

ZERO

Building a net-zero economy

Net-zero means that any residual greenhouse gas (GHG) emissions from the economy are completely offset by removals, through activities such as reforestation or bioenergy with carbon capture and storage. The UK's 2050 target covers all GHGs, not just carbon dioxide (CO₂), but only UK territorial emissions, not those associated with imported goods or services. Globally, net-zero GHG emissions must be achieved by 2070 if global warming is to be limited to 1.5°C above pre-industrial levels, in line with the objectives of the Paris Agreement. The UK has committed to lead the way, achieving net-zero within the next 30 years.

Practical planning and action to transition our economic infrastructure for a net-zero future.

July 2019

An urgent transformation of the UK's infrastructure is required to respond to climate change

The UK government has legislated to cut greenhouse gas emissions to net-zero by 2050. By doing so, the UK will end its contribution to further global warming and position itself as an international leader, opening economic and societal opportunities in doing so.

The net-zero challenge has been compared with the space race of the 1960s. As with the first manned flight to the moon 50 years ago, reaching net-zero will require extraordinary effort and collaboration between business, government and society. It will also generate innovations and opportunities that will define this century.

The industry coalition behind this paper is focused on how the net-zero transformation can be achieved. We are a group of infrastructure industry organisations with many decades' experience delivering major infrastructure programmes in the UK and around the world. Our insights are underpinned by a deep understanding of technical and commercial realities as well as the challenges inherent in delivering infrastructure at scale and pace.

We bring leading expertise from the infrastructure and buildings sectors and a commitment to working across industry and with government to develop the technologies, skills, supply chains, regulatory frameworks and planning regimes to build a net-zero economy.

Our aim in forming this coalition is to harness our collective expertise to support the delivery, and maximise the benefits, of UK net-zero.

Our belief is that net-zero must become an industry-wide mission that transcends traditional business relationships to become a fundamental part of the way we all work, much like health and safety has over recent decades.

Our vision is that the UK's engineering and infrastructure sectors rapidly mobilise to meet the net-zero challenge.

A focus on how

We have identified five overarching challenges that must be urgently addressed to build the infrastructure we need for net-zero by 2050. Our understanding and articulation of these challenges will change over time, but we will use this framework to guide our activities. Our focus will be on how these challenges can be addressed.

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|----------|--|---|
| 1 | Deliver an urgent transition in a flexible way | <ul style="list-style-type: none"> • Map and implement critical near-term activities for delivery of 'difficult' infrastructure such as that for the production and supply of hydrogen for industry, transport and domestic uses. (Industry and government) • Balance trade-offs between commitments now and flexibility for future options and innovation. (Government with industry support) • Develop and apply adaptive approaches to manage future uncertainty. (Government with industry support) |
| 2 | Develop institutional and regulatory frameworks for net-zero | <ul style="list-style-type: none"> • Remove barriers and create enabling framework, recognising the cross-sector nature of infrastructure. (Government with industry support) • Develop institutional arrangements to overcome siloed approaches to infrastructure delivery and drive net-zero across all tiers and parts of government. (Government with industry support) • Align economic regulators with net-zero, ensuring all infrastructure investments support it. (Government with industry support) • Implement a coherent framework for co-ordinated action at local, city, regional and national scales. (Government with industry support) |
| 3 | Mobilise and transform supply chains | <ul style="list-style-type: none"> • Map skills requirements for the net-zero infrastructure pipeline. Feed into national and regional skills strategies. (Industry and government) • Identify and implement opportunities for transitioning workers from carbon-intensive to net-zero infrastructure sectors. (Industry and government) • Scale up capacity and skills rapidly, across all educational stages and into the workplace. Ensure key actors such as local authorities have the leadership and technical capabilities needed. (Government and industry) • Align investment, procurement and regulation to cut lifecycle carbon. (Industry and government) • Transform the way infrastructure projects are delivered and contracted to deliver low-carbon outcomes. (Industry and government) |
| 4 | Maximise the benefits | <ul style="list-style-type: none"> • Integrate net-zero with broader environmental and social governance best practice. (Industry and government) • Identify and implement strategies to maximise the economic benefits of UK leadership on net-zero through jobs, exports and inward investment. Include net-zero as grand challenge or mission in a revamped industrial strategy. (Government and industry) • Empower UK regions to develop skills and economic development strategies to take advantage of net-zero infrastructure. In doing so, rebalance the UK's economy. (Government and industry) |
| 5 | Minimise costs, mobilise finance | <ul style="list-style-type: none"> • Use digital technologies, new business models and behavioural change to get more out of our infrastructure systems and minimise the amount of new infrastructure needed. (Industry supported by government) • Reduce deployment costs by learning from recent successes such as offshore wind. (Industry supported by government) • Build on recent positive developments (such as those resulting from the Task Force on Climate-related Financial Disclosures) to rapidly redirect capital flows away from carbon-intensive investments towards infrastructure compatible with net-zero. (Government with industry support) |

This industry coalition

This coalition consists of organisations committed to developing a practical, actionable response to the net-zero agenda, and to playing a leading role in achieving it.



In addition to the partners named here, we have engaged with other leading infrastructure players and envisage expanding as a group throughout 2019 and beyond.

Our objectives are to:

1. Identify the necessary enabling environment (policies, incentives and regulations) to deliver net-zero while minimising costs and maximising wider environmental, social and economic benefits across all regions of the UK.
2. Develop a practical understanding of the urgent activities and critical paths for the most difficult (and often least-understood) areas of new economic infrastructure required for net-zero, such as net-zero industrial clusters, the hydrogen economy and nationwide electric vehicle charging.
3. Bring a collaborative, mission-oriented whole-system approach (based on systems thinking and systems engineering principles) to all aspects of planning and delivering infrastructure for net-zero, recognising the interactions between infrastructure sectors.
4. Provide a collaborative hub for infrastructure industry efforts on net-zero, convene cross-sector expertise in partnership with the government, and mobilise and communicate industry action on net-zero.

In pursuing these objectives, we will focus on areas where there remain substantial gaps in understanding, address those we can, and support others where they are better placed to act.

Through May-July we have engaged with the Committee on Climate Change (CCC), National Infrastructure Commission (NIC) and the Department for Business, Energy & Industrial Strategy (BEIS), Aldersgate Group, Green Construction Board, Energy Systems Catapult and Major Projects Association. We will be engaging with HM Treasury and the Infrastructure & Projects Authority (IPA) in the autumn. As we move forward, we will continue working with government

so that our contributions are relevant and practical for policymakers, and with other industry groups, so that our outputs are complementary to their existing and planned work.

Our focus is economic infrastructure – those assets that promote economic development and activity such as buildings, transport, water, waste and energy. We recognise the critical importance of social infrastructure such as schools, hospitals and public spaces but do not envisage these being central to our scope of work.

Next steps

We aim to progress at speed in the second half of 2019. Activities will include engaging government

and stakeholders to further scope and analyse specific issues relating to our five identified key challenges. We will hold a series of workshops leading to initial outputs and recommendations by the end of 2019. We expect this to include critical path analysis for key infrastructure areas and the development of a whole-system mission-based approach for driving the delivery of net-zero infrastructure. We will supplement this with knowledge sharing and industry engagement.

In parallel, we will look at how we evolve and expand as a group. As we move forward we would welcome the participation of others involved in the delivery and operation of infrastructure who are

committed to net-zero. We invite our colleagues in the infrastructure industry to join us and bring your expertise to bear in solving the most urgent challenge of this century. Collectively we can shape the UK's transition to net-zero and gain from the global opportunities this will bring.

And we invite national and local government to work with us. By harnessing our collective experience of managing economic infrastructure and delivering major projects, we can jointly develop the pathways and actions that will deliver net-zero, demonstrate UK leadership internationally and bring benefits across the country.

“In May, we provided our advice to the UK government to set an ambitious new target for the UK to achieve ‘net-zero’ greenhouse gas emissions by 2050. Now that Parliament has adopted this target it is urgent for all sections of society to come together to make sure we achieve it. Ending the UK’s contribution to global warming requires ambitious action across all sectors of the UK’s economy, and we are delighted to see the infrastructure industry coming together to help deliver this objective. We look forward to supporting this initiative.”

Why infrastructure matters

Infrastructure is a fundamental driver of economic development and human prosperity. Each pound spent on railways, power plants and housing results in a substantial multiplier effect across the economy through employment and productivity gains. Well-designed infrastructure not only has positive impacts on long-term growth but can also contribute towards a better quality of life, more social cohesion, and the protection and enhancement of natural ecosystems.

At the same time, infrastructure development over the last two centuries has resulted in the carbon emissions that are now causing climate change.

The Treasury's Infrastructure Carbon Review concluded that infrastructure was responsible for over half of all UK greenhouse gas emissions in 2013, of which around one third is related to the construction, operation and maintenance of infrastructure assets and two thirds to the end use of those assets. Without fundamental changes to infrastructure design, delivery and use, the relative impact of infrastructure on overall emissions is expected to rise further and net-zero will simply not be achieved.

There are two overarching requirements for infrastructure in mitigating climate change.

1. Infrastructure assets must have the lowest possible whole life GHG emissions. This ultimately means decarbonising materials like concrete and steel and using low-carbon energy in asset construction and use, as well as minimising end-user emissions.
2. The overall scale, pace and type of infrastructure built across the economy must be aligned to net-zero.

This implies transformative change, repurposing of existing infrastructure assets and the creation of entirely new infrastructure systems. Decisions over what economic infrastructure is built and how it is delivered must also recognise the rapid societal and technological changes arising through digitisation, decentralisation and wider macroeconomic trends. These changes have the potential to transform our needs for infrastructure, radically shift approaches to construction and improve the efficiency of infrastructure use.

Adaptive, system-level perspectives must underpin infrastructure planning and delivery so that net-zero is achieved in ways that are flexible and responsive to a changing wider landscape.

“Infrastructure assets must have the lowest possible lifecycle GHG emissions. And the overall scale, pace and type of infrastructure must be aligned to net-zero – all while recognising the rapid societal and technological changes occurring.”

Advancing net-zero in the built environment

To meet the challenge of mitigating GHG emissions in the built environment, the World Green Building Council has launched its Advancing net-zero campaign, which sets a target for all buildings to be net-zero in operation by 2050 and all new buildings to meet this standard by 2030. In the UK, the UK Green Building Council (UKGBC) is developing a consistent approach for the measurement and reporting of whole-life carbon emissions and has recently launched a framework definition for how to achieve net-zero in building construction and operation. UKGBC will update this framework over time to tighten standards in collaboration with other industry organisations.

Infrastructure Carbon Review (2013)

The Infrastructure Carbon Review, published by HM Treasury and developed by the Green Construction Board, sets out actions for government, clients and suppliers to reduce carbon from the construction and operation of the UK's infrastructure assets. The infrastructure industry was responsible for 53% of UK GHG emissions in 2013, of which 30% was directly related to the construction, operation and maintenance of assets and 70% to the users of infrastructure. The review highlighted the importance of leadership, innovation and procurement in driving down supply chain emissions and minimising lifecycle emissions in turn cutting costs by cutting carbon.g

The current state of UK infrastructure

Investment in infrastructure has been lower in the UK than many other OECD countries in recent decades.¹ According to the NIC, Britain's infrastructure must overcome major challenges if it is to meet the needs of future generations. Weaknesses in infrastructure planning must urgently be addressed to build future capacity, avoid congestion and cut carbon.² The 2018 National Infrastructure Assessment set out seven core proposals including national full fibre broadband by 2033, half of the UK's power to come from renewables by 2030 and a national standard of flood resilience for all communities by 2050.³

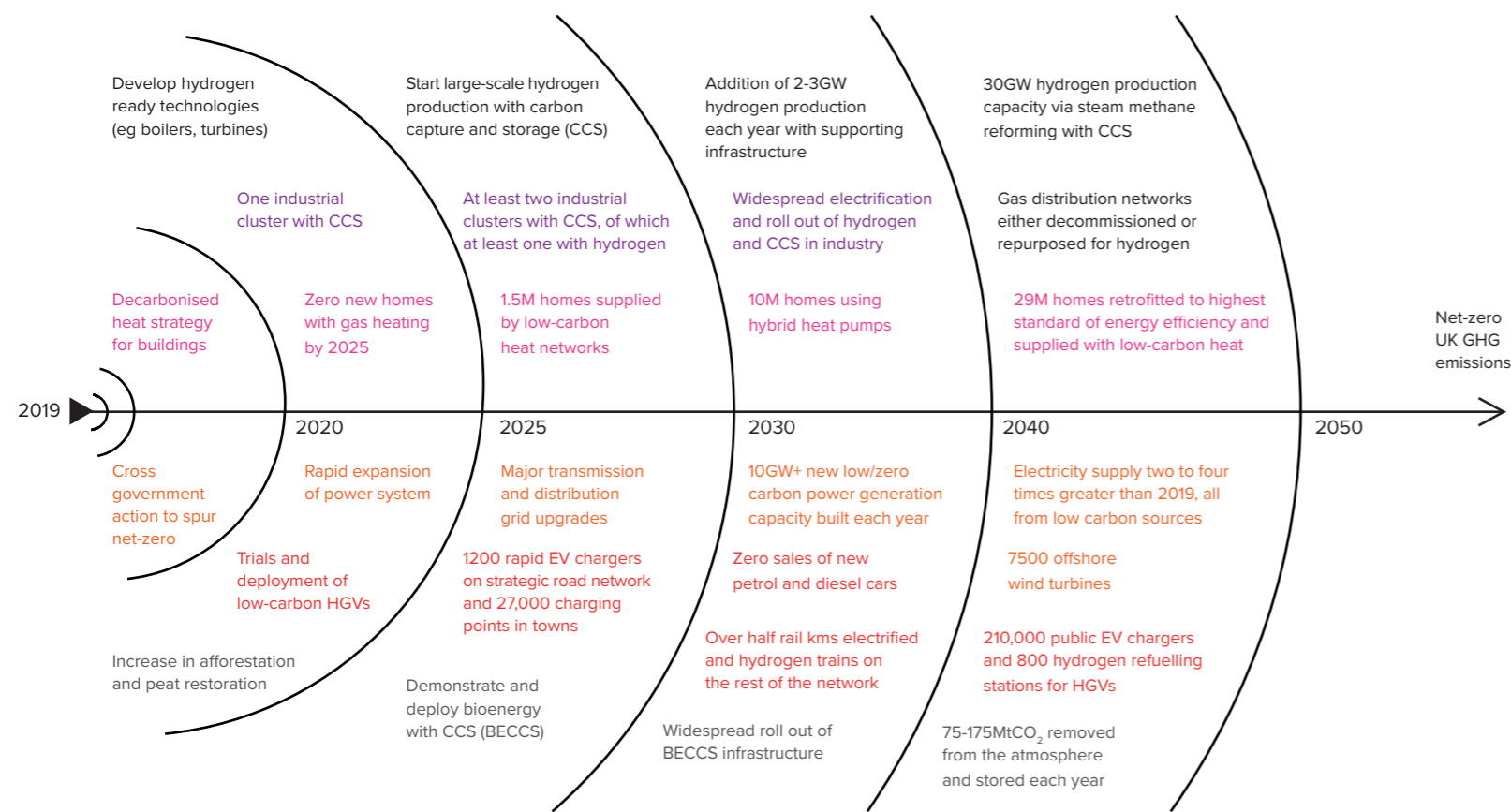
1. OECD (2015) Improving infrastructure in the United Kingdom. Economics Department Working Paper No. 1244

2. NIC (2017) Congestion, Capacity, Carbon: Priorities for national infrastructure

3. NIC (2018) National Infrastructure Assessment

The scale of transformation required

While there are multiple possible pathways to net-zero, they will all require a radical and urgent transformation of the UK's economic infrastructure.



- Hydrogen
- Industry and CCS
- Buildings
- Power sector
- Transport
- GHG removal

Note: This figure is indicative only. All dates and numbers are from the CCC report Net-zero (2019), but it is not a comprehensive summary of the CCC's pathway. In reality there will be many possible pathways to net-zero.

In its recent advice to government, the CCC set out the key components of one such pathway, indicating an unprecedented scale and pace of infrastructure delivery across the economy.⁴ The CCC's analysis suggests net-zero requires:

- Doubling or even quadrupling the capacity of the UK's electricity generation system by 2050 to meet increasing demand, with all generation from low-carbon sources. This means building the equivalent of 7500 offshore wind turbines and upgrading transmission and distribution networks.
- Developing hydrogen fuel production facilities comparable in scale to today's gas-fired power station fleet, along with associated storage and transportation infrastructure (including repurposing the gas grid), in order to meet industry, freight haulage and shipping needs.
- Large-scale deployment of GHG removal technologies to absorb CO₂ from the atmosphere and store it away for long periods, compensating for residual fossil fuel emissions in sectors such as aviation. These could include bioenergy plants with carbon capture and storage (CCS) and new 'direct air capture' technologies.
- Phasing out of petrol and diesel vehicles by ensuring that by 2035 at the latest, all new cars and vans sold in the UK are electric or hydrogen powered, supported by 210,000 public charging points nationwide.
- Creation of at least five low-carbon industrial clusters with hydrogen usage and CO₂ capture, transportation and storage infrastructure, enabling hard-to-decarbonise industries to go zero-carbon while maintaining the UK's industrial base.
- Retrofitting 29M homes and virtually all non-residential buildings to achieve high standards of energy efficiency, supplied by low-carbon heat via heat pumps, hydrogen, or large-scale district heat networks.

Infrastructure supply chains in the UK are currently sized according to market demand, which is typically limited to the build of a few large projects at any one time – such as Crossrail and Hinkley Point C. Net-zero will require a substantial scale-up of these supply chains, strategic co-ordination across multiple sectors and development of significant new capacity to enhance, refit, upgrade and repurpose established infrastructure. Relevant historical examples of rapid infrastructure delivery in the UK include railway construction from 1830 to 1860 and the switch to natural gas central heating systems in the 1970s.

4. Committee on Climate Change (2019) Net-zero: the UK's contribution to stopping global warming

The need for urgency

Infrastructure development is one of the main factors limiting the rate of decarbonisation achievable. New infrastructure assets have long lead-in times and lifecycles that frequently span decades or even centuries. As a result, building the infrastructure needed and adapting that already in operation for net-zero by 2050 requires urgent action within the next few years. The longer action is delayed, the more expensive and difficult net-zero will become.

For example, deploying carbon capture and storage (CCS) at scale at multiple locations by 2030 requires the right policy frameworks to be put in place now. CCS is still an immature technology. Innovation, development, incubation, technology transfer, business models and early deployment activities must be initiated now, and by the mid-2020s the UK will need to be deploying working CCS technologies at scale with suitable delivery infrastructure in place. CCS is just one of many requirements that demand urgent attention.

It is also critical that infrastructure investment decisions being made now are aligned with net-zero. This is all too often not the case, as exemplified by Northern Rail's recent purchase of a new fleet of diesel trains. Urgent attention is required to ensure that every investment decision from this point onwards supports low-cost pathways to net-zero. Where there are essential investments required in new GHG-emitting infrastructure assets, these should be designed to be converted to zero-carbon solutions at the earliest opportunity. An example could be procuring dual-fuel trains that can initially run on diesel but will ultimately be fully electric or hydrogen-powered.

The UK has a mixed record of infrastructure planning and delivery. The National Infrastructure Assessment highlights the need for decisive action to address the too often slow and uncertain delivery of major infrastructure projects.⁵ While government and industry have taken positive steps in recent years to address this, net-zero requires a further fundamental shift in approach and commitment.

Though the pursuit of net-zero is urgent, it is also important to proceed thoughtfully with new infrastructure investments, considering alternative options, the potential offered by innovation, and the different ways society, the economy and technology could develop. Wherever possible, flexibility in design should allow for the possibility of reconfiguration and re-use, in much the same way that the London 2012 Olympic Park was designed to be repurposed for a broad range of urban uses after the games had finished.

“The longer action is delayed, the more expensive and difficult net-zero will become.”

The UK's improving institutional architecture for infrastructure planning and delivery

Following the launch of the first National Infrastructure Plan in 2010, successive governments have taken steps to improve the UK's poor record of infrastructure planning and delivery. The NIC, created in 2015, provides impartial, expert advice on long-term infrastructure challenges and the IPA provides a centre of expertise for project delivery across government.

The UK's system of independent economic regulators overseeing network monopolies has generally performed well in incentivising efficiency and investment. But these regulators, along with other government bodies involved in infrastructure planning and delivery, now urgently need to place the requirements of a net-zero economy at the front and centre of their regulatory approach.

5. NIC (2018) National Infrastructure Assessment

The role of government

Reaching net-zero by 2050 requires a mobilisation of society's resources at a scale and pace not achieved for generations. Letting the market decide will not be sufficient. Instead, government must play a critical leadership role by articulating the strategic vision, putting net-zero at the centre of all its activity, and providing the resources, near-term decisions and long-term certainty to maintain transformational change over three decades.

Through the UK's Industrial Strategy, important progress has been made in this direction. By placing 'grand challenges' and 'missions' at the heart of future UK economic activity, the government is drawing on lessons from some of the major scientific and technological successes of the 20th century including the Apollo programme and development of the internet. Net-zero demands a strengthening of this approach and a new policy framework to drive mission-oriented innovation and growth. A clear signal of intent here would be to make net-zero infrastructure a grand challenge or mission under a revamped Industrial Strategy.

Much of the infrastructure needed for net-zero will come in the form of enhanced or new infrastructure such as electricity networks, hydrogen production and distribution, and CO₂ transportation and storage – infrastructure that is inherently shared by organisations within industrial sectors, and also by different sectors. This calls for integrated thinking and decision-making across government. And through regulation, it requires government to drive the development of key enabling infrastructure by promoting appropriate ownership models, risk allocation and long-term financial incentives, in the form of predictable revenue.

While all the technologies required to achieve net-zero are all available or under development, innovation will be needed to bring new technologies to market, reduce costs and maximise benefits to the UK economy. Partnership between industry and government is fundamental to successful innovation. The government's sector deals provide an effective model for this type of collaboration and the UK's experience with offshore wind should give policy-makers confidence in the value of this type of approach.

The CCC estimates that net-zero will cost 1-2% of the UK's GDP to 2050. This amounts to a cumulative investment of £50bn-£70bn a year. The CCC argues that the distribution of this cost between government, businesses, taxpayers and ratepayers must be transparently fair to sustain public support over time.⁶ The government's role here is threefold: it must invest itself; it must provide the framework to leverage private investment; and it must do this in ways that prevent costs disproportionately falling on those who can least afford them.

“What is the cost to our health and environment if we do not avert the breakdown of our climate, and with it the ecosystems that support the way of life of billions [of people] around the world? The benefits, including health and environmental, could almost fully offset the costs of moving to a net-zero emissions economy – and that doesn't account for the huge economic opportunity of leading the global shift to a greener, cleaner economy.”

Claire Perry, former climate minister and newly appointed president of COP26, June 2019

A 'just' transition

The costs of a rapid transition to a net-zero economy are not just measured in GDP but by the changes that can disadvantage certain industries and workers if suitable plans are not put in place. The notion of a 'just' transition, embodied in the United Nations' Just Transitions Silesia Declaration signed by many countries including the UK, emphasises the need to support and reskill workers whose jobs will be lost or transformed. In the UK, the Trades Union Congress has issued a statement on 'A just transition to a greener, fairer economy', which sets out the need for a comprehensive plan and coherent industrial strategy to support UK employees in taking advantage of the opportunities presented by net-zero.

6. The Stern Review (2006), commissioned by the UK government, concluded that the benefits of strong, early action on climate change far outweigh the costs of not acting.

Five key challenges

- 1** Deliver an urgent transition in a flexible way
- 2** Develop institutional and regulatory frameworks for net-zero
- 3** Mobilise and transform supply chains
- 4** Maximise the benefits
- 5** Minimise costs, mobilise finance

Challenge 1

Deliver an urgent transition in a flexible way

Pathways to net-zero require major infrastructure transformations to be substantially under way by 2030. There is an urgent need to better understand the specific timescales and activities required over the next decade across a number of ‘difficult’ and emerging infrastructure areas such as industrial clusters, hydrogen production and distribution and electric vehicle charging. This is likely to point to critical actions, decisions and policy interventions being required over the next two years.

A key challenge will be balancing the need for commitments in the short-term with long-term flexibility. There will be trade-offs between delayed decisions that increase uncertainty and pressure on timescales, and earlier decisions that risk closing down innovation and better long-term options.

Heat decarbonisation is an example of an area where these issues will play out, with options such as hydrogen, electrification and district heating all representing potential pathways. Each requires major investments in shared infrastructures that, once built, could risk locking-in a suboptimal approach. The urgency of net-zero means this to some degree may be inevitable as action can no longer be delayed. But planning in advance for the possibility that decisions may be wrong can help to mitigate negative consequences.

Potential areas of focus include:

1.

Critical path analysis for key emerging infrastructure areas.

2.

Assessment of key decision points, low-regret options and interactions between different sectors, drawing on engineering systems approaches.

3.

Case studies and lessons learned from comparable historical and international examples.

4.

Enhancement of decision-making models to cover options value, eg through the HM Treasury Green Book Appraisal.

5.

Social and behavioural dimensions of potentially rapid and disruptive infrastructure changes.

UK carbon capture and underground storage (CCUS) action plan

In 2018, following advice from the CCUS Cost Challenge Taskforce, the government set out an action plan for deploying CCUS at scale in the UK in the 2030s.⁷ The plan sets out a timeline and next steps for government and industry to ensure the UK is on course to meet its carbon capture and storage objectives.

Comparable plans are now needed for other key infrastructure areas fundamental to enabling net-zero, covering near-term activities such as demonstration activities, supply chain mobilisation, financing, planning requirements and site preparation and construction.

7. HMG (2018) Clean growth – the UK carbon capture usage and storage deployment pathway: an action plan

Challenge 2

Develop the institutional and regulatory frameworks for net-zero

Reaching net-zero by 2050 will demand a level of concerted activity and co-ordination not normally experienced by democratic countries outside of wartime. This calls for new approaches within government to ensure all key arms of the state are aligned towards this objective and joined up across Whitehall, between the national government and the devolved administrations, and between national, regional and local authorities.

A radically strengthened sense of common purpose is needed to ensure that regulatory barriers to net-zero infrastructure can be removed and the right enabling framework rapidly implemented. Too often over the last decade, changes have been made to policy that have undermined progress towards a low-carbon economy. Various institutional options could facilitate this transition, for example:

- Strengthening the capabilities and remits of existing organisations
- Different regulatory structures
- Creation of a new cross-departmental delivery unit at the heart of government, responsible for overseeing and co-ordinating progress towards net-zero

Any such change will need to break down the siloed approach to infrastructure delivery in the UK, particularly given the cross-sector nature of many of the big net-zero infrastructure challenges such as electric vehicle roll-out and the decarbonisation of buildings.

In many cases, our current regulatory framework is simply not aligned with net-zero. The UK's economic regulators, for example, have been successful in driving efficiency, and to some degree innovation, but are too often not sufficiently long-term in their investment time-horizons. Building regulations are another example – too often inflexible, not sufficiently focused on the whole-life carbon impacts of new buildings and too weak in their coverage of changes to existing buildings. These and other regulatory approaches urgently need to be reformed and repurposed.

Infrastructure solutions are often best implemented at local, city or regional scales – taking account of specific circumstances and preferences and allowing for co-ordination of planning and delivery. A key challenge for government will be to set the overarching framework whilst supporting and resourcing more localised delivery.

Potential areas of focus include:

1.

Identification of key regulatory barriers for urgent critical path infrastructures and recommendations for change.

2.

How to bring different regulatory bodies together to ensure a shared vision of regulatory alignment for net-zero.

3.

Exploring the introduction of carbon budget compliance for all projects in the National Infrastructure and Construction pipeline.

4.

Policies and guidance on whole-life cost asset investment models for long-term investment and ownership.

5.

Embedding carbon into government and private sector procurement frameworks and investment decision-making.

6.

How to build delivery, technical and procurement capacity at local and regional tiers of government.

Ofgem's RIIO-2 price control framework

There is currently a misalignment between Ofgem's regulatory price control framework and the urgent action needed to ensure the UK is on the path to net-zero emissions by 2050.

Ofgem is responsible for setting price controls for the monopoly companies that run the UK's gas and electricity networks and these companies are currently drafting their business plans for the next price control period (RIIO-2), which runs from April 2021 to March 2026. The guidance for RIIO-2 was issued before legislation for the new emissions target, meaning there is no specific requirement to demonstrate a pathway to net-zero. In turn, there is a risk that the relatively short time period of RIIO-2 will result in infrastructure investment decisions that are not aligned with long-term ambition, leading to inconsistent outcomes or delayed investments.

Given the critical importance of the 2020s for transforming the UK's energy system, RIIO-2 business plans should be reviewed and updated to ensure alignment with net-zero.

Challenge 3

Mobilise and transform supply chains

Infrastructure supply chains in the UK are sized according to market demand, which is typically limited to the build of just a few large projects – such as Crossrail and Hinkley Point C – at any one time. Net-zero demands a substantial scale-up of this capacity and the building of a skills value chain across all stages of education and into the workplace. This must cover every part of the labour force from the recruitment of early career professionals and apprenticeships to mid-career reskilling and leadership development.

The rapid pace of change in the construction and engineering sectors are compounding the challenges of supply chain development. Whilst traditional fabrication and trades skills will need to be expanded to undertake the huge scale of building retrofits required to improve energy efficiency, new skills in digital-based and offsite construction, artificial intelligence, complex system planning, green finance and carbon management will all also be needed at scale. This will require increased numbers of science, engineering, technology and maths (STEM) graduates and vocational apprenticeships and a renewed focus on continual professional training and career-long learning.

There is an urgent need to understand the aggregate skills requirement across the net-zero infrastructure pipeline and put in place strategies to ensure this is delivered. This will require an integrated approach across government, industry and the educational sector, building on recent examples of success such as the offshore wind sector deal. Such approaches should also be tailored for different regions of the UK, to help drive economic development in areas that have suffered from deindustrialisation, and support a transition of workers from carbon-intensive sectors to new net-zero sectors with similar skills requirements, such as hydrogen and CCS.

Potential areas of focus include:

1.

Joint mapping of future skills requirements for the net-zero infrastructure pipeline, considering all regions and sectors of the economy.

2.

Identifying and implementing opportunities for transitioning workers from carbon-intensive sectors into suitable new areas of infrastructure delivery.

3.

Joint mapping and evaluation of critical supply chains, leading to options for creating volume certainty between public and private asset owners.

4.

Development of standard methodologies for carbon management and compliance in public and private procurement.

5.

Quantifying and driving down embodied and lifecycle GHG emissions associated with a net-zero infrastructure pipeline.

6.

Transforming the way infrastructure projects are delivered and contracted to deliver low-carbon outcomes.

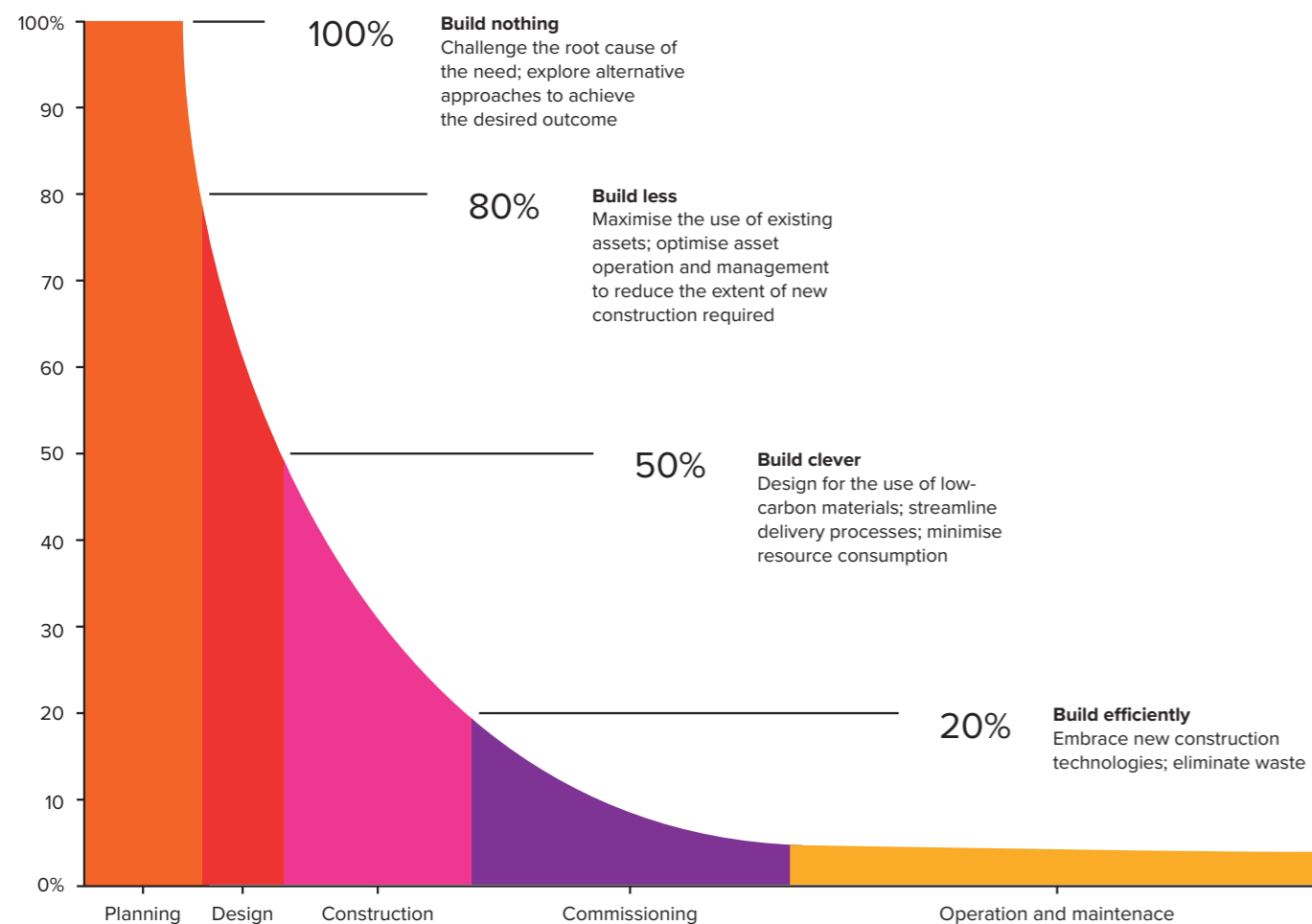
Looking beyond skills, some UK supply chains that will be critical to delivering net-zero are characterised by their small scale and fragmentation into multiple trades. For example, many accredited heat pump installers only install one or two pumps per year. High costs and variable quality are often issues for small markets that lack critical mass. Lessons can be learned from other sectors. For example regulated monopolies have used alliancing strategies to build sustained and competitive supply chains over time. And public and private employers have jointly mapped the nuclear skills pipeline. A shared vision between major employers and government, backed up by clear policy certainty, will allow industry to make the necessary investments in UK supply chains.

In terms of the lifecycle carbon of new infrastructure assets, progress has been made by industry in recent years to reduce emissions, guided by the principles set out in the Infrastructure Carbon Review and the international standard for managing infrastructure carbon, PAS 2080. The basic tools are now in place to design, build and operate infrastructure in an increasingly low-carbon way.

These approaches must now urgently be strengthened and made mainstream across infrastructure supply chains. Investment decisions, procurement and regulation must align to require ever lower lifecycle carbon over time and ultimately lead to zero-carbon construction via the development of low-carbon variants of materials such as cement, concrete and steel. Given the scale of infrastructure build required over the coming decades, early and rapid action to reduce the impact of infrastructure supply chains is an urgent priority, otherwise there is a risk of perverse outcomes and increased emissions from the infrastructure sector in the short-term.

The infrastructure sector's broken operating model also needs to be fixed. Too often the wrong projects are delivered over budget, past deadline and below par. By developing new business models based on enterprise rather than traditional transactional arrangements, and by integrating digitally-driven developments such as offsite manufacture and robotic construction, infrastructure delivery can be transformed in support of net-zero.

Carbon reduction potential



National digital twin

In its 2017 report 'Data for the public good' the NIC set out recommendations for the UK's infrastructure to become digitally connected in order to drive improvements in the delivery and performance of assets. One key recommendation was to develop a national 'digital twin' (computer model) of the UK's infrastructure to help plan, predict and understand our assets. A key purpose of digital twins is to optimise the performance and use of existing assets, meaning less new infrastructure needs to be built. Current work on a UK digital twin is being led by the Digital Framework Task Group, which published the 'Gemini Principles' in 2018, setting out foundational definitions and principles to guide future work.

PAS 2080 – carbon management in infrastructure

PAS 2080 is a publicly available specification – it is a verification scheme that establishes a common understanding, approach and language for whole-life carbon management in the provision of economic infrastructure. Publicly available specifications perform a similar role to industry standards and are recognised internationally. PAS 2080 was authored by Mott MacDonald and Arup under the British Standards Institute and constitutes the world's first low-carbon infrastructure specification – fulfilling a recommendation of the 2013 Infrastructure Carbon Review. It covers the integration of carbon management into infrastructure delivery and operation, and includes a process for target setting, baselining, reporting, monitoring and continual review and improvement.

Supply chains for zero-carbon Manchester by 2038

In February 2019, Manchester City Council endorsed a framework to meet the city's target of being zero-carbon by 2038. The business case supporting this plan indicates the scale of supply chain development needed to deliver this target. It is estimated that undertaking a deep retrofit programme of the city's building stock will create 55,000 new jobs, with a further 30,000 new entrants (including STEM graduates) required across in the sustainability and environmental sectors.

Project 13

Project 13 is an industry led initiative launched by the Institution of Civil Engineers to develop an outcomes-focused approach to the delivery and management of infrastructure projects. It promotes business models based on enterprise rather than transactional arrangements. Drawing on best-practice case studies it sets out principles for commercial arrangements that use incentives and risk allocation to facilitate collaboration and innovation between those involved in infrastructure delivery and operation.

Offshore wind sector deal

The deployment of offshore wind has been one of the big success stories of the UK's economic development over recent years. This has been underpinned by effective public-private collaboration, recently culminating in the Offshore Wind Sector Deal. This deal, part of the UK's Industrial Strategy framework, includes a government commitment to 30GW offshore wind by 2030 and sets out joint measures with industry to develop UK supply chains. These include a standardised skills and training framework, apprenticeship opportunities and 'offshore energy passports' to enable workers to transition between extractive and renewable industries.

Challenge 4

Maximise the benefits

Better, more modern infrastructure lies at the heart of most positive visions of social and environmental transformation. Net-zero must be embedded alongside the wide range of additional societal, economic and environmental benefits that infrastructure must deliver.

Future economic prosperity, protection against flooding, better transport connectivity, healthier lifestyles and greener cities, richer and more vibrant ecosystems – the infrastructure that we build over the next 30 years must deliver against all of these priorities in addition to net-zero. In this way, net-zero infrastructure can sustain broad-based public support over time.

Transforming our infrastructure system is also essential for closing the UK's productivity gap and driving the development of new markets, jobs and exports. By being a leader in the global push to net-zero the UK can position itself as a world leader in clean growth and a first mover in key low-carbon sectors.

The UK's Industrial Strategy rightly positions decarbonisation as a driver of economic development, laying the foundations for the UK to build on its strengths in science, engineering, finance and digital technologies to take full advantage of the economic opportunities presented by clean growth. This approach must now be strengthened in pursuit of net-zero. In doing so, the UK will increase its attractiveness as a place to invest, and increasingly be able to export expertise delivering net-zero around the world.

Net-zero also offers a unique opportunity to rebalance the UK's economy and strengthen regional economic performance. New and repurposed infrastructure is required across all parts of the UK to deliver net-zero, and with effective skills and education strategies as well as public-private collaboration to develop local supply chains, these opportunities can be captured by those living close by. In addition, some of the major new types of infrastructure will necessarily be clustered in specific regional locations due to resource availability or geographical features such as salt caverns or old gas fields, providing a potential further boost to these areas.

Managing the delivery of multiple major infrastructure programmes that are being implemented in parallel – often with complex interdependencies – will require integrated systems thinking. This will be essential in safeguarding against unintended consequences and can also help to identify synergies in the planning and implementation of new infrastructure, in turn reducing costs and disruption.

“Transforming our infrastructure system is essential for closing the UK's productivity gap and driving the development of new markets, jobs and exports.”

Potential areas of focus include:

1.

Integrating net-zero with broader best practice in environmental and social governance for infrastructure.

2.

Identifying clean growth and innovation opportunities that the UK is uniquely placed to exploit.

3.

Applying holistic engineering systems approaches to the planning and delivery of net-zero infrastructure.

4.

Enabling local solutions, developing consumer-focused business models and supporting innovation in technology and emerging solutions not visible to central government.

5.

Understanding the global transition and identifying synergies and opportunities for UK leadership, linking into export and trade policies.

6.

Understanding how to develop and export the UK's net-zero expertise to international markets.

UK industrial strategy

The government's Industrial Strategy 'Building a Britain fit for the future' was published in 2017 and set out a long-term plan to boost productivity and incomes in the UK. By embracing a strong and strategic role for the state in directing UK economic development it marks a welcome departure from approaches adopted over preceding decades and reflects evidence that governments can play a critical role in driving innovation and economic prosperity in partnership with industry.

The industrial strategy sets out the four grand challenges of artificial intelligence and big data, clean growth, the future of mobility and meeting the needs of an ageing society, and has led to a framework of strategic missions, challenge funds and sector deals.

Challenge 5

Minimise costs, mobilise finance

There is huge potential to minimise the amount of new infrastructure needed through behaviour change and new technologies, business models and operational practices.

With increasing urbanisation, infrastructure providers are facing the cost and reputational implications of capacity failure and, as such, are turning to demand reduction techniques as a core part of their operations. By reducing demand and improving the efficiency of infrastructure systems, the overall cost of a net-zero transition will be reduced.

Digital technologies, for example, can transform our need for economic infrastructure, whether through remote working, reducing the need for energy networks through smart systems, or by shifting how we educate ourselves through life. Digital twins of physical assets are starting to make possible live simulation of how infrastructure performs, allowing optimisation at the whole-system level. Reducing demand and using what we have more efficiently are major areas of under-exploited potential.

Where new infrastructure is required, recent experiences in areas such as offshore wind have demonstrated the types of approach that are effective in driving innovation up and costs down. Government commitment, bankable revenue streams, partnership between public and private sectors and a transition to competitive auctions at an appropriate stage of commercial deployment have combined to demonstrate success and can be replicated for other emerging areas of new infrastructure.

The Treasury estimates that around half of the UK's projected £600bn infrastructure investment pipeline over the next 10 years is forecast to come from the private sector. Net-zero is likely to push these requirements even higher and a critical task for government, in addition to investing itself, will be to mobilise these private financial flows at scale and in ways that minimise costs of capital. Compounding this challenge will be the novelty of much of the new infrastructure seeking finance, meaning careful consideration will need to be given to the role of state-backed finance and how risk can be fairly allocated between public and private sectors. Likewise, insurance solutions will be needed for new infrastructure models and sectors.

“The novelty of much of the new infrastructure seeking finance means careful consideration will need to be given to the role of state-backed finance and the fair allocation of risk between the public and private sectors.”

Potential areas of focus include:

1.

Identifying opportunities for regulatory reform to drive greater efficiencies in the use of shared infrastructure networks.

2.

Maximising the integration of digital technologies into infrastructure systems to improve delivery, operation and use.

3.

The design of regulatory principles and processes needed to apply a regulated asset base model to new infrastructure.

4.

The development of suitable business models with the right incentives and risk allocation to drive up performance and minimise the cost of capital.

5.

Identify strategies to mobilise finance for the rapid deployment of new areas of infrastructure that may be subject to higher than normal perceptions of risk.

6.

Exploring how green finance products and services can be mainstreamed into infrastructure funding.

Transforming the financial system to support a net-zero economy

Several developments are helping to create a framework to turn financial flows away from carbon intensive investments. In 2017 the Task Force on Climate-related Financial Disclosures (TCFD) produced guidelines on how the financial sector should report on climate risk and align with the Paris Agreement. In the UK, the government expects all financial institutions and asset managers to report under the TCFD by the end of 2020 and has stated that it may be mandatory from 2022. The new UK Green Finance Strategy sets out further measures to direct capital to investments consistent with net-zero. Yet globally and in the UK, investments continue to be made in new fossil fuel infrastructure. It is imperative that recent positive developments are now built on and rapidly catalyse a large-scale redirection of finance towards infrastructure compatible with net-zero.

Next steps

Over the second half of 2019 and beyond, this industry coalition will undertake a programme of activity targeted at the most difficult and urgent aspects of delivering infrastructure for a net-zero economy, drawing on the unique expertise that we collectively bring.

We envisage doing this in close partnership with government bodies – including the CCC, NIC, BEIS and HM Treasury – as well as other industry groups. We will ensure our efforts are aligned and feed into milestones such as the National Infrastructure Strategy (expected late 2019) and, we hope, the COP26 international climate change convention that will be hosted in London in 2020.

Proposed programme of activity for this industry coalition in 2019

For each of the five key challenges identified in this paper, we will engage stakeholders to undertake a rapid review of the key gaps in current evidence and knowledge, identifying a prioritised list of specific questions and activities for our coalition to address.

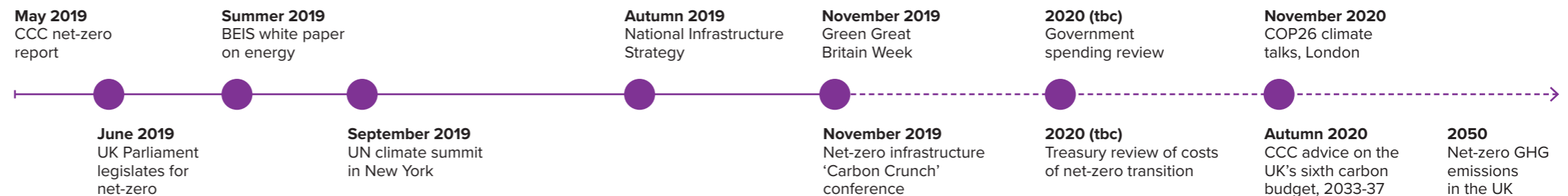
By the end of 2019, we will have held a series of workshops and produced initial outputs for the most urgent infrastructure priority areas, culminating in the identification of actions and policy recommendations to be implemented in 2020. We expect this to include critical path analysis of key infrastructure areas.

In November 2019, we will use Mott MacDonald’s annual Carbon Crunch event to hold an industry conference on ‘Building infrastructure for net-zero’. We will also input into other industry and academic events such as the Major Projects Association conference in September 2019.

We will collaborate with New Civil Engineer and other publications to produce regular pieces of thought leadership on net-zero.

We will explore options for how we evolve and expand as a group based on a ‘form follows function’ philosophy. Options range from a loose alliance of committed organisations working through existing structures to a more formalised arrangement modelled on effective examples of industry-government alliances.

We invite you to join us on this journey.



Combating the causes and effects of climate change

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