Civil engineering insights on pathways to decarbonisation: Delivering the UK Government's Net Zero Strategy

January 2023

Executive summary

In October 2021, the UK Government published its Net Zero Strategy, setting out its high-level plan for how the UK will meet its legal obligation to reduce domestic greenhouse gas emissions to net zero by 2050.

The strategy marked a significant step forward for UK climate policy. However, there is growing concern that the UK is falling off track for meeting the 2050 objective. Both the Climate Change Committee (CCC) and the National Infrastructure Commission (NIC) have warned of failures in policy, implementation and contingency planning that are threatening the UK's climate goals.

The UK's carbon emissions are continuing to fall – they are now almost half (47%) 1990 levels according to the CCC's latest annual progress report to Parliament. Despite this progress, the CCC has warned that the Net Zero Strategy as published will not deliver the enormous emissions cuts still required to reach net zero by 2050. It has identified serious risks to the government's plans for achieving over a third of those cuts.

In July 2022, the government lost a legal challenge on the basis of gaps in the Net Zero Strategy. The High Court ruled that the strategy does not comply with the government's obligations under the Climate Change Act 2008 as it lacks sufficient explanation or quantification of how the government's plans will achieve the Sixth Carbon Budget.

The areas of greatest concern identified by the CCC lie primarily outside of economic infrastructure, in agriculture and land use. However, infrastructure has a huge role to play in delivering net zero. Surface transport remains the largest source of domestic emissions, while there are major gaps in plans to improve energy efficiency and questions about the readiness of engineered carbon removals.

The impact of climate change is becoming increasingly evident. The UK experienced record temperatures during the summer of 2022. The window of opportunity to limit global heating to the Paris Agreement target of 1.5°C this century is closing fast, according to the UN Environment Programme's (UNEP) latest emissions gap report.

The UK has been a world leader in establishing an ambitious, credible and legally binding net zero goal, and setting out a strategy for achieving it. It can continue to be an example to others by demonstrating and sharing best practice for delivering that strategy while capitalising on the economic opportunities the green transition will bring.

However, action is needed quickly to provide the detail and start implementing the high-level policies and proposals set out in the Net Zero Strategy if it is to be a success. Society needs to change much more quickly than is happening to meet the targets. The scale of that change is immense and cuts through every industry, government authority and down to the level of individual households.

This insight paper will outline the key challenges and obstacles, and the actions required across the infrastructure sector to make the Net Zero Strategy a reality. It draws on input from senior figures in the relevant sectors and insight from experts on the ICE's Decarbonisation and Low Carbon Energy Community Advisory Boards.

The Net Zero Strategy's pathways to 2050

The Net Zero Strategy[1] lays out three scenarios for 2050, each with a different focus and varying depending on how technologies could develop over the next two decades:

- Scenario 1: High electrification – Explores the impact of widespread electrification to support transport, heating and industry decarbonisation, relative to other scenarios, with deep decarbonisation of electricity supply.
- Scenario 2: High resource – Explores the impact of using low-carbon hydrogen more extensively, particularly for decarbonising buildings, power and heavy vehicles. It also assumes higher levels of tree planting are achievable, increasing the 'negative emissions' available from land-use sinks.
- Scenario 3: High innovation – Explores how successful innovations could enable lower residual emissions to be reached in aviation, while higher capture rates increase the impact of carbon capture technologies, with higher levels of direct air carbon capture and storage deployed over the 2040s.

Compared with the 2019 baseline energy generation, the 2050 scenarios all show a big increase in energy generation from wind and scenario 1 shows a big increase from nuclear. Scenarios 2 and 3 rely heavily on using natural gas to produce hydrogen with carbon capture and storage. The energy demand for all 2050 scenarios is assumed to be around double the 2019 demand.

Policy and delivery gaps in key sectors

On a global level, there is currently no credible pathway to limit global warming to 1.5°C according to major reports published in 2022 by the Intergovernmental Panel on Climate Change (IPCC) and the UNEP.[2]

In the UK, the CCC's latest Progress Report to Parliament warned that 'tangible progress is lagging the policy ambition' for decarbonisation. It says 'greater emphasis and focus must be placed on delivery' of net zero and identified significant risks across all key sectors.[3] The NIC also used its annual monitoring report to highlight 'major gaps' in the Net Zero Strategy and the lack of policy detail impeding progress in critical areas.[4]

These gaps include answering the question of who will pay for the infrastructure needed to deliver net zero. A public inquiry held by the Public Accounts Committee cautioned that there is still no clear understanding of how much the transition will cost, along with who will pay for it, and how.[5] Delaying answering these questions is holding up delivery of key infrastructure.

The indicative delivery pathways for expected emission reductions and key dates set out in the Net Zero Strategy are generally high level. Detailed implementation plans are still missing to at least some extent in all sectors. Metrics and data to monitor progress are often lacking.

Electricity supply has the most mature plans, given the amount of work done in the sector to date. However, functional pinpointed activities are still needed to deliver them. Detailed plans are also needed for developing new technologies into practical application.

Transport is the largest source of greenhouse gas emissions in the UK, accounting for 24% of the total in 2020, primarily from road vehicles.[6] The government's indicative delivery pathway to 2037, the end of the Sixth Carbon Budget period,

[1] BEIS (2021) Net Zero Strategy: Build Back Greener
[2] IPCC (2022) Climate Change 2022 – Mitigation of Climate Change; UNEP (2022) Emissions Gap Report 2022
[3] CCC (2022) 2022 Progress Report to Parliament
[4] NIC (2022) Infrastructure Progress Review 2022
[5] Public Accounts Committee (2022) Achieving Net Zero: Follow up
[6] BEIS (2022) Final UK Greenhouse Gas Emissions National Statistics: 1990–2020

shows the significant reductions needed before then. However, there has been very little change in transport emissions over the past couple of decades. Even in 2037, there will remain significant emissions from surface transport.[7]

Just reaching the 2037 target will require investment in the UK's aging transport asset base, increasing modal shift from private vehicles to public transport, a reduction in overall demand and progress on decarbonising freight.

The transport sector does have some credible plans and frameworks, including the Transport Decarbonisation Plan,[8] but others carry significant risks. The CCC has argued that 'a more coherent vision for how [transport] investments will work together to deliver an improved overall transport system' will help the UK meet its climate targets.[9] The ICE has recommended that this could be enabled by developing a new National Transport Strategy for England.[10]

The buildings sector has policy gaps linked to energy efficiency in homes and the roll-out of low-carbon heating in general. Eighty per cent of the UK's 2050 housing stock already exists but most of it is not insulated. In addition, new homes are still being built that do not meet minimum efficiency standards and will require retrofitting. The planning system also needs to be updated to reflect the UK's legal obligations for climate mitigation. The need to address the rising cost of energy is an opportunity to accelerate action to improve energy efficiency in the UK's buildings, however the necessary programmes are not there to be implemented.

Achieving the Net Zero Strategy is still possible, but consistent, detailed implementation plans that address the current policy gaps and provide certainty and direction to all levels of government, industry, businesses and consumers are needed urgently.

Alongside these must be clear trackers to monitor progress across key sectors regularly and consistently. Specific, tailored and short-range carbon budgets that fit more closely with the political cycle would help prevent the actual carbon reduction effort from constantly 'creeping to the right'. The UK is behind the curve on carbon reduction and this will only be understood with transparent, accurate data. In addition, constant time creep means that there are more emissions to remove from the atmosphere to reach net zero and therefore steepens the reduction curve (and therefore the total cost, risk and pace of change required) in later years.

In certain areas and technologies there will be a need for adaptable pathways rather than top-down targets in light of the uncertainties. For example, in heating, the deployment of new technologies, replacement and retrofit all need to happen at pace and at scale. This will require difficult decisions with incomplete information and planning must therefore be flexible to adapt to changing circumstances and drivers while managing costs.

The National Engineering Policy Centre (NEPC), of which the ICE is a member, has proposed a range of 'low regrets' actions that can be taken now. Immediate investment in these measures would reduce emissions in these key sectors and help stimulate the actions needed to position the UK to meet the challenge of achieving net zero. They include scaling up deployment of proven technologies, improving efficiencies in resource and energy use across all sectors, and demand reduction.[11]

A formal system of net zero governance

The UK's system of legislative governance on carbon reduction targets, built around the CCC, is world leading. However, while there are many processes that govern net zero, there is no formal system of governance or guidance for translating high-level targets into net zero governance at a policy or local level.

[7] CCC (2022) 2022 Progress Report to Parliament
[8] Department for Transport (2021) Transport Decarbonisation Plan
[9] CCC (2022) 2022 Progress Report to Parliament
[10] ICE and APPGI (2022) Accelerating the Delivery of the Integrated Rail Plan
[11] NEPC (2021) Rapid 'Low Regrets' Decision Making for Net Zero Policy

This lack of formal governance has not prevented widespread change from happening. Across much of the local, combined authority and sometimes subnational government tiers, climate and specific net zero policies are in place, albeit without consistency of progress reporting or alignment. Many of these have targets ahead of the legally binding 2050 goal.

In the context of infrastructure, supply chains are changing. Tier 1 civil engineering contractors and the larger civil engineering consultancies are engaged with the net zero transformation, with many of them seeking verification of their efforts with UN-endorsed Science Based Targets Initiative (SBTi) standards, including 1.5°C alignment and (separately) their net zero standard aimed at corporates and the private sector.

However, to draw together these public and private sector initiatives and maximise the collective impact, a stronger system of formal governance is crucial. Within government, there will be examples where particular policies fall between departments and would benefit from better cross-departmental working. To achieve optimum outcomes and economic efficiency, sectoral strategies must be aligned. For example, policy on electric vehicles is separated between those responsible for rolling out charging infrastructure, those encouraging switch-over, and those dealing with the impacts of increased demand on the energy system.

Below strategy-setting, which will remain the government's domain, there are myriad complex interconnected delivery challenges that need to be navigated and coordinated to enable a coherent, fair, cost-effective net zero transition.

Action is also needed to ensure that infrastructure-related outcomes from net zero and other long-term national goals, such as levelling up, are aligned. Levelling up and net zero must be mutually reinforcing if either is to be a success. Through the Green Finance Strategy, the government should outline an integrated approach to investment in net zero and levelling up, aligning the net zero transition with the outcomes from the wider levelling up missions.[12]

The UK benefits from strong political alignment on the importance of transitioning to net zero. Up until now, there has been a consensus across the UK political parties in favour of the transition to net zero. This provides a relatively stable policy environment to develop a formal governance framework and long-term delivery plans. There may be other mechanisms and frameworks that would help maintain long-term policy consistency. For example, regarding overseeing the spending of carbon, lessons could be learnt from approaches to developing fiscal policy and controlling the spending of public money.[13]

Reaching net zero is an objective unlike previous political and policy challenges. It requires transformation across several vital and interconnected systems of infrastructure, regulation, finance and human behaviour. Driving change across multiple sectors at the same time carries the risk of an intervention in one sector creating unintended consequences elsewhere. Conversely, there will be opportunities to develop joined-up solutions in areas such as skills and regulation that cut across multiple sectors. A systems approach is essential for implementing the Net Zero Strategy at the speed required.

Embedding net zero across all roles and responsibilities

There is a need to embed decarbonisation and the net zero goals across all sectors. Delivery plans need to detail individual roles, responsibilities and accountabilities, including across government, regulators and industry. This will in turn require training and capacity building to achieve the requisite awareness and skills.

In the context of infrastructure, there has been progress in embedding net zero thinking across broad sectors and through the infrastructure life cycle. Net zero is present across investment plans and strategies in businesses and government at all scales. However, there is still a risk that the focus on delivering net zero veers towards visible, large infrastructure investments, such as in renewables, CCUS (carbon capture usage and storage) and hydrogen. The unintended risk is the assumption that everything else can carry on as it always has.

Planners must always ask whether new infrastructure is needed or if existing infrastructure or brownfield sites could be reused. New-build solutions contribute additional embodied carbon. While this is only a small percentage of the yearly total carbon in the UK, there is a collective need to spend carbon wisely. More can be done to accelerate the Low Carbon

[12] ICE (2022) ICE Policy Position Statement: Defining the Outcomes from Levelling Up
[13] ICE (2022) The UK Net Zero Strategy – One Year On: ICE Presidential Roundtable Summary

Concrete Routemap and Modern Methods of Construction to reduce the volume of concrete and other materials being used.[14]

The progress being made in the infrastructure sector needs to be reinforced by long-term government commitment, planning and decision-making to maximise the economic and environmental opportunities. There is already a widespread policy and practice shift underway at subnational government levels, and across many of the private-sector firms operating in the civil engineering and infrastructure markets. These are 'thin-layer' dispersed changes that mean the relative importance of carbon (and other greenhouse gas) impacts is growing in everyday decision-making across the UK. The UK Government should do more to recognise, support and endorse these changes and encourage their acceleration.

One area where a real focus is needed is on whole-life carbon assessments across government departments. The Infrastructure and Projects Authority has been effective in making the case but will need support from the construction industry to amplify the message.

Applying the Green Book's carbon values to all business cases

The Green Book already mandates the consideration of climate and environmental impacts in government decision-making. Its guidance also outlines the need to include the costs of emitting greenhouse gases when estimating the social cost of an intervention using the carbon values.

The carbon values, published by the UK Government's Department for Business, Energy and Industrial Strategy (BEIS) in September 2021, represent the monetary value that society places on one tonne of carbon dioxide equivalent (£/CO_2e). They are used to estimate the cost of the greenhouse gas impact of policies, projects and programmes. The 'carbon emissions impact' must be estimated in tonnes CO_2e and assigned an economic value, currently £248/tonne, rising to £378 by 2050.

The requirements have been strengthened, including that the carbon values be used for all projects, not just 'green' ones. This is a robust way of viewing whole-life carbon and cost together within benefit-cost ratio calculations. However, awareness of the carbon values is low and this mechanism to monetise carbon needs to be more widely communicated.

Carbon is also firmly linked to economic growth via PAS 2080 (and other emerging mechanisms).[15] Mandating PAS 2080 would also help to transparently quantify and reduce the carbon impact of infrastructure construction, operation and maintenance.

Accelerating renewables to deliver net zero and energy security

The world has changed significantly since October 2021 when the Net Zero Strategy was published. Russia's invasion of Ukraine, and its impact on the supply and cost of natural gas, has pushed energy security to the top of the political agenda in many countries.

In the UK, the government's responses to the energy crisis, including the April 2022 British Energy Security Strategy, have emphasised the need to expand and accelerate the deployment of renewable energy sources, which is positive. However, there have been suggestions of further oil and gas exploration as well.[16] This would be incompatible with the long-term objective of decarbonisation and make achieving the target of net zero by 2050 more doubtful.

The British Energy Security Strategy also makes a commitment to new nuclear reactors, but it is questionable whether this is deliverable. Experience suggests nuclear power stations take at least ten years to build. The scale of the required build is also challenging, given that Hinkley Point C will deliver 3.2GW and a requirement for up to 40GW of nuclear has been

[14] ICE (2022) Low Carbon Concrete Routemap
[15] Carbon Trust (2022) PAS 2080 – Carbon Management in Infrastructure
[16] BEIS (2022) British Energy Security Strategy

suggested in some scenarios.[17] The cost of adding nuclear capacity is also significant, with Hinkley Point C expected to cost £25bn to £26bn.[18]

The greatest risk to security of energy supply is overinvestment in any single source of low-carbon generation. Nuclear will need to be a significant part of the solution. However, the UK will need to build 12–16GW of new generation capacity across all sources each year between now and 2035 to hit its decarbonisation targets – the equivalent of building Ireland's entire energy system each year. The average build rate for 2017–2021 was 3.2GW.[19]

Achieving these targets will require a blended approach combining significant contributions from nuclear and offshore wind with smaller contributions from other sources. The energy crisis is an opportunity to pivot away from fossil fuels towards cheaper renewables. Worldwide, the cost of low-carbon technologies has fallen dramatically over the past decade.[20] In the UK, proposals to speed up deployment of hydrogen, solar, carbon capture storage and wind have been outlined.

Following the latest round of Contracts for Difference (CfD) auctions, the Department for Business, Energy and Industrial Strategy (BEIS) confirmed an additional 11GW of new renewable power projects will be built – more than was auctioned in all three previous CfD rounds combined. The projects already have planning permission, and all are due to be ready by 2026/27.[21]

The prices will be four times lower than the current cost of gas and 70% less than the first CfD auction round in 2015. The new capacity will mainly come from offshore wind (7GW) and solar (2.2GW) but includes some onshore wind and tidal stream.

Nevertheless, the pace of new build and complexity of the challenge means the dash to decarbonise power by 2035 may no longer be a credible ambition for the UK. As a minimum, we need a sense of urgency to start accelerating these programmes if they are to be achievable.

The timescales for these supply solutions will not solve the immediate energy security crisis. However, any short-term demand and cost of living solutions should, and can, be aligned with net zero. Reducing demand by improving energy efficiency in homes will have the dual benefit of bringing down short-term energy costs while easing the scale of long-term energy capacity that will need to be delivered.

The NEPC's 'low regrets' actions include measures that would help the UK navigate the current energy crisis and move towards long-term energy security. The paper demonstrates how the UK could act quickly to reduce energy demand, improving energy efficiency, and scaling up deployment of proven technologies.[22]

Reducing demand and enabling behaviour change

Around two-thirds of greenhouse gas emissions are directly or indirectly linked to household consumption. However, the Net Zero Strategy 'does not include significant ambition to reduce consumer demand for high-carbon activities'.[23] Policies on domestic insulation and energy efficiency were notably absent from both the Net Zero Strategy and the British Energy Security Strategy. A much stronger focus on demand-side solutions and behaviour change is needed to meet the net zero target and navigate short-term challenges linked to the energy crisis.

Some of the messaging in the Net Zero Strategy risks being counterproductive in this regard. International shipping and aviation is set to be the largest-polluting sector in 2050; however, the strategy suggests the advance of zero emission

[17] BEIS (2020) Modelling 2050 – Electricity System Analysis
[18] EDF (2022) Hinkley Point C Update
[19] Atkins (2022) Unprecedented Build Rate Required to Decarbonise UK's Energy System by 2035
[20] IPCC (2022) Climate Change 2022 – Mitigation of Climate Change
[21] BEIS (2022) Biggest Renewables Auction Accelerates Move Away from Fossil Fuels
[22] NEPC (2021) Rapid 'Low Regrets' Decision Making for Net Zero Policy
[23] CCC (2022) 2022 Progress Report to Parliament

planes will allow people to ‘fly guilt-free’. Relying on the development of new and nascent technologies risks perpetuating the myth that climate mitigation can be delivered without the need for societal participation or changes to our lifestyles.

The strategy implicitly allows for demand growth by suggesting that we can continue living as we are doing now by simply switching to low-carbon energy sources. This overlooks significant hurdles, including the scale of future generation capacity required and the production of enough greenhouse gas removals technology, which has yet to be proven at scale.

Transportation – modal shift and road pricing

Some changes will be imposed on people, for example by different energy mixes. However, many demand solutions will require personal choices which can be influenced directly or indirectly with the right policies.

In transportation, for example, achieving any plan to reduce tailpipe emissions by the required level will be difficult without significantly reducing demand as well, even with the uptake of electric vehicles (EVs). However, polling for the ICE found that over two-thirds of the public (68%) would currently find it difficult to live car-free.[24] The Transport Decarbonisation Plan goes some way to recognising the need to reduce traffic growth, increase average car occupancy, and increase journeys that are walked or cycled.[25]

However, policies are needed that make it easy for the public to take these decisions. There is a need to invest in the aging public transport asset base and low-carbon transport options to make the shift from cars practical and desirable. New road schemes will also need to consider how to manage the network more effectively rather than just adding capacity.

Policymakers need to consider how road pricing could help reduce demand, alongside addressing the pressing issue of replacing the current generation of motoring taxes. Earlier this year, the Office for Budget Responsibility (OBR) announced a faster-than-expected uptake in EVs, meaning the impact on the £36bn revenue currently raised from motoring taxes will become apparent much sooner than anticipated.[26]

A combination of decreased fuel duty and Vehicle Excise Duty (VED) receipts, alongside more generous capital allowances for EVs through the corporation tax regime, resulted in the OBR forecasting a £2.1bn revenue reduction to the Treasury in 2026–27. The government’s decision to end tax breaks for EVs from 2025 does not go far enough to address the revenue gap. The ICE has estimated that the government has until the end of the decade to implement a fair, reliable and sustainable system that replaces fuel duty and VED.

The ICE has already explored this issue in a policy paper that examines the practical, technological, social, political and regulatory challenges to establishing a ‘pay as you go’ (PAYG) model for the Strategic Road Network. It outlines a range of high-level recommendations that must be delivered in order for any future PAYG model to be effectively and fairly administered. The ICE’s research showed that there is public support for a road pricing system that is coupled to clear benefits, particularly on improved maintenance and condition of roads, and if there is no overall increase in the tax burden.[27]

A public engagement strategy

Evidence suggests a strong willingness among the public to change behaviours, but a lack of understanding about how to do this. There are also few easy-to-access incentives to drive change, and those that do exist, such as rebates on heat pump installation, are perceived to be difficult to access and understand. The ICE identified ten of the most impactful actions the public can take to reduce their household emissions. However, recent polling shows how hard much of the

[24] ICE (2022) How Easily Does the British Public Find it to Take Personal Action on Climate Change?
[25] Department for Transport (2021) Transport Decarbonisation Plan
[26] OBR (2022) Economic and Fiscal Outlook – March 2022
[27] ICE (2019) Pay As You Go – Achieving Sustainable Roads Funding in England

public would find it to make positive changes in those areas. For example, over half (57%) would find it difficult to renovate their home to improve energy efficiency.[28]

The Net Zero Strategy lacks a plan for building public understanding and acceptance of the required changes and ingraining them in day-to-day behaviours. Demand-side behaviour changes are urgent and vital. However, more focus is needed to involve the public in understanding what is holding them back from making net-zero-aligned shifts in behaviour and 'co-developing' solutions. Drawing on expertise from managing transitions in other settings could help deliver this work.

Taking a realistic approach to new technologies

One consequence of the Net Zero Strategy giving too little attention to reducing demand is over-confidence in the ability of technology to transition the UK to net zero. Compared to the CCC's Balanced Pathway to net zero, all three of the government's Net Zero Strategy scenarios have a greater reliance on engineered removals and aviation technology to meet the target.[29]

Carbon capture usage and storage (CCUS) and hydrogen are the two technologies of most concern, given the gap between the strategy's reliance on them to help meet future needs and their still unproven deployment at scale. All the government's pathways to net zero rely on the success of CCUS technologies. The strategy also positions hydrogen as an integral part of the future energy mix, but there are still many questions about how much can actually be produced and how it could be used.

The value of hydrogen is its versatility and high specific energy content (energy per unit mass). It has the potential to store energy in large quantities that could help manage intermittent supply from other sources and changes in demand. However, the NEPC has cautioned about significant risks and dependencies involved in scaling up production and that 'a pragmatic and carefully managed delivery' will be required.[30]

Hydrogen is generated from other compounds, such as water and methane, but doing so requires a huge amount of energy. Achieving large-scale, efficient and low-carbon production is a major challenge, with a significant gap between current production and the levels needed for reaching net zero.[31]

Green hydrogen uses renewable energy to split water by electrolysis to produce hydrogen and oxygen. Yellow hydrogen achieves electrolysis solely through solar power. Pink hydrogen uses nuclear energy for the same process. These methods will require a lot of water to produce the hydrogen and, although pilot projects are underway to extract hydrogen from treated seawater, this has not yet been proven at scale.

Blue hydrogen uses reforming to split natural gas into hydrogen and carbon dioxide. However, it relies on the use of CCUS to capture the carbon dioxide instead of releasing it into the atmosphere (and is called grey hydrogen when the carbon dioxide is not captured).

The UK currently relies on gas to produce around three times the electricity that is produced from renewable sources. It is unlikely that we would be able to produce enough hydrogen to replace all our gas needs. The focus should therefore be on how much hydrogen could realistically be produced and where it is best used. For example, low-grade heat is needed for residential uses so this might not be the best use for limited supplies of hydrogen. Instead, hydrogen should be directed towards industrial uses and other areas that are hard to decarbonise by other means.

[28] ICE (2022) How Easily Does the British Public Find it to Take Personal Action on Climate Change?
[29] CCC (2020) Sixth Carbon Budget; BEIS (2021) Net Zero Strategy: Build Back Greener
[30] NEPC (2022) The Role of Hydrogen in a Net Zero Energy System
[31] Ibid.

The plans for hydrogen are essentially to use it as a battery, but as battery technology is improving all the time, in 20 years we may have grid-scale batteries that can store excess wind power. Finland, for example, recently developed and commercially installed a low-cost, low-impact battery made from sand.[32]

Within the infrastructure sector there is real potential to achieve change based on solutions that are long-proven. The contribution of infrastructure sectors in adapting existing systems and assets across the buildings, transport, water, waste, digital and energy spaces is critical to the success of the UK's net zero 2050 obligation. This should be a real emphasis for onward change in parallel with developing future technological solutions.

Evolving funding and regulation frameworks

Funding

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, to unlock the market and are tailored to net zero outcomes.

In many instances, this work is already underway within government. The Nuclear Energy (Financing) Act 2022 embeds the Regulated Asset Base (RAB) model for nuclear in legislation, while CfD auctions are now held annually and contain a wider array of generation technologies.

The UK Infrastructure Bank has a mandate to crowd-in private finance, support new technologies and build up capacity to develop and deliver net zero projects at subnational level. However, at that regional and local level, there is also a need for clearer alignment between levelling up and net zero, including for more sustainable funding models that allow for long-term projects to be developed and implemented.[33]

A strong funding and financing framework will give companies the confidence to innovate and scale up pilot projects and expensive new technologies, such as CCUS and hydrogen. At a household level, the costs of net zero supportive actions, such as installing heat pumps, are still largely prohibitive. Many of the existing 'green loans' are means tested and not accessible for large parts of the population. Targeted incentives would help drive sustainable actions and behaviour changes.

It is important to emphasise that there is no trade-off between decarbonisation and economic sustainability. According to the IPCC, the long-term economic outlook of acting now to mitigate climate change is favourable. The cost of inaction is greater. Investing now in renewables, electric vehicles and energy efficiency measures will save money compared to continuing with fossil fuel alternatives.[34] The Sixth Carbon Budget suggests a large, sustained increase in investment for the Balanced Pathway: adding around £50bn annually by 2030 (compared to current economy-wide investment of nearly £400bn) would be offset by savings in fuel costs in later years.[35]

Investment in nascent low-carbon technologies and sectors also has the potential to fuel whole new industries, create local employment at large scale and improve the UK's international economic competitiveness.[36] In short, the economic benefits of limiting warming to 2°C through mitigation measures far outweigh the costs in most scenarios.

Regulation

Almost half of the UK's infrastructure, chiefly water and energy, is financed and delivered by the private sector, and paid for by consumers, under the RAB model.[37] The model of regulation has generated significant investment and improved

[32] Polar Night Energy (2022) Sand Battery
[33] ICE (2022) ICE Policy Position Statement: Defining the Outcomes from Levelling Up
[34] IPCC (2022) Climate Change 2022 – Mitigation of Climate Change
[35] CCC (2020) Sixth Carbon Budget
[36] Ibid.
[37] ICE (2018) State of the Nation 2018: Infrastructure Investment

performance over the past decades. However, it was not designed to meet the challenge of delivering the 2050 net zero target.

Regulators' duties vary considerably, with inconsistency on aspects such as resilience and security of supply. Crucially, none of the regulators have a direct duty to consider the government's long-term policy commitment of achieving net zero. Given the increasingly complex long-term solutions that are required, the regulation of economic infrastructure needs to be more flexible.[38] Taking forward the government's planned consultation on economic regulation, announced in November 2021, would be a positive step.

Regulating to mandate decarbonisation requirements into tender procurement and contracts would drive a faster and more comprehensive move from the most economically advantageous tender to the most advantageous tender for broader environmental value.

Regulation has a role to play in reducing consumer demand for high-emissions activities and encouraging more sustainable choices, for instance through more net-zero-aligned price signalling and rewarding sustainable actions. It can also be used to penalise polluters who resist change. The Carbon Offset Fund imposed on developers in London by the Greater London Authority is a small-scale example of this kind of mechanism.

The concept of throttling, currently used to restrict broadband usage beyond a certain daily usage threshold in some deals, could be considered for energy use. More examination of the knock-on effects is needed, such as the impact on people who live in rented housing with low energy efficiency or who cannot afford the latest energy efficient technology. Nor should any pricing structure enable wealthier households to continue polluting. However, revenue could also be redirected into energy efficiency improvements for lower-income households.

About the ICE

Established in 1818 and with over 96,000 members worldwide, the Institution of Civil Engineers exists to deliver insights on infrastructure for societal benefit, using the professional engineering knowledge of our global membership.

For more information, please contact:

David Hawkes, Head of Policy, ICE: policy@ice.org.uk

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