NO emissions

Are we ready?

Delivering Net Zero in the built environment

Contents

Foreword by Hannah Vickers

In May 2019, the Committee on Climate Change (CCC) recommended that the UK should achieve Net Zero greenhouse gas emissions by 2050. A month later, this ambition was signed into law – making us one of the first major countries around the world to take such as step. While COVID-19 has inevitably diverted our attentions this year, there is no doubt that climate change remains the defining challenge of our times.

Society has already responded. Politicians have made bold claims on Net Zero with the Prime Minister stating it is central to his vision for a post-pandemic "green recovery". Building on large and growing public support, campaigners are urging us to go even further and faster. As highlighted in previous Association for Consultancy and Engineering (ACE) research, *Future of the Workplace*, businesses have responded too and are aware that in order to appeal to the emerging generation, they need to be a proactive force for good in the fight against climate change.

While Government has made the right noises and, in many respects, taken bold and positive steps, there is no denying that we have – as the report points out – focused on the "low hanging fruit" to date. Now comes the difficult and detailed work of embedding Net Zero across all aspects of our lives. Of course, this includes the built environment and infrastructure.

Are we ready? Delivering Net Zero in the built environment is, I believe, the first report of its kind to ask how our industry will meet this challenge. While our sector's problem-solving skills mean we are uniquely placed to imagine and develop innovative approaches, what are the project level or policy issues standing in our way? What precisely is the role for our consultancies? How does this impact on our relationships with clients?

I hope that this report helps to bring these conversations from the edges of our industry to its core. We will need to be confident in future discussions with colleagues, investors and partners. We will need to be educators too, articulating visions for a Net Zero future for every client we work with.

We owe it to humanity and future generations to the find the answers. It is clear to me that our industry has a central role to play in averting a global man-made climate catastrophe. This report is a great first step towards unlocking the innovation our industry will need if it is to play the central role that society expects of us.

Hannah Vickers,
Chief Executive, Association for Consultancy and Engineering.

Introduction by Sarah Prichard

When I was asked to chair a new joint Association for Consultancy and Engineering (ACE) and Environmental Industries Commission (EIC) Net Zero taskforce, I had no hesitation. It is an issue so fundamental to how we live, work and how Buro Happold does business, that it was an easy role to accept.

However, I did have a few initial concerns as to whether I was the right person for the position – I had no specific environmental background, I had not personally worked on many green projects, and I am a long way from what I might describe as being a sustainability expert. However, I quickly realised that all of that does not matter – the fact is that all business leaders, in and outside our industry, will have to face up to the Net Zero question in the years ahead.

Our taskforce *is* made up of experts from across the built environment and green technologies and services sectors. With the input of both ACE and EIC's membership bases, as well as key external stakeholders such as the University of Lancaster, we have created what I believe is an important milestone on our collective Net Zero journey.

Plenty has been written about the problem ahead of us, the consequences of inaction, and the scale of the solution required. What has been less forthcoming are the practical and tangible steps that take us beyond theoretical discussions.

Like many of you reading this, I am an engineer by profession and a natural born problem solver. While by no means providing a complete solution, *Are we ready? Delivering Net Zero in the built environment* is the first step for our industry in articulating what will be required, and the changes that need to happen at both a project and policy level.

The report also showcases some great examples of Net Zero principles already in action in projects across the country. In many ways it is encouraging to see that our members already have some of the answers.

It has also reinforced in my mind that – more than most other sectors – our industry's role will be critical if we are to win this battle. However, this will only happen if we all get involved – from large companies to SMEs via individuals – and make a pledge to lead by example and be the change.

The work of the taskforce has only just begun, but I'm delighted to share with you our first report, and a vitally important next step for the industry.

Dr Sarah Prichard,
Net Zero taskforce chair, ACE and EIC,
& UK Managing Director, Buro Happold.

Executive summary

The Climate Change Act gives us only three decades to eliminate carbon from our built environment. We know this is a huge task but, outside the energy sector, little progress has been made in recent years. Real action can no longer be delayed.

The *Government's 10 Point Plan for Net Zero*[1] starts to put some of the key building blocks in place. It is intended to target public sector investment on core Net Zero challenges, while drawing in private sector funding to transform our economy.

The impact of investment in our built environment is shaped by national policies and regulations, but also by the approach taken at a project level by designers, consultants, contractors and clients. To be ready to deliver a Net Zero built environment, we need both these elements – the national and the project-specific – to work in tandem.

Looking across the different built environment sectors, it is clear that this is not yet happening. Different obstacles appear in different sectors, but none are truly ready for what lies ahead. Some of this is due to cross-sectoral issues. Net Zero is a unique challenge that does not always sit well with existing policy approaches, while attempts to retrofit carbon control into existing policy tools such as Environmental Impact Assessments (EIAs) have not always been successful.

So what needs to change?

At national level we need a revised framework for assessing which projects should be prioritised as we transition to Net Zero. This framework needs to extend to the regional planning level, so that as we roll out regional approaches to decarbonised heat and transport networks, and integrate carbon capture and storage (CCS) industrial clusters, we can ensure that our built environment investments are compatible with this.

At programme level we need more clarity on what we are aiming for – for example, what Net Zero means at project level. We also need to make sure that new initiatives aimed at transforming the way the construction industry operates have Net Zero at their core. The role of the consultancy sector is central and it will need to mobilise its unique capabilities to help clients understand what Net Zero means, what it involves, and to design the projects that will enable a Net Zero built environment. This will involve developing new business services and upskilling employees.

1. The need for action

We have been talking about carbon reduction in the built environment for many years but, outside of energy generation, very little real progress has been made. This must change.

The task set by the Climate Change Act is clear. The UK has to end its contribution to climate change by 2050.

Infrastructure, in its widest sense – i.e. our built environment like homes, schools, offices, as well as our economic infrastructure networks such as energy, water, and transport – contributes a large part of our annual UK emissions through the operational energy which infrastructure assets themselves use, or those created by those who use them.

Emissions are also released in creating and transporting construction materials such as cement and steel widely used in the built environment.

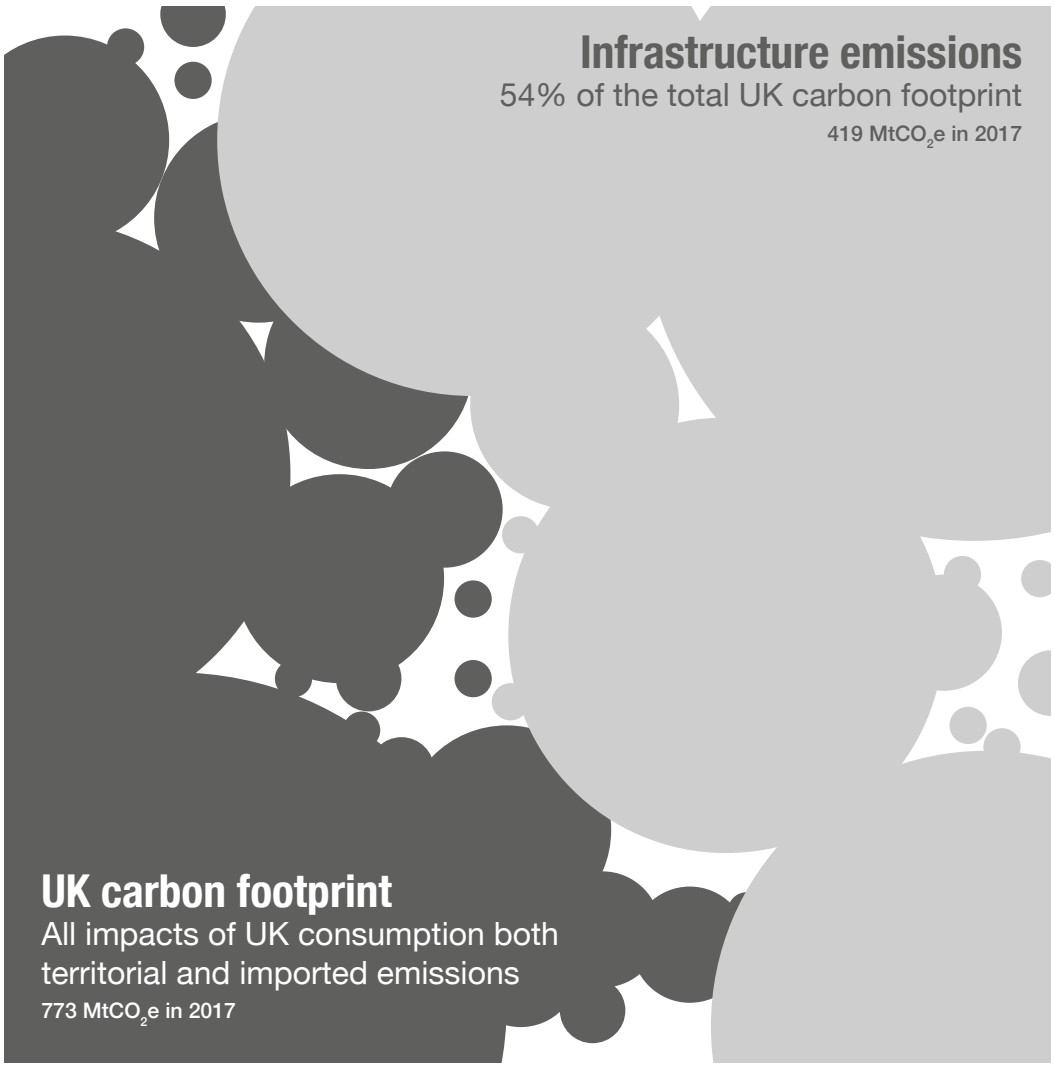


Figure one: Infrastructure emissions in 2017

ICE Carbon Project[2]

While total UK emissions have been falling and the UK has remained within its five year rolling carbon budgets, the bulk of this progress has been achieved through phasing out coal power and replacing it with increasingly affordable renewable generation. While a vital step, it is effectively the 'low hanging fruit' with most built environment sectors yet to reduce their direct emissions.

Figures two and three show that infrastructure emissions need to decrease more rapidly to stay on track for the 2050 target. In practice, one would expect that the rate of decrease over time is likely to fluctuate due to the 'lumpy' nature of infrastructure investment and timescales, but the charts below illustrate the overall scale of the challenge.

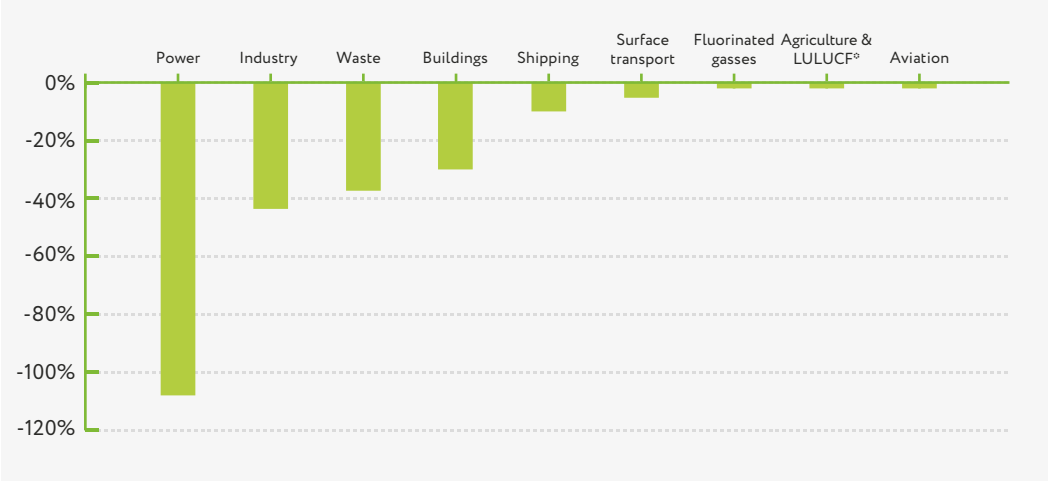


Figure two: Infrastructure emissions are not falling quickly enough

* LULUCF = Land Use, Land-Use Change and Forestry

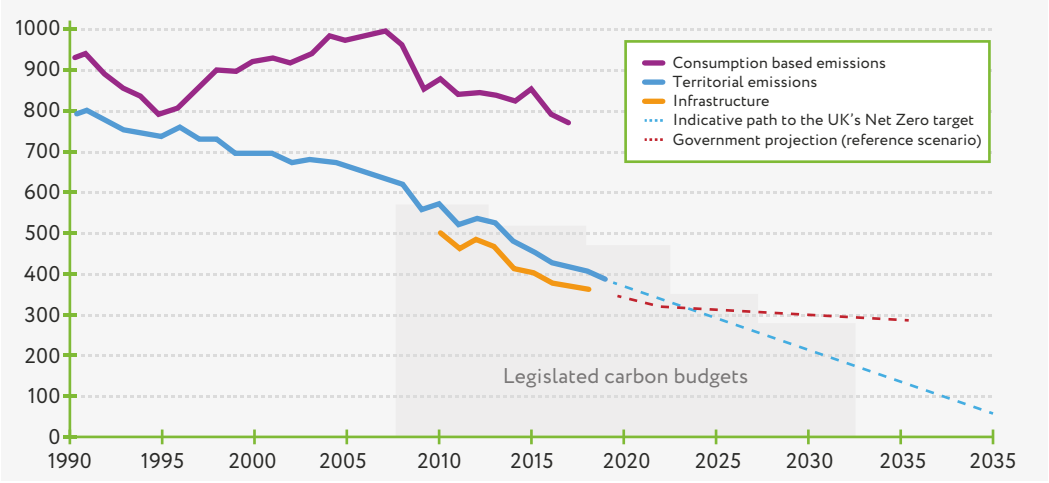


Figure three: Infrastructure emissions are not falling quickly enough

Source: ICE Carbon Project[3]

The publication last month of the Prime Minister's *10 Point Plan for Net Zero*[4], along with the UK hosting of COP26, bring a sense of momentum. We must use this to deliver the built environment our children need and deserve.

2. How ready are we?

The *10 Point Plan for Net Zero*[5] sets out some of the building blocks for the Net Zero transition and sends a strong signal to the market that the Government is serious and is willing to commit funding and develop policy to tackle the problem.

For the Plan to succeed, private and public investment needs to flow into built environment projects which genuinely contribute, little by little, to creating the functioning zero emission system we must have in place by 2050.

Furthermore, this must happen not just for new build projects or for flagship regeneration schemes, but for every refurbishment or repurposing of an ageing building or asset, however low its profile.

All built environment projects share common characteristics. They arise from the need to achieve an identified outcome. They involve different parties with different roles working together, such as designers, architects, contractors and the clients themselves. They must fit within the context of national and sectoral policy and regulation and are hugely influenced by the client's business model and approach.

The figure below shows a typical project context in illustrative form.

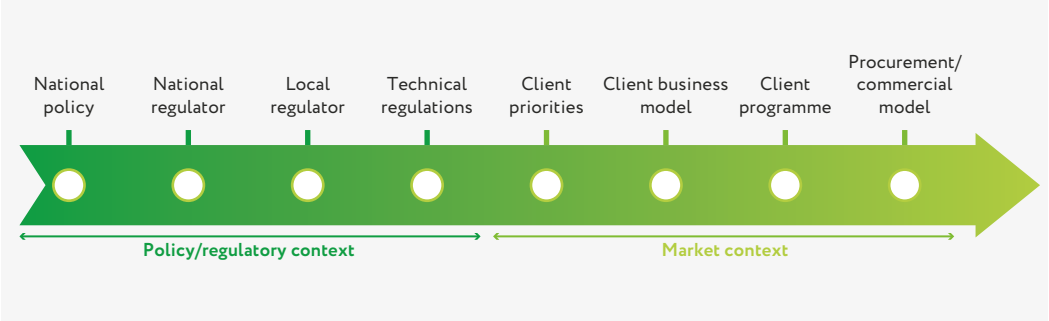


Figure four: Typical built environment project context

To achieve a Net Zero outcome, this project ecosystem needs to be 'Net Zero ready'. Problems or disconnects in any part of the chain can undermine this. The case study below shows for illustrative purposes, how this might occur in a rail sector project, although we recognise that through initiatives such as *Network Rail's 2020 Sustainability Strategy*[6], the rail sector is already taking steps to address this.

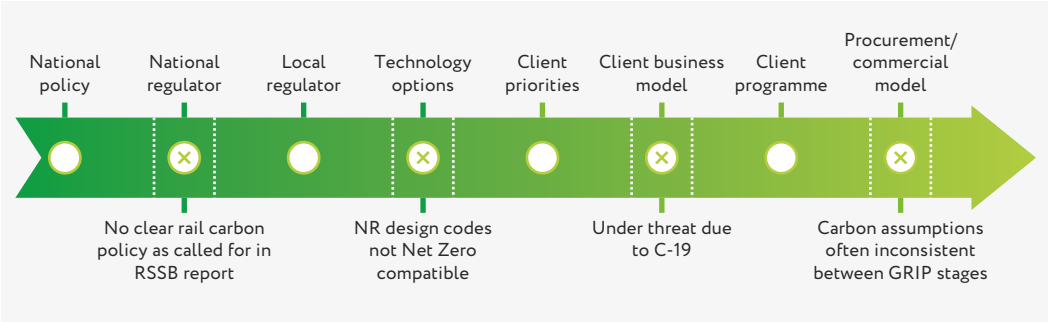


Figure five: Case study – rail sector project challenges

To assess the readiness of different built environment sectors, we identified a set of standard criteria. Each of these criteria relate to the Committee on Climate Change (CCC) pathways for the particular built environment sector, as outlined in figure six overleaf.

These criteria are as follows:

- Technical feasibility – Are technologies identified in the CCC pathways understood and seen as technically feasible to deploy in real world situations?
- Capacity to deliver – Does the relevant built environment sector – consultants, contractors and the supply chain – have the business and skills capacity to deliver the pathway?
- Regulatory ease – Do the current sector specific regulations (product, planning, etc..) facilitate the necessary investment and deployment against the pathway?
- Social acceptability – Is the public broadly supportive of the direction of travel?
- Private sector acceptability – Does the pathway align with the business models and outlook of the major private sector clients in this sector?
- Public sector acceptability – Does the pathway align with the outlook and processes of the main public sector clients?
- Procurement – Are clients likely to specify products and technology consistent with the pathway in their procurement?
- Investor appetite – Do investors believe they can earn a return by investing in projects consistent with the pathway?

Case study:

Intelligent building management in London

The Crown Estate's London portfolio includes some of the capital's most prestigious real estate on Regent Street and in St James. The Estate has a plan to significantly reduce carbon emissions and with **Arup's** help, it is using intelligent building management to make huge strides towards achieving this goal, realising significant energy savings in the process.

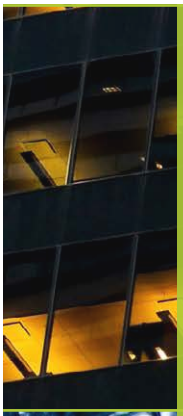
By gathering detailed data on heating and ventilation usage, the Estate has identified energy and financial savings, increased plant lifecycle and its maintenance programmes are more efficient.

This information is constantly analysed using software that Arup developed for this purpose, to show areas where internal environmental conditions are falling below expected levels.

Thanks to the information being collected and tracked in real time, Crown Estates receive daily updates. This means that they have the opportunity to move away from schedule-based maintenance to a performance-based approach. In other words, fixing what needs to be repaired when it requires attention, not after the fact.

Arup is now using the same digital skill set to help the Crown Estate assess and improve occupant satisfaction, internal air quality and water efficiency. These are driven by both environmental and commercial factors.

Intelligent building management has the potential to completely change the way buildings operations are run. It means problems are tracked earlier and can be dealt with quickly, and detailed intelligence enables those managing the asset to both improve energy efficiency and maintain property value.



Non-domestic buildings

- Phase out the installation of high-carbon fossil fuel heating by 2030.
- 25% reduction in demand for non-electric fuels due to energy efficiency by 2050.
- 46% of remaining heat demand met through low-carbon heat networks by 2050.
- Heat pumps for non-residential buildings in areas not suitable for heat networks.
- Electrification of catering and other non-heat uses of gas and oil.
- 21% reduction in electricity demand for non-heat uses due to energy efficiency.
- Gas, oil and conventional electric heating systems replaced by heat pumps by 2045 and biomass boilers are replaced by heat pumps by 2050.
- By 2050 heat networks no longer using natural gas to meet peak demand - larger heat pumps and large water stores or hydrogen from gas grid instead.

Water

- New build homes to be water efficient and have low-carbon water heating by 2025.
- Heat batteries to reach cost parity with hot water cylinders by 2030.
- Wastewater treatment companies to assess and implement operational measures to reduce GHGs from water treatment in the 2020s.
- Demonstrate and test in the early 2020s more advanced technologies to treat wastewater.
- Wastewater treatment plants to achieve a reduction in methane and N2O emissions of least 20% by 2050.

Airports

- 1.4% annual improvement in fuel efficiency delivered by more efficient engines and airframe design, limited deployment of hybrid-electric planes in the 2040s and improvements in operations and airspace management.
- 10% uptake of sustainable biofuels in 2020s.
- Demand constraint to limit aviation growth to 25% above 2018 levels.
- Sector must support GHG removals elsewhere in the economy to help balance out emissions at Net Zero.
- The sector and government must encourage progress in international agreements to reduce aviation emissions (e.g. through CORSIA).
- Need to ensure their ground operations are as close to zero-emission as possible by 2050 (e.g. through all-electric ground vehicles).
- Surface travel to/from airports must be compatible with broader Net Zero transport roadmaps.

Waste

- Separate waste collection should be introduced by 2023 and supporting measures to increase municipal recycling rates to 70% by 2025 (or 2030 at the latest).
- A 20% reduction in avoidable food waste by 2025.
- Increase recycling of municipal waste across 70% by 2025
- Ban biodegradable waste to landfill no later than 2025.
- Work towards zero avoidable waste by 2050.
- A 20% reduction in avoidable food waste by 2025 rising to 50% reduction by 2050.
- Further innovation in digital recording of waste movements along with incentivising public behaviour changes.

Figure six: Committee on Climate Change pathways - adapted

Source: CCC

Rail

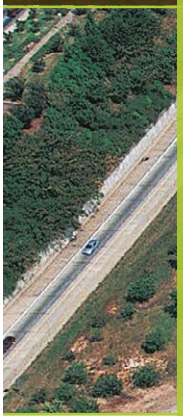
- Major rolling electrification programme in 2020s.
- At least 54% of rail track electrified by 2040 with key freight corridors electrified.
- Rail to support freight and mobility needs of other decarbonising sectors eg industrial clusters with Carbon Capture and Storage, reduced internal UK flights, and production and storage of hydrogen at scale.
- Emissions from stations must be zero by 2050.
- Traction emissions on the rail network must be virtually zero.

Ports

- Improvements to fuel efficiency and operations, for example, more efficient hull coatings.
- Transition to ammonia/hydrogen in shipping through the 2040s with such fuels produced in a zero carbon way, i.e. from zero-carbon electricity or with CCS.
- Development of supply chains for ammonia/hydrogen.
- Landside operations need to be decarbonised along with land travel to and from the port. Development of shore to ship electrical connections.
- There will still be shipping emissions in 2050 - sector must support GHG removals elsewhere in the economy to help balance out emissions at Net Zero.
- Sector and the UK government to encourage progress in international agreements to reduce shipping emissions, for example through IMO.
- Development of an international market in hydrogen shipped from countries with low costs of low-carbon hydrogen production.

Energy

- Decisions will be required from the mid-2020s on the balance between electrification and hydrogen in decarbonising heating, and the implications for gas networks.
- At least one CCS cluster should be operational by 2026, and the others following soon after.
- It is important that grid capacity constraints do not impede electric vehicles in the 2020s. It will therefore be important either to make anticipatory investments to upgrade electricity.
- Over the period to 2035, up to 35 GW onshore wind, 45 GW offshore wind and 54 GW solar PV could be needed to accommodate rapid uptake of electric vehicles and hybrid heat pumps.
- Given the large amount of CCS required by 2050, long lead-times for CO2 infrastructure (especially CO2 storage) and infrequent refurbishment rates in industry, developing regional 'cluster'-based infrastructure is critical. As well as enabling industrial CCS, it will also provide the opportunity for low- carbon hydrogen for industry, which we expect to be most cost-effectively produced with CCS.
- 29-96 of GW of onshore wind, 145-615 GW of solar power and 95-245 GW of offshore wind in the UK by 2050.
- The current wind fleet will need to be repowered by 2050, with the expectation that newer, larger turbines would replace them, at significantly lower cost.
- Up to 35 GW of nuclear capacity on existing nuclear sites in the UK by 2050.
- Power generation from BECCS to increase to 200 TWh by 2050.



Roads

- Increased modal shift to walking, cycling and public transport - assumes 10% of car miles will be shifted as a result by 2050.
- Government will need to make decisions how HGVs will be decarbonised in the second half of the 2020s.
- Significant infrastructure investment, for example public electric refuelling infrastructure for cars and vans, hydrogen refuelling stations, electric catenaries and extremely fast chargers for HGVs.
- By 2030, at least 1,200 rapid chargers and 27,000 chargers and biofuell to deliver around 11% of road fuel by energy.
- End the sale of petrol and diesel cars and vans by 2030.
- 40% of small HGVs are plug-in hybrids and battery electric vehicles by 2030.
- 25% of new bus and coach sales are electrified and 25% switch to hydrogen by 2030.
- Zero emission HGVs to reach nearly 100% of sales in 2040.
- Uptake of low emission buses and coaches must reach 80% of sales by 2050.

We then surveyed 135 sector experts across ACE and EIC member companies. These individuals are experts in each sector and work with private and public sector clients of all sizes on projects.

We asked them to rate the broad readiness of each sector to adopt the CCC pathway against the criteria outlined beforehand.

	Technical feasability	Capacity to deliver	Regulatory ease	Societal acceptability	Acceptablity to private sector	Acceptability to public sector	Client-relevant technology	Investor appetite
Roads	5	5	5	6	5	6	5	5
Buildings	7	6	6	7	6	7	6	6
Water	4	4	3	7	6	5	4	5
Rail	8	8	7	8	8	8	8	8
Ports	2	3	2	9	3	7	3	3
Airports	3	4	5	4	5	5	6	5
Energy	6	5	4	7	6	6	6	5
General	6	6	5	7	5	6	6	6
Waste	6	6	5	7	7	5	6	6
Others	6	8	6	7	7	8	8	8

Figure seven: Most infrastructure is not ready for a Net Zero pathway

Source: ACE/EIC member survey; 10 fully ready – 1 no prospect.

The results shown in figure seven are mixed. Few sectors were rated highly across all criteria. Appendix one gives more sector by sector analysis, but from the ratings and survey comments several themes emerged:

- Apart from one or two sectors such as ports and airports, the technology itself is not seen as an issue.
- Public views are broadly supportive.
- The most common challenges across sectors often included, client business models being incompatible with Net Zero pathways, and disconnects between different regulators.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3. What needs to change – national policy

The current policy framework for infrastructure is not well adapted to the Net Zero challenge.

It is based on an approach whereby choices between major built environment investments are made on the assumption that a range of desirable policy goals must be balanced against each other and against project costs. This does not automatically deliver a solution compatible with the absolute nature of Net Zero. There is also a frequent assumption that where a project with environmental impacts is approved, then those impacts can be mitigated and dealt with at a local level.

A further problem is where an attempt has been made to retrofit carbon control into a policy tool that was never designed for this. A good example is the introduction of carbon chapters within environmental impact assessments, see EIA case study on page 15.

	Current approach	Net Zero challenge
Strategic benefits/ impacts of project	Cost-weighed against mix of relative benefits – connectivity, regional economic impacts, trade flows, ROI, etc..) each analysed through multiple indicators.	Need in addition to judge projects against an absolute single metric and target date, but with complexity of control/influence.
Project appraisal	Whether in public or private sector, project appraisal methodologies often include some calculation of the carbon involved.	Methodologies rarely enable a judgment to be made about whether wider portfolios of projects are consistent with the 2050 target.
Local environmental impacts	Planning system and EIAs used to regulate local impacts against legally set limits (air quality, noise, etc..)	Greenhouse gas emissions have a global, not local, impact so no way to judge the 'significance' of a project's carbon emissions as clear EIAs are supposed to.
Project responses	Typically involve commitments to cut but not eliminate carbon impact – acceptable in context of UK's previous 80% reduction target.	Shift from 80% target to Net Zero means that a 'lower carbon project' may still lock-in carbon for 2050 so could risk either stranding the asset or undermining the national efforts to reach Net Zero.
National Policy Statements	Intended to simplify and provide certainty in strategic planning by setting out Government policy framework for that sector.	All NPS's pre-date the Net Zero target and do not provide a framework for aligning infrastructure planning decisions with Net Zero.

Figure eight: Examples of policy challenges

The *10 Point Plan*[7] gives a clearer sense of overall policy direction, and the CCC's Sixth Carbon Budget advice builds on this. However, we still need a policy framework that translates the high level trajectory into a context for individual projects. Figure nine shows how this might work in practice.

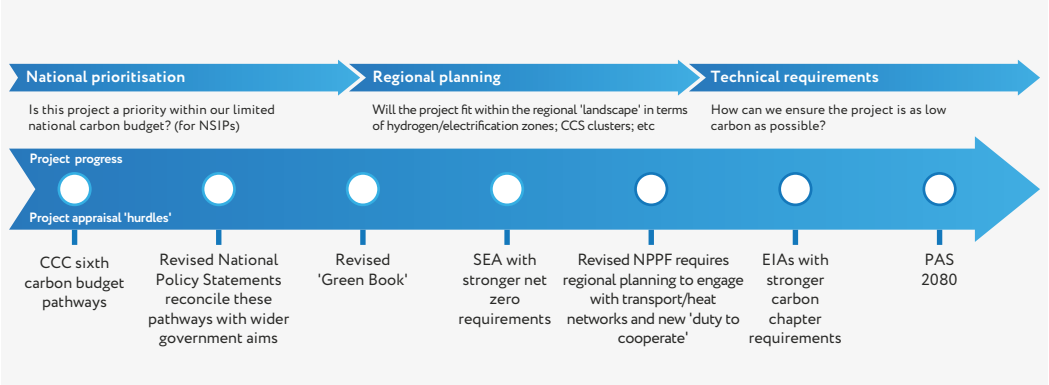


Figure nine: Key elements of a Net Zero built environment policy framework

Case study:

EIA carbon chapters

To understand how these challenges impact individual projects we commissioned Lancaster University to explore the effectiveness of one of the key pieces of regulation intended to manage infrastructure carbon emissions. These are the carbon chapters which since 2017 have been legally required to be included in Environmental Impact Assessment (EIA) reports.

IEMA has produced guidelines[8] which set out a logical process for using the EIA to both quantify/assess the carbon impact and to mitigate it. While the guidelines are not perfect they do provide a basic assurance that the EIA process is having some impact on carbon.

Lancaster University analysed the carbon chapters of a sample of recent infrastructure projects and assessed how effectively they had followed the IEMA guidelines.

The results in the figure below showed that EIA carbon chapters are of variable quality, often with inconsistent approaches to measurement and sometimes failing to lead to mitigation.

Researchers at Lancaster University interviewed EIA carbon experts in consultancies to understand how and why the system is not working effectively.

It is clear that the EIA process which is designed for more locally specific environmental and environmental impacts, is simply not effective for aligning infrastructure projects with Net Zero.

Sector	Baseline settings	Proporti-onally	Goal and scope definition	Study boundary definition	Calculation data	Calculation method	Uncert-ainties	Significance	Mitigation	Reporting	Monitoring
Transport (Road) 1	A	B	C	A	A	A	A	B	A	B	B
Transport (Road) 2	A	A	B	A	A	A	C	B	B	B	C
Transport (Road) 3	A	B	B	A	A	A	C	B	A	B	B
Transport (Air)	A	A	B	B	B	B	A	C	B	B	B
Energy/ Transport (Air)	C	B	B	C	C	C	D	B	D	C	D
Energy	C	B	B	C	A	A	A	D	D	C	D
Energy/ Waste	A	A	A	B	B	B	A	D	C	B	D

Figure 10: GHG assessment scoring against criteria derived from IEMA guidance

Source: Lancaster University

> *That's one of the things I've ben seeing in terms of how people report on carbon emissions – its not consistent.*

> *The impact assessment process, especially around EIA is quite late on in the planning system.*

> *A lot of carbon specialists had never had reason to do EIA and a lot of EIA practitioners had never had reason to think about carbon.*

> *The ambiguity in the guidelines creates conflicts for consultants when their professional judgement is challenged by a client on the grounds of cost. There are varying degrees of ability to align professional integrity over client requirements for speed and cost.*

> *I think most practitioners in climate change are probably members of IEMA which is a broad institution for environmental assessment, it's not specific to climate change so they have less focus on that and they produce less guidance.*

Figure 11: Comments from EIA interviews

Source: Lancaster University

4. What needs to change - project level

Clarifying what we are aiming for

What does Net Zero mean at a project level? The legal target itself is for the territorial UK, not for any individual project. A further complication is in the interdependencies between different built environment sectors – for example, the power source of electricity used in a building – and between asset owners and operators and the users of those assets.

Because of this, the welcome desire by many clients to make their project Net Zero can obscure more than it illuminates. For example, a Net Zero project could be seen as one where capital carbon is reduced and the remainder offset; or where capital and operational carbon reduced and remainder offset. Furthermore, what about user carbon? Should that be ignored or must it be reduced or eliminated?

Valuable initiatives such as the UKGBC frameworks[9] and the PAS2080 standard[10] are starting to bring a standardised approach particularly for new build projects, but current market approaches are varied.

In practice, those shaping infrastructure projects and investments often have most influence over the carbon embedded in the asset itself, and in the carbon used in its physical construction. Inevitably this has led to a strong focus for responding to Net Zero within the construction and built environment sector being through pledges to reduce embedded carbon.

A lot of real progress has been made here and there are some great examples of best practice, especially for new build, such as the target set for reducing embodied carbon by HS2. (see case study on page 18).

Reducing capital and construction carbon in projects that take place over the next 30 years is clearly important. It will help the UK keep to its five yearly carbon budgets over that period, and will also increase demand for low carbon building materials.

However, reducing embedded carbon by itself will not create a functioning Net Zero infrastructure system in 2050. By then, it will be the ongoing operational and user carbon emissions from the infrastructure assets that will be crucial as building materials used from 2050 onwards will be produced in a zero carbon way – for example cement and steel works with carbon capture and storage.

A reliance on calculating whole life carbon does not fully address this either, as it equates carbon emitted now, when there is still headroom in the UK's rolling carbon budget, with carbon emissions beyond 2050, when the asset has to be producing no emissions at all. Figure 12 proposes an approach that projects should take as standard.

	Projects in 2020s…	…must deliver for 2050
Capital Embedded carbon	Minimise and offset *	No offsetting allowed – capital inputs should be manufactured with zero emissions.
Construction carbon	Minimise and offset *	Zero emission construction machinery and vehicles.
Operational in use carbon	Design and assurance now should prioritise minimising this over time **	Must be absolute zero (no offsetting) or asset will be stranded.
Asset users carbon ('usecarb')	Asset must be future proofed to facilitate relevant Sixth Carbon Budget pathways (for example, EVs, hydrogen boilers)	Asset must only be available to zero emission users (with exception of aviation) or will be stranded.

Figure 12: Built environment and Net Zero – 2020 vs 2050

* Consultants must ensure that client offsetting is genuinely a last resort and to establish high quality control standards
** Depending on proportions, there is a case for minimising 'op-carb' at the expense of higher embedded emissions if necessary.

Making the Construction Sector Deal work for Net Zero

The Construction Sector Deal[11] has led to an ambitious, Government-backed attempt to address the longstanding challenges within construction such as fragmentation, adversarial working relationships, and a focus on lowest cost. This agenda has been reinforced by the Government's current desire to "build back better" through planning reform[12] and the implementation of 'Project Speed'[13].

The Deal itself refers to improving the energy performance of new buildings as one of its objectives, and the cluster of initiatives stemming from it presents a huge opportunity to embed Net Zero approaches and thinking in ways that have not been possible before.

However, the pace of change, and the economic imperatives behind it, also create risks for Net Zero. Figure 13 below summarises what needs to be done to seize the opportunity.

The Construction Leadership Council (CLC) is at the heart of reforming the construction agenda and should prioritise making Net Zero a core element across the various initiatives – as a prominent CLC member, ACE will play its part in this.

Initiative	Opportunity	Risk	Recommendation
Construction Innovation Hub Value Toolkit - Value Definition[14]	Widely used to ensure carbon aims at project level explicitly understood.	Multiplicity of value options/indicators dilutes absolute nature of Net Zero obligations.	Minimum weighting for opcarb/ usecarb + Track % of uses of toolkit that prioritise carbon.
Construction Innovation Hub Value Toolkit - Client & Market Approach[15]	Widely used and highlights impact of delivery and commercial model on carbon strategy.	Carbon implications not highlighted.	Consultants use Client & market Approach Framework to ensure clients understand carbon implications of choices at key decision points.
Construction Playbook	Resets govt procurement approach to carbon.	Little focus on the Net Zero content in Playbook rollout sends wrong message.	Playbook must ensure public sector clients focus on net zero solutions.
Modern methods of Construction (MMC)	Wide take up of MMC lowers capcarb/concarb and performance gap.	Bias towards modular volumetric and poor quality OSM leads to weak carbon benefit.	Presumption in favour of MMC + strong monitoring on usecarb especially.

Figure 13: Recommendations for the Construction Sector Deal

Case study:

HS2's Curzon Street station in Birmingham

Curzon Street Station in central Birmingham has been designed to be Net Zero in operation, using a range of technologies to generate energy from renewable sources. Among other approaches, this landmark project achieves a sustainable and efficient design, and is an exemplar in the UK for low carbon development that can be applied to future publicly and privately funded projects.

The challenge:

HS2 has committed to building the most sustainable high-speed railway in the world. To deliver on this commitment, HS2 has set a contractual requirement for achieving operational net zero (regulated load) on all new stations in the phase one programme.

The need to reduce lifetime (120 year) carbon emissions by 50% is also mandated, to be proven through detailed modelling and analysis.

These two requirements were included to support the Government's commitment to deliver Net Zero by 2050.

The solution:

From the outset, **WSP in the UK's** energy, LCA and carbon teams were central to the delivery process – specifying, guiding and constructively challenging the design. Low carbon approaches were also made the responsibility of all architectural, design and deliver partners, not just those responsible for responding to HS2's carbon technical standards.

Engaging, supporting and constructively, and consistently, challenging the design over a two year period demonstrated the intricate level of care and consideration needed to achieve a range of outcomes for carbon, as well as themes – among others – community, climate, biodiversity, materials and waste.

A good example of this level of integration was the use of a 'future ready' workshop to kickstart the RIBA2 design, with the 40 delivery partners collaborating to consider what might be possible on the scheme across technological, community, resources and climate themes. The breadth of expertise at the workshop generated some 150 future ready ideas, many of which have proved fundamental in the success of the design, such as engineering flexibility into the station for a future connection to the Birmingham District Energy Scheme.

For carbon, bespoke design workshops and ongoing engagement identified over forty opportunities for carbon reduction, which were approved and integrated within the Scheme Cost Plan. For example, pre-fabricated timber soffit units that are 27 times more carbon efficient than aluminium comparators will be installed in the main station roof, and paving in the public realm has been reduced in depth by 38% to reduce embodied carbon.

Further carbon efficiencies were brought out through the application of circular design principles .g. the building has been designed for future flexibility and deconstruction. For example, the main concourse has a high single span roof at over 300m in length that does not require internal support through vertical columns. Therefore, the space beneath is available to be adapted for a myriad of future use, without significant re-work. Furthermore, 100% recycled content steel roof sections comprise only seven variations and will be bolted together, rather than welded. A 'Design for Deconstruction' report was also produced to capture the intended approach to adapting and dismantling a wide variety of different elements of the station.

In combination, all low carbon opportunities approved for the station's lifetime will reduce emissions by over 87,000tCO2e, and hence meet the 50% reduction target set.

To further support these measures, a dedicated area of habitat will be planted on the Curzon Street site through the creation of 0.4ha of native woodland trees, incorporating a woodland glade that will also have a function for carbon sequestration.

The station will also be Net Zero for those assets that can be regulated, such as heating, cooling, and lighting, through the use of PVs – 2,855m^2 solar panels will be located on the platform canopies - ground source heat pumps and LED lighting. The design also worked hard to minimise the number of car parking spaces on site, and ensure that 100% of the allocated spaces are future-proofed through service ducting to accommodate expected electric vehicle charging points.

Actions taken on the scheme have been further validated through the pursuit of the BREEAM excellent rating, and WSP in the UK continues to work with HS2 to push the scheme to an outstanding rating.

HS2's Curzon Street station in Birmingham - p.18

5. The role of the consultancy sector

The UK has a world class consultancy sector which is uniquely placed to address many of the challenges outlined in this report. The sector has evolved in recent years and has the capabilities to support the design and delivery of the Net Zero systems we need.

- Range of involvement – Consultancies are involved in the vast majority of infrastructure projects, large and small. Often a consultancy will help shape the 'optioneering' that decides what gets built, and then it or another consultancy will be involved at the detailed design stage.
- Blend of skills/knowledge and values – Bring together policy knowledge and practical engineering skills and professional standards/ethics. Large firms also have multi-disciplinary teams.
- Systems perspective – Able to see connections and system interdependencies between them. This is expertise is vital as we move beyond decarbonising the power sector to the much more complex challenges of creating Net Zero heat and transport systems at community and regional levels.
- Data-led asset management – Expertise in optimising the performance of assets in use on basis of, often real time, data flows.
- Digital design and project integration – Use of BIM and related software to enable digital designs to be created and used to ensure early integration of different parts of a project.
- Global perspective – Large firms have global expertise and reach and can access best practice and innovation from across the world.

In addition, consultants are seen as trusted advisers by both public and private sector clients. The sector must make use of this position, and mobilise its resources and expertise if we are to have a realistic chance of delivering Net Zero by 2050.

However, the traditional consultancy model is often based on selling 'hours' to deliver specified inputs to a project, and is not conducive to unlocking the sector's full potential.

ACE's *Future of Consultancy* campaign[16] has been exploring how the sector can develop new ways of working and offer clients new services. Figure 14 below shows how many of these will have significant Net Zero applications.

Business service	Description	Example Net Zero applications
Asset systems optimisation	Streamline disparate asset management information to create one single useable asset info system.	Reduce energy use across asset systems.
Value based master planning/strategic planning	Mix of value modes driving value led design (not just cost /quality parameters). Transparent, objective consideration of what should be built as well as how that should be built.	Support for local authorities delivering climate emergency-driven planning.
Intelligent asset management (buildings)	Retrofitting building stock with sensors to track in real time a building's performance.	Address building 'performance gap' issues.
Design mastermind	Strategic controlling mind for design, integration and oversight of all detailed design packages. Ensures design stays true to programme outcomes.	Avoids risk of carbon aims for project getting lost through multiple sequential project stakeholders.
Business case model	Join the dots between the early (and parallel)activities of design and business case evolution by building a digital model to hold all of the business case data. Ensure smart iterative development through modelling of options.	Can be applied to carbon to ensure lowest possible whole life carbon is achieved.
Digital twin creation	Capturing and presenting all of the detailed design and as built data into a digital asset for the client to use alongside the physical asset	Can be used to monitor and reduce operational and user carbon.

Figure 14: Examples of new consultancy business services that can accelerate Net Zero projects

Source: ACE's Future of Consultancy

Case study:

Net Zero strategy for Bristol

Bristol City Council has made a clear political commitment to Net Zero by 2030. **Ricardo** worked with partners Centre for Sustainable Energy and Eunomia to develop the evidence base to achieve this, assessing the level of technical ambition required, as well as the investment needed.

Analysis focused on cutting to near zero the carbon emissions associated with the city's use of fossil fuels such as gas, petrol/gasoline and diesel, the electricity it consumes and the waste it produces.

Drawing on this analysis, the strategy outlined key interventions to help the city achieve Net Zero by 2030. These include fostering shared purpose and enabling active participation, securing powers and capacity, implementing the technology required to achieve Net Zero, as well as sector-specific initiatives.

Ricardo focused on achieving carbon neutrality in transport with specific recommendations in this area. These included the major investments to encourage modal shift, such as the development of public transport and active travel infrastructure to secure a rapid reduction in vehicle miles, reclaiming road space from private vehicles, encouraging freight consolidation, and discouraging car journeys in and around the city.

In terms of electrification, a controlled approach to EV charging infrastructure roll-out was recommended, with a sustained push for EV car clubs and mobility as a service. A key enabler for this was identified as the implementation of an electricity distribution network upgrade programme, including smarter operation, to accelerate the achievement of a *Network for Net Zero*.

Case study:

Moata Carbon Portal

Moata Carbon Portal by **Mott MacDonald** allows detailed embodied carbon accounting and planning at all stages of the project and is globally compliant with PAS2080 certification.

The portal delivers rapid calculations and insight that highlight major opportunities for innovation, efficiency and competitive advantage for clients, and aligns these with their end-goal of reducing their carbon emissions.

This technology helps Mott MacDonald's clients from all industries with carbon mitigation and physical adaptation – on current and future projects.

The portal measures the carbon footprint of BIM designed assets while offering real-time carbon, cost and saving calculations. As well as being compatible with systems around the world it has a rich data library from which it can make assumptions.

As well as design savings, it provides up to 90% project-time saving, a subsequent reduction in carbon vs. manual methods, and can provide 30 carbon assessments in 30 seconds.

In practice it has helped reduce the carbon impact of a number of high-profile projects:

- 8,740 tCO2e on the A303 Sparkford to Ilchester dual carriageway scheme
- 16% carbon reduction at RIBA 3 project stage and £450,000 saving on disposal costs for the Transport for London Northern Line Extension,
- 651tCO2e saved, a 30% reduction, for Colwyn Bay Waterfront Enhancement Scheme
- An extraordinary 99.9% reduction, equivalent to 700tCO2e, carbon reduction for a Yorkshire Water project. Rigorous attention to carbon led to an alternative solution that did not involve building the new asset at all.

Conclusions and recommendations

After twenty years of gradually increasing focus on climate change, the issue is finally receiving the urgency it demands, from both Government and the wider business community.

However, the challenge of Net Zero is its absolute nature – it requires every part of the economy to make enormous changes, and these changes must not just be about reducing emissions, they must in most cases be about their complete elimination.

For this reason, better national level policy is not sufficient, we need a new holistic approach to all levels of policy and all types of built environment projects.

Recommendations for Government:

On nationally significant infrastructure projects:

- Create a Super-National Policy Statement to reconcile Net Zero and other Government expectations across all economic infrastructure. This must draw on and interpret the CCC pathways to be announced in the Sixth Carbon Budget (or alternative pathways if evidence-backed), and set out clearly how they will be reconciled with other Government priorities.

- Update all individual National Policy Statements (NPS). These all pre-date the Net Zero target.

- Reform Strategic Environmental Assessment regulations. Require Net Zero compatibility/ optimisation.

On local planning:

- Reform EIAs carbon chapters. Avoid 'scoping out' carbon and require carbon mitigation, not just measurement.

- Revise the NPPF[17] and require Local Plans to make a Net Zero strategy a planning condition for new developments. This could cover how the development is future-proofed for zero carbon heat options, for example.

Recommendations for the Construction Leadership Council (CLC)

As part of its Net Zero workstreams, promote the role of the Construction Innovation Hub Value Toolkit in enabling the prioritisation of Net Zero in projects and track the proportion of Toolkit uses that do this.

Recommendations for consultants

Taking a stand.

- Sign up to Pledge to Net Zero[20] and Engineers Declare[21]

Upskill for Net Zero.

- Ensure carbon literacy throughout the organisation so that all disciplines, whether structural or design engineering teams, are able to discuss Net Zero priorities with clients and embed them into wider design and engineering work on projects.

Codify best practice.

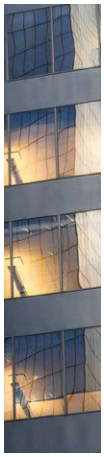
- Support IEMA to update EIA carbon chapter guidelines[22]
- Promote and use PAS 2080[23]

Help clients do the right thing.

- Commit to offering clients a Net Zero compatible design as an option, even if not prioritised by client in the value profile.
- Help clients with land and asset portfolios optimise land use for climate/natural capital.
- Help clients understand difference between Net Zero commitments now and what must be prioritised in run up to 2050.

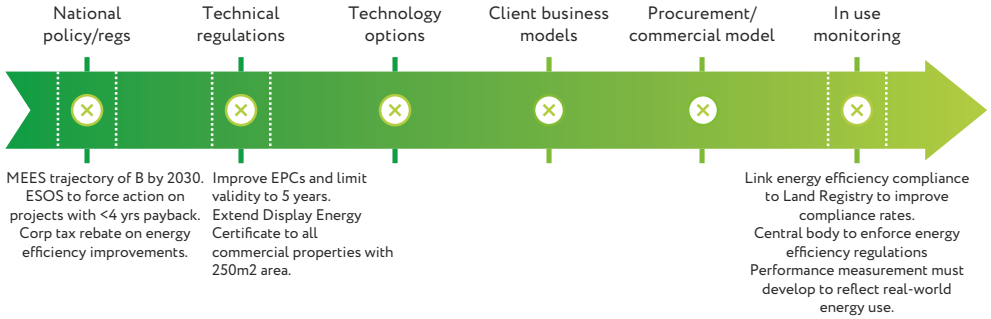
Appendix one:

Example technical recommendations by sector (drawn from ACE/EIC member survey of sector experts)

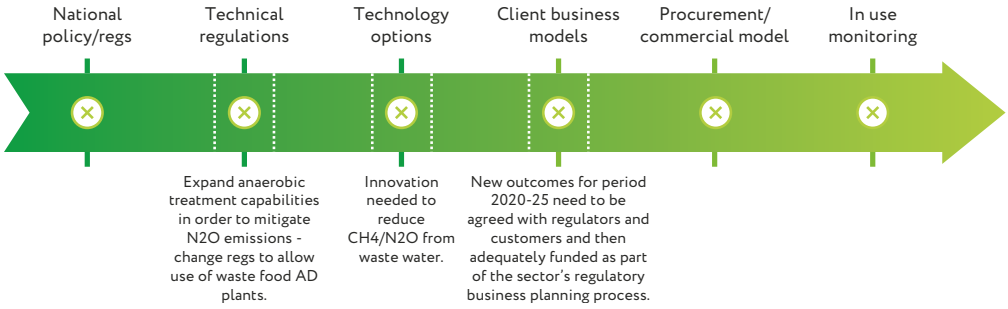


Non domestic buildings

Economic opportunity:
Labour intensive insulation refurbishments

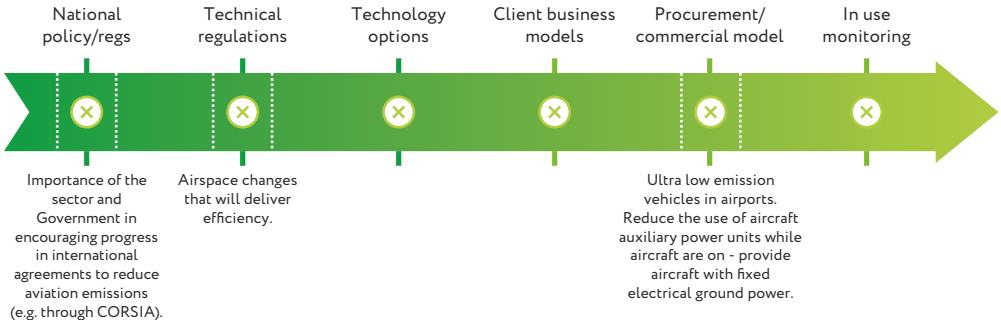


Water



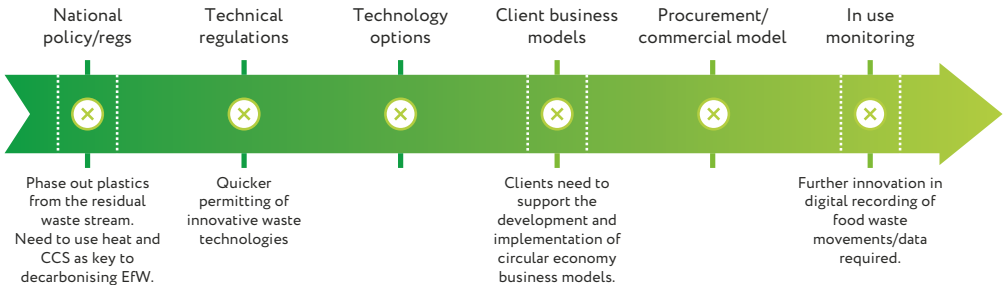
Airports

Economic opportunity:
Make the UK world leader in sustainable aviation fuel.

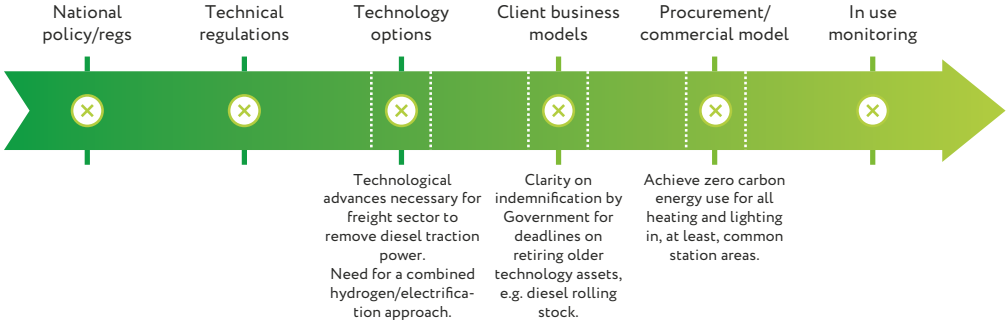


Waste

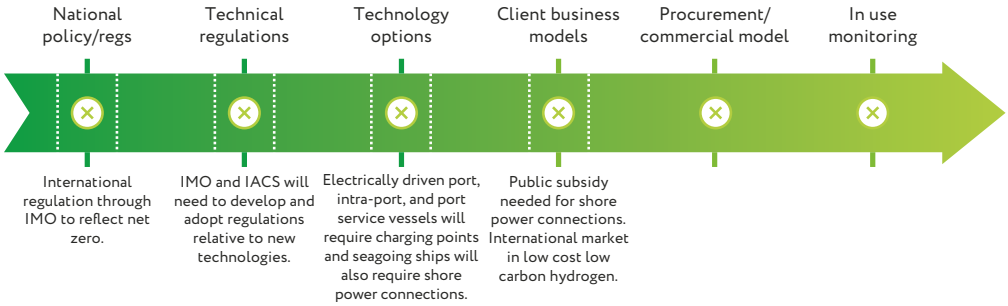
Economic opportunity:
Labour intensive reuse / repair facilities.



Rail

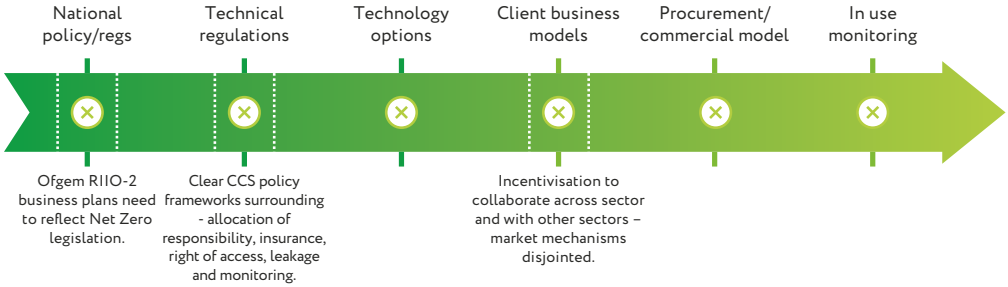


Ports

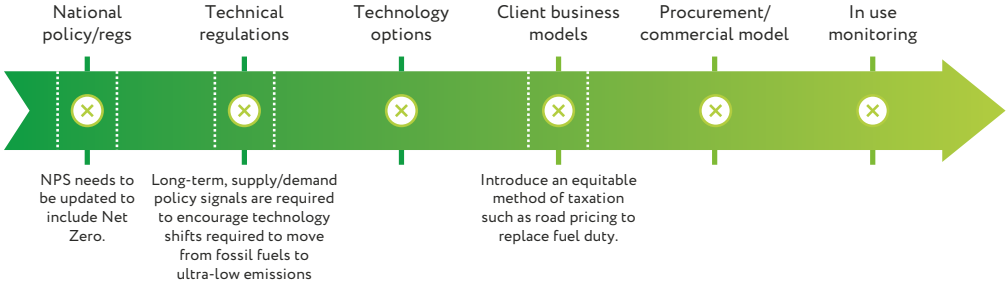


Energy

Economic opportunity:
Make UK world leaders in renewable marine energy



Roads



Appendix two:

ACE/EIC Net Zero taskforce

How society responds to the Net Zero challenge is the biggest question of our time.

The joint campaign is delivered as a partnership between the **Association for Consultancy and Engineering (ACE)** and sister organisation the **Environmental Industries Commission (EIC).**

Chaired by **Sarah Prichard, (Buro Happold)** the Net Zero taskforce brings ACE and EIC members together to outline a carbon free future.

Find out more: www.acenet.co.uk/campaigns/net-zero/

Name	Company	Job title
Andy Barker	AECOM	Managing Director Environment & Ground Engineering
Piers Burroughs	Burroughs	Managing Director
Tim Chapman	Arup	Director of Infrastructure
Lynsey Clarke	Jacobs	Global Technology Lead: Sustainability & Climate Action
Natalie Cropp	Tony Gee	Sustainability Director
Tim Danson	WSP	Associate, Sustainability
Alex Ferguson	Delta Simons	Managing Director
Alban Forster	SLR Consulting	Director
Sam Friggens	Mott MacDonald	Global Practice Lead – Climate Change
Neil Humphrey	Waterman Group	Chief Operating Officer
Matthew Hunt	RHDHV	Director, Environment
David Lindsey	Max Fordham	Senior Partner
David Macleod	Rybka	Managing Director
Bram Miller	Ramboll	Director
Sarah Prichard	Buro Happold	UK Managing Director (Chair)
Ross Ramsay	Mott MacDonald	Senior Consultant
Jonathan Riggall	Stantec	Director
Michael Rudd	Bird & Bird	Partner
Anusha Shah	Arcadis	Director
Sunil Shah	Acclaro Advisory	Director
Juan Troyano	FCC Environment	Head of Technical, Engineering and Construction
Adarsh Varma	Buro Happold	Associate Director

Appendix three:

Glossary and definitions

Net Zero Compatible with the legal target set out in the Climate Change Act, so that total territorial greenhouse gas emissions in 2050 are equal to, or less than, greenhouse gas removals from the atmosphere within territorial UK (therefore excluding any international carbon offsetting).

'Capital carbon', 'capcarb' or 'embedded carbon' Emissions associated with the creation of an asset.

'Operational carbon' or 'opcarb' Emissions associated with the operation and maintenance of an asset. It is analogous to operational cost and is quantified in tCO2e/year.

'Whole-life carbon' Combines both capital and operational carbon and is analogous to whole life cost.

'User carbon' or 'usecarb' Emissions from the end-users of infrastructure assets.

'Built environment' Man-made structures, features, and facilities viewed collectively as an environment in which people live and work.

BREEAM Building Research Establishment Environmental Assessment Method
CAA Civil Aviation Authority
CCC Committee on Climate Change
CCS Carbon Capture and Storage
CORSIA Carbon Offsetting and Reduction Scheme for International Aviation
EIA Environmental Impact Assessment
ESOS Energy Savings Opportunity Scheme
EPC Energy Performance Certificate
EfW Energy from Waste
GRIP Governance for Railway Investment Projects
IEMA Institute of Environmental Management in Assessment
IMO International Maritime Organisation
ISO International Standards Organisation
LEED Leadership in Energy and Environmental Design
NERL National Air Traffic Services En-Route Limited
NPS National Policy Statement
NPPF National Policy Planning Framework
PAS Publicly Available Standard
RSSB Rail Safety and Standard Board
SEA Strategic Environmental Assessment

Appendix four:

Endnotes, list of figures and case studies

Endnotes:

1 https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution/title
2 ICE Carbon Project "https://www.ice.org.uk/eventarchive/2020-unwin-lecture-zero-carbon-webinar" 2020 update against Infrastructure Carbon Review prepared by Dr Jannik Giesekam
3 Ibid
4 https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution/title
5 Ibid
6 https://www.networkrail.co.uk/wp-content/uploads/2020/09/NR-Environmental-Strategy-FINAL-web.pdf
7 https://www.gov.uk/government/publications/the-ten-point-plan-for-a-green-industrial-revolution/title
8 IEMA EIA Carbon Chapter guidelines, https://www.iema.net/
9 https://www.ukgbc.org/ukgbc-work/unlocking-the-delivery-of-net-zero-carbon-buildings/
10 https://shop.bsigroup.com/ProductDetail?pid=000000000030323493
11 https://www.gov.uk/government/publications/construction-sector-deal
12 https://www.gov.uk/government/consultations/planning-for-the-future
13 https://www.gov.uk/government/speeches/pm-economy-speech-30-june-2020
14 https://constructioninnovationhub.org.uk/wp-content/uploads/2020/07/20200715_BR_09_ValueFrameworkReport_Digital_Pages.pdf
15 Ibid
16 https://www.acenet.co.uk/campaigns/future-of-consultancy/
17 https://www.gov.uk/government/consultations/planning-for-the-future
18 https://constructioninnovationhub.org.uk/wp-content/uploads/2020/07/20200715_BR_09_ValueFrameworkReport_Digital_Pages.pdf
19 Ibid
20 https://www.pledgetonetzero.org/
21 https://www.engineersdeclare.com/
22 IEMA EIA Carbon Chapter guidelines, https://www.iema.net/
23 https://shop.bsigroup.com/ProductDetail?pid=000000000030323493

Case studies:

Figures:

NO emissions

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