021	Vodafone	NIA-072	Alstom UK & Ireland
NIA-022	British Ports Association	NIA-073	The Edge
NIA-023	Viridor	NIA-074	Trees and Design Action Group
NIA-024	UK100	NIA-075	Waterwise
NIA-025	Carbon Capture & Storage Association	NIA-076	Engineering Construction Industry Training Board
NIA-026	Commercial Boat Operators Association	NIA-077	The Wildlife Trusts
NIA-027	Mineral Products Association	NIA-078	Chartered Institution of Highways and Transportation
NIA-028	Nuclear Industry Association	NIA-079	Rail Freight Group
NIA-029	Heathrow Area Transport Forum	NIA-080	UCL
NIA-030	Orsted	NIA-081	Rachael Webb
NIA-031	Hertfordshire County Council	NIA-082	Greengauge 21
NIA-032	Airport Operators Association	NIA-083	Nigel Pearce
NIA-033	Consumer Council for Water	NIA-084	Graham Latham
NIA-034	Midlands Connect	NIA-085	GLA/TfL
NIA-035	University of Birmingham	NIA-086	Environment Agency
NIA-036	Cadent Gas	NIA-087	Tees Valley Combined Authority
NIA-037	Bodvoc Ltd.	NIA-088	Southern Water
NIA-038	National Grid Electricity Systems Operator's	NIA-089	Scottish Power
NIA-039	Historic England	NIA-090	Deryck Dillon
NIA-040	Biffa	NIA-091	Federation of Small Businesses
NIA-041	Northumbrian Water Limited	NIA-092	WRAP
NIA-042	Association of Decentralised Energy	NIA-093	UK Energy Research Centre
NIA-043	Transport for West Midlands	NIA-094	Sustainability First
NIA-044	Environmental Services Association	NIA-095	Gill Ringland
NIA-045	Drax	NIA-096	East Hendred Parish Council
NIA-046	Chartered Institute of Logistics and Transport	NIA-097	Zenobe Energy Limited
NIA-047	Transport East	NIA-098	Openreach
NIA-048	Global Infrastructure Investors Association	NIA-099	Catapult Energy Systems
NIA-049	Transport for the South East	NIA-100	UK Major Ports Group
NIA-050	University of Bristol	NIA-101	CBI
		NIA-102	National Grid