



State of the Nation 2020: Infrastructure and the 2050 net-zero target



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Foreword

As we publish this report, we find ourselves in truly extraordinary times. The Covid-19 pandemic has had a dramatic impact on the lives and livelihoods of people not just in the UK, but around the world.

As with many sectors of the economy, the immediate impacts of the pandemic have profoundly affected the infrastructure sector. Construction sites closed. Transport networks ground to a halt. Meanwhile, our telecommunication and energy systems have never been more essential for keeping us connected and productive, while water networks have had to adapt rapidly to a more distributed type of demand.

Perhaps we are in a transition to a 'new normal': one where we commute less regularly, use active travel instead of public transport, and build more off site. While no one knows for sure what the future will hold, it seems likely our infrastructure systems will need to operate differently going forward.

Even in the aftermath of the Covid-19 health crisis, we have to remain focused on climate change – which also threatens people's way of life around the world. The UK's 2050 net-zero greenhouse gas emissions target continues to be as important as ever.

By legislating the 2050 net-zero target in 2019, the government positioned the UK as a global leader. Global climate leadership is imperative – and will remain in focus as the UK co-hosts COP26 in 2021. As we take that leading role on the global stage during the recovery from the Covid-19 pandemic, we must focus on keeping our net-zero target front and centre on the agenda. In my view, there has never been a more important time for well-designed and delivered infrastructure to help rebuild the UK and deliver a stronger, cleaner and more resilient economy.

The UK has already made real progress decarbonising its energy networks over the recent decades and this has to continue. However, we need to facilitate an acceleration in connected energy, particularly in data and transport networks to support the deployment of electric and autonomous vehicles, as we address the huge need for decarbonising our towns and cities today.

This report examines the contribution of the UK's infrastructure systems to achieving net zero by 2050. It recommends a series of policy solutions to help overcome the challenges of achieving net zero and ensure the UK is well positioned to achieve the net-zero target following the pandemic.

The report emphasises a sense of urgency, not just in the context of the Covid-19 recovery, but also in transitioning infrastructure to a net-zero footing. We as engineers must step up to meet this net-zero challenge. By fostering innovation, thinking systemically and developing new capabilities for a net-zero future, we can make the most out of the challenges posed by the pandemic and rebuild a better, more sustainable society.

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Key points from our report

1. Infrastructure is a major contributor to the UK's greenhouse gas emissions. While we have made progress in reducing emissions, especially in the energy sector, much more is needed.

2. Before the 2050 net-zero target became law, the UK was already failing to meet the less ambitious target of reducing greenhouse gas emissions by 80% based on 1990 levels.

3. While 2050 may seem distant, in many cases the infrastructure currently under development will take decades to deliver and will be operational well beyond 2050. The infrastructure we plan and deliver today needs to be consistent with the net-zero target.

4. The economic response to the Covid-19 pandemic presents a unique opportunity for the UK to recalibrate its approach and rebuild the economy around the net-zero target. The UK lacks a comprehensive plan for climate change adaption and mitigation. To achieve net zero by 2050 we need to foster leadership and collaboration across the infrastructure ecosystem.

5. A step change in societal behaviours and business practices is required to drive demand and supply-side changes and embed net-zero decision-making across the infrastructure value chain.

6. We cannot simply build our way to net zero. Many of the infrastructure assets needed in 2050 are already built, so we must also focus on better using our existing assets through whole-of-life-cycle approaches and better use of data and technology.

7. Transforming infrastructure for net zero is an opportunity to level up regions throughout the UK, overcome regional inequalities and build new green-economy skills and workforces.

8. Overall, a coherent plan for how the infrastructure sector can contribute to reaching net-zero emissions by 2050 is required, which is underpinned by the most appropriate procurement frameworks and the right levels of investment.



Executive summary

The need to mitigate climate change is not new. The impacts of climate change are already being felt. The Earth is warming, rainfall patterns are changing and sea levels are rising – resulting in the increased severity and frequency of heatwaves, floods, droughts and fires. Climate change presents a major threat to the world's people, environment, economies and health.

We have long known about the importance of reducing greenhouse gas emissions. The UK has had a statutory target for reducing emissions since 2008. But the establishment of the net-zero target in mid-2019 has refocused this mission and brought a renewed sense of urgency to the task.

Achieving the net-zero target by 2050 will require an unprecedented transformation of infrastructure systems. The vital infrastructure systems on which the UK is built – such as energy, transport and utilities – currently contribute the majority of the UK's emissions. Transport and energy alone account for around 60% of the UK's CO₂ emissions.¹ Given the urgency of the climate emergency and the long lead times and life cycles of infrastructure, the challenge of transitioning these systems over the next 30 years will be immense.

Meeting the net-zero target will require unparalleled innovation across the economy – innovation not just in new technologies and processes, but in new and better ways of deploying existing infrastructure and technologies. This will require new business models, new consumer services and, most importantly, new policy, regulation and market design.

Only 10% of British adults think the right conditions are in place for infrastructure to transition to net-zero.
YouGov (2020)

As the planners, designers, builders and operators of the UK's infrastructure, engineers have a critical role and responsibility to provide leadership in this net-zero transformation. Fortunately, engineers are great problem solvers and love to innovate. The climate emergency and net-zero transition present an unprecedented challenge for engineers to solve.

But real policy change is required to support engineers in overcoming the impediments to solving this challenge; that is, policy interventions that will foster the necessary enabling environment (policies, incentives and regulations) to empower engineers and influence infrastructure users' behaviours. This will require coordination and collaboration throughout the infrastructure ecosystem, and an integrated systems approach to the net-zero transition.

The time for action is now. The cumulative impact of carbon in the atmosphere means that the sooner action is taken, the greater the benefit. In addition, the economic response to the Covid-19 pandemic presents a unique opportunity for the recalibration of the economy around the net-zero target. To do this, a credible and long-term plan for transitioning the UK's infrastructure systems for net zero is required.

About this report

This report examines the contribution of the UK's infrastructure systems to achieving net zero² by 2050. Building on the work of the Committee on Climate Change and its net-zero advice,³ this report recommends a series of high-level policy solutions to overcome the challenges of achieving net-zero emissions. It does not seek to contest the Committee's analysis, rather it responds to the key policy obstacles the Committee has identified, including:

- strengthening policy-making
- ensuring businesses respond
- engaging the public to act
- determining who pays
- providing the skills
- ensuring a just transition
- developing the infrastructure

The recommendations included in this report are not intended to be exhaustive, but they are important next steps for the UK that will help the infrastructure sector to reduce emissions in line with the UK's net-zero target. Of course, tackling climate change will require both adaption and mitigation; however, the focus of this report is on mitigating climate change in the context of the net-zero target.

This report is the product of an extensive evidence-gathering process. ICE has held evidence-gathering workshops and focus groups in Scotland, Wales, Northern Ireland and the regions of England, inviting contributions from infrastructure experts across the public, private and third sectors. Through a national opinion poll conducted by YouGov,⁴ members of the public have also been consulted for their views. ICE has engaged with more than 400 expert individuals or organisations during the production of the report.

Section 1 of the report provides the context for infrastructure's transition to net zero, Section 2 outlines policy recommendations to support the transition, while Section 3 summarises ongoing work at ICE in support of built environment professionals.

1 BEIS (2020) 2019 UK Greenhouse Gas Emissions, Provisional Figures

2 Net zero is a statutory target under the Climate Change Act 2008 for at least a 100% reduction of UK greenhouse gas emissions by 2050 (compared to 1990 levels). Net zero means that any residual greenhouse gas (GHG) emissions from the economy are completely offset by removals.

3 Committee on Climate Change (2019) Net Zero – The UK's Contribution to Stopping Global Warming

4 All YouGov polling data in this report is from two online surveys that were undertaken between 27-28 May and 3-4 June 2020. Total sample sizes were 1,670 and 1,705, respectively. The figures have been weighted and are representative of all GB adults (aged 18+).

Recommendations



Strengthening policy-making

1. As part of the National Infrastructure Strategy, a Net-Zero Infrastructure Plan for transitioning the UK's economic infrastructure networks to a net-zero footing should be delivered.



Developing the infrastructure

2. The Green Book should be reformed to better reflect the net-zero target in project appraisals and assessments.

3. Clients and regulated asset managers should prioritise and elevate the value of emissions reduction impacts in procurement criteria, so it is at the same level as value for money, and health and safety outcomes.



Ensuring businesses respond

4. Models of regulation should be updated to promote the achievement of net zero, and enable owners and managers of regulated assets to take longer-term and more flexible strategic planning and investment decisions.

5. Through procurement policy, clients should require better collection, sharing and use of data on infrastructure assets to enable improved decision-making in the context of the net-zero target.



Ensuring a just transition

6. Power and responsibilities for infrastructure policy and service delivery should continue to be devolved to ensure the economic opportunities of the net-zero transition are distributed throughout the UK, to support the 'levelling up' agenda.



Determining who pays

7. Contracts for Difference and the Regulated Asset Base model should continue to be used, where appropriate, to unlock the market for net-zero technologies identified by the Committee on Climate Change.

8. A UK Investment Bank should be established, with a sustainability mandate to invest in net-zero-aligned infrastructure and crowd-in private finance.



Engaging the public to act

9. A net-zero education and awareness-raising campaign for the built environment should be developed. Details of the campaign should be set out as part of the Net-Zero Infrastructure Plan.



Providing the skills

10. An Infrastructure Skills Plan to ensure the UK has the capability within the built environment sector for the transition to net zero should be delivered. Details for the development of the skills plan should be set out as part of the Net-Zero Infrastructure Plan.

Section 1: Infrastructure's transition to net zero

Overview

This section introduces the net-zero target and infrastructure's contribution to UK emissions. It outlines data from the Department for Business, Energy and Industrial Strategy (BEIS) on the UK's greenhouse gas emissions to illustrate the transition required in the infrastructure sector.



The UK Government has legislated to cut greenhouse gas emissions⁵ to net zero by 2050.⁶ This target meets the UK's obligations under the Paris Agreement⁷ and responds to the urgent need for action highlighted by the Intergovernmental Panel on Climate Change (IPCC).⁸ But ending the UK's contribution to climate change under the net-zero target requires urgent, ambitious action across all sectors of the UK's economy – none more so than for the UK's infrastructure systems.⁹

Infrastructure – energy, transport, utilities and digital communication – is the foundation upon which our economy is built. Well-designed and constructed infrastructure not only facilitates long-term economic development but also contributes towards a better quality of life, more social cohesion and the protection and enhancement of natural ecosystems.

The infrastructure sector can't wait for breakthrough technologies to deliver net zero. Instead, it should plan to respond to climate change using today's technologies.¹⁰ Failure to act today will result in much higher costs in the future, as the UK would face an even tougher challenge to reduce emissions in a shorter period of time, given the cumulative nature of carbon in the atmosphere. New infrastructure assets have long lead times and life cycles that often span decades. As a result, building the infrastructure needed and adapting that already in operation requires urgent action. The longer action is delayed, the more expensive and difficult net zero will become.¹¹

“ It is likely energy will need to achieve net zero well before 2050, given decarbonising transport and heating will depend to a significant degree on decarbonising electricity.

Infrastructure's contribution to UK emissions

The Committee on Climate Change is the UK Government's advisory body on climate change. It has warned that the UK is not on course to meet the fourth and fifth carbon budgets. These carbon budgets were set on the basis of the previous 80% target, and will therefore need to be outperformed to achieve net zero by 2050.¹² The Committee will revise its assessment for the sixth carbon budget in late 2020 (covering 2033–2037).

In 2018, UK emissions of greenhouse gases were estimated to be 451.5 million tonnes CO₂ equivalent. CO₂ is the main greenhouse gas, accounting for 81% of total UK greenhouse gas emissions. With the exception of waste management, most non-CO₂ greenhouse gases are from agriculture and outside of the scope of this report.¹³

The UK has made progress in reducing emissions. In 2019, total UK greenhouse gas emissions were estimated to be 45% lower than in 1990 and 3.6% lower than 2018.¹⁴ But as a net importer of goods, a significant proportion of the emissions that result from UK consumption come from overseas. Indeed, while territorial emissions have nearly halved, the carbon footprint associated with overall consumption has remained high. In 2017, embodied emissions from imports represented around 46% of the UK's total greenhouse gas footprint.¹⁵ So while UK emissions have been reducing, global emissions have risen, with no sign of peaking in the next few years.¹⁶ The UK should not achieve net zero by simply offshoring its emissions. However, the net-zero target covers only territorial emissions, not those associated with imported goods or services.

Accounting for carbon

Net-zero infrastructure needs to be considered in the context of whole-life carbon. Whole-life carbon is accounted for in terms of operational and embodied carbon.

Embodied carbon is the carbon footprint of a material. In the context of infrastructure, this includes the carbon emitted in producing the materials used in construction, their transport to and installation on site, as well as their disposal at end of life. Embodied carbon is often measured from cradle to (factory) gate, cradle to site (of use) or cradle to grave (end of life). Even assets perceived to be low carbon in operation will have embodied carbon.

Operational carbon is the carbon footprint of the operation and maintenance of an asset in use. This includes the emissions associated with heating, cooling, ventilation and lighting systems, as well as by equipment and machinery. For some infrastructure assets (e.g. roads), the users of those assets (drivers) generate most of the carbon.

For the purposes of accounting and reporting, greenhouse gas emissions are categorised into three 'scopes': **Scope 1** covers direct emissions from owned or controlled sources; **Scope 2** covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company; **Scope 3** includes all other indirect emissions that occur across the value chain, including upstream and downstream emissions.

5 Greenhouse gas emissions' refers to the basket of gases identified by the Kyoto Protocol: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃).
6 UK Government (2019) UK Becomes First Major Economy to Pass Net Zero Emissions Law
7 United Nations (2015) Paris Agreement
8 Intergovernmental Panel on Climate Change (2018) Global Warming of 1.5°C
9 Mott Macdonald (2019) Building a Net-Zero Economy
10 Allwood, J., et al. (2019) Absolute Zero

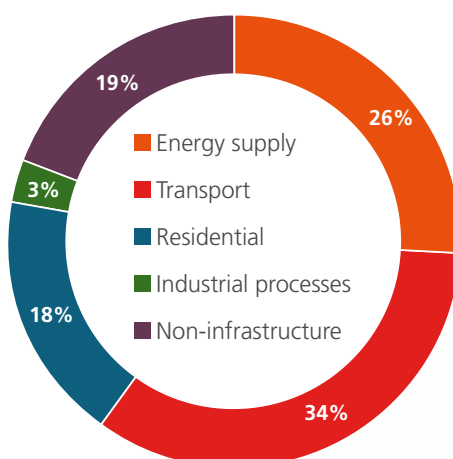
11 Mott Macdonald (2019) Building a Net-Zero Economy
12 Committee on Climate Change (2019) Reducing UK Emissions – 2019 Progress Report to Parliament
13 BEIS (2020) 2018 UK Greenhouse Gas Emissions, Final Figures
14 BEIS (2020) 2019 UK Greenhouse Gas Emissions, Provisional Figures
15 Department for Environment, Food & Rural Affairs (2020) UK's Carbon Footprint 1997–2017
16 United Nations Environment Programme (2019) Emissions Gap Report 2019



The following graphic presents a breakdown of UK territorial CO₂ emissions relating to the infrastructure sector. Energy supply has historically been the largest source of CO₂ emissions, but this has changed with the shift towards renewable electricity generation and greater efficiency from improvements in technology.¹⁷ Transport is now the largest source of emissions, deriving primarily from the use of petrol and diesel in road transport. The majority of emissions from the residential sector come from the use of natural gas for heating and cooking.¹⁸ The vast majority of emissions from waste management derive from the methane released from landfill sites, waste incineration and the treatment of wastewater.¹⁹

While the industrial process sector is not specifically infrastructure, it produces key inputs to the built environment. For example, the largest source of emissions from the sector in 2018 was cement production, with other processes such as iron and steel production also contributing significantly.²⁰

Total UK CO₂ Emissions



Source: BEIS (2019) Provisional Figures
Waste management rounds to 0%

While there is no single agreed route to net zero, the Committee on Climate Change has developed scenarios and evaluated how net zero could be achieved. This paper builds on the road map identified by the Committee and recommends policy solutions that will support the infrastructure sector as it transitions to net zero by 2050 or earlier. The following table highlights the Committee on Climate Change's key priorities relating to infrastructure for achieving net zero.

16% of all CO₂ emissions
come from the use of natural gas and coal at power stations.

Less than 1% of cars
in the UK are EVs.



¹⁷ BEIS (2020) 2018 UK Greenhouse Gas Emissions, Final Figures
¹⁸ BEIS (2020) 2019 UK Greenhouse Gas Emissions, Provisional Figures
¹⁹ BEIS (2020) 2018 UK Greenhouse Gas Emissions, Final Figures
²⁰ BEIS (2020) 2019 UK Greenhouse Gas Emissions, Provisional Figures

Sector	Immediate Priorities	Longer term priorities
Surface transport	<p>Sales ban on internal combustion engine vehicles by 2030–2035</p> <p>Clearer approach to EU vehicle standards and testing</p> <p>Stronger incentives to purchase cleaner vehicles</p> <p>Plans for roll-out of zero-emission HGVs and stretching targets for CO2 reductions</p> <p>Schemes to support active travel and public transport</p>	<p>Continued development of charging infrastructure</p> <p>Decision on future for HGVs in the 2020s</p> <p>98% reduction in emissions by 2050</p>
Aviation & Shipping	Formal inclusion in Climate Change Act targets	Strategies for aviation and shipping that reflect the net-zero target
Carbon Capture and Storage (CCS)	<p>Identify preferred mechanism for developing CO2 infrastructure</p> <p>Plan for operational CCS by mid-2020s</p>	Large-scale emissions removal (e.g. biomass with CCS) from the 2030s
Hydrogen (H2)	Strategy for developing low-carbon hydrogen use, production and infrastructure	270 TWh low-carbon hydrogen production by 2050
Buildings	<p>Low-carbon heat strategy and plans to phase out fossil fuels in the 2020s from buildings not connected to the gas grid</p> <p>Policies to improve energy efficiency for all buildings</p> <p>New build standards to ensure all new homes are ultra-efficient and use low-carbon heating from 2025</p> <p>Closure of the performance and compliance gaps</p>	<p>Decision on the future of the gas grid in the mid-2020s</p> <p>All new heating systems to be low carbon from 2035</p>
Power	<p>Completion of 2019 offshore wind auction</p> <p>Route to market for onshore wind and solar</p> <p>Contingency plans for delayed or cancelled low-carbon generation projects</p> <p>Plans for networks to be capable of meeting higher demand for electrical energy</p>	<p>320 TWh of low-carbon generation by 2030</p> <p>99–100% low-carbon generation by 2050</p>
Waste	Commitment to ban landfill of biodegradable waste by 2025	Limit emissions from non-bio wastes (e.g. with CCS)

Source: Committee on Climate Change (2019) Reducing UK Emissions – 2019 Progress Report to Parliament

Covid-19 and a net-zero recovery

The Covid-19 pandemic is changing our society. But the lasting impacts of the pandemic on how we use and interact with infrastructure systems are uncertain.²¹ Polling suggests that only 9% of people want everything to go back to how it was before the pandemic.²² The growth in travel is predicted to slow and virtual interactions for work and play are predicted to remain widespread post-pandemic.²³ These changes will likely shape the nature of transport and telecommunication investment going forward.

The majority of Britons believe that, in the long term, climate change is as serious a crisis as Covid-19, and that the economic recovery from the pandemic should prioritise climate action.²⁴ The Committee on Climate Change has advised governments as to how climate policy should play a part in the economic recovery. The Committee argues that actions towards net-zero emissions will help rebuild the UK with a stronger, cleaner and more resilient economy. The Committee identifies six principles to guide action:²⁵

While not specific to the infrastructure sector, these principles are consistent with the recommendations made within this report. Our recommendations also seek to build on the academic research on a net-zero economic recovery from Covid-19.²⁶ The next section will explore our recommendations in greater detail.

1. Use climate investments to support economic recovery and jobs.

2. Lead a shift towards positive, long-term behaviours.

The government can lead the way to new social norms that benefit wellbeing, improve productivity and reduce emissions.

3. Tackle the wider 'resilience deficit' on climate change.
Strong policies are needed to reduce the UK's vulnerability to climate change and to avoid a disorderly transition to net zero.

4. Embed fairness as a core principle.
Lost or threatened jobs of today should be replaced by those created by the new, resilient economy.

5. Ensure the recovery does not lock-in greenhouse gas emissions or increased risk.
Any support for carbon-intensive sectors should be contingent on real and lasting action on climate change.

6. Strengthen incentives to reduce emissions when considering tax changes.
Revenue could be raised by setting or raising carbon prices for sectors of the economy that do not bear the full costs of emissions.

²¹ ICE (2020) The Use of Infrastructure Systems – Insights into the New Normal

²² RSA (2020) Finding the Road to Renewal

²³ Automobile Association (2020) Life After Lockdown; ICE (2020) The Use of Infrastructure Systems – Insights into the New Normal

²⁴ Ipsos MORI (2020) How Do Great Britain and the World View Climate Change and Covid-19?

²⁵ Committee on Climate Change (2020) Building a Resilient Recovery from the COVID-19 Crisis

²⁶ Allan, J., et al. (2020) A Net-Zero Emissions Economic Recovery from COVID-19, Oxford Smith School of Enterprise and the Environment | Working Paper No. 20-01; Hepburn, C., et al. (2020) Will COVID-19 Fiscal Recovery Packages Accelerate or Retard Progress on Climate Change?, Oxford Review of Economic Policy 36(S1)



Section 2: Addressing the challenges to achieving net zero

Overview

The previous section of this report has examined infrastructure's contribution to the UK's emissions and has outlined the scenarios identified by the Committee on Climate Change for transitioning to net zero by 2050. This section builds on these findings by exploring the policy interventions ICE believes are required to transition the UK's infrastructure to net zero. This section is structured around the key obstacles identified by the Committee on Climate Change to overcome in order to achieve the net-zero target, including:

Committee on Climate Change
key obstacles to achieving the
2050 net-zero target:



Strengthening policy-making



Developing the infrastructure



Ensuring businesses respond



Ensuring a just transition



Determining who pays



Engaging the public to act



Providing the skills

Taking a whole-of-system approach to infrastructure is integral to achieving net zero. A systems approach is critical to managing the linkages and interdependencies between different infrastructure systems, as well as the policy, regulatory, fiscal and governance settings which support those systems. In planning for net zero we need to think about all aspects of design, planning, development, operation and use of our infrastructure (both new and existing).²⁷ This will help in safeguarding against unintended consequences and in identifying synergies in the planning and implementation of new infrastructure. Similarly, a systems approach will help foster a coordinated and collaborative approach to net zero by the government, industry and the public.

While the following recommendations are targeted at government and industry decision-makers within the infrastructure sector, it is important to emphasise that everyone shares responsibility for the transition to net zero. This is a societal and global challenge, and solutions need to be developed in a coordinated and integrated manner.



Strengthening policy-making

What the Committee on Climate Change said:

The net-zero challenge must be embedded and integrated across all departments, at all levels of Government and in all major decisions that impact on emissions. It must also be integrated with businesses and society at large. Since many of the solutions cut across systems (e.g. hydrogen has a role in electricity generation, transportation, industry and heating), fully integrated policy, regulatory design and implementation is crucial. That may require new frameworks, for example to ensure that departments, other than BEIS alone, sufficiently prioritise net-zero GHG emissions. Policy teams across departments must be sufficiently resourced to develop and implement the changes required.

A net-zero target with no plan

In legislating the 2050 target, the government provided a legally binding goal for the UK to reach net-zero emissions. While the UK now has an ambitious target, it does not have a comprehensive plan for how it will be achieved.

Arguably, the government's previous plan for decarbonising the UK economy was its 2017 Clean Growth Strategy – developed on the basis of the previous 80% target.²⁸ While the strategy provides a foundation for action, based on the economic opportunities of decarbonisation, it needs to be strengthened to reflect the changes required for net zero.

In the absence of a clear national plan to achieve net zero, industry and governments at all levels are developing their own action plans and initiatives. For example, local authorities throughout the UK are declaring climate emergencies and developing net-zero plans based on the powers and resources available to them. Encouragingly, many actors in both the public and private sectors are leading the way with innovative approaches to decarbonisation and ambitious self-imposed targets.

Only 31% of British adults think Government has a plan for net-zero. YouGov (2020)



²⁷ ICE Expert Panel Submission

²⁸ BEIS (2017) The Clean Growth Strategy

Net-zero targets in the infrastructure sector

Many organisations within the infrastructure sector are announcing their own net-zero targets. Targets vary in ambition and detail. Some focus solely on Scope 1 and 2 emissions (emissions from a company's own operations), while others include Scope 3 (value chain emissions). These are examples of a few such targets:

Mace, the international construction and consultancy firm, has released a **strategy** to achieve net-zero carbon emissions in its own production and operations in 2020, through a combination of emissions reduction and offsets. The strategy is underpinned by the launch of Mace Tech in 2019, a new digitally enabled off-site construction method which reduces waste by up to 70%.

Major contractor Skanska UK has set a **target** of being carbon neutral by 2045 without using carbon offsets. This includes all emissions generated from the supply chain for their projects, in addition to their own direct emissions. Skanska is deploying innovative green Building Information Modelling (BIM) approaches to optimise environmental performance and life-cycle cost of their projects.

Costain, a technology-based construction and engineering company, has released a **Climate Change Action Plan** to decarbonise all operations, including its supply chain, by 2035. In addition, Costain has committed to providing at least one low-carbon option to all clients by 2023.

The National Grid Electricity System Operator has announced its **ambition** to operate Great Britain's electricity system with zero carbon by 2025. To do this it is integrating newer technologies across the system – from large-scale offshore wind to domestic-scale solar panels – and increasing demand-side participation, using new smart digital systems to manage and control the system in real-time.

The UK water industry has **committed to a goal** of net-zero carbon emissions by 2030. This is the first sector-wide net-zero commitment in the UK. The water industry has engaged two consultancies to identify how the goal can be achieved.

But there remains a lack of coordination at a national level. As highlighted by the Committee on Climate Change, this leaves a significant policy gap for achieving net zero (see Section 1). This is particularly the case in the infrastructure sector, where the required changes and the long timeframes for infrastructure development mean action must be taken now. The UK Green Building Council has also pointed out that there is no specific target for the infrastructure sector which businesses and projects can work towards.²⁹

Delivering a Net-Zero Infrastructure Plan

ICE has long called for a National Infrastructure Strategy to provide a holistic, evidence-based approach to planning and delivering infrastructure in the UK.³⁰ In the context of net zero, this is more important than ever.

A Net-Zero Infrastructure Plan for transitioning the UK's economic infrastructure systems to a net-zero footing should be delivered. We note that the National Infrastructure Commission has recently analysed its own existing recommendations, such as those covered in its National Infrastructure Assessment, to ensure their consistency with net zero.

69% of British adults think the UK Government is responsible for reaching the net-zero target by 2050.
YouGov (2020)

Recommendation 1:

As part of the National Infrastructure Strategy, a Net-Zero Infrastructure Plan for transitioning the UK's economic infrastructure networks to a net-zero footing should be delivered.

It found that its recommendations are aligned with the 2050 target, although some are now more urgent.³¹ ICE therefore believes that the proposed Net-Zero Infrastructure Plan should form part of the forthcoming National Infrastructure Strategy.

The Net-Zero Infrastructure Plan should set the overarching framework and policies for transitioning infrastructure to net zero. It should provide clear direction to other levels of government and to industry, including subsidies and incentives required to support the transition to net zero. Investors and industry seek clear and stable direction from the government and a simple, investable set of rules and incentives to enable them to act and innovate for net zero.³²

The development of the Net-Zero Infrastructure Plan will require an integrated systems approach and broad consultation across all levels of government and with experts across industry and academia. The plan should recognise that legislation, regulations and policy need to act as an interdependent system, rather than as a set of independent and at times conflicting components. The delivery of the plan should be measured against interim emissions targets established in conjunction with the Committee on Climate Change's Carbon Budgeting to provide credible long-term signals to industry and keep the UK on track to achieve net zero by 2050. Finally, the Net-Zero Infrastructure Plan should also consider the governance architecture most suitable for supporting the transition to net zero, including changes in the machinery of government and the devolution of powers. Examples could include a Ministry of Carbon, a Climate Change Emergency Executive (similar to the Health and Safety Executive), a Net-Zero Delivery Agency or similar.

Simply put, the UK net-zero target needs to be underpinned by a plan for meeting its target. As the Committee on Climate Change has said, 'Government must set the direction and provide the urgency.'³³

²⁹ UK Green Building Council (2017) Delivering Low Carbon Infrastructure

³⁰ ICE (2016) National Needs Assessment; ICE (2018) State of the Nation 2018: Infrastructure Investment; ICE (2016) State of the Nation 2016: Devolution; ICE (2019) What Should be in the National Infrastructure Strategy?

³¹ National Infrastructure Commission (2020) Commission Recommendations and the Net Zero Target

³² Committee on Climate Change (2019) Reducing UK Emissions – 2019 Progress Report to Parliament

³³ Ibid

Sweden's Climate Policy Framework

In 2017, Sweden adopted a new **Climate Policy Framework** consisting of a Climate Act, climate targets and a Climate Policy Council. The purpose of the framework is to create a clear and coherent climate policy to ensure long-term signals for business and society in the transition.

The Climate Act

The Climate Act establishes that the government's climate policy must be based on the climate targets and specifies how the implementation is to be carried out. The Act states that the government shall:

- present a climate report in its Budget Bill each year
- make sure that climate policy goals and budget policy goals work together
- draw up a climate policy action plan every fourth year to describe how the climate targets are to be achieved.

The Climate Targets

The long-term target for Sweden is net-zero greenhouse gas emissions by 2045 at the latest. After 2045, Sweden is to achieve negative net emissions. The long-term 2045 target is also supported by several interim targets for 2020, 2030 and 2040.

Climate Policy Council

The Climate Policy Council is an interdisciplinary expert body tasked with providing independent assessments of how the overall policy presented by the government is compatible with the national climate targets.

The Council engaged a **Stockholm-based start-up** to create a digital platform, **Panorama**, to provide a digital road map to meet net-zero emissions by 2045. It brings together data from throughout the Swedish Government to present a sector-by-sector breakdown of emissions, current climate policies and their intended impact. This big-data approach provides a bird's-eye view of Sweden's climate policies and breaks down silos to give the government a clear picture of where policy gaps lie.

The Swedish Government has also commissioned the Fossil Free Sweden initiative to encourage industry to draw up their own **road maps** for becoming fossil-fuel free.



Developing the infrastructure

What the Committee on Climate Change said:

Reaching net-zero emissions will require development or enhancement of shared infrastructure such as electricity networks, hydrogen production and distribution and CO₂ transfer and storage. Government, in partnership with the National Infrastructure Commission, should give urgent consideration to how such infrastructure might best be identified, financed and delivered. Regional coordination will be required, including for transport where powers are devolved.

A Net-Zero Infrastructure Plan will be key to ensuring the UK has a plan for transitioning infrastructure to a net-zero footing by 2050. But it is also critical that infrastructure-related investment decisions align with net zero.

Embedding net-zero in infrastructure procurement

HM Treasury's Green Book provides guidance on how to appraise policies, programmes and projects.³⁴ The importance of the Green Book's influence on government policy and investment decisions cannot be overstated. In the 2020 Budget, the government announced a review of the Green Book to make sure that public investment spreads opportunity across the UK as part of the 'levelling up' agenda.³⁵ As part of this review, the Green Book should be reformed to better reflect the net zero target in project appraisals, alongside a consideration of how every region can contribute to, and benefit from, the transition to net-zero. Changes to the Green Book will then flow throughout the infrastructure supply chain and help to shape private-sector decision-making.

Currently, the Green Book does not adequately reflect the climate emergency. It was most recently updated in early 2018, before the net-zero target was legislated. Accordingly, the government's promotion of low-carbon solutions hasn't translated into the procurement and delivery of infrastructure projects that align with net zero. We continue to fund diesel trains rather than network electrification and road projects that promote increased car use instead of public transport.

To achieve the 2050 target, the Green Book will need to better capture the value of whole-of-life-cycle social and environmental impacts of a project, including adopting best practice climate risk management. Public procurement policies need to be adapted to better reflect the outcomes the government is seeking to achieve (e.g. net-zero emissions by 2050). This could be through shadow carbon pricing, prequalification for carbon certification or net-zero-specific questions, or some combination of these.

Emissions reduction is not sufficiently valued in procurement. Emissions reduction is often viewed as a 'nice to have' rather than a threshold question in procurement. Clients³⁶ and regulated asset managers should prioritise the value of emissions reduction impacts so as to more heavily weight low or zero emissions solutions in appraising the procurement of infrastructure.³⁷ Net zero should be elevated to the same level as value for money and health and safety outcomes for clients. This will help to clear up any competing business priorities.

Lessons can be learnt from the radical changes to health and safety witnessed in the construction industry over recent decades. A health and safety culture is embedded throughout the industry and permeates throughout the project life cycle. This has been achieved through a mix of awareness building, regulation, financial incentives (fines) and fear of reputational damage, as well as changes to procurement rules. For instance, health and safety performance criteria, risk assessments and reporting are embedded in the procurement process.

Recommendation 2:

The Green Book should be reformed to better reflect the net-zero target in project appraisals and assessments.

Recommendation 3:

Clients and regulated asset managers should prioritise and elevate the value of emissions reduction impacts in procurement criteria, so it is at the same level as value for money, and health and safety outcomes.

During delivery, health and safety issues are monitored, reported, assessed and enforced by the independent work-related health and safety regulator, the Health and Safety Executive. The Health and Safety Executive also embeds a preventative health and safety culture in industry through stakeholder influencing and engagement, and in the creation of knowledge and awareness of health and safety risks.³⁸ Coupled with other incentives, by embedding net zero in procurement decision-making, there are opportunities to foster an emissions reduction culture throughout the infrastructure sector, at all stages of the project life cycle. Moreover, net zero can become a major driver of innovation within the sector.³⁹

³⁴ HM Treasury (2018) The Green Book

³⁵ HM Treasury (2020) Budget 2020

³⁶ 'Clients' refers to an entity, individual or organisation commissioning and funding the project, directly or indirectly. The client is sometimes referred to as the promoter, owner, purchaser, principal, developer or authority.

³⁷ ICE (2020) Civil Engineering Insights into Alternative Ways of Appraising Infrastructure Procurement

³⁸ Health and Safety Executive (2020) HSE Business Plan 2019/20

³⁹ UK Green Building Council (2017) Delivering Low Carbon Infrastructure



Ensuring businesses respond

What the Committee on Climate Change said:

Some previous policies have delivered the desired business response in full (e.g. the banning of inefficient gas boilers in the 2005/06 Building Regulations, the offering of long-term contracts to offshore wind farms). Others, like the Green Deal and vehicle emissions standards, have not. For a net-zero GHG target, standards will need strict enforcement and incentive schemes must be designed with businesses and investors in mind. The ends (i.e. stopping GHG emissions) should be clear, but there should be flexibility to meet them in the most effective way. Crucially, there should be a stable and long-term approach.

It will be businesses that deliver many of the changes required to achieve the net-zero target. Analysis of the current National Infrastructure and Construction Pipeline illustrates that funding for net-zero infrastructure will likely be split evenly between the public and private sector.⁴⁰ Businesses across the infrastructure sector are already taking action to reduce emissions, but we must ensure these actions go far enough.

Regulating for net-zero

The National Infrastructure Commission's regulatory review found that the UK will fail to reach net zero by 2050 if regulators aren't given new powers to ensure utility companies invest in sustainable infrastructure. While the UK's system of regulation has generally performed well in incentivising efficiency and investment, it is increasingly facing new challenges that it was not designed to address.⁴¹

Regulators have a crucial role to promote the achievement of net-zero and support asset owners and managers to take a whole-of-life asset management approach to infrastructure decision-making and investment. While the current regulatory system does not need to be completely redesigned, it does need to be updated for net zero.

Regulators, like other government bodies involved in infrastructure planning and delivery, need to place net zero at the centre of their regulatory approach.⁴² There is a lack of consistency and integration across regulators' approach to decarbonisation and the achievement of net zero does not form part of regulators' duties – generally their focus is on cost and consumer protection. The government does not use regulators to target or enforce emissions reduction.

For many investments in regulated assets, such as incremental changes to a network, the current price control process provides a stable regulatory environment. But for longer-term strategic investments, a medium-term price control horizon may not be the appropriate length of time.⁴³

Recommendation 4:

Models of regulation should be updated to promote the achievement of net zero, and enable owners and managers of regulated assets to take longer-term and more flexible strategic planning and investment decisions.

Through regulation, industry can be incentivised to look beyond the short term and be encouraged to plan beyond current regulatory cycles. The achievement of net zero will likely require transformative investments (e.g. decarbonising heating or developing charging infrastructure for electric vehicles) which may more closely align with the Committee on Climate Change's Carbon Budgets or climate change projections. Alternatively, net zero may require regulators to incentivise greater investment in upgrading and retrofitting existing assets.

By updating models of regulation to promote net-zero outcomes and enable owners and managers of regulated assets to take longer-term and more flexible strategic planning and investment decisions, the government will be able to encourage appropriate ownership models, risk allocation and long-term financial incentives for net zero.

65% of British adults think business is responsible for reaching the net-zero target by 2050. *YouGov (2020)*

⁴⁰ Infrastructure and Projects Authority (2018) Analysis of the National Infrastructure and Construction Pipeline

⁴¹ National Infrastructure Commission (2019) Strategic Investment and Public Confidence

⁴² Mott MacDonald (2019) Building a Net-Zero Economy

⁴³ ICE (2020) Aligning Long-Term Government Policy and the Regulation of Utility Companies

Ofgem's plan for net zero

For the most part, the UK's regulators have not been leaders in the transition to net zero. In early 2020 Ofgem, the UK's energy regulator, published its [Decarbonisation Action Plan](#) to support the UK in achieving net-zero emissions by 2050. This follows concerns over the misalignment between Ofgem's regulatory price control framework (RIIO-2) and the net-zero target. The guidance for RIIO-2 was issued before legislation for the target, meaning there is no specific requirement to demonstrate a pathway to net zero.

The plan outlines nine actions Ofgem will take by August 2020 to achieve the decarbonisation objective:

1. Designing cost-effective networks for net zero
2. Long-term planning and innovation
3. More effective coordination to deliver low-cost offshore networks
4. Making progress on low-carbon heat
5. Preparing system operators for a net-zero future
6. Supporting flexibility
7. Enabling electric vehicles at low cost
8. Promoting retail innovation
9. Adapting the organisation

Delivering net zero at 'lowest cost' lies at the heart of Ofgem's plan. The plan also signals some support for anticipatory investments from companies but expects that companies will demonstrate a high value-for-money proposition for higher-risk investments. Finally, the plan also promotes innovation across the entire value chain, with an increased focus on retail and consumer engagement. Ofgem recognises it has a crucial role to play in helping the UK decarbonise its economy and in protecting consumers in the transition.

Other regulators have not yet released their plans for net zero. However, Ofwat's 2019 [price review](#) did outline a number of measures aimed at climate adaption and mitigation over the five-year regulatory period.

Delivering smarter infrastructure with a whole-of-life-cycle approach

The UK cannot simply build its way to net zero. It must do more with its existing infrastructure assets. Longer-term decision-making, accounting for all stages of an asset's life cycle, is needed to improve how risks, costs and benefits are accounted for in the context of net zero. This will encourage more sustainable asset management, including greater reuse, upcycling and retrofitting. Owners of existing assets could consider commissioning studies on how they might best reduce operational carbon, recognising that in many cases (e.g. roads) it is the users of those assets who produce most emissions. For new assets, consideration needs to be given to 'no-build' (i.e. modified use of existing assets), 'low-build' and aspects such as choice of materials and methods of construction. Importantly, this should also involve end-of-life considerations such as designing for disassembly and recoverability of materials.



Lessons from the circular economy

The circular economy provides a useful illustration of a whole-of-life-approach. A circular economy aims to reduce waste and maximise resources by moving away from the linear take-make-and-dispose approach to a system that focuses on product longevity, renewability, reuse and repair. The circular economy can be seen as a business strategy, not just a sustainability consideration.

The City of Toronto spends approximately CAD 2 billion on public procurement annually. It has identified that this buying power could be leveraged by integrating circular economy approaches into the city's procurement processes. The city has developed a [Circular Economy Procurement Implementation Plan and Framework](#) to drive waste reduction, economic growth and social prosperity through a circular economy approach. The framework will be piloted to 2021.

Circular economy interventions ('reduce, reuse or recycle' materials and products) have the potential to provide significant energy and resource savings that will contribute to achieving net zero. Waste, redefined as a resource, can both create value and respond to climate change.

To have the greatest impact, the whole-of-life approach should seek to reduce emissions throughout the supply chain. To illustrate this, the UK Green Building Council provides a useful example:⁴⁴

“ The traditional construction process means that material suppliers are often the last to be engaged/consulted... For those further down the supply chain, cost reduction through a fixed-cost contract is a perverse mechanism – material suppliers don't want to sell less material. Innovation is best enabled through performance requirements rather than prescriptive requirements, yet not all projects are framed in this way.

The supply chain is fundamental to providing low-carbon products and solutions. A whole-of-supply-chain perspective – which embraces new ways of working, collaborating at the earliest possible stages, taking a long-term perspective and embracing product and process innovation – will be key to achieving net zero.⁴⁵

The greater collection, sharing and use of data is also vital. ICE has previously examined how advances in digital technology and data are transforming how we design, deliver and operate infrastructure. ICE has made recommendations as to how digitalisation can improve productivity and future-proof infrastructure networks.⁴⁶ The essential role of digital infrastructure, such as broadband, has become even more evident during the Covid-19 pandemic. Digital technologies have enabled businesses to continue to operate and employees to remain connected at a professional and social level.

To achieve net zero, we need smart infrastructure that can increase the performance of new and existing assets throughout the life cycle. Data-driven design, procurement, construction, operation and maintenance is needed to improve transparency, quality and efficiency, and to maximise longevity of asset life and reduce waste in the infrastructure sector.

Recommendation 5:

Through procurement policy, clients should require better collection, sharing and use of data on infrastructure assets to enable improved decision-making in the context of the net-zero target.

Already tools such as Building Information Modelling (BIM) and PAS 2080 are being used to take a whole-of-life-cycle approach to cost and carbon management. Open-source data could have a huge impact on improving industry best practice.

Many construction companies are already using data to measure and limit the whole-life carbon impact of their projects, including supply chain emissions.⁴⁷ By measuring emissions and through a data-driven whole-of-life approach, net-zero decision-making becomes embedded into the asset management process, enabling timely interventions linked to carbon, cost and resilience.

Data and digitalisation have already transformed many sectors throughout the economy and are beginning to have a real impact on the construction sector and our infrastructure systems. Technologies such as Artificial Intelligence, Energy Management Systems, BIM, Digital Twins and Off-Site and Modern Methods of Construction have the potential to make significant impacts on how the UK's infrastructure assets are designed, delivered and operated. This will continue to be the case as infrastructure transitions to net zero.

⁴⁴ UK Green Building Council (2017) Delivering Low Carbon Infrastructure

⁴⁵ ICE Expert Panel Submission

⁴⁶ ICE (2017) State of the Nation 2017: Digital Transformation; ICE (2020) Civil Engineering Insights into Digitally Retrofitting Infrastructure Assets and Networks

⁴⁷ UK Green Building Council (2019) Net Zero Carbon Buildings: A Framework Definition



Ensuring a just transition

What the Committee on Climate Change said:

Building on the reviews of who pays and of skills, the Government should assess more broadly how to ensure that the overall transition is perceived as fair and that vulnerable workers and consumers are protected. That must include analysis at the regional level and for specific industrial sectors. We note that Scotland has already appointed an independent Just Transition Commission to advise on 'a carbon neutral economy that is fair for all'

Levelling up through net-zero

Net zero offers a unique opportunity to strengthen regional economic performance and rebalance the UK's economy. Transforming the UK's infrastructure systems for net zero will help to close the UK's productivity gap and drive the development of new markets, jobs and exports.⁴⁸

The London School of Economics has highlighted the interrelationships between the government's ambitions to achieve net zero, to redefine the UK's role in the world following Brexit, and to reduce regional disparities through the 'levelling up' agenda. Done well, these ambitions could result in higher UK living standards underpinned by UK businesses innovating and adopting cutting-edge zero-carbon technologies and practices.⁴⁹ This becomes even more appropriate in the context of the government's economic response to the Covid-19 pandemic. The role infrastructure systems can play in realigning the UK towards a more socially inclusive, environmentally sustainable and economically robust nation will need to be considered.

The transition of the UK's infrastructure to net zero is expected to create new industries and green-economy jobs. This could make a significant contribution to regional development and the rejuvenation of disadvantaged areas of the UK, providing new infrastructure and local employment.⁵⁰ The opportunities and benefits associated with the transition must be fairly distributed throughout the UK. Equally, it will be important to mitigate adverse effects by supporting sectors and regions affected by the transition.

Net zero in the devolved nations and regions

To achieve a just transition and level up the UK's regions through net zero, power and responsibilities for infrastructure policy and service delivery should continue to be devolved – with the overall aim of improving quality of life and sustainability. A means of achieving this is through the development of regional infrastructure strategies to ensure effective integration of infrastructure planning at multiple geographic scales.⁵¹ Regional infrastructure strategies, developed under an overarching framework provided by the National Infrastructure Strategy and its Net-Zero Infrastructure Plan, will help identify and deliver the low-carbon infrastructure needed at a local level, and shape a systems approach to decision-making by planners, investors and developers.⁵² Of course, devolution should be conditional on a region's readiness (in terms of expertise, capacity and capability) to take on additional powers and responsibilities, as well as alignment with the national net-zero target and ambitions.

The National Infrastructure Commission has recommended that regulatory frameworks should reflect the devolution of powers within the UK and that regulators should put in place mechanisms to ensure they have regard to the strategic vision set out by the devolved administrations, where devolved and reserved powers interact.⁵³

Recommendation 6:

Power and responsibilities for infrastructure policy and service delivery should continue to be devolved to ensure the economic opportunities of the net-zero transition are distributed throughout the UK, to support the 'levelling up' agenda.

The devolution agenda reflects the net-zero planning and initiatives already underway at a local level, including through local development planning and the National Planning Policy Framework. But this needs to go further. ICE believes local stakeholders are best placed to plan and deliver local infrastructure for net zero and understand the unique regional requirements and opportunities.⁵⁴ Simply, devolution brings local communities closer to the infrastructure decisions that impact their daily lives. Paying due attention to ensuring a just transition to net zero has the potential to rejuvenate regional economies, enable local communities to play a key role in shaping their low-carbon futures and provide skills, training and employment opportunities for existing and future workers.⁵⁵

⁴⁸ Mott MacDonald (2019) Building a Net-Zero Economy

⁴⁹ London School of Economics Growth Commission (2020) Delivering Strong and Sustainable Growth in the UK

⁵⁰ Local Government Association (2020) Local Green Jobs – Accelerating a Sustainable Economic Recovery

⁵¹ ICE (2016) State of the Nation 2016: Devolution; ICE (2016) National Needs Assessment

⁵² Energy Systems Catapult (2020) Innovating to Net Zero; Energy Systems Catapult (2018) Local Area Energy Planning: Supporting Clean Growth and Low Carbon Transition

⁵³ National Infrastructure Commission (2019) Strategic Investment and Public Confidence

⁵⁴ ICE (2016) State of the Nation 2016: Devolution

⁵⁵ ICE Expert Panel Submission

Determining who pays

What the Committee on Climate Change said:

If policies are not sufficiently funded or their costs are seen as unfair, then they will fail. HM Treasury should undertake a review of how the transition will be funded and where the costs will fall. The review should cover the use of fiscal levers and Exchequer revenue, costs from carbon trading schemes, the impact on energy bill-payers and motorists, and the costs to industries especially where they are carbon-intensive and trade-exposed. It should cover costs from now through to 2050.

The Committee on Climate Change estimates net zero will cost 1 to 2% of the UK's GDP to 2050. This amounts to an average investment of £50 billion to £70 billion a year. But the precise investment requirements are difficult to predict and will depend on the mix of technologies deployed and the willingness and ability of society to adapt.⁵⁶ Funding will need to come from a combination of public and private sources – but in the end the cost will either be borne by taxpayers or by consumers of goods and services.⁵⁷

Decisions on how the transition to net zero is funded in a manner that is perceived to be fair will need to be made. Action to mitigate climate change should not exacerbate inequalities, rather address them. HM Treasury is currently conducting a net-zero review to understand how the transition to net zero will be funded and assess options for where the costs will fall.⁵⁸

Although pricing carbon is beyond the scope of this report, the role of, and approach to, carbon pricing to promote decarbonisation across the economy at lowest cost will need to be determined in order to make polluters pay.

Set against the costs, there will be significant benefits, including avoided costs – such as those required to adapt to more extreme weather conditions. The Committee on Climate Change identifies three main benefits likely to follow from a net-zero target: avoided climate damages, economic opportunities, and health and environmental impacts (such as improved air quality).⁵⁹



⁵⁶ Committee on Climate Change (2019) Net Zero – The UK's Contribution to Stopping Global Warming

⁵⁷ Imperial College London (2020) Paying for Net-Zero – The Fiscal Framework for the UK's Transition to Low-Carbon Energy

⁵⁸ HM Treasury (2019) Net Zero Review: Terms of Reference

⁵⁹ The Committee on Climate Change (2019) Reducing UK Emissions – 2019 Progress Report to Parliament

Investing in green infrastructure as stimulus

The costs and benefits of net zero are particularly relevant when considering the role of infrastructure investment in the government's economic response to Covid-19. Analysis of fiscal policy responses to the 2008 global financial crisis found that investment in green stimulus policies had numerous advantages over more traditional stimulus policies.⁶⁰ In particular, the IMF has shown that, in a sample of advanced economies, a one percentage point of GDP increase in infrastructure investment increases the level of output by 0.4% in the same year and by 1.5% four years after.⁶¹ Clearly, there is a real opportunity for net zero-aligned infrastructure investment to form part of the government's efforts to rebuild the UK economy.⁶²

Research from Oxford University shows that designing Covid-19 recovery packages around investment in infrastructure such as renewable energy, energy storage, grid modernisation and carbon capture and storage technology would offer both high economic multipliers and positive climate impacts. Similarly, 'shovel-ready' projects such as electric vehicle charging infrastructure, roll-out of broadband and energy projects, including onshore wind and solar, are all consistent with net-zero and could provide the rapid economic stimulus required to kick-start the economy. Simply put, green projects create jobs, deliver high short-term returns per pound spent, and lead to increased long-term cost savings, by comparison with traditional fiscal stimulus.⁶³

Ensuring the enduring success of Contracts for Difference

The Government's primary mechanism for supporting new low carbon power infrastructure is known as the **contract for difference** (CfD) scheme. Introduced in 2010, CfD works by fixing the prices (known as the strike price) received by low carbon generation over a number of years, reducing the risks developers face from a fluctuating wholesale power price, and ensuring that eligible technology receives a price for generated power that supports investment.

CfDs are mostly decided at auctions, known as allocation rounds, to allow competition between technologies and help keep prices low. To date, there have been three allocation rounds. In addition to auctions, CfDs can also be decided by bi-lateral negotiation, such as the CfD agreed for the Hinkley Point C nuclear power plant.

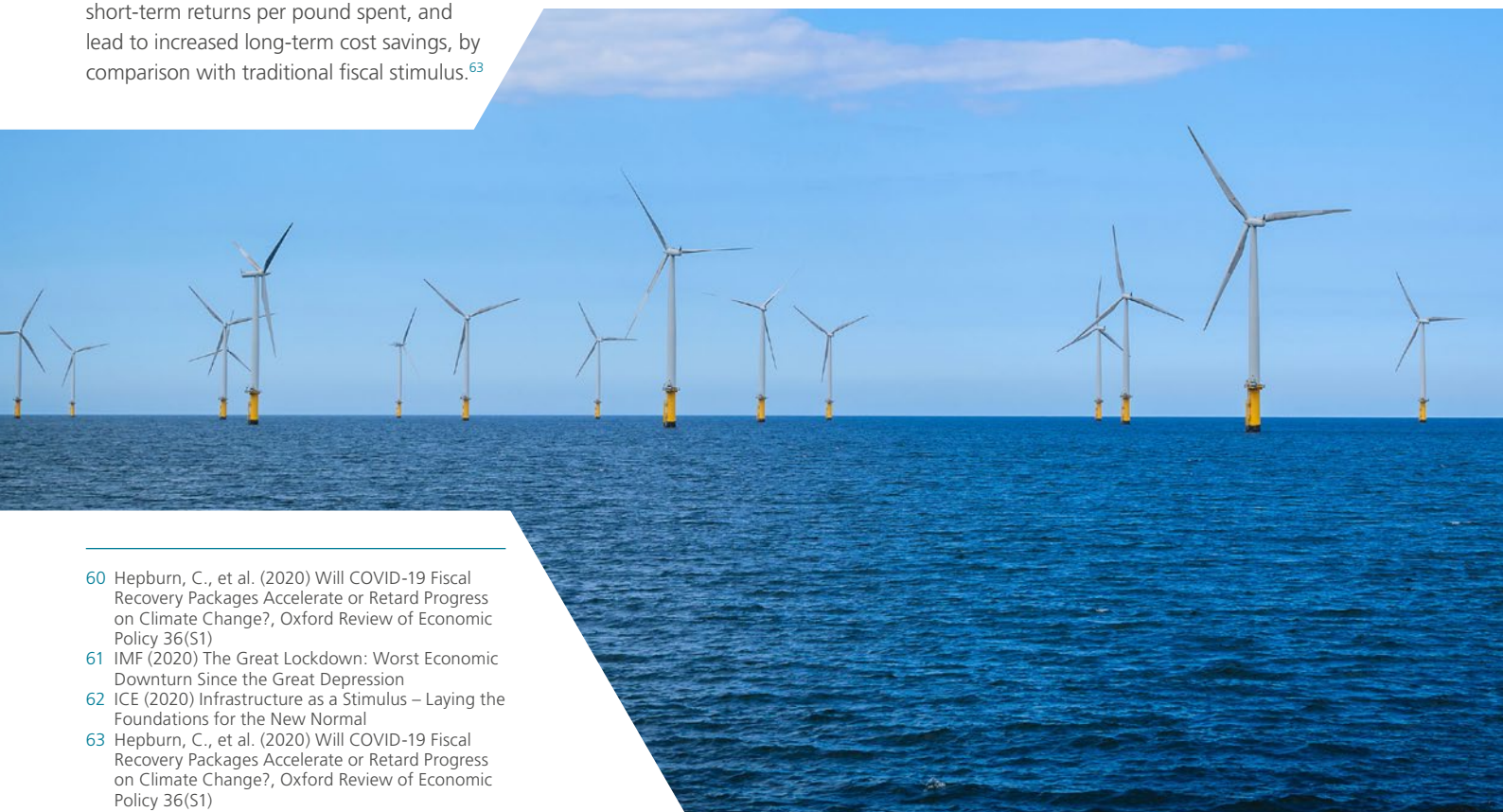
The CfD funding is set out in 'Pots' which group the technologies that can compete:

- Pot 1 is 'established technologies' including Onshore wind, Solar Photovoltaic, Energy from Waste with combined heat and power (CHP), Hydro, Landfill Gas and Sewage Gas;
- Pot 2 is 'less established technologies' including Offshore Wind, Remote Island Wind, Advanced Conversion Technologies, Anaerobic Digestion, Dedicated Biomass with CHP, Wave, Tidal Stream, and Geothermal.

Ahead of the planned fourth auction in 2021, Government is running a **consultation** on changes to the way the CfD scheme operates to ensure it is able to support the increase in ambition needed to deliver the 2050 net zero target.

The CfD auctions appear to have been successful in achieving low bids for low-carbon technologies. CfD and its predecessor (the Renewables Obligation) are credited with bringing forward investment in **at least 30GW of clean energy capacity**. CfD has been most successful in reducing the cost and increasing the scale of offshore wind power. In just 4 years, the CfD scheme has provided the support necessary to **cut offshore wind costs by 65%**.

⁶⁰ Hepburn, C., et al. (2020) Will COVID-19 Fiscal Recovery Packages Accelerate or Retard Progress on Climate Change?, Oxford Review of Economic Policy 36(S1)
⁶¹ IMF (2020) The Great Lockdown: Worst Economic Downturn Since the Great Depression
⁶² ICE (2020) Infrastructure as a Stimulus – Laying the Foundations for the New Normal
⁶³ Hepburn, C., et al. (2020) Will COVID-19 Fiscal Recovery Packages Accelerate or Retard Progress on Climate Change?, Oxford Review of Economic Policy 36(S1)



Adapting funding and financing mechanisms for net zero

The financial sector also has a vital role to play in delivering increased or redirected capital in support of net-zero-aligned objectives.⁶⁴ Financing offers an opportunity to spread the costs and risks across multiple parties and longer timeframes.

For the most part, the funding and financing mechanisms required to support infrastructure's transition to net zero already exist. The key will be adapting and iterating existing mechanisms so they can be deployed where appropriate and are tailored to net-zero outcomes. In many instances, this work is already underway within government, including a review of the Regulated Asset Base model⁶⁵ and amendments to Contracts for Difference.⁶⁶ These mechanisms could also be considered for the deployment of carbon capture and storage technologies, hydrogen infrastructure and other sources of renewable energy, such as tidal lagoons.

ICE has also recommended that energy storage and other emerging technologies receive enhanced government support, drawing on the successful impact of Contracts for Difference on the renewable energy market.⁶⁷ Consistent with this recommendation, in early 2019 the UK Government announced its £20 million Storage at Scale competition to drive innovative, replicable solutions for market-competitive alternatives to conventional commercial, large-scale energy storage technologies, such as pumped-hydro or batteries.⁶⁸

What is soon to be lacking with the UK's departure from the European Union is a UK financial institution to provide attractively priced infrastructure finance in the event the UK loses access to the European Investment Bank. While the European Investment Bank is not without faults, it played a valuable role in supporting the UK economy following the 2008 financial crisis, crowding-in private finance, and investing in environmental, social and regional development.⁶⁹

Building on the lessons from the previous Green Investment Bank,⁷⁰ the European Investment Bank and Germany's KfW Bank, a new and differentiated UK Investment Bank should be established as part of the National Infrastructure Strategy.⁷¹ A UK Investment Bank would manage and reduce risk in infrastructure projects and leverage private finance.⁷² With an explicit sustainability mandate, the bank could seek out net-zero-aligned projects. It would invest in projects that demonstrate good value (i.e. socio-economic, environmental or regional development benefit) beyond commercial considerations. This could help to crowd-in private investment in projects with risk profiles incompatible with private markets, such as risky early-stage projects or unproven emerging technologies.⁷³ Ultimately, a UK Investment Bank would overcome market failure and facilitate the movement of capital at scale towards net-zero-aligned projects that cannot currently be financed by the market.⁷⁴ A potential first role for the bank could be to support the post-pandemic economic recovery through investment in net-zero infrastructure.

Recommendation 7:

Contracts for Difference and the Regulated Asset Base model should continue to be used, where appropriate, to unlock the market for net-zero technologies identified by the Committee on Climate Change.

Recommendation 8:

A UK Investment Bank should be established, with a sustainability mandate to invest in net-zero-aligned infrastructure and crowd-in private finance.



Germany's KfW Banking Group

KfW is a German state-owned development bank established in 1948 to support the reconstruction of the post-war economy in Germany and internationally. The German federal government owns 80% of the bank and the remaining 20% is held by German states (Länder). As such, its work is closely tied to the priorities of the state.

KfW is one of the largest banks in Germany, functioning as a promotional bank for the local economy and a development bank for partner developing economies. Today, KfW has the mandate to promote and finance measures to expand economic and social infrastructure, and to protect the environment and natural resources.

According to KfW's **annual report**, in 2019 it provided promotional funds totalling EUR 77.3 billion, of which 38% was spent on measures aimed at protecting the climate and environment. Similarly, 60% of KfW's Development Bank funding was earmarked for climate change mitigation and environmental protection projects.

In 2020, the bank is due to focus on supporting the German federal government in implementing its Climate Action Programme 2030. In addition, KfW is currently working with the German government to establish an equity fund of up to EUR 10 billion to promote future-oriented technologies, particularly in the areas of digitalisation and climate technology. In parallel, KfW continues to work with the government on further initiatives in the fields of transport, buildings and energy.

⁶⁴ BEIS (2019) Green Finance Strategy

⁶⁵ BEIS (2019) RAB Model for Nuclear

⁶⁶ BEIS (2020) Contracts for Difference for Low Carbon Electricity Generation

⁶⁷ ICE (2018) State of the Nation 2018: Infrastructure Investment

⁶⁸ BEIS (2019) Storage at Scale Competition

⁶⁹ ICE (2019) Response to Infrastructure Finance Review

⁷⁰ National Audit Office (2017) The Green Investment Bank

⁷¹ ICE (2019) What Should be in the National Infrastructure Strategy?

⁷² Allan, J., et al. (2020) A Net-Zero Emissions Economic Recovery from COVID-19, Oxford Smith School of Enterprise and the Environment | Working Paper No. 20-01

⁷³ ICE (2019) Response to Infrastructure Finance Review

⁷⁴ London School of Economics Growth Commission (2020) Delivering Strong and Sustainable Growth in the UK

Engaging the public to act

What the Committee on Climate Change said:

Much of the success so far in reducing emissions (e.g. power sector decarbonisation and even the phase-out of inefficient gas boilers) has happened with minimal change or awareness needed from the public. However, this cannot continue if the UK is to reach net-zero emissions. Public engagement and support will be particularly vital for the switch to low-carbon heating – people will need to make changes inside their homes and coordinated central decisions must be taken on the balance between electrification and hydrogen. People should understand why and what changes are needed, to see a benefit from making low-carbon choices and to access the information and resources required to make the change happen.

Understanding net-zero

Public support for the changes needed to reach net zero is critical. According to the UK Government's Public Attitudes Tracker, only 35% of respondents were aware of the concept of net zero.⁷⁵ However when the concept is explained, 82% of respondents support the commitment to reach net zero by 2050⁷⁶ and 64% do not believe that the UK is doing enough to reach the target.⁷⁷

Clearly there is a gap in public awareness of net zero and in understanding the changes necessary to achieve the target. Polling suggests the public is unwilling to pay for the changes required to meet net zero, with 59% unwilling to pay more tax or higher charges to support investment in greener infrastructure.⁷⁸ Similarly, the public has a limited awareness of the low-carbon transport and energy technologies needed to transition the UK to net zero. Only 38% are aware they need to change the way their home is heated. This contrasts with Committee on Climate Change advice that 90% of homes need to install low-carbon heating systems to achieve the target. Similarly, less than half of UK adults (44%) realise they will have to switch to an electric vehicle.⁷⁹ But road transport is a major contributor to emissions and around 56% of trips in a car are less than five miles in length. Of course, there will need to be a focus on mode shift to active travel and public transport as well as the transition to electric vehicles.⁸⁰ But it seems people will only convert en masse if the alternative is as good as, or better than, the existing situation (e.g. cheaper and/or better quality), not just as a result of a social or environmental choice.

We have witnessed the extensive climate change awareness raising already underway throughout society (Extinction Rebellion, school climate strikes, IPCC, COP26). Citizens Advice says that without a public understanding of why these changes are needed, support to help make those decisions and help when things go wrong, public faith and trust in the process will be undermined. It argues that this could make achieving net zero impossible.⁸¹ Similarly, there are significant parallels that can be drawn from the government's education and awareness-raising efforts for the Covid-19 pandemic, including the importance of experts, trust, health risks, collective action and co-benefits.

Recommendation 9:

A net-zero education and awareness-raising campaign for the built environment should be developed. Details of the campaign should be set out as part of the Net-Zero Infrastructure Plan.

Changing behaviours through education and awareness

Analysis by the Committee on Climate Change shows that technological change alone is insufficient to reach the net-zero target, with over half of the emissions cuts needed requiring people to change behaviour.⁸² The public must be engaged in the challenge, and policy and infrastructure design must reflect this.⁸³ Societal engagement is essential for meeting net zero given the nature and pace of the changes required, and the government has a role in rallying public support for change.

To this end, the proposed Net-Zero Infrastructure Plan should set out a blueprint for a net-zero education and awareness-raising campaign to be delivered through a partnership between the government and industry. The campaign should articulate a vision for a net-zero future and its social, economic and environmental benefits. It should inspire a step change in societal behaviours and choices when it comes to the way the public interacts with infrastructure. This will help to reduce the psychological distance between a recognition of the climate problem and the need for action, while explaining the costs and trade-offs required to achieve net zero, and the potential benefits. The campaign will help to embed a culture of carbon reduction and thus influence individual behaviour in respect of the infrastructure sector.

The UK Government's Citizens' Assemblies on Climate Change provide a good model for engagement. Engaging civil society through inclusive processes will be an essential part of bringing people along the journey towards a net-zero future. Involving them in the design and deployment of their net-zero communities can help create a greater sense of positive engagement in the transition, as well as ownership of the actions required at a local and regional level.⁸⁴

⁷⁵ BEIS (2020) BEIS Public Attitudes Tracker: Wave 33

⁷⁶ Citizens Advice (2020) Zero Sum

⁷⁷ Copper Consultancy (2020) Public Attitudes to Net Zero Emissions in the UK

⁷⁸ Copper Consultancy (2020) Public Attitudes to Net Zero Emissions in the UK

⁷⁹ Citizens Advice (2020) Zero Sum

⁸⁰ ICE Expert Panel Submission

⁸¹ Citizens Advice (2020) Zero Sum

⁸² Committee on Climate Change (2019) Reducing UK Emissions – 2019 Progress Report to Parliament

⁸³ Ibid

⁸⁴ ICE Expert Panel Submission

Public education in the Icelandic Climate Strategy

In Iceland, almost all heating and electricity generation is provided by renewables – hydro and geothermal energy. The largest sources of emissions in Iceland are industrial processes (aluminium production), road transport, fisheries and waste management.

In 2018, Iceland launched a new **Climate Strategy**, aimed at making the country carbon neutral by 2040. Alongside measures to directly reduce emissions, such as phasing out fossil fuels in transport or increasing carbon sequestration in land use, the strategy also identifies several public education actions, including:

- public education on climate change – emphasising how individuals can decrease their carbon footprint
- a climate fund – primarily supporting green technology and public education projects
- climate education in schools – a plan will be made for education on climate issues in schools, in cooperation with schools and non-governmental organisations.

Local governments throughout Iceland are also forming partnerships for awareness raising. For example, the City of Reykjavik and **Festa**, the Icelandic Centre for Corporate Social Responsibility, have formed a partnership with over 120 local businesses to fight climate change and adapt to it. The partnership involves organised training, dialogue events, conferences and workshops on climate change and CSR. entire infrastructure system value chain.

10 things the public can do to support the transition to net zero

Around two-thirds of greenhouse gas emissions are directly or indirectly linked to household consumption. Analysis of demand-side solutions for reducing emissions has identified a list of 10 actions the public can take to reduce their household emissions.⁸⁵ The table below outlines these 10 actions and their respective carbon savings, as well as ICE's own polling on the ease of making these changes.

Given the annual carbon footprint of an average European is around 7.5 tonnes of CO₂ equivalent, these actions can have a big impact on the public's contribution to reducing emissions.⁸⁶ The response to the Covid-19 crisis has already shown that the public are willing to make major changes to the way they live. This analysis shows that some of these actions are not too difficult to do and can have a major impact on reducing emissions.

Conversely, some of these actions are perceived to be difficult and the public therefore requires more in order to effectively carry them out. Irrespective, the proposed net-zero education and awareness-raising campaign will assist in promoting behavioural change such as shifting to cleaner transport modes, encouraging the uptake of electric vehicles and selecting more sustainable energy sources.

Average annual reduction in CO ₂ emissions per person	Action to reduce emissions	Longer term priorities	
Tonnes of CO ₂ equivalent		Easy to do	Difficult to do
2.04	Live car-free	18%	68%
1.94	Shift to a battery electric car	24%	44%
1.68	Take one less long-haul flight per year	50%	12%
1.60	Purchase or produce your own renewable energy	17%	53%
0.98	Use public transport more	36%	42%
0.90	Refurbish/renovate your home to improve energy efficiency	25%	49%
0.80	Switch to a vegan diet	14%	67%
0.80	Install a heat pump	9%	42%
0.65	Use more energy-efficient cooking appliances/equipment	49%	25%
0.64	Shift to renewable-based heating	21%	43%

* **Note:** the remaining percentages relate to 'not applicable' or 'don't know' responses

Source: YouGov (2020) ICE State of the Nation 2020 Polling; Ivanova, D., et al. (2020) Quantifying the Potential for Climate Change Mitigation of Consumption Options, Environmental Research Letters

85 Ivanova, D., et al. (2020) Quantifying the Potential for Climate Change Mitigation of Consumption Options, Environmental Research Letters

86 Ivanova, D., et al. (2020) Quantifying the Potential for Climate Change Mitigation of Consumption Options, Environmental Research Letters

Providing the skills

What the Committee on Climate Change said:

The Government has recognised the importance of developing skills in its Industrial Strategy and sector deals. These should be used to tackle any skills gaps that would otherwise hinder progress. For example, new skills support for designers, builders and installers is urgently needed for low-carbon heating (especially heat pumps), energy and water efficiency, ventilation and thermal comfort, and property-level flood resilience.

Levelling up through net-zero

In addition to public education and awareness raising, the UK needs to ensure it has the capabilities within the infrastructure sector to deliver the transition to net zero. A plan for skills across the infrastructure value chain is needed. There are already examples of this underway around the world. For example, a key aspect of South Africa's National Infrastructure Strategy is a skills framework to overcome the skills shortages in engineering and the built environment. This framework provides signals to training and educational organisations of future infrastructure workforce requirements.⁸⁷ Work is already underway by many organisations across the sector to identify the skills implications for the transition.⁸⁸ It is already clear that the UK does not have the necessary skills to realise key net-zero technologies such as the deployment of heat pumps, carbon capture and storage, and low-carbon hydrogen.⁸⁹ Industry and academia will need to continue innovating, sharing best practice and building workforce capability.

Recommendation 10:

An Infrastructure Skills Plan to ensure the UK has the capability within the built environment sector for the transition to net zero should be delivered. Details for the development of the skills plan should be set out as part of the Net-Zero Infrastructure Plan.



⁸⁷ South African Government (2012) National Infrastructure Plan

⁸⁸ ECITB (2020) Towards Net Zero: The Implications of the Transition to Net Zero Emissions for the Engineering Construction Industry; National Grid (2020) Building the Net Zero Energy Workforce; Energy & Utility Skills Partnership (2020) Workforce Renewal and Skills Strategy 2020–2025

⁸⁹ Committee on Climate Change (2019) Reducing UK Emissions – 2019 Progress Report to Parliament

Life-long learning and skills development will be essential to ensure the infrastructure required can be delivered.⁹⁰ To achieve this, the proposed Net-Zero Infrastructure Plan should set out the details of a Skills Plan for a net-zero workforce. This will prove especially valuable in the context of the Covid-19 recovery. The economic downturn has resulted in high levels of unemployment and longer-term structural shifts in the labour market are likely as we transition to a new normal following the pandemic. In response to the pandemic, workforces may need to reskill and retrain for a new, greener economy.

In this context, the Infrastructure Skills Plan should identify current skills gaps, emerging skills requirements, barriers to upskilling and retraining, and education/training requirements, as well as foster a more diverse and inclusive workforce. It will be important for education and industry to be linked more closely at regional level, so that training reflects local skills needs. Carbon literacy will be paramount for the infrastructure workforce of the future, ensuring people have the knowledge and skills to act and make decisions consistent with net zero.

Building the Net Zero Energy Workforce

National Grid is the owner, manager and operator of energy infrastructure assets in the UK and internationally. Building on the Committee on Climate Change's analysis, National Grid released its [Building the Net Zero Energy Workforce](#) report to explore the employment opportunities and skills needed to help the UK's energy sector reach the net-zero target.

According to National Grid, action is required now to ensure that during the 2020s the energy sector:

- increases low-carbon electricity generation by around 50%, from sources such as wind or solar power
- installs low-carbon heating systems in around 2.8 million homes
- develops carbon capture and storage technology, and hydrogen networks
- installs around 60,000 charging points to power around 11 million electric vehicles.

Emerging skills gaps form one of the biggest obstacles to reaching net zero. National Grid identifies that the energy industry needs to recruit for 400,000 jobs between now and 2050 to get the UK to net zero. Tens of thousands will be needed in every region across the UK, with significant employment opportunity in the North, where nearly 100,000 jobs will become available, the Midlands (over 50,000 jobs) and the devolved nations of Scotland, Wales and Northern Ireland (nearly 90,000 jobs). But there are a number of challenges, including:

- loss of existing talent due to a baby-boomer retirement crunch
- competition for skilled workers from other sectors, such as finance and technology
- a limited pipeline of young people choosing science, technology, engineering and mathematics (STEM) qualifications
- lack of diversity

According to National Grid, reaching the 2050 target will require a workforce which combines technical expertise with softer skills and a passion for climate action. National Grid's report provides a useful piece in the net-zero skills puzzle, but a more coordinated and systematic plan is required for the entire infrastructure system value chain.

⁹⁰ ICE Expert Panel Submission

Section 3: Providing the knowledge, skills and expertise to reach net zero

Overview

What can ICE do to support built environment professionals?

This section outlines how ICE plans to support the recommendations made in this report with a programme of thought leadership and knowledge sharing. With a focus on delivering a programme of outputs leading up to COP26, ICE is coordinating an industry-wide response, bringing together leaders and experts from across the supply chain to tackle some of the challenges that are slowing progress towards net zero. This is the start of a long-term programme of collaborative work which will seek to share knowledge and best practice on delivering low-carbon solutions across the industry.



Given the role engineers have in creating, operating and maintaining, refurbishing and repurposing infrastructure assets, ICE has a responsibility to lead its members and the engineering profession towards achieving net zero.

At the start of 2020, briefings with industry leaders were held which allowed us to start unpacking the issues, learn about the progress individual firms are making, and share some of the challenges we are all facing. These sessions highlighted areas where ICE could make a genuine difference. Throughout the discussion we were reminded of some key maxims:

- **COP26 is a milestone not an end point** – ICE's work in this area should use COP26 to focus our efforts but this is only the start of the journey.
- **Don't reinvent the wheel** – there is already a great deal of work and good practice in this area. Our role should be to collaborate with others, and to gather, collate and share information. Only if there are genuine gaps and needs should we create something new.
- **Net-zero at any cost is a hollow victory** – climate action is one of the 17 UN Sustainable Development Goals; consideration needs to be given to how it can be achieved while ensuring we also meet or positively contribute to all the other goals.
- **Climate Change is a global issue** – as well as focusing on the UK's targets, we should work with our global partners to see how actions can be replicated elsewhere, and discover what we can learn from others.

Bearing this in mind, we have identified three workstreams where ICE can make an immediate impact and provide focus for our activities before, during and after COP26.

Work Stream One: Measuring, sharing and benchmarking of carbon impacts

The Infrastructure Carbon Review showed that infrastructure is associated with over half of UK greenhouse gas emissions.⁹¹ Measuring, sharing and benchmarking of carbon impacts – covering all stages of the infrastructure life cycle – is integral to facilitating carbon management as a routine aspect of infrastructure design. This was reaffirmed by the National Infrastructure Commission when it set out principles for major infrastructure projects: climate, people, places and value.⁹²

The net-zero challenge requires a cross-industry response with collaboration at its heart. An open approach to carbon reporting will hasten industry transformation and bolster collaborative efforts. The whole value chain – including asset owner/managers, designers, constructors and product/material suppliers – should be able to contribute to and benefit from these developments.

Consideration of carbon impacts covering capital, operational and user emissions will allow management of carbon within both the control and influence of infrastructure. Taking a whole-life approach will maximise opportunities for carbon and cost reductions. The scope of capital carbon considerations will need to include materials, products, design solutions and construction techniques.

Measuring and monitoring is important because if we do not monitor and measure, we will not know if our interventions are delivering the desired change, or if we are

focusing our intervention effort on the most important, impactful areas. Consideration of carbon impacts – and understanding these impacts within the context of the Paris Agreement – will allow the value chain to better understand the impact and value of the project. This can have a motivational effect and link in with a broader appraisal of project outcomes, for example based on the UN Sustainable Development Goals.

Sharing is important because it helps engagement and enables benchmarking. Benchmarking and having sound data in the public domain changes attitudes and priorities.

This workstream will deliver the following objectives:

- Embed the calculation and sharing of whole-life carbon methodology in projects into everyday engineering practice.
- Create an industry standard for the output of existing carbon reporting tools so that these outputs can be used by all, regardless of which tool was used. This will unlock current challenges around the continuous flow of data at different life-cycle stages.
- Allow engineers to better understand how their individual projects contribute to progress.

First Step Actions:

- Collection of the output formats of existing carbon reporting tools. Once compiled, a gap analysis of the links and missing connections of these outputs will be undertaken to better understand how we might deliver an industry standard for universal carbon reporting.

Embedding carbon in decision-making

In 2019, the Environment Agency **announced its aim** to become a net-zero organisation by 2030 – ensuring that its own activities and its supply chain are taking as much carbon out of the atmosphere as they put into it. The Agency is also exploring whether it could become an absolute-zero organisation – eliminating all carbon emissions from its own activities and its supply chain – by 2050.

As part of its sustainability strategy, e:Mission2030, and the pursuit of the UN Sustainable Development Goals, the Environment Agency aims to tackle a broad range of social and economic development issues.

The Environment Agency takes a collaborative approach to carbon reduction and delivery of low-carbon assets, building upon the efforts made in quantification, methodology, training and capability building across the organisation and supply chain. The Agency created the 'Eric' carbon planning tool to provide a mechanism for assessing carbon over the asset's life cycle. The Agency is now able to forecast future carbon projections across the portfolio and at a project level. Carbon decision-making is embedded in asset management systems and plans across the organisation.

91 HM Treasury (2013) Infrastructure Carbon Reviews

92 National Infrastructure Commission (2020) Design Principles for National Infrastructure

Work Stream Two: Capability building in low-carbon design and delivery

Making progress on net-zero carbon design and delivery against cost pressures, the demands of clients and society requires new skills, refreshed knowledge and professional support, especially when it comes to new regulations, challenging design standards and codes, specification of zero-carbon solutions and designing for automated delivery.

This workstream will deliver the following objectives:

- Complete a UK-level assessment of current low-carbon design capacity and capability, sector by sector and by type of firm, to identify needs and opportunities.
- With our partners, identify, support, develop and/or provide access to learning programmes to build professional capacity for delivering low-carbon infrastructure in the areas of greatest need and opportunity.

- Identify barriers to and potential enablers of carbon reduction in regulations and standards, consider recommendations for change and the creation of new complementary standards and/or best-practice guides to encourage greater carbon reduction.

First Step Actions:

- Describe the skills, knowledge and attributes the future civil engineer requires to deliver a net-zero built environment.
- Enlist supporting organisations to encourage their staff to complete a survey aimed at identifying existing knowledge gaps and learning needs
- Deliver a series of knowledge programmes by the end of 2020 that will enable engineers to adapt, analyse risk, learn new things and go outside the safety net of codes and standards.

Work Stream Three: Identifying systems-level reductions in in-use carbon

Infrastructure is heavily networked and interconnected, composed of 'systems within systems'. Reducing the greenhouse gas emissions associated with its use therefore requires a strategic approach. The majority of the assets that will be in use by 2050 have already been built. So to achieve the net-zero target we need to make the assets we already have work more efficiently. The current Covid-19 pandemic is an opportunity to ask questions of what society truly wants from its infrastructure systems, and whether long-term demand will continue to increase unchecked.

This workstream will deliver the following objectives:

- Clarity on the role that infrastructure systems play in delivering net-zero through carbon reductions of our in-use assets, from both a UK and international perspective.
- Exploring what role the Green Book could play in evaluating projects in a more balanced, systematic way.
- Thought leadership on how to build back a global economy that provides the quality of life that society wants but that is not carbon dependent.
- Describing what a zero-carbon compatible world might mean for individuals, what behavioural change must be embraced to make it happen, and what infrastructure organisations must do to play their part in the journey.

First Step Actions:

- Update the UK emissions figures from the Infrastructure Carbon Review.⁹³ The figures behind the Infrastructure Carbon Review are often cited and used to make strategic decisions about carbon reduction. We now have an additional seven years of data for most of the primary sources listed, plus a wealth of sector-specific data that was not being routinely gathered at the time.
- Work with the ICE Research and Development Enabling Fund to set out a call for funding to support research in the areas of greatest need.

Carbon trade-offs for the M4 Relief Road

The M4 Relief Road was proposed as a major new bypass around the city of Newport in Wales. It was the first major project in Wales to be publicly challenged on the grounds of its climate change impact.

After a year-long public inquiry, in June 2019 the Welsh Government announced the decision not to proceed with the construction of the M4 bypass on the grounds of affordability and potential damage to the Gwent Levels. Notwithstanding the wider socio-economic implications, carbon was not publicly identified as a contributory factor to the decision. In fact, at the inquiry, it was highlighted that: *'If the M4 is a most unusual road project and the inquiry fails on carbon terms, then there should not be another road scheme ever built in the UK!'*

Unlike most bypass road schemes, the M4 Relief Road was modelled to be carbon neutral rather than carbon increasing over its life cycle. The construction of this linear infrastructure asset would have resulted in a carbon benefit much wider than its alignment – relieving the congestion of significant arteries in the whole of South Wales – the boundary is well beyond the direct control of the asset. Relative to the baseline 'do minimum' scenario, the congestion relief and reduced distance travelled (the relief road was a shorter route than currently exists) would have resulted in a reduction of the current user carbon emissions, paying back the embodied carbon invested for the road's construction.

Since this decision, in early 2020 plans for a third runway at Heathrow Airport were put on hold by the Court of Appeal on the grounds that the plans were inconsistent with UK Government's net-zero commitments.

93 HM Treasury (2013) Infrastructure Carbon Review

Carbon management in infrastructure with PAS 2080

In 2013, HM Treasury published an **Infrastructure Carbon Review** which recognized the opportunity for infrastructure value chain participants to cooperate in the development of low-carbon infrastructure projects. With the support and input of the Green Construction Board, BSI developed PAS 2080, the world's first specification for managing whole-life carbon in infrastructure.

PAS 2080 supports leaders and practitioner-level individuals in different value chain organisations (asset owners/managers, designers, constructors and product/material suppliers) responsible for delivering infrastructure by providing a common framework for all infrastructure sectors and value chain members on how to manage whole-life carbon when delivering infrastructure assets and programmes of work.

The individual value chain requirements in the carbon management process are structured around the following components:

1. Setting appropriate carbon reduction targets
2. Determining baselines against which to assess carbon reduction performance
3. Establishing metrics, e.g. Key Performance Indicators for credible carbon emissions quantification and reporting
4. Selecting carbon emissions quantification methodologies to include defining boundaries and cut-off rules
5. Reporting at appropriate stages in the infrastructure work stages to enable visibility of performance
6. Continual improvement of carbon management and performance.
In adopting PAS 2080, a more integrated value chain will form, communicating in a common language and working in a culture of genuine collaboration and innovation.

PAS 2080 promotes reduced carbon, reduced-cost infrastructure delivery, more collaborative ways of working and a culture of challenge in the infrastructure value chain through which innovation can be fostered. It includes requirements for all value chain participants to show leadership and to establish effective governance systems for reducing whole-life carbon through the use of a detailed carbon management process. All value chain participants can claim conformity to PAS 2080 by demonstrating that the relevant requirements in the PAS have been met.

Beyond the UK

Climate Change is a global issue and will impact us all, regardless of where those emissions arise. While this programme of work will initially have a UK focus, it is important to understand what others are doing, what role we can play in offering support and what we can learn in return.

This programme of work will therefore run alongside other programmes of activity that have a more international audience:

The Sustainability Route Map

Kick-started by the 2018 Global Engineering Conference, the Sustainability Route Map sets out a programme of activity that uses the UN Sustainable Development Goals as a framework to provide built environment professionals with a better understanding of how their work can influence, impact and accelerate the delivery of sustainable infrastructure.

World Federation of Engineering Organisations (WFEO)

ICE chairs the WFEO Committee on Engineering and the Environment (CEE). The main focus of the CEE is to raise awareness and share best practice on Sustainable Development Goal 13: climate action.

ICE's net-zero workstreams will be working closely with these programmes to ensure an international dimension is considered in our programme of activity.

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- Cadent Gas
- Cardiff University
- Cavendish Nuclear
- Civil Engineering Contractors Association
- CITB
- Committee on Climate Change
- Cornwall Council
- Devon County Council
- Dorset Council
- Drax
- East West Railway
- EDF
- Energy UK
- ENGIE
- Environment Agency
- Ernst & Young
- Global Infrastructure Investor Association
- Gloucestershire County Council
- GRAHAM
- Green Finance Institute
- Green Investment Group
- Hermes Infrastructure
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- West of England Combined Authority
- West Midlands Combined Authority
- WSP

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