

ICE submission to the National Infrastructure Commission's call for evidence on the second National Infrastructure Assessment Baseline Report

February 2022

Introduction

The first National Infrastructure Assessment was a cornerstone of the UK's strategic infrastructure planning regime and represented the first cross-sector assessment of its kind in the UK. As a clear, well-evidenced analysis, it provided certainty to both policymakers and industry during periods of political turmoil caused by Brexit and Covid-19.

In August 2021, ICE launched a consultation seeking views on what should be in the second National Infrastructure Assessment.¹ A policy position statement was published in October 2021, drawing on evidence from the infrastructure and engineering communities, and made several recommendations.²

This submission draws on that policy position statement, as well as from engagement with ICE Fellows with expertise across the infrastructure spectrum, to answer the majority of the questions in the Baseline Report.

The coming decades will require us to sustainably implement complex infrastructure changes to meet population growth, demographic shifts, imbalances in socio-economic prosperity across the nation and, of course, removing carbon from the economy – all while ensuring costs are distributed fairly.

ICE is ready to support the National Infrastructure Commission through the development of the next National Infrastructure Assessment to achieve these aims.

¹ ICE (2021) [ICE Green Paper: What Should be in the Second National Infrastructure Assessment?](#)

² ICE (2021) [ICE Policy Position Statement: What Should be in the Second National Infrastructure Assessment?](#)

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?

In the broadest sense, the nine challenges cover the most pressing issues, set against the backdrop of a growing and ageing population, the need to decarbonise and become more climate resilient, and regional inequalities to be addressed through infrastructure interventions.

ICE has identified four main changes to infrastructure demand drivers since NIA1 that must be considered in NIA2:

1. The climate emergency and net zero
2. The Covid-19 pandemic
3. The need to address regional socio-economic inequalities
4. The impact of digital infrastructure availability and new digital technologies

The Baseline Report considers all of these to some degree; in particular, ICE agrees with the Baseline Report's focus on climate resilience, net zero and "levelling-up". As these three areas are intimately related, they should be considered holistically.

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.

To do this, the NIC must look at infrastructure as a complete system that is interconnected. The challenges our economic infrastructure faces are system level and can be solved by system solutions. NIA2 therefore needs to be system-based and address the overall performance of our systems, not projects.

Linked to this is the need for infrastructure owners to make better use of information. This is not about rolling out new digital technology, more about making the best use of information held across assets and networks and the need to value information itself as an asset.

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.

There will be a need to introduce, broaden, and better align user-pay funding options in the coming years. Globally, governments are under pressure to pass more of the cost of infrastructure to users – either as taxpayers or bill payers – but there are concerns about public acceptability. Greater alignment between users and payers will need to be found if the government is to deliver the National Infrastructure Strategy, in particular its net-zero commitments. There will be a need to bring the public along on the journey to net zero and develop a compelling narrative that highlights the wider benefits of net-zero infrastructure investment.

Road pricing

The NIC should consider the challenge of falling fuel duty and Vehicle Excise Duty income due to continued electrification of vehicles and the impacts on funding available for infrastructure spending.

ICE has explored this issue, producing a policy paper that examines the practical, technological, social, political and regulatory challenges which exist to establishing a ‘pay as you go’ (PAYG) model for the Strategic Road Network.³ This work outlines a range of high-level recommendations that must be delivered in order for any future PAYG model to be effectively and fairly administered. This work also showed that there is public support for a road pricing system that is coupled to clear benefits, particularly on improved maintenance and condition of roads, and if there is no overall increase in the tax burden.

Funding options for public transport

The NIC should also consider the long-term funding for public transport, both at national and local level. The Covid-19 pandemic highlighted the need for industry-wide bus and rail fiscal support to protect service provision. It has illustrated the case for a new approach.

The Commission’s scenario analysis work on infrastructure and behavioural change in 2021 highlighted that four out of five scenarios would see a reduction in annual trips on public transport by 2055. The analysis illustrates that even limited changes in public behaviour can affect overall demand or distributional patterns.

Policies aimed at growing the economy and strengthening the resilience of transport networks can at the same time address longstanding environmental challenges and social inequalities if they are designed and implemented well. If a lack of funding forces operators to cut services or increase fares, public transport becomes both less attractive and less affordable. This would undo the years of progress in improving passenger numbers, reliability and journey satisfaction and jeopardise meeting net-zero targets.

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.

Across 2020 and 2021, ICE surveyed over 900 UK-based members on the NIC’s design principles for national infrastructure. The results fed into an extensive report on UK civil engineers’ experiences of design.⁴ Among the findings was that better outcomes for climate, people, places and value would emerge if they were clearly identified early in a brief, particularly if based on a local needs assessment and were able to identify wider systemic opportunities. A number of recommendations are being taken forward, and ICE is happy to engage with NIC further on this topic.

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.

N/A

³ ICE (2019) [Pay As You Go – Achieving Sustainable Roads Funding in England](#)

⁴ ICE (2021) [What Makes Good Design?](#)

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.

Planning and delivering infrastructure at subnational level

Addressing regional inequalities has always been implicit in the NIC’s objective to support sustainable economic growth across all regions of the UK, but has gained a new focus and imperative under the current government’s ‘levelling up’ ambition. Moreover, the value of place-based decision-making has been demonstrated through the devolution success of combined authorities and Metro Mayors. Many local authorities and Metro Mayors have adopted targets on net zero that are more challenging than the government targets, so they need the tools to be able to deliver on the ground.⁵

Locally, actions have long been aimed at the broad ambition of ‘levelling up’, but are often inhibited by the lack of joined-up approach from central government in relation to timescales, funding and approval mechanisms.

The recent Levelling Up White Paper does provide a clearer definition of what the government wants to achieve, though is lacking in metrics to measure success. Without this overarching direction, the investment directed towards addressing regional inequalities could be wasted, as could the opportunity to support delivery of other national objectives such as net zero.

Given the urgency of the coming decade’s major challenges, there will be little time to waste. Strengthening the ability for the infrastructure planning and prioritisation system to get it ‘right first time’ is imperative and a stronger role for subnational actors is essential.

Some forms of national infrastructure will always require centralised decision-making. However, given trends to greater devolved responsibility for delivery, local engagement in the infrastructure that underpins communities, and the need to demonstrate inclusive decision-making, the NIC should make recommendations for how infrastructure decision-making governance should evolve, taking into account the above considerations.

The NIC could provide frameworks to guide this responsibility, accountability and decision-making, enabling local government to commit to clear pathways over the long term.

ICE has previously recommended that capability in infrastructure planning and prioritisation should continue to be built at the subnational level by evolving subnational transport bodies to become subnational infrastructure bodies, tasked with creating regional infrastructure strategies, backed up by spatial strategies.⁶

Net-zero governance

There are many potential ways to deliver net zero, all challenging, but the outcomes must be affordable and deliver a wider array of benefits – environmental, social and economic – rather than impose costs.

In the immediacy, there must be recognition that the infrastructure required to meet net zero by 2050 is unlikely to materialise without sound governance. Reaching net zero is an objective unlike previous political and policy challenges. It requires transformation across several vital and interconnected systems of infrastructure, regulation, finance and human behaviour. The UK’s system of legislative governance on carbon reduction targets, built around the Climate Change Committee, is world leading. However, while there are many processes which govern net zero, there is no formal system of governance or guidance for translating high-level targets into net-zero governance at a policy or local level.

⁵ ICE (2021) [The Role of Subnational Leadership in Achieving Net-Zero](#)

⁶ ICE (2020) [‘Levelling Up’ and the Role of Infrastructure](#)

There will be examples where particular policies fall between government departments and would benefit from better cross-departmental working. Rapid decarbonisation of electricity supply will provide a platform for the decarbonisation of other sectors such as heating and transport, but for optimum outcomes the sector strategies must be aligned. For example, policy on electric vehicles is separated between those responsible for roll-out of charging infrastructure, those encouraging switch-over, and those dealing with the impacts of increased demand on the energy system.

With infrastructure needing to be considered on a systems basis, NIA2 should consider the governance required to deliver net-zero infrastructure. Below strategy-setting, which will remain the government's domain, there are myriad complex interconnected delivery challenges that need to be navigated to enable a coherent, fair, cost-effective net-zero transition. It would be worth NIA2 considering whether an additional body is required to provide the guidance needed.

On top of this, it should also be recognised within NIA2 that new evidence could emerge that causes the 2050 net-zero target to be accelerated. The consequences this may have for infrastructure provision and delivery should be considered.

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?

There is huge untapped potential for the public to shape their engagement with infrastructure, providing opportunities for them to personalise and improve services (e.g. mobility-as-a-service), reduce costs and even for the assets of private citizens – such as electric vehicles and microgeneration – to become part of the wider infrastructure system. This potential should be considered within NIA2, exploring the growing role and impact of individually owned assets as part of the infrastructure system, as well as the regulatory structure that may need to develop to account for this evolution.

The biggest benefits can be delivered by data-driven decision making that leads to the re-use, re-purpose and operation of existing assets. In many cases, this can move away from the traditional assumption that new assets need to be built. Intelligent Traffic Systems (ITS), for example, use existing infrastructure and overlay software to allow for data-driven decisions such as better operation practices and congestion relief measures.

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).

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.

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 greatest risk to security of supply is overinvestment in one single source of low carbon energy generation. There needs to be a blended approach to decarbonised generation.

To decarbonise the UK's power generation within the timescales required means building 9–12GW of new or replacement capacity every year between now and 2050.⁷ There is no realistic scenario for decarbonising energy demand in the UK without a significant contribution from nuclear and offshore wind, as well as smaller contributions from other sources. Within this model, managing the intermittency of offshore wind requires either more nuclear capacity or CCGT (combined cycle gas turbines) with CCUS (carbon capture utilisation and storage), or both.

Trying to establish what the exact electricity generation mix will look like in 2035 or beyond is unlikely to be a productive exercise given the vastness of the challenge and the unknown potential of some technologies. Alongside reducing energy demand, it is likely that we must build as much energy generation infrastructure as we can and build faster than ever before.

Within the current framework, the UK would rely on the privatised energy market to build and pay for the required infrastructure. In reality, there is an extremely limited supply of organisations with access to the available finance that would be willing to fund such projects. Therefore, the real challenge is not just what to build and how to build it, but how it is paid for.

A flexible strategy that is owned and executed by central government, albeit supported by numerous stakeholders, is required rather than a completely market-led approach. This will require constant review to stay relevant and achievable in meeting the original goal.

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?

Heating and hot water for buildings make up around 40% of the UK's total energy demand, and 20% of its total greenhouse gas emissions. Given this contribution to emissions, the success of a decarbonised heating system is likely to depend on the success of decarbonising the national energy system.

A pathway based on hydrogen combustion in home boilers would entail vast quantities of hydrogen production, initially via natural gas and later by the scaling of water electrolysis. There are, however, many technology questions around electrolyzers that use electricity to break water into hydrogen, as this has not been done at scale. In any event, this pathway assumes that, where geography makes access to hydrogen impractical, heat pumps would be required.

Building a national hydrogen transmission system is considered a high-risk venture, though the extent of the engineering and logistical effort that will be required is as yet unknown.

But underlying all of this is an economic situation where large-scale hydrogen production does not yet work commercially, and to seriously entertain a hydrogen route means a need to quickly learn how to increase its commercial viability.

It is possible the government will need to back multiple production technologies to discover the best way forward, rolling out solutions in different parts of the country – some of which may turn out to be 'dead ends'. This may be a necessary, albeit politically unpalatable path.

Electrical heating would require the majority of homes in the UK to be fitted with heat pumps (generally air source or where homes have gardens, ground source). Several million homes will also need be connected to centralised district heat networks.⁸ Solar panels could be considered as an addition since they are becoming more efficient and cost-effective. Air source heat pumps are becoming more efficient with the addition of technology like 'solar iboost' and homes can now connect solar panels to the air source hot water tank, negating the requirement for solar thermal.

⁷ Atkins (2019) [Engineering Net Zero](#)

⁸ Mott MacDonald (2020) [The Path to Zero Carbon Heat](#)

The biggest barrier to any initiative is likely to be insufficient acceptance by the public and the high cost of installing the infrastructure. This position is likely to become further entrenched because of recent high energy costs and the raising of the energy price cap. Most consumers will be concerned about having sufficient means to maintain their current energy needs without being asked to consider these new initiatives.

The consumer also needs to understand the return period on the investment for heat pumps or other technologies. There is therefore an implied obligation on the government to be transparent on this and to provide financial support, grants, or feed in tariffs, above and beyond what is currently offered.

It is important to state that one heating solution will not be the answer in all cases or in all parts of the country - the right answer in one location will depend on the resources and needs of that region. For example, localised wind turbines can be added to the hybrid basket of solutions at rural properties that have available land.

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

N/A

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?

From a practical standpoint, the UK's pathway to decarbonisation is becoming de facto electric. Hydrogen will likely have a place, but will need to fight for this as the infrastructure for it does not currently exist.

The longer it takes to make an intervention around hydrogen, the more it means that electricity will have established the pace and become increasingly difficult to dislodge over time. Nevertheless, there is an important case for hydrogen to prove what it can do in the areas where it will have a natural advantage, such as within energy-intensive industries.

Accordingly, any strategy for delivery will need to be balanced and affordable. The greatest barriers to long term growth are resources and ensuring the industry has the appropriate skill set to meet the demand to fulfil government plans and expectations.

How the value chain can be successfully executed will be challenging, but the strategy for a strong and resilient value chain needs to be established soon, as opposed to closer to 2030.

It is not easy to identify what parts of the value chain are currently more challenging than others. The journey to the establishment of a robust hydrogen industry will help establish which are the most sensitive parts of the supply chain. Hence, the industry will need to be flexible to meet its needs.

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

Historically, obtaining planning consent for large industrial projects has been challenging. For CCS and indeed other major parts of the net-zero puzzle, there should be a much more realistic approach to planning for schemes that are of national importance and for the public and politicians to be convinced of the wider benefits for accepting such schemes.

A second and no less significant barrier is the availability of suitable sites across the UK for CCS. In addition to the geology and access, environmental considerations will need to be addressed, as well as commercial viability and the resources and skills required.

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.

Most infrastructure that supports the UK's national resilience over the next 30 years already exists and will do so for many years after. Maintenance of infrastructure assets and systems must be further up the agenda. With much of the UK's infrastructure dating back to the post-war or even Victorian eras, this poses a growing risk as they are put under additional pressure due to climate change, such as heat stress and increased surface water run-off in urban environments.

There is a need to better understand the current condition of assets and their structural integrity, the maintenance measures needed to improve their operation and resilience, as well as the impacts of new infrastructure on existing systems. NIA2 should set out the state of existing infrastructure networks and the maintenance required to bring them up to an acceptable level that meets national goals.

There is a wider awareness from both policymakers and the public of how to meet national challenges through infrastructure interventions, including the crucial questions of which projects to promote and how to promote them. In some cases, policymakers are already shifting their requirements away from the presumption that infrastructure solutions require new assets to be built. The NIC should look to the Scottish Government's Investment Hierarchy, as part of its Draft Infrastructure Investment Plan. The Investment Hierarchy 'prioritises enhancing and maintaining assets over new build' – seeking to maximise the use of extant infrastructure assets in line with future need, with replacement or new build considered where upgrading existing infrastructure would be unsuitable.⁹

The Government Soft Landings programme provides a to analyse how BIM has affected asset management practices. Requirement for every asset owner to embed monitoring into everything (e.g. number of users, maintenance frequency etc.)

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?

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?

The upkeep and improvement of existing infrastructure should be reviewed within NIA2 to avoid rebuilding where possible and minimise the impacts of embodied and operational carbon. To this end, ICE recommends that the 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. The principles of the circular economy in achieving this should also be considered. ICE is planning work on the circular economy this year and would be happy to work with the NIC on developing its thinking further in this space.

⁹ ICE Scotland (2020) [State of the Nation Report 2020: Climate Ready Infrastructure](#)

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?

ICE has explored road pricing in this submission earlier, and it is one of a suite of solutions to reducing congestion via demand management, including retail parking charging and workplace parking levies. In Singapore, road user charging is not seen as a revenue-generating exercise.¹⁰ Instead, it is understood by the public that the benefits are reduced congestion and better air quality. Indeed, distance-based road user charging must be about delivering outcomes that benefit society, including cleaner air, better journeys and improved public transport accessibility.

There is therefore a need to think strategically and holistically when considering potential road user charging solutions.

It is vital that the implementation of measures such as congestion charges are preceded by, or at least implemented with, improvements to the transport system. In doing this, congestion is reduced and public consensus is built on charging schemes supporting modal shift away from private cars.

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

The barriers primarily lie in governance. The inability for transport authorities to control funding settlements beyond a single year, coupled with the separation of planning and transport functions between competing bodies, does not produce coherently planned transport networks and services.

Additionally, the private control of bus and rail services means preparing and delivering a coherent transport plan can prove difficult.

ICE also recommends that the NIC looks in more detail at the role active travel can play individually and integrated with other sustainable modes, as the Baseline Report does not consider this in great detail.

The impacts of the Covid-19 pandemic

The Covid-19 pandemic has driven changes to how people live and work, which has affected demand for infrastructure services and sped-up shifts in long-term demand. Most notably, there has been a transformation in the confidence of individuals and businesses in remote working for tasks that do not require a physical presence.

This has had numerous impacts, not least on commuting patterns within and between towns and cities. ICE has previously explored the potential impact of these changes on public transport funding, including the need for operators and policymakers to think differently about service and revenue models, which are currently based on traditional peak commute times.¹¹ It is also likely that commerce will shift further online, which introduces new demands on freight transport and the need for a coherent low-carbon freight strategy, and impacts on interurban transport strategies.

ICE welcomes the fact that NIC will continue to monitor the impacts of behaviour change as data emerges. As part of this, NIA2 should take a coordinated approach to transport demand, including the interfaces between how the public chooses to travel for different purposes (for example, through work and leisure), the associated transport modes they may take for each, and how they can work together to deliver for various scenarios of future demand. This would include consideration of active travel modes, modal interchange hubs and timetabling/ticketing, together with an associated freight strategy.

¹⁰ Transport Committee (2021) [Reforming Public Transport After the Pandemic](#)

¹¹ ICE (2021) [ICE Discussion Paper: Public Transport Funding Post-Covid](#)

About ICE

Established in 1818 and with over 95,000 members worldwide, the Institution of Civil Engineers exists to deliver insights on infrastructure for societal benefit, using the professional engineering knowledge of our global chartered membership.

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