The **Green Construction Board**

# Good progress but not fast enough

The Infrastructure Carbon Review was published in November 2013 with the call to action ‘cut carbon, save cost’. Seven years on, and with the UK government committed to achieving net-zero emissions by 2050, this stocktake assesses progress to date on decarbonising infrastructure.

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# Context: Seven years of progress

November 2020 marked the seventh anniversary of the Infrastructure Carbon Review (ICR), a watershed document that set out actions for government, clients and suppliers to reduce carbon from the construction and operation of infrastructure.

In 2013, a core group of clients, consultants and contractors made an enthusiastic commitment to reduce the carbon footprint of infrastructure and have been engaged ever since in carbon reduction activities. Carbon reduction progress has been made and must be celebrated, as we continue building up momentum for others to join in the effort.

The international and national political landscape has changed dramatically since 2013, a notable marker being the United Nations Paris Agreement on climate change in 2015. After ratifying this, in 2020 the UK became the first country to introduce a legally binding agreement to achieve net-zero carbon by 2050 – a significant increase in ambition from the Climate Change Act 2008.

With heightened public awareness of the climate emergency and the dire consequences of inaction, high-profile infrastructure projects are being legally challenged on the grounds of climate change impact and capital programmes risk disruption until a clear plan to decarbonisation is in place.

The UK government's Industrial Strategy and its clean growth challenge are creating the environment for decarbonisation in construction, but sector-specific, co-ordinated efforts are not in place to respond to it.

The ICR highlighted that UK Infrastructure is responsible for more than half of the national carbon footprint. UK Infrastructure can play a pivotal role in accelerating decarbonisation towards the net-zero aspirations.

The urgency for decarbonisation has moved on since the ICR was launched and has put more pressure on the infrastructure value chain. The case studies in this paper are a good start; the insight and lessons learned from them are invaluable for upping our game.

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# Context: Cut carbon, cut cost

The ICR delivered a clear, simple message: that cutting carbon is achievable, and there is a commercial upside to doing so. In short, cutting carbon reduces cost.

Since the inception of the ICR more than 70 organisations have made carbon reduction commitments. Innovations have been brought to market and are being scaled. An specification for managing infrastructure carbon, PAS 2080:2016, has been created, providing the know-how for any organisation in the industry to realise the benefits. We now have project examples that show how far those carbon and cost benefits can be driven.

The case studies in this report were identified through consultation across the infrastructure value chain. They are organised under headings that reflect the key enablers of carbon reduction outlined in the ICR as well as policy and planning and other recent international good practice:

1. Leadership and governance
2. Collaboration and culture
3. Baseline and metrics
4. Commercial solutions
5. Innovation and standards
6. Beyond the UK
7. Policy and planning

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The case studies show that our industry has made progress since 2013, particularly in the water, environment and energy sectors, but also highlight the scale of the challenge ahead and the need for urgent acceleration and much greater ambition if a net-zero carbon UK is to be achieved by 2050.

They show practical solutions that the infrastructure value chain can implement from lessons learned in a number of projects, but also reveal differences in 'carbon maturity' across infrastructure sectors, with the water sector providing numerous success stories and the transport sector many fewer.

Since the ICR was published we have seen:

### Raising ambitions

Organisations raising their ambitions and setting net-zero carbon targets, many of which have been informed by science. Water is the first sector working to become net-zero by 2030.

### Collaboration

Tier 1 contractors and consultants working more collaboratively with the wider value chain and delivering low-carbon, low-cost innovations for asset owners.

### Culture change

The principles of PAS 2080 being more frequently considered in promoting a culture of challenge and collaboration, although the level of verification remains relatively low Carbon training being more widely adopted across the infrastructure value chain.

### Quanitifcation and assessment

New carbon quantification and assessment tools being developed and more widely used during option appraisal. However, lower carbon solutions are still focusing on capital and operational carbon, with user carbon remaining peripheral to decision-making, particularly in transport projects.

### Capitalising

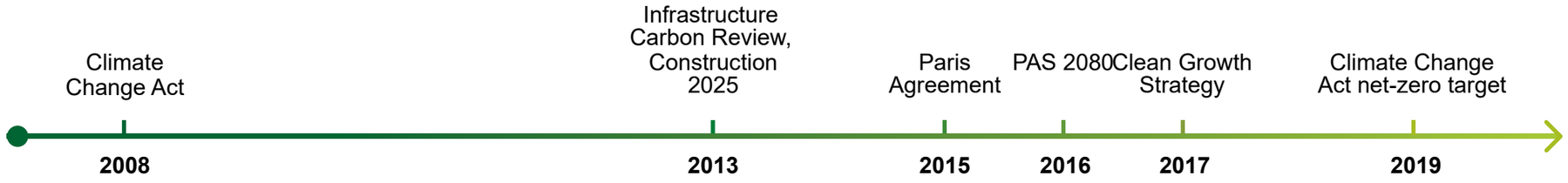
Leading organisations are capitalising on the benefits of embedding carbon management in their programmes of work and gaining wider commercial benefits such as raising a green bond. This is despite procurement and commercial solutions remaining at a relatively low level of maturity.

### Innovatation

More low-carbon, low-cost innovations in the industry. These range from lower-carbon materials (such as the recent national effort to accelerate the deployment of cement-free concrete) to alternative lower carbon products and technologies through more proactive supply chain involvement. In addition, natural solutions (such as land use changes) are becoming more widely considered.

### Influencing

Good carbon management practices in the UK influencing asset owners internationally, such as in the UAE and New Zealand, where the low-carbon, low-cost message has resonated.



# 1.

# Leadership and governance

The ICR set out three key requirements for effective leadership on carbon reduction:

**Vision** – Provide the highest-level sponsorship, vision and commitment

**Values** – Embed carbon reduction as a core organisational value – make it part of the DNA

**Policy** – Deliver clear and consistent policies on carbon reduction

Since the ICR was launched leadership has been shown in several ways:

- 70 organisations have signed their support for the principles of the ICR
- With industry support, the British Standards Institute created an international standard for managing infrastructure carbon, PAS 2080
- Carbon is a focal issue for diverse working groups.
- Organisations throughout the value chain have pledged to act by signing statements that 'We declare a climate emergency'
- Carbon reduction as an outcome is supported through the Infrastructure Client Group's 'Project 13' approach to enterprise working
- The level of ambition has now been raised to net-zero carbon

Examples from organisations that have shown leadership at all levels have aligned their own supply chains to deliver low-carbon innovations (for example, Skanska) but also achieve wider commercial gains such as in the case of Anglian Water, which has raised a green bond.

Nevertheless, we have seen little progress in fully embedding carbon management across organisations and programmes of work following appropriate governance structures to fully consider carbon, and the best low-carbon, low-cost innovations are still seen in selective projects.

**70**

**organisations signed their support for the principles of the ICR**

# 2.

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# Collaboration and culture

The ICR set out three key requirements for collaboration and culture to achieve carbon reduction:

**Behaviour** – Be clear what carbon behaviours are wanted and reward them

**Communication** – Share carbon knowledge effectively within your organisation, your supply chain and the wider industry

**Skills** – Develop carbon skills at all levels through education and training

Several collaboration platforms with the common focus of industry decarbonisation have been created across the industry: i3P (construction innovation), the Infrastructure Client Group ICE (ICG, clients, government and industry) and the Supply Chain Sustainability School.

They provide good forums for communication and exchange on carbon reduction initiatives, although their practical application and progress in changing the industry have been limited. Large projects such as HS2 and Heathrow Expansion have made good progress in engaging with the supply chain to improve carbon literacy across the supply chain.

Client organisations such as Anglian Water, Yorkshire Water, Thames Water, Scottish Water and HS2 have set clear carbon reduction targets and communicate them through their procurement processes; the emphasis on capital or whole-life carbon, and the incentives set to achieve them, vary between organisations.

A key enabler of collaboration is PAS 2080. No single party, whether a client, a designer, a contractor or the supply chain can undertake decarbonisation on their own. In a traditionally competitive industry, cutting carbon requires a change in every organisation's behaviour. Indeed, the industry uptake of PAS 2080 has been cautious – only a few organisations are externally verified.[1]

Others have aligned with the requirements of PAS 2080 and self-verified. In the case of organisations that have implemented the specification, the relationship between carbon and cost is evident.

The logic supports this linkage, with carbon being an excellent proxy for materials and energy consumed when building infrastructure. Therefore, the measurement and challenge around carbon reduction should also include cost reduction to ensure a successful approach and evidence of the wider collaboration across the value chain.

1. Anglian Water; Mott MacDonald, Arup; Skanska, contractor JVs working on HS2 ; Aggregate Industries

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So far the PAS 2080 audit process has focused on organisational compliance rather than programmes or projects, thereby demonstrating skills and intent for collaboration. The next step is to evaluate the effectiveness of a team effort. The British Standards Institution (BSI) has been consulting stakeholders to gauge whether PAS 2080 should be updated to reflect changes in industry awareness and practice – as well as the national commitment to net-zero emissions. The BSI is also looking at whether to evolve the PAS into an ISO standard.

The latest CEEQUAL sustainability scheme increased its focus on carbon reduction on projects and includes PAS 2080 certification as a minimum requirement if an ‘Outstanding’ rating is to be awarded. More projects on its register have demonstrated significant carbon and cost savings: a wind farm in Ireland that achieved capital payback in less than three years; a 40% carbon reduction on a UK tunnelling project; and a Middle Eastern project that achieved a 17% carbon reduction through design and construction – without a mandate from the client.

One drawback that has emerged from the culture change has been the reluctance or inertia among most clients and asset owners to drive ambitious carbon reduction. Rather than embracing the pivotal role of a carbon integrator, most of the carbon management responsibilities and leadership are delegated to the supply chain. Importantly, the industry still operates in silos and there is no single collective ambition and plan for decarbonisation.

The focus has been at individual level, concentrating on the low hanging fruit without reference to the wider aim and the systemic interdependence of infrastructure carbon.

# 3.



# Baseline and metrics

The ICR set out five key requirements to reduce carbon:

**Baselines** – Know where you're starting from; establish a baseline against which to measure performance

**Targets** – Set stretching carbon targets and strive to beat them

**Tools** – Put appropriate carbon modelling tools into the hands of those that need them

**Visibility** – Shine a light on carbon performance

**Governance** – Build carbon control into the delivery process

Target-setting began as a voluntary activity, with organisations exercising discretion as to what they measured and how. That has changed with the introduction of internationally accepted science-based targets[2] (SBT) to guide reductions in emissions, and the UK's commitment to achieve net-zero greenhouse gas emissions by 2050. However, work is still needed to set specific and sufficiently demanding targets for infrastructure. Without them there is a substantial risk that the industry – and the nation – will undershoot the net-zero goal.

Data is essential for setting targets. Since 2013 more asset owners, designers and constructors have been gathering better data. They are developing carbon modelling tools, looking at operation as well as delivery, and capturing data from across the project delivery chain. This is to be applauded, but work is needed to develop standardisation so that the industry can understand and manage carbon reduction in a more coherent and co-ordinated way.

Most organisations considering carbon reduction in individual projects and programmes of work have set baselines to be able to compare lower carbon alternatives. But in some cases, especially in major projects, there is no clear evidence that projects are outcomes-focused whereby build nothing/build less solutions are systematically assessed by challenging the root-cause of a problem. New metrics and approaches for setting baselines and appropriate functional units are required, especially when the new challenge is net-zero carbon infrastructure.

There has been good progress in developing effective carbon data and quantification tools to inform low-carbon alternatives, such as those demonstrated in the Costain, Environment Agency and Mott MacDonald tool case studies, as well as the collaborative effort to update the Inventory of Carbon and Energy database. However, there is still no evidence of a common data environment across infrastructure.

The time-consuming nature and complexity of collecting such data deters many organisations from investing in the time and effort required to embed it in their investment appraisal process. More must be done to understand the indirect influence of infrastructure on carbon emissions – for example, the effect that building new roads or improving existing ones have on travel choices, vehicle use and driver behaviour.

When it comes to targets, the most forward-thinking clients have shown that setting ambitious goals delivers results. For the most part, our industry is still playing safe and demanding only incremental reductions from their supply chains. Although all carbon savings are useful, much greater stretch is possible and desirable – and is proven to deliver commercial benefits.

2. https://sciencebasedtargets.org

# 4.



# Commercial solutions

The ICR set out three commercial requirements for reducing infrastructure carbon:

**Procurement** – Bake carbon into commercial and contractual solutions; create a commercial environment in which innovation can thrive

**Reward** – Align supply chain objectives with reducing carbon; support positive carbon behaviours through long-term incentives; share risk and reward equitably

**Integration** – Remove blockers in the value chain

The ICR urged clients: "Embed carbon reduction into your procurement process. Make carbon reduction a prerequisite for winning work. Integrate your supply chain and align it with your carbon objectives. Share carbon-related risk and reward equitably and incentivise outperformance of your targets. Create the environment in which innovation can thrive."

However, there has been disappointingly little movement away from traditional lowest-cost procurement and confrontational contracting.[3]

As leading low-carbon organisations have shown, significant carbon reductions can be achieved with corresponding cost savings – in the order of 2:1 carbon to cost. The commercial footing of a project determines the behaviours and achievements of the supply chain, from project inception to handover.

Innovation and collaboration must be baked hard into procurement, with incentives to reward progress in reducing carbon and cost.

While many organisations have incentivised better collaboration and alignment of the supply chain in infrastructure projects and programmes of work, there has been little progress in clearly embedding carbon into procurement and commercial models. In other cases (such as in some large projects), although there are requirements to meet a carbon target, there are no compelling incentives to do so.

The relationship of cost and carbon has been progressing in procurement models. But there is more to be done, as demonstrated in the GAIA case study. The challenge will be to understand what the tipping point on pricing carbon is and how this can be integrated into procurement to better inform project outcomes.

Wider commercial advantages from reducing carbon and cost have been demonstrated in the industry, such as the case of raising the first utility green bond.

3. www.ice.org.uk

# 5.



# Innovation and standards

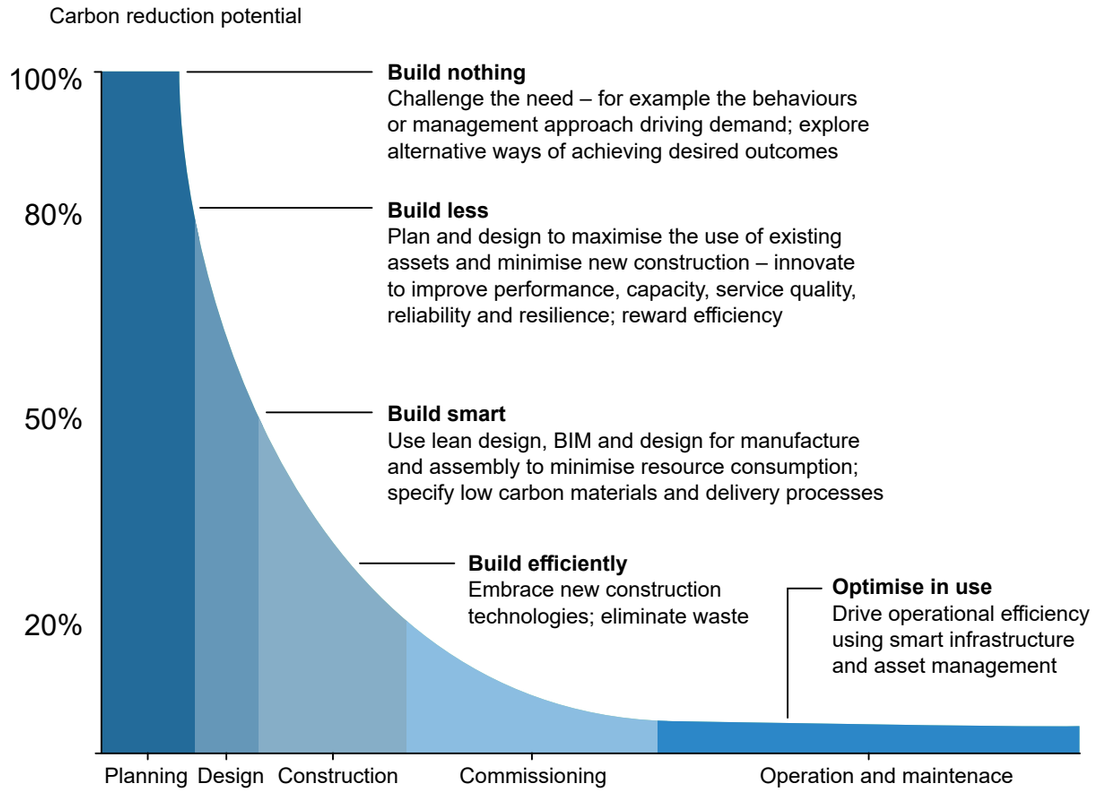
The ICR set out two key requirements for achieving the efficiency step-change that is essential for carbon reduction:

**Innovation** – Unleash new thinking across the supply chain

**Standards** – Enable existing standards and specifications to be challenged; set new standards for carbon best practice

To achieve different results, you have to do things differently – hence reducing carbon requires innovation in every part of the infrastructure value chain. In the past seven years innovations in procurement have championed enterprise working of integrated teams with agreed objectives and commercial incentives to drive behaviour. New approaches to the use of existing assets represent progress in avoiding the need for new construction.

Design and construction innovations have enabled reductions in materials use. And the supply chain has been developing alternative products and delivery techniques, with concrete and steel decarbonisation the focus of innovation efforts. Digital solutions are used to unlock latent capacity in existing infrastructure, as well as enable offsite construction and accelerated construction programmes.




However, most innovation efforts have been focusing on the low hanging fruit in construction and operation. Progress is modest, partly because there is no overarching plan or realistic target for what can be achieved through technological transformation in the time available. Industry inertia is prolonged with the unrealistic expectation that technology will be the panacea for decarbonisation and no other change is being prioritised.

# 6.



# Beyond the UK

The ICR and PAS 2080 have attracted interest from other parts of the world. Asset owners in New Zealand and the Middle East, for example, have benefited from considering carbon management in a more systematic way when delivering projects and work programmes.

In New Zealand, capital carbon accounts for more than 50% of a typical infrastructure programme of work. Watercare has taken leadership here to quantify and reduce capital carbon across its 10-year investment programme. The water utility has aligned its value chain under a common delivery model to identify carbon hotspots and promote low-carbon, low-cost innovations.

In the UAE, wastewater services company ADSSC has embedded the principles of carbon management across its organisation and supply chain. It too has shown leadership in the region by adopting PAS 2080 across its organisation to change the way it delivers infrastructure.

There are many international examples of how low-carbon thinking has been considered in infrastructure projects and programmes of work, such as in Sweden, the US and south-east Asia.

7.



# Policy and planning

The UK's national legal obligation of achieving net-zero carbon by 2050 is now having an effect on infrastructure programmes.

Even before the Climate Change Act was updated, infrastructure schemes such as the M4 Newport bypass were challenged on the grounds of climate change impact. The quashing of the Heathrow Airport expansion development consent order, which was based on the Airports National Policy Statement (ANPS), was an industry first. The Court of Appeal ruled that the secretary of state had made an error in not considering the Paris Agreement when approving the ANPS in June 2018. Heathrow's plans for a third runway were put on hold as a result.

Other infrastructure programmes are being challenged for incompatibility with the net-zero carbon plans. It is likely that the infrastructure sector will find it increasingly difficult to embark on capital projects without a wider strategy that links them to an overarching national decarbonisation plan.

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# Accelerating change: analysis and case studies

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# Accelerating change

## Carbon progress in numbers

How much has the infrastructure industry contributed to the national decarbonisation goal? The Institution of Civil Engineers' (ICE) Carbon Project[4] has updated the ICR carbon dataset for infrastructure. Figure 1 shows the CapCarb, OpCarb and UseCarb trends in economic infrastructure sectors since 2010.

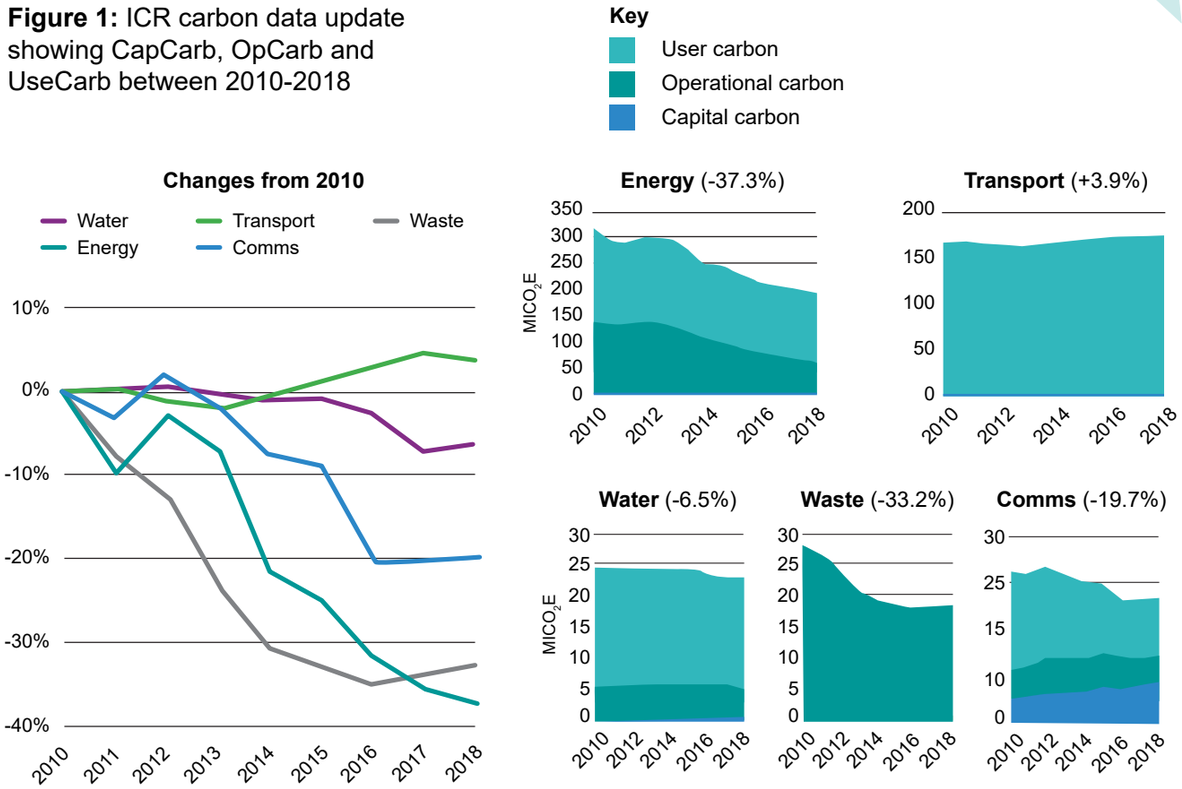
The trends show that overall emissions have been falling, although these have been driven largely by the gradual decarbonisation of the electricity grid. But whole-life carbon has been rising in some sectors, such as transport, mainly as a result of increases in UseCarb. Capital carbon has also been increasing in all sectors due to demand for new infrastructure and refurbishment of existing infrastructure.

The data also demonstrates the specific sector-level challenges:

- Energy is key in achieving net-zero; the industry has made great progress in recent years in reducing carbon in all infrastructure sectors (OpCarb and UseCarb), but there is a lot more to do
- Heating and cooling (UseCarb in the energy sector) present a significant challenge, requiring retrofit and upgrade works across the existing building stock to improve thermal efficiency
- Transport is now the single biggest carbon-emitting sector
- Capital carbon has been increasing in all sectors
- Land use must accommodate growing food, housing people, sequestering carbon and resilience
- Imported and aviation emissions are not currently accounted for but are part of the total carbon impact of the UK

4. www.ice.org.uk/knowledge-and-resources/carbon-project

**Figure 1:** ICR carbon data update showing CapCarb, OpCarb and UseCarb between 2010-2018




(a) Annual UK sector emissions to date based on CCC (2019) Net-Zero report and DEFRA data on consumptive emissions;

(b) same data for the infrastructure sectors only and comparison with the ICR (2013) assessment.

Note: energy in the ICR includes power, oil and gas. Power in the CCC report includes electricity only.

Source: Data from WS3 Group of the ICE Carbon Project, available to download from www.ice.org.uk/news-and-insight/the-civil-engineer/november-2020/carbon-in-infrastructure-where-and-how-much

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# Lessons learned

The case studies presented in this paper are testament to the increasing maturity of decarbonisation in infrastructure projects.

The infrastructure value chain has started reducing carbon in construction at project and programme level as well as taking steps to decarbonise their organisational activities. Actions include progress in setting baselines and quantifying carbon, exploring and adopting low-carbon materials, and developing and sharing tools with the supply chain.

However, the urgency to mitigate the causes of climate change is greater than ever, and manifested in the legislative change in the UK. The net-zero carbon ambition will require extraordinary effort and collaboration between business, government and society and infrastructure has an important role to play in such transformation.

From observing the assembled case studies in this paper:

- Least progress has been made in procurement and commercial solutions, which holds back almost everything else
- The industry is still working in silos. Cross-sector collaboration is essential
- Most of our efforts have focused on capital carbon reduction, even though the narrative was always about whole-life carbon. The need for upfront capital investment for whole-life decarbonisation has yet to be communicated clearly
- Systems-thinking is yet to be reflected in the maturity of our decarbonisation efforts. The case for integrated infrastructure has not yet been made
- PAS 2080 has been highly effective in communicating carbon reduction behaviours by providing a consistent framework for carbon management, including the requirement for strong leadership. However, few organisations have truly embedded the principles of PAS 2080 into their investment decision-making and lack of true leadership has limited the benefits that collaboration could bring in reducing carbon
- We still need an exemplar programme that drives a step change in whole-life carbon reduction
- No consideration yet of retrofitting existing infrastructure to be fit for a net-zero carbon UK
- Regulators need to align sector-level price control with the net-zero carbon requirement

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# Moving forward

## The UK infrastructure industry must rapidly gear up to support the UK delivery of net-zero carbon within the next 29 years.

Accelerating the reduction efforts also requires broadening the scope and ambition, particularly for operational and user carbon reduction. Further, it requires recognising infrastructure as a system that is critical in enabling deep decarbonisation across the nation.

Each individual asset enables part of the system to function and does not exist in isolation from the others. Given that 95% of all infrastructure that the UK requires is already built and is highly carbon-emitting, the meaningful outcome for any new economic infrastructure intervention would be to decarbonise what we have now.

The 2050 target redefines the scope of new infrastructure: the intended outcome of new transport projects should not be increased transport capacity; instead, it is about decongesting transport routes already in place and optimising the most efficient and decarbonised modal mix for passengers and goods. This substantial change of scope must be reflected in the procurement of infrastructure projects. It requires an unambiguous definition of whole-life carbon of all infrastructure, which is reflected in the cost benefit evaluation of the UK's decarbonisation efforts.

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## Key considerations towards a net-zero carbon era

# 1.

### Create the role of a national infrastructure integrator

Infrastructure is a complex system of interdependent systems, vital for national social, economic and environmental prosperity. This complexity must become an overarching consideration in prioritising and implementing all infrastructure interventions.

The infrastructure industry should cultivate a systems-thinking approach. It should establish a new cross-sector infrastructure integrator role that directs where and how system decarbonisation is prioritised, including at the interface between sectors. Its main function should be to align the infrastructure pipeline with the national net-zero requirement in a practical and implementable way.

# 2.

### Align valuation and procurement with whole-life value and the net-zero carbon objective

Despite significant progress in national decarbonisation commitments, business cases and project procurement in infrastructure are still based largely on traditional minimum capital cost objectives, including for new flagship projects that will be operational until 2050 and beyond.

A low-carbon transition should ensure that the definition of value incorporates the whole-life carbon impact of assets and programmes towards the 2050 net-zero target:

a) This should be reflected in an entirely new approach to procuring for whole-life value and net-zero carbon ambition across all infrastructure; this approach should integrate natural capital.
b) Nurture new carbon-focused supply chains and markets and accelerate the understanding and opportunities of net-zero infrastructure.

# 3.

### Support regulatory frameworks to integrate net-zero infrastructure across all sectors

The traditional role of regulators focuses on price control of capital and operational programmes. At a time when infrastructure expenditure must be aligned with net-zero carbon imperative, regulatory frameworks have a central role to play in directing net-zero policy at sector level. Performance metrics for net-zero outcomes should be included in all regulatory frameworks, which should also recognise the need for cross-sector carbon coordination (see 1).

# 4.

### Stimulate research and innovation

There is already significant interest in low-carbon innovation, focusing on small carbon wins in materials and construction technology. Research and innovation should also develop the systems-thinking infrastructure approach, and be directed towards cross-boundary optimisation of infrastructure systems, including those for energy, transport and flood defences.

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# 5.

## Integrate natural capital and land regeneration in the purpose of infrastructure

Traditional development of infrastructure has had a detrimental impact on the use of land, such as direct environmental degradation and severance of natural systems, as well as urban sprawl and more invasive planning patterns. In return, infrastructure assets and the built environment they serve are affected by land degradation, with ever-less resilience to extreme weather, such as flooding, and climatic effects, such as the heat islands caused by urban expansion.

Infrastructure institutions must urgently develop an in-depth understanding of the infrastructure-induced regenerative land use patterns that can reduce existing carbon emissions as well as enable significant environmental resilience and nature-based carbon sequestration at scale. Embedding natural capital metrics in the valuation of infrastructure interventions could prioritise land regeneration as an infrastructure outcome.

The white paper[5] on planning reform addresses the role of infrastructure in restoring or regenerating the use of land for carbon reduction as well as nature-based carbon sequestration and increased resilience.

5. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/958420/MHCLG-Planning-Consultation.pdf

# 6.

## Embed carbon leadership and knowledge-sharing

Professional institutions should develop a requirement that their qualified members practise low-carbon thinking.

They should work to encourage organisations across all sectors to integrate PAS 2080 orthodoxy into their investment decision-making, driving collaboration and whole-life decarbonisation in every activity.

# 7.

## Promote a demonstrator programme

The carbon case studies reviewed show good progress, but none is yet an exemplar of whole-life decarbonisation at asset and system level. We must collectively create this exemplar programme that becomes a source of inspiration and benchmarking for a net-zero carbon compatible transition.

# 8.

## Review and plan for retrofitting decarbonisation and land regeneration in existing infrastructure

Most infrastructure assets now in place are highly carbon emitting, so a strategic overview of systems and interdependencies is paramount. Priority must be given to the retrofit actions that will unlock system decarbonisation and long-term sustainability and resilience.

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# Leadership and governance

### Water UK industry net-zero carbon target 2030 – public interest commitment

The water industry is the first industrial sector in the UK, and one of the first major sectors in the world, to commit to a carbon-zero future by 2030. The commitment is one of five exacting social and environmental ambitions, and forms part of the industry's public interest commitment made in April 2019.

Water companies in England launched a project in December 2019 to design the plan that will help to deliver their world-leading goal of net-zero carbon emissions by 2030.

The industry also intends to share the lessons learned to help other energy-using industries to deliver their own plans. Systems thinking and new approaches to decarbonisation pathways are being developed. The sector decarbonisation route map was launched in 2020.

### Skanska – carbon reduction leadership and net-zero carbon targets

In May 2019, Skanska UK announced its intention to achieve net-zero carbon emissions by 2045 and published its supporting comprehensive strategy. The evidence-based target was developed to be ambitious, yet realistic, using analysis of historic data from 2010 to 2018, combined with projections of construction's most important supply chain sectors.

The target incorporates all emissions from the company's entire supply chain – the first contractor in the UK to conduct such an audit. Historically, companies have targeted their direct emissions only, but Skanska's strategy addresses 10 times its Scope 1 and 2 emissions by incorporating indirect emissions. By including the entire supply chain Skanska has developed relationships with clients and partners to collaborate on delivering low-carbon assets and has implemented PAS 2080 to support them.

To ensure the strategy is integrated throughout the business, each year Skanska's six sectors set carbon action plans that are reviewed by the managing director. These allow individual sectors the flexibility to target their specific markets. Skanska continues to work with clients, offering and providing low-carbon solutions on all tenders and live schemes, and extends training and development beyond its own staff to include the value chain.

Skanska has several test projects with digital integration and BIM 5D+ models to integrate carbon throughout the development and decision-making process. Work with the supply chain (innovations and solutions) ensures these are built into the model from the outset, realising best value through integrated cost carbon design, procurement and commercial mechanisms.

### National Grid – net-zero commitment

National Grid's strategy to meet the net-zero transition is threefold: tackle the climate crisis by helping the markets in which it operates transition to a net-zero economy; reduce its own impact on the environment; and ensure its networks operate reliably under changing conditions. Supporting this, the company developed investment plans to deliver the UK's net-zero target. National Grid has announced its commitment to be net-zero for Scope 1 and 2 emissions by 2050, and its electricity system operator is aiming for zero carbon by 2025.

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## Environment Agency – net-zero carbon commitment

The Environment Agency is aiming to become a net-zero organisation by 2030 – ensuring that its own activities and those of its supply chain are taking as much carbon out of the atmosphere as they put into it. The government department will also explore whether, by 2050, it could become an absolute-zero organisation – by eliminating all carbon emissions from its own activities and supply chain.

It has adopted the United Nations Sustainable Development Goals (also known as the Global Goals) as a framework for eMission2030. To tackle a broader range of social and economic development issues, this strategy is supported by the Environment Agency's net-zero commitments. The agency's collaborative approach to carbon reduction and delivery of low-carbon assets build upon the efforts made in quantification, methodology, training and capability building across its own organisation and that of its supply chain.

A whole-life, cradle-to-grave, evidence-based approach to carbon quantification, validation and analysis of data from 2015 to 2020 has enabled the organisation to make carbon projections at a portfolio level while being able to estimate carbon alongside cost at a project level.

## Arup – Leadership in decarbonisation

Arup is committed to rapid and deep decarbonisation of its business and the wider built environment. It contributed to the Infrastructure Carbon Review and it is a signatory of the Paris Pledge for Action as well as the Construction Declares initiative. It co-authored PAS 2080 and produced the Low Carbon Routemap for the Built Environment.

Corporate commitments include a science-based carbon reduction target of 30% by 2025 followed by a 2030 net-zero goal. Arup's sustainable development strategy focuses on six principles to shape client engagement, project delivery and investment decisions. A rapid transition to net-zero carbon within Arup and in its services to clients is core to the company's global strategy, as is adopting circular economy principles, essential for reducing the UK construction industry's current rate of emissions of c50Mt$CO_2$e each year.

Arup recognises that it is only one of many contributors that must act to decarbonise our economy and believes in joining forces to achieve more together. It has partnered with national and international networks, such as C40, the Ellen MacArthur Foundation and World Business Council for Sustainable Development, to inform and amplify the impacts of decarbonisation efforts.

## Mott MacDonald – net-zero carbon leadership

Mott MacDonald strongly supports the UK's net-zero targets. It recognises that, in achieving net-zero, the UK will no longer contribute to further global warming but will position itself as an international leader exploiting the economic and societal opportunities presented by this generational mission. Mott MacDonald's leadership in creating the Net-Zero Infrastructure Coalition is a prominent example of its approach.

The coalition has brought together some of the leading figures in infrastructure and government, aiming to tackle many of the significant challenges to achieving net-zero. Mott MacDonald's focus in forming this coalition has been to harness collective expertise to support the delivery, and maximise the benefits, of UK net-zero. Beyond the coalition the contractor engages in many other net-zero initiatives with industry groups and engineering bodies.

Mott MacDonald's work in the UK and globally helps clients and societies decarbonise more generally. Notable projects include the development and deployment of key technologies, including CCUS, hydrogen, and the development of net-zero roadmaps in the UK in the energy, transport, water and buildings sectors. It works with governments around the world to develop low-carbon development pathways in projects ranging from the UK 2050 Carbon Calculator to improving energy access through use of renewables in Least Developed Countries. Mott MacDonald is increasingly working with commercial clients, public bodies and central and local government on net-zero and what it means for them. The consultancy previously set itself an organisational carbon-neutral target for the end of 2020. Following on from this, it is now committing to becoming net-zero by the end of 2040.

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# Collaboration and culture

### Carbon management training and upskilling – supply chain school training module

The Green Construction Board, working with its steering group, identified the need to disseminate the business benefits and key aspects of the PAS 2080 standard. Action Sustainability was engaged to develop and deliver an e-learning module aimed at practitioners and managers of carbon in construction organisations.

The module is publicly available and free to access for anyone in industry through the Supply Chain Sustainability School platform (orchestrated by Action Sustainability), CEEQUAL and the Carbon Trust websites – you can view the module online here. The content was developed collaboratively, drawing on GCB members for subject matter expertise and Action Sustainability for development and technical support for the module itself.

The title of the module, Reduce Carbon, Reduce Cost, which came from the Infrastructure Carbon Review, was a deliberate hook to draw in people from the industry. Cost is an issue that focuses the mind for the majority of businesses and from this point the module introduces the learner to the key elements of PAS 2080 and the wider sustainability benefits that can be achieved by reducing carbon.

Throughout the development phase it was recognised that the module needed to be informative and engaging for the learner. Great effort was made to ensure that the module contained a range of content, including interactive exercises, video clips and case studies to impart knowledge and skills in various ways.

### Anglian Water – applying pas 2080 throughout its capital programme

Since becoming the first company to be independently assured against PAS 2080 in 2016, Anglian Water has continued to apply the principles of the standard, resulting in an overall capital carbon reduction of 61%.

Anglian Water's investment programme is delivered through several alliance partnerships. With more than 900 projects delivered in the 2015-20 AMP period, the commitment of partners and suppliers is critical in managing and reducing carbon in capital programmes. Embedding carbon within the governance process for investments allows reductions to be tracked and challenged from initial design to solution. This process has also enabled Anglian Water to demonstrate the link between reducing carbon and cost reductions.

Baseline principles are common for all schemes, and targets are aligned at both programme and project level. With around 1200 options available through the carbon modeller tool, designers and engineers can compare the carbon impact of different solutions. Innovation has been driven by leaders setting ambitious targets and providing the support and tools to enable engineers to compare the carbon in their designs with traditional solutions as well as the targets. Regular workshops, training and presentations are provided to reinforce practices that are essential to drive down carbon.

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### Developing an accessible framework to support PAS 2080 and implementation on projects

Atkins, with support from i3P, is developing a carbon management framework that is built on the requirements of PAS 2080 and the guidance document that sets out practical steps to enable more successful implementation on projects. The framework is a response to the relatively small take-up of carbon management principles and PAS 2080 on the delivery of infrastructure projects and work programmes.

The framework focuses on providing more detailed behavioural guidance on individual project roles and further clarifying the benefits of taking action. The project involved a wide stakeholder consultation to collate successful examples of carbon reductions achieved.

The framework is designed to be an end-to-end process and individual roles and responsibilities are being defined by job type for all organisations, building on the examples included in the guidance document for PAS 2080.

This guidance is supported with case study examples. The framework was still under development at the time of writing. Further information can be found at www.i3p.org.uk.

### Circular ecology – industry collaboration to update ICE carbon database

The ICE Database is a source that provides embodied carbon factors for the main construction materials. It was updated in 2019 and released by Circular Ecology and the University of Bath, where it was created, as a free download. Funding came from three infrastructure sector organisations, Heathrow, the Rail Safety and Standards Board (RSSB) and the Environment Agency.

The latest version takes into account standards such as PAS 2080 and EN 15804 on environmental product declarations, and more information on embodied carbon as a result of the infrastructure carbon review. The updated embodied carbon data focused on the key infrastructure sector construction materials. Data was discussed with key industry representatives. Enhancements to the data include quality indicators, more detailed statistics that allow a better appreciation of uncertainty, and more consistent data due to improved carbon footprint methods and standards.

### Yorkshire Water – carbon literacy

Yorkshire Water collaborated with framework partner Galliford Try to become the first in the UK water sector to run accredited carbon literacy training. Carbon literacy is a national initiative which aims to improve awareness and engagement that supports essential behavioural change.

Launched in November 2019, Yorkshire Water's interactive carbon literacy course was part of the company's first Carbon Week. More than 200 colleagues and supply partners participated in a series of events, all raising awareness of climate change and encouraging and enabling people to take action in their personal lives and through their work.

Having updated and improved the course, Yorkshire Water is rolling this out further to encourage all colleagues and supply partners to take part. The course covers:

- Climate change awareness.
- Carbon management: what it is and the role of infrastructure operators.
- Yorkshire Water's carbon reduction targets and opportunities.
- Interactive sections to aid further understanding of climate change and key impacts.

The company also engaged customers during Carbon Week, including opening a pop-up poo-powered pub in the heart of Leeds. The quirky approach secured media and public interest to raise awareness of climate issues in relation to water and wastewater services.

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### Thames Water and Eight20 – carbon managment across capital programme

Over the past five years, Thames Water's eight2O – an alliance of eight capital delivery partners – developed and implemented a comprehensive approach for reducing carbon across its capital programme. This is fully aligned to Thames Water's corporate sustainability approach, is compatible with its business processes and systems, and consistent with the requirements of PAS 2080.

The approach, which was embedded from the start, included: assessing the baseline position for all investment lines; setting a target to reduce capital carbon by 25% against the baseline; assessing the capital and net operational carbon for each project using practical accounting tools; providing training and guidance on ways to reduce carbon and improve sustainability; and regular reporting of progress.

Collaboration between the partners was fundamental to its success. For example:

- On a project to improve water supply in the Guildford area, the design and construction partners worked closely with suppliers to fabricate a new ultraviolet treatment plant off site and install it on site with minimum civil works, avoiding the need for a bespoke membrane treatment plant.
- At a large treatment works serving part of London, new filter tanks were designed and constructed from pre-cast concrete panels that were fixed together and sealed on site instead of constructing them by placing concrete in situ, which would have had a higher carbon footprint.
- In rehabilitating underground water pipelines, eight2O partners employed a process of slip-lining new plastic pipes within existing pipelines to minimise carbon-intensive open trench works.
- Materials from excavations and demolished structures have been reused and recycled aggregate has been used when possible. Collaborative working between sites enabled leftover aggregate from one to be reused as backfill around structures at another.
- To improve flood resilience, eight20 worked with framework suppliers to protect critical assets with small-scale local flood-proofing measures, avoiding the need for high carbon site-wide barriers.
- Carbon reduction has been part of an integrated approach to delivering wider sustainability benefits, including improvements to surface water management, flood resilience and biodiversity, in line with Thames Water's performance commitments, as well as saving time and cost and improving safety.
- By the end of 2018, carbon assessments and 'sustainability workbooks' were being completed on nine out of 10 projects.

This process is ready and available for Thames Water's future capital programme, irrespective of delivery route. The keys to successful application have been to: set clear, unambiguous targets at senior leadership level; implement the process from the start; embed it quickly within the delivery culture and make compliance a gateway governance requirement; keep it simple and provide practical training so that everyone knows how to contribute; instigate clear, evidence-based reporting (alongside other key metrics); and publicise success widely and often to encourage people to do more.

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## London Power Tunnels – embedding carbon and sustainability into ways of working, Skanska-Costain for national grid

The London Power Tunnels (LPT) project was the longest single tunnelling contract in Europe. The £1bn project created a 32km long subterranean electricity superhighway to ensure Londoners are connected to safe and reliable electricity supplies. London Power Tunnels is the most significant addition to the capital's electricity system since the 1960s.

In February 2011, a joint venture between Costain and Skanska (CSJV) began construction on the seven-year £324M tunnelling contract using two tunnel boring machines (TBMs). Work also involved constructing 14 shafts and headhouses. From the inception a key focus was delivery of a genuinely sustainable project, and achieving an excellent CEEQUAL score was embedded as a project target for all parties.

To drive the sustainability agenda throughout, the project strategy had several focus areas:

1. Carbon awareness. Using whole-life carbon assessment tools to assess and identify carbon hotspots and potential opportunities for improvement. Raising carbon awareness was linked closely to a whole-life cost exercise.
2. Challenging technical specifications to drive the optimal sustainable solution.
3. Innovation fed into the project throughout its lifecycle.
4. Sustainability reviews were significant enablers and conducted regularly with main stakeholders to ensure all sustainable considerations remained central to the project.
5. Cultural change was key to the success of LPT's sustainability agenda, ensuring knowledge sharing and promotion of industry-leading best practices with all parent organisations as well as the wider industry and supply chain. This led to the development of aids such as the National Grid's Sustainability Options Assessment Tool, which will benefit future projects.

By assessing the project's carbon footprint, the LPT team identified a reduction opportunity of 40% in $CO_2$ emissions throughout the lifecycle of the asset. This was achieved by:

1. Minimising lorry movements by reusing tunnel spoil at National Grid gasholder decommissioning projects in the London area. The synergy that has been achieved through this sustainable and innovative way of working gained the project a Brownfield Briefing Award for Best Reuse of Materials in 2012.
2. Procuring low-carbon tunnel segments (with a high content of pulverised fuel ash or ground granulated blast furnace slag) and polyethylene reinforced concrete.
3. Redesigning the tunnel ventilation requirements to reduce the necessity for their continuous use, thereby saving wasted energy.
4. Engagement with local communities, undertaking landscaping and voluntary work in parks and cemeteries along the tunnel's route. This has encouraged the conservation of habitat and protection of local species.
5. An energy education centre was created at the main project office in Willesden to help young people learn about energy, climate change and sustainability. Intended to encourage interest in science, this free facility was aimed at primary and secondary school children, providing information about energy production, its use and the need to change our relationship with energy in order to safeguard our future.

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# Baseline and metrics

**Outling a robust approach to the development of science-based targets**

Science-based targets (SBTs) are greenhouse gas (GHG) emissions reduction objectives, consistent with the decarbonisation required to limit global warming to less than 1.5–2°C. On behalf of the RSSB, Arup and the University of Leeds assessed the feasibility of setting SBTs for the UK rail industry. This was the first SBT setting at industry level, presenting the rail sector with the opportunity to become an early adopter and encourage faster action from other modes of transport.

The study outlined a proposal for the delivery of SBT based on evidence gathered across the rail industry, including a wide stakeholder workshop. Feasibility included 10 evaluation criteria of the readiness of the industry to adopt SBT, including data, skills and policy context. The assessment concluded that establishing an SBT programme to drive the rail industry decarbonisation was feasible. “Operational roll-out” was considered the most difficult challenge to overcome due to the uncertainty and complexity of governance structures and the challenge of a consistent industry-wide approach. The other key challenges were to ensure data consistency and resources for implementation.

To address the key challenges, the RSSB needs to do three things: establish a technical approach (industry guidance, a standardised framework and a roll-out programme); create a governance structure (including a decarbonisation board to provide industry buy-in, leadership and stewardship); and publicly spell out the business case (whole-life costs and benefits, skills, resources, timeframe and policy implications). Throughout this process, engagement with stakeholders and collaboration with partners is crucial.

This study was the precursor for the decarbonisation outline plan[6] that the RSSB, together with the Rail Industry Decarbonisation Taskforce, submitted to the minster for rail in 2019.

**UKPN – science-based targets**

UK Power Networks signifies its environmental and sustainability responsibilities by setting measurable milestones and robust roadmaps. It had aimed to reduce emissions by 16% by the end of the 2015-23 regulatory period, at the rate of 2% a year. But it has already surpassed this with a reduction of 20.5% from the 2014-15 baseline.

In 2019 it became the first electricity distribution network operator in the UK to achieve the Carbon Trust standard in recognition of its achievements in managing and reducing greenhouse gas emissions. However, UK Power Networks wants to go further in the next regulatory period.

To ensure its targets are independently assessed, expertly reviewed and developed, it is working with the Carbon Trust, developing science-based targets that align with keeping global temperature increases to 1.5°C from pre-industrial levels.

The company has completed the first stage of this work, identifying long-term goals for its own, directly controlled carbon emissions. It is setting carbon budgets aligned with its regulatory price control periods, supported by detailed plans to achieve them. Over the past five years, UK Power Networks used 340,000t of carbon. From the work with the Carbon Trust it knows that for the next regulatory period it has a maximum carbon budget of just 180,000t. To help to achieve this reduction it is investigating the extent of carbon use in its supply chain.

6. www.rssb.co.uk/sustainability/decarbonisation

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### Yorkshire Water – From science-based targets to net-zero carbon

Yorkshire Water is working to go beyond science-based targets by committing to net-zero emissions by 2030. The company has already reduced its operational emissions by 80% since 2004 by growing its own renewable generation and buying certified green energy only. Yorkshire Water is now re-doubling its efforts and updating its climate change strategy to go beyond the focus on energy that is so dominant in its emissions footprint.

To achieve net-zero the company is exploring all its sources of emissions and its options to deliver further reductions. For example, as well as more investment in renewables and energy efficiency, the company has been developing a fleet strategy to reach net-zero.

By drawing on a history of collaboration and leadership on carbon, the English water industry is the first to commit jointly to net-zero by 2030. Consistency and rigour of carbon accounting and public reporting is enabled by use of UK water industry tools and processes that follow international best practice. There is recognition for a hierarchy of preferences with efficiency prioritised over renewables and then offsetting.

### Elephant and Castle Station capacity upgrade

The London neighbourhood of Elephant and Castle is undergoing a regeneration programme, key to which is improved public transport access. An upgrade to the London Underground station will accommodate an extra 27,000 commuters at peak time each day.

To increase station capacity and improve pedestrian flow, the escalators, overbridge and retaining wall orientations are to be reconfigured, delivering a more efficient structural arrangement and optimised construction logistics. To assess the station's carbon footprint, the RSSB Rail Carbon Tool was used. This considered the emissions associated with proposed materials and the station's operational carbon emissions.

Compared with the original feasibility design baseline, a capital carbon saving of 3,500t$CO_2$e was achieved (25% saving). During the concept design stage, emphasis was put on developing the carbon and cost elements in parallel. As a result, a 27% cost saving was achieved due to the capital carbon reduction. The decarbonisation potential of the wider transport system was also considered. By removing car and bus traffic from London's road network, the station upgrade will save 1Mt$CO_2$ per year.

### Costain – carboon infrastructure transformation tool

The project is a collaboration between industry and academia, in partnership with the i3P priority programme scheme, to deliver a low-carbon world. Research was carried out by the University of Edinburgh Business School and smart infrastructure solutions company Costain. It was funded by the Construction Climate Challenge (CCC), hosted by Volvo Construction Equipment.

The Carbon Infrastructure Transformation Tool (CITT) provides an assessment of the carbon impact of a project at the resource level that is both more detailed but also more user-friendly than many other tools. The CITT measures the embodied carbon emissions of infrastructure projects, specifically those associated with producing the materials used. The process involves integrating emissions data with outputs from estimators, planners and building information modelling (BIM) technicians. The tool focuses on integrating with contractors' costing and planning processes and digests data from the schedule of activities for carbon impacts to be tracked and managed monthly in the same way that cost is. This significantly reduces reporting time during project delivery.

The tool has been used on large infrastructure projects in the UK.

### Mott MacDonald – Moata Carbon Portal

Moata Carbon Portal is a tool for modelling the capital and operational carbon of new assets. It enables designers to find carbon hotspots during the optioneering phase of a project, when decision-making is most flexible and the reduction opportunity is the greatest.

The portal is built on one of the most comprehensive carbon and asset group databases in the industry, covering water, transport, energy and other infrastructure asset models. It is integrated with BIM, enabling the carbon impacts of design changes to be visualised as they are made.

The portal reduces the assessment calculation to seconds and has a drag/drop functionality. The asset group models have been developed to be aligned with the quantification principles of PAS 2080 and enable users to visualise hotspots to inform reductions in different stages of the delivery process.

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### Environment Agency – ERIC tool and use in project delivery

The Environment Agency looks after more than 5000km of coastline and main rivers principally in England and is responsible for flood and coastal risk management. To fulfil its goal of promoting low-carbon solutions, it created the ERIC carbon planning tool, which provides a mechanism for assessing carbon over the whole life of built assets.

Carbon reductions are monitored at project level and from an overall national perspective. The breakdown is via the following categories: capital; operational; replacement; refurbishment; demolition; residual carbon.

ERIC consists of two components: a carbon modelling tool (CMT) and a carbon calculator. The CMT baseline (whole life) is compared against the end-of-construction calculator to measure reduction and to see whether it meets the reduction target. It enables solution options through development of whole-life carbon models and captures data that will allow the agency to set supplier carbon targets and support the promotion of reduced carbon solutions on its construction works.

The process requires the CMT to be completed alongside a carbon optimisation report, which highlights the carbon drivers, actions and opportunities. These are taken forward as part of the project and reflected in the final carbon calculator and the final carbon report, which details the actions and opportunities implemented.

Carbon is assessed alongside cost. This is because the current system requires that the CMT is undertaken with the project cost tool (PCT) asset level data to allow for such a comparison. At the end of construction, the PCT end-of-construction and final-carbon-calculator data are used as part of a cost, carbon and efficiency correlation.

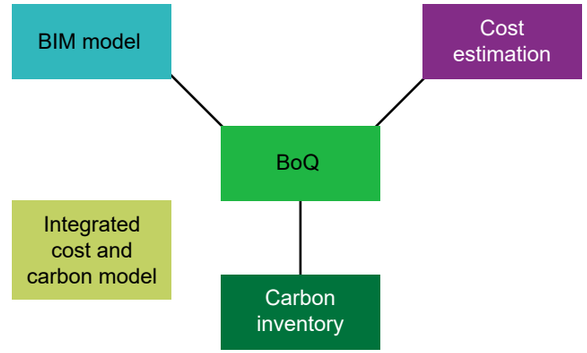
The ERIC tool is used across all capital projects. It can quantify whole-life carbon at different delivery stages, from optioneering to design and construction. Using the outputs from construction to create additional data within CMT informs early design decisions and ensures continual improvement of data for future planning. The Environment Agency has implemented an extensive low-carbon training programme internally and externally for its supply chain partners and is now developing a combined carbon and cost tool to better align estimation of these two factors.

### 5D+ Integrated cost and carbon estimation (Skanska Costain Strabag JV for HS2 MWCC S1 & S2)

SCS has developed a collaborative workflow integrating the carbon and cost calculation for the project, based on accurate quantity take-offs from the BIM model. This innovative approach is intended to produce accurate carbon measurements tied in with the associated financial costs, so that carbon and cost can be monitored side by side. The 5D+ integrated workflow links relevant functions (sustainability specialists, estimators/quantity surveyors and BIM/data managers) that are otherwise disconnected to achieve coherent carbon and cost measurement.

A single data management platform is used to scope and extract quantities from the BIM model and structure them into the bill of quantities (BoQ). Cost and carbon values are then mapped against this BIM-based BoQ. The integrated model helps to speed up calculations, minimise errors and improve the compatibility and consistency of the outputs. Using a single platform enables interoperability and consistency of information, facilitates replicability, increasing productivity and reducing cost.

The logic is simple: whatever is designed will be priced, whatever is priced will be measured and scoped in the BoQ. Therefore, using the BoQ as a basis, we can confidently capture all of a project's constituents. The 5D+ approach allows us to scope and baseline cost and carbon and then track how they change as the project goes through the stages of optioneering and detailing.



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# Commercial solutions

## GAIA – Carbon cost savings driven by procurement

The Glasgow Airport Investment Area (GAIA) scheme forms part of the Renfrewshire City Deal: two major infrastructure projects worth about £130M in total involve new roads, realignment of existing roads, substantial earthworks, structures and several bridges, including a new opening bridge across the River Clyde.

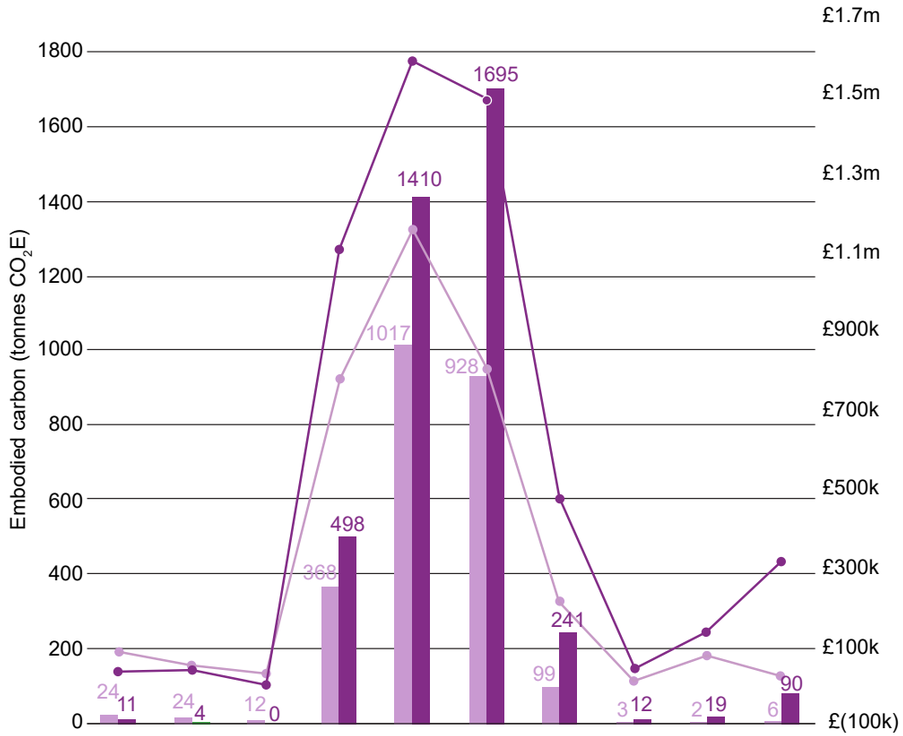
As part of the application of PAS 2080 and supply chain integration, carbon reduction was worth 5% of the quality score at the GAIA prequalification stage and contractors were challenged with a savings target of 2,000t of carbon (about 20% of the total carbon footprint) at the tender stage.

Through this process, a commitment was established within the tender requirements for the successful contractor (Wills Bros Civil Engineering) to deliver its proposed carbon savings during construction. By incorporating carbon as a factor in the procurement process, the project clearly communicated its importance and value throughout the supply chain.

Substantial carbon reductions of more than 30% against the specimen design had already been realised through the design phase. By reconsidering the need for a gateway road, the design by engineering consultancy Sweco saved about 5000t of carbon. Additional design elements, such as replacing a bridge with a toucan crossing, reduced carbon by a further 900t. Ultimately, we are expecting embodied carbon savings of at least 7900 t.

The carbon reductions on the GAIA project so far have been matched by correspondingly large cost reductions. Sweco voluntarily moved well beyond project and PAS 2080 requirements by collaborating with its colleagues in Sweden to investigate the carbon/cost relationship further. This research is being shared across the civil engineering industry.

**Demonstrable carbon/cost correlation**



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### Anglian Water – Embedding carbon in procurement and launching a green bond

In 2010 Anglian Water set out to halve the carbon footprint of all new assets within five years. The utility exceeded this goal and delivered capital efficiencies of more than 20%. This approach has been fully embedded within the organisation through the introduction of PAS 2080.

Demonstrating a continuing commitment to carbon management resulted in annual independent assurance against the standard. This gave a platform for Anglian Water to apply ICMA green bond principles, a standard for green finance. This led to it becoming the first utility to launch a Sterling green bond in 2017. The first bond raised £250M and green finance has now provided more than £800M for Anglian Water.

The Green Bond Framework has been a win for Anglian and its investors. No project is approved if it lacks ambitious targets for reducing carbon and cost. Sharing these targets with an integrated supply chain has been critical to driving innovation and beating the targets. Anglian's ability to leverage this form of finance, with all the benefits it brings, can be traced back to the action and governance systems it has taken to cut carbon over many years.

The 2019 Green Bond report highlights that more than 850 projects have been funded by such means, with capital carbon reductions of more than 160,736t$CO_2$e – 61% lower than the 2010 baseline.

### HS2 – Euston and Birmingham interchange stations

HS2 endorsed the Infrastructure Carbon Review and committed to "minimising the carbon footprint of HS2 as far as practicable and to delivering low-carbon journeys". It was the first large infrastructure project that set an ambitious 50% carbon reduction target as part of the construction contracts, mandating compliance with PAS 2080 requirements.

Arup worked on the scheme design of the Euston and Birmingham interchange stations as part of phase 1. With a carbon management process integrated with the multidisciplinary design development, the project teams identified significant carbon reduction opportunities across the whole life of the stations – both from capital and operational emissions. Throughout the design development, both through dedicated carbon workshops and within regular co-ordination meetings, Arup captured ideas, assessed their potential and incorporated them through a progressive assurance approach.

At the end of the scheme design, both projects achieved the 50% reduction requirement – nearly 350,000t$CO_2$e at Euston and a further 80,000t$CO_2$e at Birmingham against a conventional station design baseline. Further reduction opportunities could be realised in later design and construction phases. Implementing carbon management on such high-profile design contracts highlighted the need for procurement to explicitly incentivise ambitious carbon reduction so that the significant commercial pressures are balanced out and stimulate further decarbonisation.

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### National Grid – Procurement

As part of its commitment to the Infrastructure Carbon Review, National Grid has embedded carbon management into the tendering process for its larger contracts, including restrictions on Scope 3 emissions in the supply chain. This is one part of an end-to-end process that integrates carbon into all aspects of the project lifecycle. National Grid has committed to a new carbon-neutral construction target by 2026 in the RIIO-2 business plan for electricity transmission, so the role of the supply chain is as crucial as ever in driving innovation.

Between 2015 and 2019, National Grid included carbon as part of the weighted score of construction projects together worth over £1bn. This requires the bidders to provide an estimate of the carbon impacts of their proposed solutions and set out the ways in which their proposed designs have incorporated low-carbon solutions. Bidders are scored quantitatively.

This approach has clearly supported the principle that low carbon equals low cost, with more than 80% of winning bidders demonstrating this relationship. On aggregate, the best carbon submission was 26% lower than the highest, showing the importance of careful supplier selection and the potential for carbon savings. National Grid is planning to develop the approach on more contracts as it enters its next regulatory deal and use it as a lever to achieving its carbon-neutral construction goal.

### IFC, World Bank – carbon pricing mechanisms for the construction value chain

Carbon pricing attributes a cost at source to the negative impacts associated with the release of greenhouse gases. It aims to influence sectors and supply chains to alter their behaviour in favour of lower-carbon choices. On behalf of the International Finance Corporation (IFC), an effective carbon pricing mechanism (CPM) for the construction value chain (CVC) was developed by Arup, Costain Group, Cambridge Econometrics and the University of Leeds.

Their report and recommendations highlighted that the most suitable CPM in a given context will depend on the multiple actors involved and level of fragmentation across the lifecycle of the project. Some project delivery methods and financing structures are better able to prioritise carbon reduction with targets and incentives/penalties.

Although there is no single fix, an effective CPM must influence the early stages of project making (such as funding, terms of reference, development and design), as well as the use stage, such that CPM is applied to the entire lifecycle of constructed assets.

A new hybrid CPM for the CVC should use a threshold or blanket carbon price and cover the supply chain construction activities and regulated energy in use. This places the constructed asset within the CPM at the point of project inception and creates the incentive to tackle carbon at the beginning of the asset's lifecycle.

A key takeaway is that collaborative industry engagement and leadership are needed in the development of CPMs to share learning, minimise threats to competitiveness, and help to fulfil local and global climate commitments.

International Finance Corporation (2019) Greening Construction: The Role of Carbon Pricing. construction (accessed: March 2020).

### Skanska UK – Strategic collaborations with the wider supply chain

Skanska has been forming more strategic supply chain relationships to meet its carbon reductions and net-zero goals. Significant reductions have been achieved through collaborations with Tarmac and Aggregate Industries to challenge specifications on traditional materials to reduce carbon and costs. For example, in collaboration with Drayton Construction, Tarmac's Ultifastpath product was approved for use by Somerset County Council. The product was used for the 3693m$^2$ cycleway instead of the initial design's standard two-layer binder and surface course system.

Skanska UK has challenged its suppliers to find alternative material/products. Examples include use of Solatainers rather than straight-diesel generators and HVO alternative fuel on Oxfordshire/Cambridgeshire Infrastructure Services contracts.

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# Innovation and standards

**The role of low-carbon cemintitious materials in reducing carbon in the built environment**

Concrete is responsible for 4-8% of the world's $CO_2$. Although new, less damaging cementitious materials are entering the market, uptake is slow. The GCB infrastructure working group has been collaborating with the BSI and MPA the Concrete Centre to address this. The BSI hosted two industry workshops on the role standards play in enabling the take-up of low-carbon concrete and cementitious materials.

The work is continuing, and a route map for low-carbon concrete technologies is being developed while ways are being explored to reduce carbon in existing OPC-based concretes.

British standards do not prevent use of innovative cementitious materials. The key standards for structural design (BS EN 1992) and product specification (BS EN 206) are performance-based; therefore, any new material that can show compliance with the requirements will conform. As such, the standards provide a pathway to approval for new technologies. BS EN 1990:2002 Eurocode – basis of structural design allows for "design assisted by testing"; novel cements can be specified so long as the testing type, number and verification are relevant for the mechanical performance, construction method and exposure conditions.

The alternative physical and chemical characteristics of new cements require new approaches to be developed for testing and validation. Some accelerated tests developed for conventional cements may not be suitable for new ones. It is necessary to review the limitations of current testing and validation approaches and develop new standards if necessary.

Lack of awareness and experience of the new materials, together with risk aversion in the industry, are also significant barriers to uptake. Education and awareness programmes are required, along with "smart" design by using less while building more.

The way forward is threefold: manufacturers should provide unequivocal evidence of testing conformity in relation to industry-accepted criteria; laboratory trials should take place followed by confirmation in field testing; and standards may have to be revised or new ones developed for new cements.

This is a continuing collaborative effort, with input from clients (HS2), consultants (Arup), testers (Lucideon), and insurers (NHBC), along with traditional and innovative manufacturers and suppliers (Hanson, Cemex, DBG Holdings, Amcrete, C-Probe) and the research community (BRE, Universities of Cambridge and Sheffield). It is essential to achieve a consensus on the solutions that will generate the maximum benefit from the initiative.

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### Conwy County Borough Council – Colwyn Bay waterfron coastal protection

The objective is to provide environmental improvements to the promenade to offer a modern, sustainable and attractive public realm. This has been combined with a significant upgrading of the predominantly Victorian coastal defences to protect the promenade and the town from the threat of the sea for years to come.

The project showcases best practice in the delivery of a highly sustainable civil engineering scheme with many additional benefits. The project achieved a CEEQUAL Excellent Whole Team Award and several other industry accolades, including awards from the ICE and CIHT. Since Phase 2 was a continuation of the wider Colwyn Bay Waterfront Project, skills and resources remained within the project team throughout, so there was strong appreciation of the benefits the CEEQUAL process could bring.

The client fully embraced this process, while the project team decided early on to use it as a guiding document so that all opportunities for best practice were grasped. From the outset, the project team used a tool developed by Mott MacDonald called Design for Resource Efficiency (D4RE), which focused on aspects such as energy reduction, water reduction and sustainable procurement.

This approach saved about £300,000 on disposal costs, while using over-ordered materials on other council schemes brought a 48% average saving on paving, street furniture and kerbs by, and carbon emissions were reduced by 30%.

Carbon calculations determined the total carbon saving associated with the final project design. With a 2,100t$CO_2$e baseline and 1,480t$CO_2$e of overall embodied carbon at the final design, this resulted in a saving of 651t$CO_2$e – a 30% reduction.

A requirement was built into all the contracts to adopt a CEEQUAL assessment with designers and contractors to aid in the achievement of the Whole Team Excellent Award. Not only this, but elements from the CEEQUAL questions were drawn out and specified as deliverables that were bound into the works information and the core clauses of the contract.

### Highways England – A303 Corridor

The A303 corridor is a vital connection between the South West, London and the South East. Although much of the route is dual carriageway, there are more than 56km of single carriageway. The 5.6km section between Sparkford and Ilchester in Somerset has both, a mix that causes localised congestion which affects journey times and reliability. Poor junction alignment and visibility are extra hazards that increase the risk of accidents. Highways England proposed to dual the single carriageway section to reduce congestion, improve journey times and make the network safer. The Mott MacDonald/Sweco joint venture was appointed to design the scheme.

The team used the Mott MacDonald Carbon Portal as a quantification tool from stage 2 (option selection) of Highways England's Project Control Framework (PCF), enabling hotspots in the designs to be identified and targeted, and carbon to be avoided where possible.

Between PCF stages 2 and 3, Carbon Portal established that design solutions would avoid 46% of carbon emissions. A principal way to achieve this was by selecting the "online" option for the dualling scheme. An "offline" option would have involved constructing an entirely new stretch of dual carriageway through surrounding countryside. But the chosen option will involve widening the existing single carriageway stretch of the A303 to dual status. Although this will require road closure and traffic diversion during construction, it will also cut carbon by 8739t$CO_2$e (45%) from 19,193t$CO_2$e to 10,454t$CO_2$e.

Changing much of the drainage design to open surface channels and ditches will help to avoid future maintenance emissions – open drains will not have to be dug up to be repaired or replaced. Growing reeds around the balancing ponds for surface water run-off will boost the scheme's long-term climate resilience by accounting for predicted rainfall increases of up to 40%. That is double the 20% specified by Design Manual for Roads and Bridges standards.

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## Digley Reservoir condition assessment

An innovative approach to assessing the condition of Digley Reservoir's dam enabled Yorkshire Water to avoid large-scale engineering work and associated cost and carbon emissions. A safety report had highlighted possible water seepage through the dam's clay core. If left unchecked, seepage can lead to structural problems – so assurance was needed that the core was watertight.

Conventionally, this would have been achieved through a physical intervention, such as localised grouting of the core or full replacement with a slurry trench. Instead, Yorkshire Water and Mott MacDonald Bentley set out to ascertain whether seepage really was the issue. Temperature-sensing fibre optics sent pulses of light to the core.

By reading temperature changes from the top to the bottom of the embankment, and from one end to the other, the team could gauge whether water was passing through the core. The fibre optic probes allowed the project team to follow up with targeted geotechnical investigations.

Analysis of the results showed that the dam was in satisfactory condition and that no remedial works were required. Avoiding repair or replacement of the dam core followed the principles of "no build" and "build less". It was estimated to save 700t$CO_2$e – a 99.9% carbon reduction compared with full replacement. It was the first time fibre optic technology had been used on a large reservoir project. The probe system has now been installed permanently, enabling Yorkshire Water to monitor the dam in real time for years to come.

## Anglian Water – low-carbon solutions

### Low-carbon concrete

Measuring and managing carbon is key to meeting ambitious reduction targets. Through this process it was identified that 80% of capital carbon emissions are from concrete, steel and site construction. Collaboration across Anglian Water's supply chain is critical in delivering future assets with reduced carbon and cost. Identification of carbon hotspots allows the company to challenge suppliers to drive down carbon and encourage product and solutions innovation.

Anglian was the first utility to trial Cemfree, a cement-free concrete from Cambridge-based supplier David Ball Group. Cemfree was first used as the base slab for a kiosk and was seen to reduce the capital carbon impact by about 60%. The use of Cemfree took the prize for Carbon Reduction Initiative of the Year in the Water Industry Achievement Awards 2016.

### Building less through reusing existing assets

A scheme at Grafham Water increases security of supply to current customers while recognising the challenges of population growth. The initial design had capital carbon emissions of 43,468t$CO_2$e and a cost of £60M, including construction of a 37km pipe. The use of innovative flow reversal modelling and trials proved it would be possible to use existing equipment and reverse the direction of flow through a water pipe already in place to feed the Grafham works from another area. Reuse of assets and the addition of strategic pumping stations and a new storage reservoir reduced capital carbon to 16,803t$CO_2$e – 61% lower than on the original design – and saved £32M.

### Natural wastewater treatment for whole-life carbon reduction

Treating water to be returned to the environment traditionally relies on carbon-heavy capital solutions. However, engagement with the Environment Agency and a partnership with the Norfolk Rivers Trust allowed for a more natural treatment process to be created at Ingoldisthorpe water recycling centre. The creation of a wetland, the first of its kind in England, allows final filtering of treated water before it is returned to the River Ingol. The solution resulted in an 89% reduction in capital carbon and provided an attractive habitat for local wildlife. targeted geotechnical investigations.

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## Environment Agency

The Environment Agency has been promoting the use of low-carbon solutions across its capital programme. It has been engaging with its supply chain partners to collate good industry practices of low-carbon innovations, and has been using those in various projects.

### Proprietary alkali-activated cementitious binders

This type of concrete has an OPC content of less than 5% by mass of binder solids and can contain other subsidiary constituents to improve concrete workability. Using proprietary AACMs rather than conventional concrete costs 15-20% more; however, the carbon savings are 60-80% compared with typical UK concrete mixes.

Use of these materials has been limited largely to non-critical infrastructure, however. The Woodbridge Flood Defence scheme is thought to be the first commercial use of CemFree in the UK. The project achieved a 67% reduction in capital carbon using CemFree (95% GGBS concrete) compared with 50% GGBS concrete.

The scheme also highlighted some barriers to implementation, which included:

- Cost: these proprietary mixes are 15-25% more expensive than conventional concrete.
- Longer striking times: on average they need a day longer to cure than conventional mixes, which can have a significant impact on the programme.
- Workability and finish of products can vary.
- Lack of long-term data on durability of reinforcement within AACM concretes.

### Brico Blocks

Brico Blocks are precast concrete blocks incorporating a peg design for simple interlock between components. They make retaining walls, bridge abutments, and temporary structures easier to build and in less time.

Vertical dowel holes align to allow high-tensile steel rebars to pass down the entire wall to be grouted into place. They can also be tied back. A built-in anchor system allows for safe handling and easy installation.

Flooding in the Wakefield area of Yorkshire (Ings Beck) prompted the Environment Agency to implement a strategic programme of works to install new defences to reduce the risk to the city. These included working within the existing channels to replace old or damaged structures.

Brico Blocks were used in many areas of the project as retaining walls and also in some of the temporary works. The team found that a wall around 30m long by 2m high could be constructed in one day. The associated carbon and cost savings were more than 15% on this project.

### Natural flood management

Natural flood management (NFM) can be used as carbon sinks to provide ecosystem service gains. NFM focuses on natural processes to manage flood risk by protecting, restoring and emulating the natural regulating function of catchments and rivers. It takes many forms and can be applied in urban and rural areas, and on rivers, estuaries and coasts.

The Environment Agency has been considering NFM options to complement traditional engineering or form part of a hybrid solution to alleviate flood risk in areas of river and floodplain restoration, woodland management, run-off management, and coast and estuary management.

Carbon reduction benefits, including reduction of whole-life carbon and lower maintenance, are associated with natural GHG sequestration when compared with typical hard-engineering solutions. There is greater understanding of the science and, as a consequence, better engagement with farmers, landowners and other catchment stakeholders.

The agency has been assessing natural flood management solutions and is working in partnership with its supply chain and other UK stakeholders to better quantify and understand the risks, carbon benefits, water quality improvements and other biodiversity and habitat provision, coupled with the level of peak flow reduction and run-off pathways.

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### Balfour Beatty – supporting Heathrow

As part of Heathrow's ambition to become a zero-carbon airport, Balfour Beatty was asked to help it to achieve Carbon Trust Level 3.

Balfour Beatty identified projects or solutions that would reduce capital carbon and could be verified by the Carbon Trust.

Replacing the Terminal 4 rooflights was marked out as a target for capital carbon savings. The rooflights spanned airside above the international departures lounge and landside over check-in. Balfour Beatty developed innovative sustainable techniques and solutions which allowed the works to be carried out safely and efficiently. Designers realised that the roof structure could be reused, which could save 130t of $CO_2e$. Rather than using glass, Balfour Beatty specified glass-reinforced plastic rooflights, which saved a further 78t of $CO_2e$.

These measures reduced the weight and cost of the rooflight project while cutting the associated carbon emissions by more than 208t.

The team's determination to seek alternative solutions brought these benefits:

- Reduction of deliveries, waste removal and lifting operations
- 98% reduction in manual handling
- Saving of 208t of carbon (helping Heathrow to achieve Carbon Trust Level 3 in December 2018)
- About £10M of improved contract costs
- Eliminated any water ingress and other weather-related events or damage
- Completion was 12 months faster than the original programme

### Yorkshire Water – natural sequestration for GHG removals

Yorkshire Water owns 28,000ha of land and works in partnership to pioneer peatland restoration and woodland planting programmes that protect water quality and reduce downstream flood risk. Its five-year plan from April 2020 introduced a performance commitment to recognise and improve the carbon benefits of these land management activities.

The company has worked with experts at Ricardo to develop a carbon accounting and modelling tool to quantify the stocks and flows of greenhouse gasses stored in, and released from, its estate. The tool is being applied to inform decision-making and improve public reporting by enabling Yorkshire Water to assess the carbon impact of different land management scenarios, such as its 10-year programme to plant one million trees.

This model is unique in the rich mix of land use types and conditions that are considered to provide an overall picture, rather than focusing on single land use types such as woodland. This allows the model to provide a full account of carbon storage, flux and scenarios across the whole catchment area.

Yorkshire Water is to share this tool with UK Water Industry Research (UKWIR) to develop and mature a national standard for the sector.

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### Thames Water with Eight20 – King's Scholars Pond Sewer, London

An inspection showed significant distress affecting the large King's Scholars Pond (KSP) Sewer, buried beneath the junction of Baker Street and Marylebone Road and above a live tunnel of the London Underground. In addition, the 170-year-old structure had settled by 166mm from the original constructed level, thereby encroaching into the kinematic envelope of the trains below.

The KSP brick sewer was built between 1848 and 1856, seven years before the first section of the London Underground opened. The two structures intersect near Baker Street station. The sewer is supported by a bridge structure spanning between the walls of the underground tunnel. Closing the line to repair the sewer from below was cost-prohibitive and would have affected three Tube lines. Similarly, the option of using the busy Marylebone Road intersection to carry out repairs by excavating from above would have caused long-term travel disruption and be carbon intensive.

To avoid these large-scale engineering works options, Stantec and other members of the eight2O alliance worked closely with Thames Water and other stakeholders to develop an innovative solution to extend the life of the structure by 120 years. The solution involved strengthening the sewer from the inside. A stainless-steel frame and reinforced resin liner were fabricated and assembled off site, dismantled and rebuilt inside the sewer, after being lowered one piece at a time through an existing access manhole.

The innovative design and precise construction of this structure demonstrated exceptional project execution, while the 2.1m high by 1.7m wide sewer tunnel remained fully operational throughout the work. This alternative "build less and smarter" approach avoided about £23M in capital costs and more than 26,000t of capital carbon emissions as well as averting disruption to rail and road users.

### UKPN – London substation

When faced with the challenge of constructing a new electrical substation in west London, UK Power Networks wanted to build it with the smallest footprint – both geographically and with regard to carbon. It turned to the principles of the Infrastructure Carbon Review and PAS 2080 to reduce both the embodied carbon content and costs.

The application of value challenges to the base solution yielded benefits that included an optimised building footprint that significantly reduced the size of basement required. Not only did this result in less excavation, reduced muck away and raw materials as well as programme savings, it simplified the temporary works requirements, obviating the need for extensive sheet piling to protect neighbouring structures.

Site constraints prevented use of a traditional steel frame solution for the roof structure, so the team considered a concrete alternative. To reduce the embodied carbon they employed a concrete waffle slab, which saved on the concrete and reinforcement required. Further benefits were realised through the use of GGBS (ground granulated blast-furnace slag) to reduce the volume of Portland cement, and all blockwork was specified to contain recycled aggregate.

By applying the ICR principles, UK Power Networks realised embodied carbon savings of 340t of $CO_2$, which represented a 60% reduction over the base solution. Other benefits included a faster construction time and 30% cost savings.

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### Skanska UK – Low-carbon solutions in collaboration with product, material suppliers

Skanska is trialling use of recycled plastic kerbing instead of concrete to reduce carbon by 40% in partnership with Hampshire County Council.
In a first for Britain, Skanska trialled graphene-enhanced asphalt with Oxfordshire County Council to increase durability and reduce maintenance.

In Essex, asphalt with 50% recycled asphalt pavement was trialled – five times more recycled material than any other motorway surface. The introduction of 50% recycled content marks a step change in the use of recycled material on UK roads that could result in huge environmental benefits if adopted across the network.

In collaboration with Aggregate Industries, a reduction of 20.8t$CO_2$e, or 12.6%, was achieved by using 3,238t low temperature asphalt over traditional asphalt. The asphalt incorporates 10% recycled material, costs the same as traditional asphalt and cools more quickly.

In collaboration with Drayton Construction, Somerset County Council approved Tarmac's Ultifastpath product. It was used for the 3693m$^2$ cycleway instead of the initial design's standard two-layer binder and surface course system. The original design specified 637.04t of asphalt, whereas the change to Ultifastpath reduced the material by 174.4t to 462.7t. The change in product produced a carbon saving of 7.8t$CO_2$e, cut costs and reduced the need for seven 20t lorry loads.

Hydrotreated Vegetable Oil (HVO) fuel replacement – the trial is testing HVO's capacity to reduce carbon emissions by 90% and whether it can cut NOx (nitrogen oxide) pollution emissions and improve air quality in large cities.

CemOptics (Thermal Integrity Profiling for buried concrete structures), developed and patented by Skanska Cementation, Cambridge University and Arup, saved 1052t$CO_2$e over traditional methods.

Anglian Water @one Alliance refurbished and expanded a water recycling centre while reducing baseline carbon by 83%, saving almost 3000t$CO_2$e. A redesign of an aeration filter tank by FLI Water allowed for off-site manufacture, eliminating onsite waste and reducing costs from £13.65M to £4.9M. The redesign also allowed for quicker installation and, by constructing the tank above ground, the need for infilling materials was eliminated.

Using the PAS 2080 ethos of "build nothing, build less", the design team identified the opportunity to reuse existing assets to avoid the construction of new buildings. This enabled the reuse of a redundant 1930s trickling filter and existing filter feed pump station process by installing new mechanical arms. This intervention reduced the operational energy consumption of the initial design by 53%, reducing energy usage by 2570kWh a year and saving £23,400.

### National Grid

National Grid has been investing in new solutions and approaches to avoid using the electrical insulating gas SF6 (a greenhouse gas) at some of its substations.

Working with its partners GE and 3M, National Grid has commissioned new G3 technology on its substations, including at Littlebrook in Kent. This solution will remove all the SF6 and replace it with a much lower-impact alternative, contributing to National Grid's net-zero target.

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# Beyond the UK

## Abu Dhabi sewerage services company (ADSSC) – from carbon reporting to PAS 2080

As the main sewerage treatment provider in Abu Dhabi, in 2014 ADSSC embarked on a journey to understand and reduce its operational carbon footprint by 2022.

The first step was for ADSSC to calculate the organisational carbon footprint and set up an in-house carbon management process to tackle operational emissions from existing assets. Capacity building and training was under way and ADSSC established a green growth strategy and low-carbon roadmap to 2030 – the first infrastructure owner in the Gulf region to do so.

Large carbon reduction opportunities were identified mainly for ADSSC's existing asset base, resulting in a potential overall reduction of 35% a year. This was equal to reducing emissions by one $1tCO_2e$ per person in Abu Dhabi and a reduction in operational costs of more than AED300M by 2030.

In addition, ADSSC has taken the initiative to tackle whole-life carbon emissions in new projects and work programmes. Guided by the requirements of PAS 2080, it undertook a comprehensive gap analysis of its organisation and supply chain systems, processes and ways of working.

ADSSC is now working on extending its in-house carbon management process to align it with the standard. New ways of working internally and externally are being developed as well as low-carbon solutions guidance for its five-year capital programme. ADSSC is aiming to achieve PAS 2080 verification soon, the first asset owner/manager working towards this aim in the region.

Despite challenges from the comparatively low energy price in the UAE extending payback periods for low-carbon investments, ADSSC has shown leadership and commitment to embrace carbon management in new and existing assets, reduce carbon and cost, and show wider influence in the region.

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### Watercare, New Zealand – capital carbon baseline and low-carbon solutions

Watercare is New Zealand's largest water and wastewater asset owner, delivering services to 1.7M people in the Auckland region. To keep up with a growing population as well as maintain and renew assets, an extensive 10-year, NZ$5.8bn management programme is in place.

The recognition to achieve wider value from infrastructure delivery led in 2020 to a new vision for Watercare's infrastructure team termed "40:20:20 Build Better Infrastructure". The vision outlines three complementary and equally important measures of value:

1. 40% reduction in carbon emissions from construction by 2024
2. 20% reduction in cost of construction by 2024
3. 20% year-on-year improvement in health, safety and wellbeing

New thinking and a new delivery model was required to deliver the vision. Termed the Enterprise Model and using guidance from the PAS 2080 framework, a range of measures, tools, processes and thinking that puts carbon reduction at the heart of decision making has been established.

Knowledge of the projected carbon impacts of a capital infrastructure programme is required if significant savings are to be unlocked. A detailed understanding of a project's carbon impacts is a start, but Watercare recognised the need for a full programme baseline to highlight where the real carbon hotspots were in the NZ$2.4bn Enterprise Model work programme.

This information has never been available on a programme-wide level to Watercare or for other asset owners in Australasia. This detailed analysis into the cause and impact of capital carbon for an asset programme highlights a new direction of travel. To gain this new information a partnership was sought with Mott McDonald that drew on international best practice.

The carbon baseline project highlighted aspects that had been expected but not proven, and others that were unexpected. This focused the mind on potential reduction opportunities that have the largest impact. Insights included:

- The carbon emissions for these projects are more than Watercare's expected operational emissions over the same period
- Most capital carbon occurs in networks and transmission, as opposed to treatment infrastructure
- Concrete and steel make up a large percentage of the baseline

To achieve carbon savings, the carbon reduction hierarchy is now being applied to the programme. The need for an individual project is being challenged ("build nothing") and investigations are being carried out into the alignment of projects to achieve broader efficiencies that could never be realised on an individual job.

Collaborative thinking has become the norm. A project can no longer be started in isolation and there is empowerment of early and creative thinking from operators, construction partners, supply chain representatives, designers and project managers as well as the traditional planning team. Partnerships with the supply chain are seen as critical in unlocking low carbon success and asset owners have the responsibility to provide clarity on direction in order to drive and reward innovation.

Hotspots have been identified to engage with Watercare's supply chain. These include:

- Concrete
- Pipeline materials
- Fuel consumption in construction and excavation
- Aggregates

The future is bright as Watercare's new decision-making criteria lead to new thinking and the opportunity to influence positive outcomes on sustainability, cost and wellbeing.

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# Policy and planning

## The M4 relief road

A new bypass had been planned to skirt around the city of Newport in south Wales. The scheme was promoted by the Welsh government to relieve the chronic congestion and proliferation of accidents along the country's main east-west transport corridor. It was the first large project to be publicly challenged on the grounds of its climate change impact.

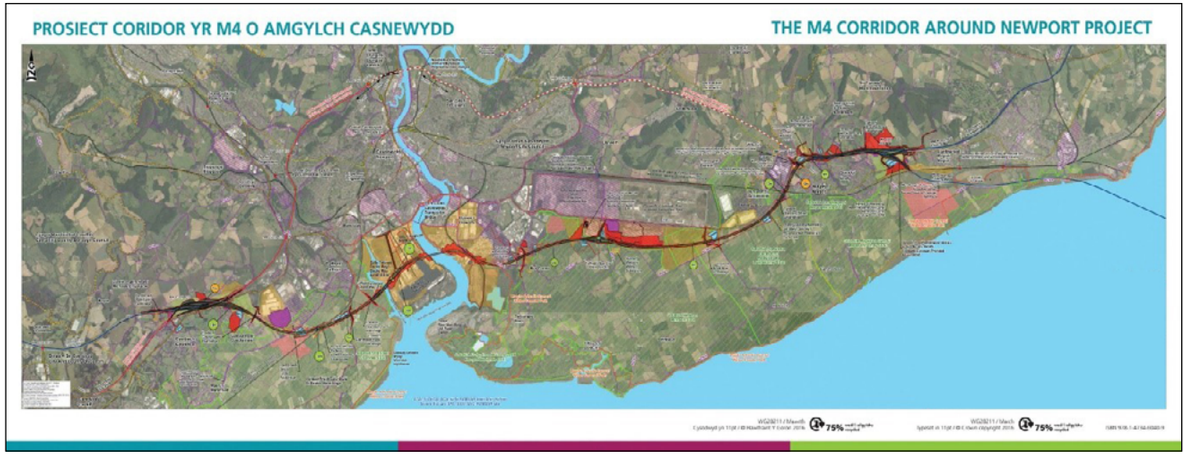
After a year-long public inquiry, in June 2019 the Welsh government announced it had abandoned the project due to affordability and potential damage to the Gwent Levels. Notwithstanding the wider socio-economic implications, carbon was not a contributory factor in the decision.

The inquiry inspector said during the hearing: 'If the M4 is a most unusual road project and the inquiry fails on carbon terms, then there should not be another road scheme ever built in the UK.'

Unlike most bypass schemes, the Newport proposal was modelled to be carbon neutral over its whole life. The construction of this linear infrastructure asset would have yielded an area-wide carbon reduction by relieving congestion across the South Wales road network. Relative to the baseline Do Minimum scenario, the congestion relief and reduced distance travelled (the bypass would have provided a shorter route than the existing one) would have resulted reduced user carbon emissions, paying back the capital carbon.

Since the inquiry, there has been an enormous change in the socio-political appetite for climate change action. This is reflected in the narrative that emerges from Westminster, fully engaging with the net-zero recommendations of the Climate Change Committee.

Climate change is no longer the concern of a few well-informed individuals and fringe protesters. It is now centre stage in our political affairs, dictating priorities in capital investment for driving growth – including building new infrastructure.



The **Green Construction Board**