National Infrastructure Commission

Second National Infrastructure Assessment – Call for Evidence

The Commission has identified nine challenges and 17 related questions, set out below. They have asked for response of no more than 10 pages by 4 February 2022.

More detail on the challenges and the narrative around the questions can be found in the Baseline Report.

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?

Arup welcomes this opportunity to respond to the Commission's call for evidence. In addition to the challenges the Commission has rightly identified, we would suggest including the following:

Skills – Across the board, in the drive to net zero, an appropriately skilled workforce will be required both to deliver new economic infrastructure and to facilitate the transition of existing infrastructure. The upskilling required will take a long time to deliver, and has implications for education provision at all ages in the UK, including the re-skilling of adults already in the workforce. Such is the scale and importance of this task, we believe it should be identified alongside the other challenges.

Environmental regeneration and nature-based solutions – Although the assessment mentions the rate of nature decline, its restoration is not included as a separate challenge. We believe it should be given its critical role in both biodiversity gain and climate mitigation and resilience. Arguably, the natural environment should be considered as a priority economic asset – rather than as a commodity – since every infrastructure asset in some way competes with nature on land take and invariably results in environmental degradation. Nature-based solutions to the other challenges should be prioritised over new hard infrastructure as much as possible.

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.

New funding sources – The firm has investigated a range of potential sources for clients considering infrastructure investments. These include tax increment funding, localisation of national taxes (see below), property-related funding streams that allow better capture than existing means, developer-related contributions, and taxes / fees on new technology, such as a minimum fee for deliveries, new mobility, and electric cars. Some of these require a change in law.

Connect funding to outcomes, not departments/specific sectors – Traditionally, funding flows via government departments but increasingly investment is generating benefits across government priorities and agencies. The Housing Infrastructure Fund is a good example of

creative thinking that has acknowledged how investment in one policy area (transport) drives outputs in another (housing).

Consider 'costs avoided' funding – This is when investment in one sector yields savings in another. This would apply, for example, when considering the savings to the NHS of an increase in active travel.

Incentives, taxation and behaviour change – These can be a powerful tool, but need to be well-configured. An example is reducing energy consumption in the domestic property sector where refurbishments are taxed, but new builds are not. This perversely incentivises activity that may embody more carbon. As well as producing a revenue stream, behaviour change mechanisms can help avoid the need for new infrastructure. This is not strictly a funding source, but worth considering as part of a multi-pronged approach, particularly when the behaviour is desirable in its own right. The obvious example here is road user charging.

Devolve decisions and resources – The common practice of competitive bidding for centralised resources between councils is often unpopular with our clients, has significant transaction costs, and discourages knowledge sharing and collaboration. Funding decisions should be embedded with local authorities, along with the powers they need to deliver locally. Truly local funding could be released through allowing hypothecated local sales or income taxes, or localising revenue from other taxes such as Stamp Duty, or Vehicle Excise Duty.

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.

Design – Good design (including a whole life-cycle approach) is essential to ensure that we do not lock in in decisions made now on delivering infrastructure and how it will be operated and upgraded in future that will lead to new challenges down the line. Indeed, the UK CCRA (2022) highlighted how the aims of decarbonisation and resilience-building can result in competing objectives and necessitate trade-offs. The climate design principle should therefore require that mitigation and resilience underpin all the challenges and not just those that specifically relate to decarbonisation, and that designs are aligned to/contribute to the UN SDGs. Note that the IPCC has emphasised 'Low Carbon Resilience' approaches such as nature-based solutions or lean design.

Context – There should also be an appreciation in relation to each challenge of the wider context – and how each relates to the other challenges – which requires a systems-thinking approach. Our work with the Resilience Shift since 2017 has promoted such a systemic approach to infrastructure decision making, see for example infrastructure-pathways.org

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.

Linked assessment – The assessment should acknowledge that nature decline and climate change are not separate crises – they are interlinked each accelerates the other. They are part of the same urgent need for joined-up action and a systems-thinking approach across decarbonisation, resilience and land use for natural regeneration. A point underlined in the Dasgupta Review last year.

Successful implementation of biodiversity net gain (BNG) will require the alignment of infrastructure and environment, and planning for the environment in the same way as we plan for and fund infrastructure. It will be unsuccessful if done only at a small scale in isolated pockets and local nature recovery strategies will be fundamental to determining this.

For example, BNG as part of infrastructure offers opportunities to deliver multiple benefits:

- Nature-based solutions to carbon capture and storage rather than technological ones
- Nature-based solutions to enhance resilience (e.g. upstream planting for flood management and SUDS surface water management).
- Using nature to improve quality of life and create liveable places (e.g. integrating natural play and access to nature in infrastructure decisions)

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.

Procurement – Net zero, resilience and BNG ambitions need to flow down into the realities of procurement, which is not currently targeted on the ambitions set out in the assessment. It is still cost-driven and does not incentivise net zero, resilience and BNG outcomes.

Multi-stakeholder engagement – We need to work together to achieve the transformation our infrastructure needs. That means unlocking barriers to new and innovative solutions throughout the design and delivery process.

Pre-development funding – Promote 'shovel-worthy' rather than 'shovel-ready' projects.

Silos – Less siloed infrastructure decision-making and reduced regulatory constraints on cross-sector funding for resilience work (e.g. between energy and water sectors).

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: 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?

Digital wins – In infrastructure resilience, our work with clients suggests that monitoring and response facilitated by these networks will be at the core of future climate resilience and asset management. Similarly, in transport if every vehicle is connected through wireless networks, then data on traffic, journey times and usage can support predictive and preventative maintenance and reduce incidents and delays. In energy, if all homes and boilers were connected through these networks, data would drive greater efficiency in generation and supply.

More generally, greater connectivity through these networks would provide for more use cases and/or outcomes related to net zero, the circular economy, efficiency and customer experience. The cost will depend on the use cases adopted.

Question 7: What barriers exist that are preventing the widescale adoption and application of 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).

Risk – Layering technology into an already complex and interconnected system creates new vulnerabilities and – without a common cross-sector data environment – may create data and technology silos, preventing communication between sectors on resilience and in response to unexpected events. City- and region-wide digital twins are one possible solution.

Barriers – One barrier in relation to resilience that we have identified is uncertainty about setting thresholds for future alerts and, as a result, how to set up monitoring and early warning systems. This can be addressed through adaptation pathway type approaches to change trigger levels and ensure future flexibility.

A further barrier to rollout of technology is end-user engagement. Technology is often deployed without user-centred design principles or sufficient training to ensure take-up and use. Solutions include planning and engagement with the target audience.

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: 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?

Risk environment – We believe the greatest risks include:

- Changes in climate – existing and new systems need to be resilient to more extreme weather and to more demand (e.g. in times of extreme heat). Climate hazard projections should be part of every stage of decision making.

- Interdependencies between multi-vector supply solution that are not recognised or well understood.

- Lack of joined-up decision making with other sectors where their decisions will increase demand (e.g. electrified transport and home heating)

Resilience – The Commission's recognition of the role of resilience in infrastructure decision making – including communication with those who depend on reliable supplies and collective response plans for disruption – should be embedded in planning for future power systems.

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: 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?

Network thinking – The areas highlighted face somewhat different challenges and opportunities, but in each, effective solutions will demand coordination between the various regulatory, financial and supply chain actors, particularly skills.

Hydrogen – Several industry players have done interesting work in the hydrogen field. For example, the Energy Networks Association's 'Gas Goes Green' campaign or the recent policy work from the Making Hydrogen Happen campaign group, representing some 60 organisations across the hydrogen supply chain.

Heat pumps – BEIS and others have laid out the challenges on heat pumps in some detail – cost, space constraints, household system retrofit to accommodate, aesthetics, etc. However, numerous successful heat pump systems have been running for some years now, so 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.

Heat networks – Ditto with heat networks. We are well aware of multiple barriers such as long investment horizons, opaque regulatory frameworks, and limited experience among local authorities and developers.

In each case, developing a responsive regulatory environment is the key to incentivising the creation of business models that can really push development and scale. The recent GFI report on 'Tooling up the Green Homes Industry' offers a good selection of useful approaches.

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

Policy consistency– Many opportunities to tackle this have slipped over the years, for example with previous and recent reviews of Part L. At base, we need to align building standards with a regulatory environment that meets the UK's climate ambitions and be prepared to ratchet up real change in pursuit of net zero ambitions.

High ambitions for energy efficiency have to be set as a pre-requisite for both new-build and renovation across the sector, so it is welcome to see some progress on building fabric standards. However, as RIBA and others have pointed out, it is already clear that the vision set out for the Future Buildings Standard needs to be aligned with actual energy use.

Real data – In addition, we note the need for far more information about real lifetime energy use to help ensure that design standards are actually effective in enhancing the performance of our building stock.

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: 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?

Regulation that matches ambition – Given the global competition to lead in this space, it is clear the UK will have to move fast on hydrogen to maximise the opportunity. The target of producing 5GW of hydrogen by 2030 set out in the 10-Point Plan is a start, but must be backed up with regulatory support.

Effectively stimulating investment in hydrogen production will have to embrace numerous elements, including accelerating the development of investable hydrogen business models; sustain a credible commitment to a hydrogen funding envelope that can rapidly scale up sector capacity; support for GW-scale electrolytic hydrogen projects; mandate hydrogen-ready boilers asap; commit to green steel using hydrogen; and ensure that government has the Ministerial leadership in place to pull the required departmental and regional policy levers.

Hard commitment – Of all these, it may be worth considering a commitment to large scale storage and infrastructure adaptation to allow 20% blended delivery as a means of unlocking the chicken and egg challenge.

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?

Consistent approaches – Policy support and a much-needed commitment to continuity in this area would be most valuable given the history of CCS policy in recent years.

A sustainable, resilient energy mix will surely demand a range of approaches and price points and the regulatory approach has to reflect this reality in the business models it seeks to support.

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: 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.

Resilience and risk – A resilience-based approach should be used in all sectors. In terms of asset management, resilience requires that infrastructure be planned, designed, delivered and operated to serve communities in both ordinary and extraordinary circumstances. That differs to traditional risk reduction approaches that focus on reducing the impact of specific hazards.

In all sectors, asset management already uses long-term thinking and a whole life-cycle approach but climate hazard projections (UKCP18) need to be introduced into this thinking to ensure we understand and plan for future asset vulnerability to extreme events and do not look only at historical data – that can include, for example, adopting leading rather than lagging indicators for maintenance.

In addition, asset management should introduce whole-life carbon accounting to ensure all aspects of the operation of long-life infrastructure assets are brought together.

Challenge 6: Surface water management – the Commission will consider actions to maximise short term opportunities and improve long term planning, funding and governance arrangements for surface water management, while protecting water from pollution from drainage.

The Commission will carry out a separate call for evidence on this challenge, as the Commission will deliver this as a separate study and report to government by November 2022, in advance of its other recommendations.

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

Recycling as part of a systems approach – This topic should be considered far beyond simply expanding recycling capacity. Arup has already done some work with the Ellen MacArthur Foundation and C40 Cities to understand the challenges and identify some of the solutions that will help us to cut costs, cut waste, and to cut the pressures we're putting on to the global environment. For example, the need for building standards and regs that will actually allow recycled materials to be used, how to shape effective materials exchanges, and the how to capture the data we need to support new business models, materials passports, regenerative design toolkits, modular construction techniques , and all the rest.

Clearly, we're still on the foothills of this journey, so the first mountain to climb is to start to understand how we can incorporate circular economy thinking into regulatory systems that have given this little practical consideration to date.

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?

Linear to circular – Moving away from the linear take-make-waste model and toward circularity is critical. Indeed, the Ellen MacArthur Foundation estimates that transitioning to a circular economy would contribute to the 45% decrease in GHGs needed to achieve net zero.

The construction sector is responsible for well over 35% of the EU's total waste generation, so it is clear we need an entirely new approach to the use – and re-use – of materials in the build environment.

Data dependency – In line with the work Arup has already done with the Ellen MacArthur Foundation, C40 Cities and the WBCSD, we need to understand the challenges far more and develop the datasets and toolkits required to make sound design choices within a supporting regulatory framework. This will help us shape the standards for effective circular economy design principles for the sector and embed circular thinking into society via truly regenerative design.

Details on how to **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: 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?

Understanding users – There is evidence from London and Stockholm of road pricing's immediate impact on congestion in urban areas, although this may be limited, over time, by factors including the normalisation of charges, exemptions, and the practical limit on the charge amount itself (both in terms of its political deliverability, and the impact on economic growth). See for example TfL's monitoring of the impacts of the London congestion charge.

There does need to be a better understanding of the distributional impacts of road user charging across different types of people, and advanced econometric techniques such as agent-based modelling, being developed at Arup, are an important investment for impact assessments of road pricing in the future.

Arup's work on Project BRUCE, a national road user charging scheme in Ireland, and schemes elsewhere, suggest that the following approaches are most effective in building public consensus for road user charging:

- A system structured around the transition of the fleet (e.g. applying to electric or automated vehicles only, and at some point in the future) rather than immediately implementing pricing.
- Hypothecation of revenues, normally for public transport.

We discussed some of these issues in a thought piece, alongside Centre for London, in 2019. To aid implementation, local schemes need to be inter-operable at the national level. By setting prices locally, they can be better optimised, and the benefits of revenue hypothecation can be more visible. Coordination at the national level can be facilitated for the consumer through journey planners and payment systems. Whilst some may argue that the technology is not yet ready, or universal enough, for a system roll-out, we suggest that this should not be a barrier for an 'in-principle' definition of a scheme.

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

Coordination is core – Decisions on investment in interurban transport are often mode-specific and silo-ised (e.g. the Integrated Rail Plan, HS2, the National Highways and Network Rail portfolios), and are often taken at the national level, by the Department for Transport or its agencies. Sub-national transport bodies have some appeal, by taking the decisions closer to the areas that are affected, and the most effective and well-recognised of these agencies (e.g. TfL, TfWM, TfGM, TfW, TS, etc) are distinguished by the democratic incentives on their political masters (Mayors, First Ministers, etc) to compile a manifesto, and often to deliver a transport strategy. The same incentives do not apply to organisations that span several jurisdictions (e.g. TfN, EEH, etc), and outside of some form of English national or regional devolution, this may remain a barrier to a balanced decision making framework.

Balanced approach – Additional pitfalls occur when considering the role of government in encouraging economic growth, alongside the emerging focus on levelling up, which demands an approach that prioritises redistribution (in the context of infrastructure investment). Current Transport Analysis Guidance (TAG) and other appraisal methods tend to reward the former. This means that decisions on the interurban transport should balance an approach whereby they honour the principles of TAG, and of the Green Book, while highlighting more prominently to decision-makers the impact that they will have on the major policy initiatives such as net-zero, housing delivery, economic growth post-Covid, and levelling up.

Decisions and investment in intraurban (and last mile) transport must complement those of interurban transport, in order to reap maximum benefit. As well as transport modes, this would include the public realm within cities, and how well it lends itself to access by active modes.

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