

10th

Carbon Crunch Reduction and resilience

A systems approach
to climate change





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Welcome to our report of
the 10th Carbon Crunch.

It's hard to believe that it's been nearly a decade since we held our first Carbon Crunch, which coincided with the launch of the Infrastructure Carbon Review, in 2013. A lot has happened since then. The value of Carbon Crunch over the years, and the reason that the event has lasted, has been collaboration. It's brought together infrastructure owners, government, regulators, academics, contractors and suppliers to share thinking, experiences and solutions, helping us all to address common challenges.

That collaboration is needed now more than ever. At this year's event, we heard about some exciting and important ways that we as an industry are working together to make progress on both decarbonisation and resilience. We'd like to thank everybody who attended and our speakers for their contributions. We hope the following extracts from the day provide further learning and food for thought.



Mark Crouch

Decarbonisation lead,
Mott MacDonald



Nikki Van Dijk

Climate resilience
discipline lead,
Mott MacDonald

Time for us all to embrace a systems approach

We are all part of an interconnected system of systems, and we will succeed or fail together.



Cathy Travers
Group managing director,
Mott MacDonald

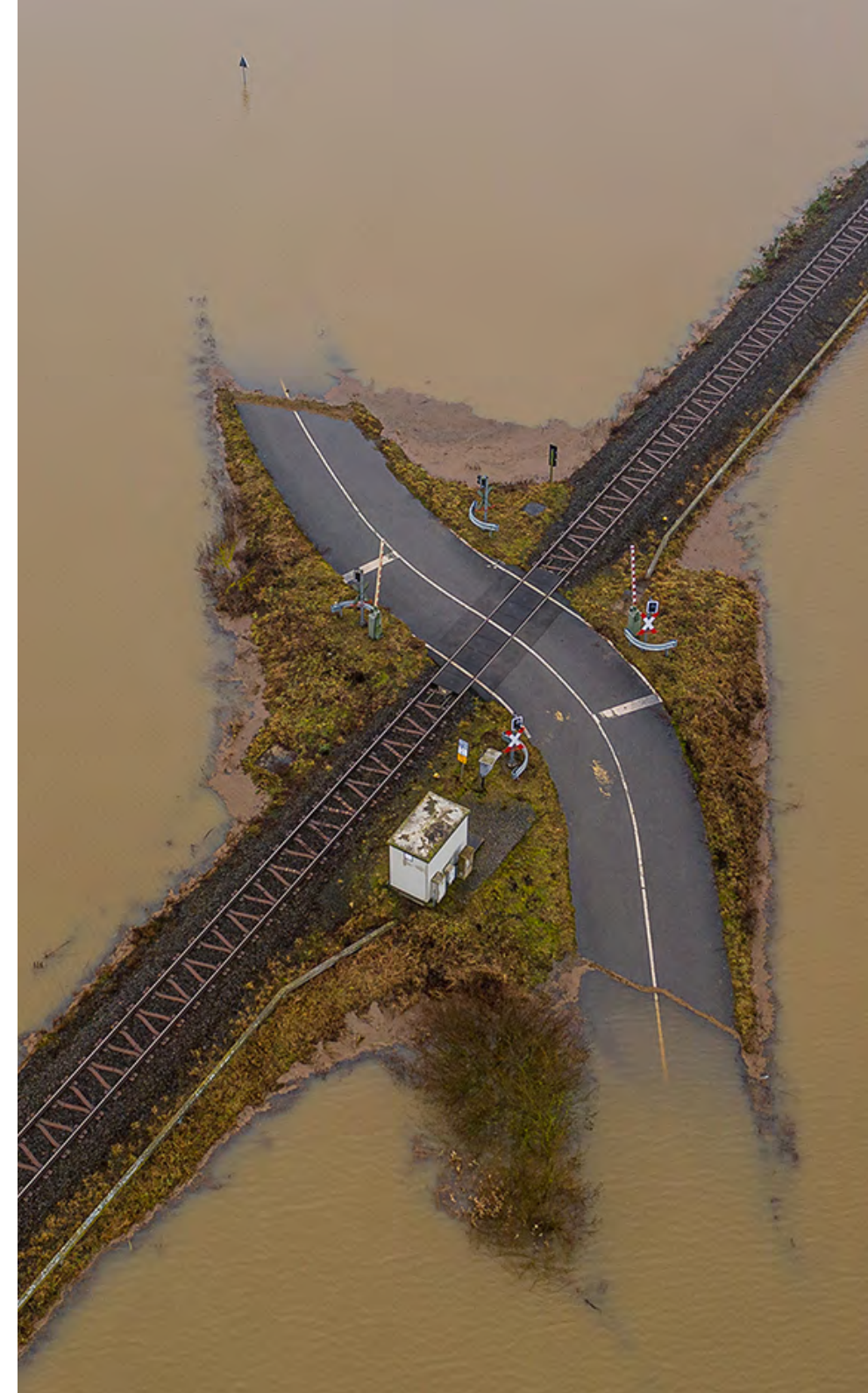
At this juncture in the climate emergency, the interconnected nature of the challenges we face is clearer than ever.

We're in the midst of an energy crisis that is testing our infrastructure, our economy and our society in equal measure. Moreover, we're all now facing climate threats that are substantial and immediate. Heatwaves, droughts and wildfires are now commonplace, while recent months have seen devastating floods and extensive hurricane damage across the world.

All of us, and the organisations that we represent, face individual challenges when it comes to decarbonisation and adapting to the physical impacts of climate change. But we're also all part of an interconnected system of systems, and that interconnectedness means that we will succeed or fail together.

The outcomes we seek across infrastructure and the built environment are systemic, and all the players and stakeholders within our systems need to work together to make them greener and more resilient. This explains the title we chose for this year's event, 'A systems approach to climate change.'

Systems thinking requires collaboration across organisational, sector and geographic boundaries; that can be difficult at times, and means amending traditional ways of working. But it's increasingly essential that we all embrace it.



Resilience must go hand in hand with carbon reduction

Robust business cases are needed to meet the funding challenge.

We are in the grip of a climate emergency. We and the organisations we represent have the capability – and therefore the duty – to act. We must curb greenhouse gas emissions, the cause of climate change, and we must address the effects of climate change, too.

Around the world, infrastructure and buildings are being damaged by increasingly severe and frequent weather events and sea level rise, and essential services are being disrupted. For infrastructure owners and operators, revenues and profits are being hit. Repair and maintenance bills are rising. It is becoming harder to attract investment and secure insurance. Value is being lost.

So, we must address the impacts of climate change – of more extreme weather events and sea level rise. Because failing to adapt and build resilience will make much infrastructure and many communities unsustainable. Globally, at least 3.3bn people are classed as vulnerable to climate change.

The resilience and operational continuity of critical infrastructure is essential: people rely on it for energy, water, transport and other key services. However, there is a funding challenge: trillions of pounds worth of investment will be required, yet it has so far been difficult to develop robust business cases and unlock capital. I'm pleased to share that the situation is improving. Mott MacDonald has been working with the Coalition for Climate Resilient Investment



Denise Bower

Executive director with responsibility for sustainability and climate change, Mott MacDonald



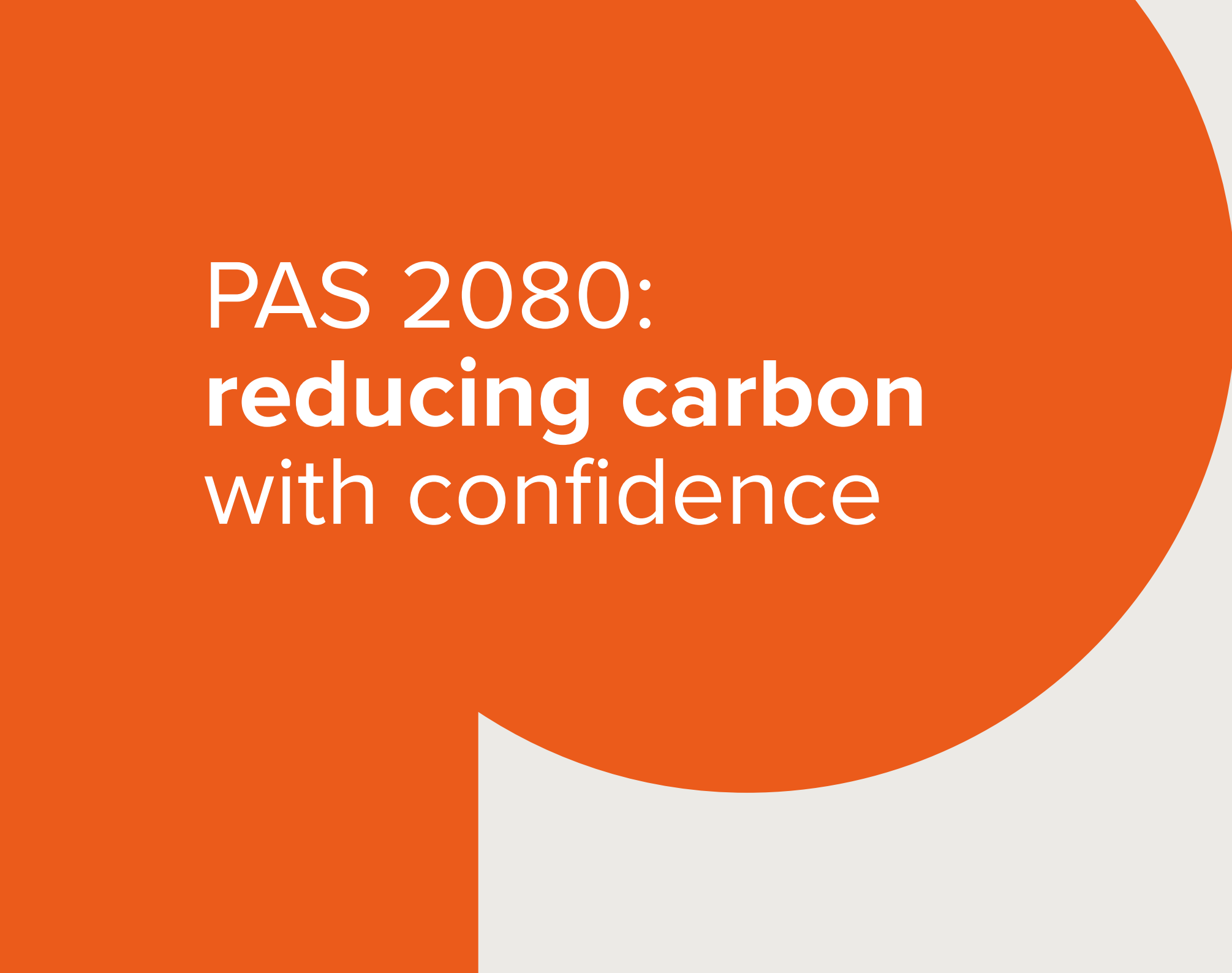
to develop the Physical Climate Risk Assessment Methodology – **PCRAM**, for short. PCRAM does what it says: it provides a methodology for assessing and understanding exposure to physical climate risks. It can be applied to existing or proposed assets and examines the probability, severity and consequences of harm. It shows infrastructure owners where to prioritise investment in resilience. PCRAM also enables resilience options to be assessed for effectiveness.

Our hope is that PCRAM will help unlock the flows of capital necessary to create resilience, not just here in the UK and other countries with mature infrastructure systems, but also in emerging economies with greater social and economic development needs and acute shortages of the infrastructure we take for granted.

\$65bn

of losses caused worldwide by climate-linked extreme weather in the first six months of 2022: double the figure for the same period in 2018

(source: Munich Re)

The logo for PAS 2080 is a large orange circle on the left side of the slide, with a vertical orange bar extending downwards from its bottom edge. The text is white and positioned to the right of the orange circle.

PAS 2080:
reducing carbon
with confidence



A platform and a roadmap for net-zero



For PAS 2080 to work, it must be fully integrated into businesses, so it runs with the grain and not against it.

Source: Simon Kidston/Genex

PAS 2080 provides a great structure for achieving change. To succeed, it must be fully integrated into the business.

Committing to net-zero has been a vital step change in policy and reframing how we think about climate change. When we attended the first Carbon Crunch conference 10 years ago, atmospheric CO₂ stood at 400ppm (parts per million). Today, it is near 420ppm and continues to rise.

Many things such as environmental, social and corporate governance (ESG) and science-based targets weren't part of the conversation a decade ago. Since then, there has been a transformation in thinking across business, and recently, COP26 has been instrumental in driving things forward. Now, the updated PAS 2080 is providing a great structure for managing carbon and generating confidence that we can achieve our goals.

Leadership is critical in this fight and PAS 2080 is a comprehensive document that gives both the platform and roadmap we need. But for it to work, it must be fully integrated into businesses, so it runs with the grain and not against it.

At the Environment Agency, we have committed to reach net-zero, something that is hard to implement. But we are trying to practise what we preach.

We have built carbon assessment into the appraisal for building new infrastructure. We have set long-term carbon budgets and will use these to inform our decision making in the same way we do for financial decision making. We will monitor our budget spend using a dashboard we have built so every team can see their carbon impact. Through procurement we incentivise suppliers to deliver on our carbon goals.

The scale of the challenge is phenomenal and is hard to comprehend, but it is fine to fail sometimes. With systematic change, and through effective public and private partnerships, we can keep moving towards our goals and deliver collaboratively in the face of this huge challenge.

Simon Dawes

Head of sustainable business,
Environment Agency

A framework for grasping the systemic picture

PAS 2080 provides a common language for the industry to drive systemic change.

To create meaningful decarbonisation, companies with net-zero target setting at an asset level need to evolve their thinking, to try to understand how an asset fits in the wider network or system, and what the carbon targets are at that level. Net-zero targets should be set at a systems level by various stakeholders, and value chain members should focus on how targets of individual assets can align to the systems-level targets. They can then have specific reduction goals using absolute tonnes of greenhouse gases.

PAS 2080 creates a common language through its carbon management framework

for managing whole-life emissions – including capital, operational and user carbon. It informs decision making and enables a focus on outcomes. It encourages organisations to understand and allocate risk, and to adopt low-carbon innovations; and it promotes thinking within and outside project and programme boundaries.

By providing practical roles and responsibilities for the value chain, and ensuring they understand their control and influence within the system, we can accelerate the transition to net-zero through more targeted decarbonisation and action.

Maria Manidaki

Technical director, Mott MacDonald



Understanding infrastructure's role in the system

PAS 2080 can help align investment and carbon priorities.

Six years on from the first publication of PAS 2080 by BSI, we are almost ready to publish its first substantial revision. Mott MacDonald and Arup have worked together on this update, with wider industry involvement and consultation. We took stock of the decarbonisation progress to date and the fast-changing policy landscape – since the first publication, we have a new legal obligation to achieve a net-zero transition by 2050.

The revised standard has a greater focus on integrating carbon in decision making at every stage, highlighting the importance of systems thinking for decarbonisation in the control and influence of every member of the value chain. The decarbonisation principles apply indiscriminately across both buildings and infrastructure; recognising that each individual asset is an inextricable part of a complex, interconnected built environment

system. It is the system that must transition towards net-zero – and much of the carbon is already locked in the existing system, which supports high-carbon behaviours.

We borrowed the concept of a nesting asset/network/system hierarchy from the Construction Innovation Hub Value Toolkit, and have used it to highlight important linkages and the scale of decarbonisation opportunities between them. Key to this approach is that different parts of the value chain can control at different levels, but engagement and collaboration in all directions is necessary to make it happen.

Every member of the value chain has a role, and government, investors and regulators can dictate decarbonisation behaviours at systems-level. Although we cannot provide normative clauses for government and regulators, we have nevertheless outlined their role in an informative annex.

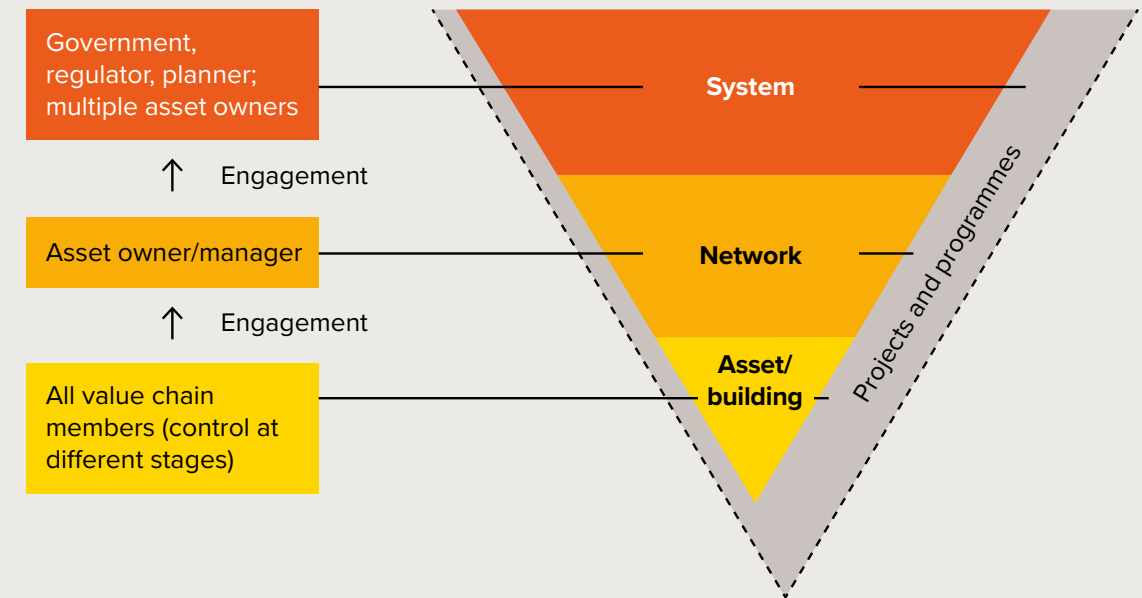
Heleni Pantelidou

Associate director – infrastructure, Arup

Systems, networks, assets

Control and influence

Control



Asset owners have control over their networks and their parts, but systems are influenced by a larger number of stakeholders

A continuous commitment to decarbonisation

Focusing on annual targets and smarter designs has helped National Grid make valuable carbon reduction progress.

Christine Glew

Sustainability manager, gas transmission and metering, National Grid

Over the last 10 years, National Grid has made significant steps in how we approach the challenge of climate change. To focus on decarbonisation, we first built a carbon interface tool to measure the carbon footprint of our schemes during design.

By the time the Infrastructure Carbon Review was published at the end of 2013, we had measured the carbon in 200 of our schemes, meaning we had a good idea of our average carbon footprint. For every £1M we spent, we produced 252t of carbon.

This focused the minds of our executive team on specific targets, including a 10% reduction year-on-year, with a goal of a 50% reduction after five years. While we only managed 33%, this was still significant and crystallised the idea that target setting did achieve results.

For every

10%

CO₂ reduction,
National Grid
achieved a

6%

reduction in cost

Looking hard at more effective, smarter design with updated technical specifications was crucial to this, as was inserting carbon as a weighting in bids. Of course, it is one thing to get a commitment, another to ensure it is delivered upon, and we found the way to do this was by setting up a delivery team and conducting a thorough sustainability review. By using this method, we have proved that by saving carbon, you save money. For every 10% CO₂ reduction, we have achieved an average 6% reduction in cost.

Our partnership with the Supply Chain Sustainability School has seen the development of a tool to help businesses model their own carbon footprints. We are confident that through similar collaborative efforts, as well as effective partnerships created through the Net-Zero Infrastructure Industry Coalition, we are well on our way to achieving the 2050 net-zero target.





Accelerating the net-zero transition



The deep decarbonisation ‘blind spot’

Despite the industry’s progress, the ‘hard yards’ of decarbonising construction activities are still to come.

As we reduce carbon in projects, we pass through several phases – the first being initial design. Here, as we reduce carbon through value engineering, we can also reduce costs because we are using fewer materials and fewer resources.

The second phase is to build less, reusing shell cores or repurposing buildings, for example, and again, this reduces cost. But as we move to the third phase – involving ‘deep decarbonisation’ – this is the hardest to implement, since it requires the full decarbonisation of projects

and systems, which will be costly. As an industry, we have a deep decarbonisation ‘blind spot’, and it is something we are going to have to contend with if we are to meet the challenges posed by global warming head on.

So how do we get there? There are plenty of decarbonisation roadmaps and plans, but many have been written by industry experts and are not yet being driven by government. They are not policy. Take steel as an example. It is estimated that \$4.4trn will be needed to decarbonise steel by 2050, increasing costs by 30% in our industry and requiring significant green hydrogen production to be in place. It is a similar story for low-carbon cement.

So, while we can do the easy yards now, the hard ones are still to come. While we can, we should focus on carbon value engineering,

\$4.4trn

will be needed to decarbonise
the steel industry by 2050

(source: McKinsey)

but it won’t get us to net-zero on its own. The nature of competitive advantage in the market means we will avoid the increased costs of deep decarbonisation until we decide who pays for it.

There are some excellent, innovative companies out there that are working on decarbonised solutions for transport and for materials, which need investment and commitment from us all to bring these solutions to market at scale. Only together can we drive change, increase the demand signals, and agitate for change. As companies, we cannot move the market on our own, but as an industry, it is possible.

Adam Crossley
Director of environment, Skanska

Disclosures needed to aid transparency

External validation
of corporate
carbon is the way
to shine a light
on real progress
against targets.

22%

of global Fortune 500
companies have committed
to a science-based
emissions target via SBTi

The Science Based Targets initiative (SBTi) is an organisation set up to drive climate action by enabling organisations to meet emissions reduction targets.

There are three components to this. First, near-term (5-15 year) targets based around scientific analysis provide immediate focus. Second, a long-term net-zero target provides clarity about the direction of travel and aids long-term strategic and investment decisions.

Third, regular ongoing (eg annual) disclosures ensure both visibility on how the climate strategy is being implemented and transparency on progress against the targets.

Targets are a fantastic start, but it is only by having third-party validation from a science-based perspective that a business can certify their efforts are making a difference and analyse whether they need to be revised.

Last year, the IPCC report informed us there was 500Gt of CO₂ left for fossil fuel companies and corporates to use. If we go over that allocation, we are unlikely to minimise global temperature rises to the crucial tipping point of 1.5 degrees.

The SBTi's aim is to try to allocate these additional carbon dioxide emissions up to 2050 between different sectors, and ultimately to specific companies, putting them on a realistic pathway to net-zero.

We are currently working with just over 4000 companies and financial institutions, representing \$38trn of market value, and we are still gaining momentum. Science-based targets can provide a pragmatic and effective way for companies to reduce emissions and achieve net-zero by 2050.

Tim Young

Net-zero manager – finance, SBTi

A **five-step process** to setting
science-based targets

1. Commit

Submit a letter establishing your intent to set a science-based target



2. Develop

Work on an emissions target in line with the SBTi's criteria



3. Submit

Present your target to the SBTi for official validation



4. Communicate

Announce your target and inform your stakeholders



5. Disclose

Report company-wide emissions and progress against targets on an annual basis

Today's decisions will shape transport's 2050 reality

Digitalisation is important to aid the full understanding of systemic carbon emissions.

A systems approach is fundamental to reach net-zero for all businesses in the built environment, and indeed across sectors. Companies know they do not operate independently and there are many co-dependencies, so that makes collaboration vital.

Systems thinking is even more crucial in terms of big infrastructure projects, because the decisions we make today and over the next few years will shape and dictate how we travel, work and live in 2050, as well as our ability to get there.

In 2021, the Department for Transport started a Carbon Management Programme to manage and reduce the emissions from its large infrastructure portfolio. It has also led a pilot

programme funded by the Treasury's Shared Outcomes Fund, called the Shared Digital Carbon Architecture Programme, which aimed to prototype a digital system to enable us to analyse infrastructure emissions at a systems level.

This programme highlighted how there are still challenges on quality and maturity of whole-life carbon assessment data for infrastructure projects. Whole-life carbon emissions assessments are there on some projects but are missing on others, and there are inconsistencies in the data collected. That is why embedding PAS 2080 across the public and private sectors is so important, to be able to inform those crucial infrastructure decisions.

If we look ahead to the next 10 years, we need to shift quickly from understanding our portfolio emissions to driving forward reductions. A lot can be done through clever design, less waste and greener plant, but the biggest challenge is how we can decarbonise materials such as steel, cement and concrete, and how we scale up solutions to move from an innovation to a market solution. Without these solutions, ultimately, we can only get part of the way there.

Giorgia Albieri

Head of infrastructure carbon, Department for Transport



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The decisions we make today and over the next few years will shape and dictate how we travel, work and live in 2050, as well as our ability to get there.

Data and behaviour are the keys to change

With the right enablers, carbon reduction and efficiency can go hand in hand across the UK's major projects.

At the Infrastructure and Projects Authority (IPA) our purpose is to continuously improve the way government delivers projects and programmes and we are focused on how we can embed environmental sustainability considerations into our processes.

Data consistency is key. At a portfolio level, getting accurate, consistent data is a challenge. However, this is something we are working on, with some progress. The next challenge will be determining how much is 'enough' with regards to carbon reductions and supporting the net-zero trajectory. Behaviour change is also critical, and it starts at the beginning of any new project and continues

through procurement, design and construction. But changing behaviour is tough and risks need to be taken to get there. Demonstrating value for money is particularly key in our current economic environment. Innovation and productivity need to become part of the dialogue, in order to demonstrate how net-zero drives efficiency and effectiveness in projects.

Client organisations need to come together to shift the markets for 'green' products and a focus on outcomes needs to be ever present. Through our work at the IPA, we hope to drive processes and behaviours to make the environment integral to the planning and delivery of the UK's major projects.

Hariom Newport

Head of environment and sustainability,
Infrastructure and Projects Authority



Moving beyond energy-based carbon

Innovation and technology is needed to tackle process emissions in the water sector.

Looking back to the first Carbon Crunch conference 10 years ago, it is obvious how far the conversation has moved on and how much the skills, capabilities, knowledge and awareness across the industry have developed.

This is true too at Anglian Water. But there are many challenges we face, both within the water sector and beyond, as we also consider the climate resilience we need to build into our system.

This is where data becomes crucial, with a greater need for evidence-based decision making. As things like digital twins become more available, the challenge is ensuring the data doesn't become cumbersome, that the narratives we have and the compelling stories we tell keep the message simple. There are a range of stakeholders out there whose knowledge is very different, and they are all important in delivering low-carbon solutions.

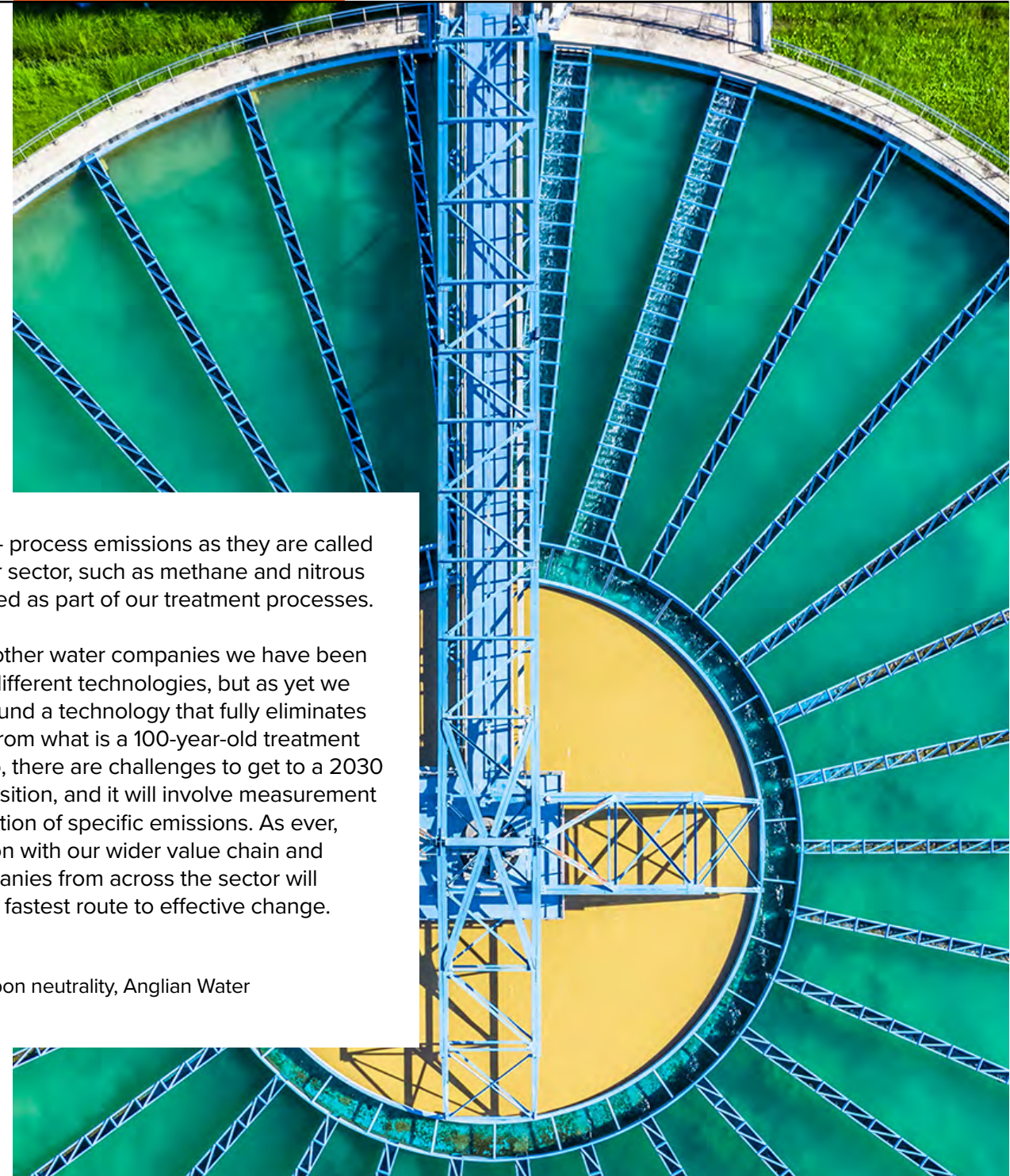
The last 10 years have been about energy-based carbon – grid electricity coming from renewables, generating more energy efficiency, reducing water consumption. We're transitioning now to thinking about non-energy greenhouse gas

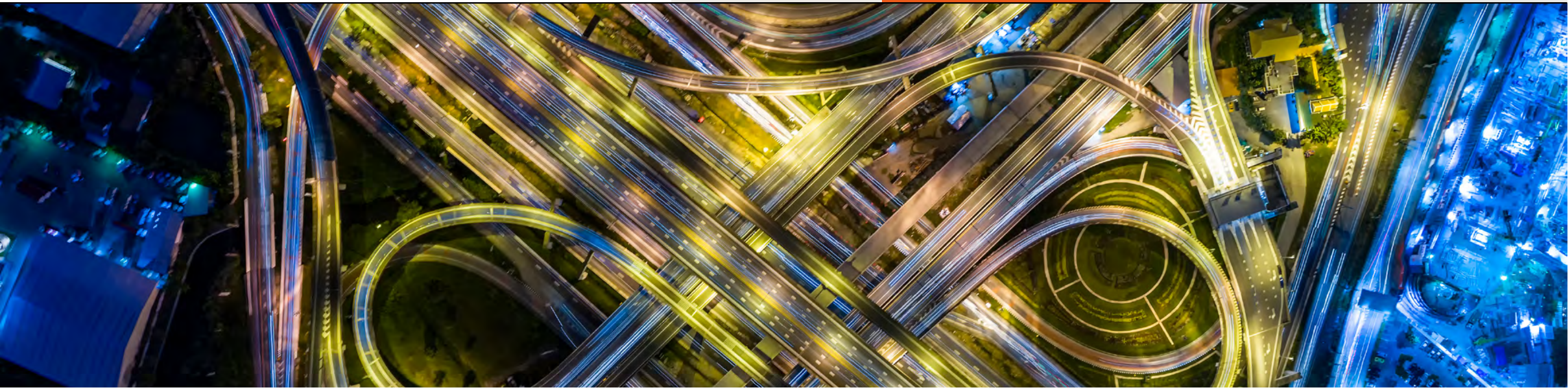
emissions – process emissions as they are called in the water sector, such as methane and nitrous oxide emitted as part of our treatment processes.

Alongside other water companies we have been looking at different technologies, but as yet we have not found a technology that fully eliminates emissions from what is a 100-year-old treatment process. So, there are challenges to get to a 2030 net-zero position, and it will involve measurement and elimination of specific emissions. As ever, collaboration with our wider value chain and other companies from across the sector will provide the fastest route to effective change.

David Riley

Head of carbon neutrality, Anglian Water





The future is federated

We need to share data
across built environment
systems to drive change.

When considering our built environment the most important thing is outcomes, for both people and nature; that focus on outcomes should be our starting point. A key definition of value in this context is providing more outcomes per pound, rather than just driving cheaper construction. There is a big difference.

Climate change affects the whole system of systems, of our built and natural environments. It doesn't happen in silos, and so we can't solve it in silos. This isn't just about achieving net-zero and climate resilience; it's also about achieving a circular economy, protecting biodiversity and enabling infrastructure equity, too.

These are all systems-level challenges that demand systems-level solutions.

These things are all connected, which in the end means that we need greater understanding of the systems, powered by data, so that we can make better decisions and intervene more effectively. To enable this, over the next 10 years, we need to see much greater information flow across our interconnected systems and across organisational boundaries. The future is federated.

Mark Enzer OBE FREng

Strategic advisor, Mott MacDonald, and lead author of the Infrastructure Carbon Review

A large orange arrow pointing from the left side of the image towards the right, serving as a background for the text.

Climate resilience: from assessment to investment

Rising to the resilience challenge

Investment in climate adaptation works; we need more of it to protect our national infrastructure.

Emma Howard Boyd CBE

Chair of the Green Finance Institute, co-chair, Coalition for Climate Resilient Investment (CCRI) and former chair of the Environment Agency

Great civil engineering underpins the modern Britain we know and love today. But the severe weather brought on in recent years by climate change threatens to overwhelm the infrastructure foundations we rely upon as a country.

This is why we must not only rise to the net-zero challenge, but also become resilient and learn to adapt our new and existing buildings and infrastructure to the future that lies ahead.

This was made stark in my final weeks as chair of the Environment Agency in July this year when the world was rocked by multiple extreme weather events. Despite this, climate adaptation-focused investments remain very low.

Positively, however, we know that when it happens, investing in adaptation works. Last year, the Environment Agency completed the

UK government's £2.6bn, six-year Capital Fund programme, on time and to budget, which meant that 700 flood schemes are better protecting over 300,000 homes, more than 600,000 acres of agricultural land, thousands of businesses and major pieces of infrastructure.

With a significant UK construction pipeline planned up until 2030, it is vital that national infrastructure is built ready for the climate events that are already locked in. At the same time, more work must be done to develop both adaptation standards and a strategic approach to managing climate risks. A better understanding of the level of adaptation investment required will also be key, including how this should be balanced between the public and private sectors.

I hope the government will consider asking the Treasury to commission a review of the

economics of resilience. This would consider the costs and benefits of resilience measures and the balance between public and private investment. Its conclusions would help establish a national ambition for climate resilience alongside net-zero and embed it in all government departments.

Initiatives such as the Coalition for Climate Resilient Investment have begun to address some of these issues, including the massive gap in resilience financing, but there is still more that can be done.

If we can align all the great work taking place across the sector and adapt the systems that underpin it, this decade will not just be when we pulled the world back from the precipice of climate catastrophe, it will be the decade we unlock a just, resilient and sustainable pathway for billions of people around the world.



Creating value through resilience

Resilience assessments can help the investment community see the value in climate adaptation measures.

From the point of view of the investment community, which is a group of practitioners that the Coalition for Climate Resilient Investment (CCRI) has been engaged with for a long time, I think there are five key issues surrounding climate resilience.

The first one is to understand the value created by investment in resilience. In other words, shifting the debate away from it being an incremental cost to it being value creative. This can be done by both optimising asset lifecycle costs – to show that upfront capital investment can result in lower operating and maintenance costs in the future

as and when climate hazards do happen – and factoring in the more predictable net operating revenues resulting from the integration of climate risks.

The second is to contrast value creation with risk transfer options. The usual practice currently is to insure against climate risks. However, this doesn't consider the dynamic aspects of climate change and that certain insurance products may become unavailable in the future, or that the premium might increase significantly as climate risks increase.

The third point is to ensure there is a methodology in place to incorporate physical climate risks in investment appraisal. With significant involvement from Mott MacDonald, CCRI has developed the Physical Climate Risk Assessment Methodology (PCRAM), which we hope will become a reference in the field.

Fourthly, PCRAM should be used by the entire investment community, on a par with ESG. This includes investors undertaking investment appraisal of assets and lenders during their due diligence. These resilience assessments should be done at important points in the life of the asset, not just during design but at completion, prior to a transfer of ownership or refinancing, during any expansion or if there is a review of part of the regulated asset base.

The final point is to think how the de-risking of an asset through investment in resilience should translate into a reduction of the capital cost. In the end, this will mean that climate risks can be priced appropriately and more money can be channelled effectively into resilience.

Alexandre Chavarot

Strategic advisor, Coalition for
Climate Resilient Investment





110km

of track between
St Pancras International
and the Channel Tunnel

A compelling business case

HS1 provides a fine illustration of how spending on climate resilience can be justified.

As a high-speed rail line, privately owned by two risk-averse investors from the pension community, HS1 can provide useful insights into how best to unlock funding for adaptation.

Covering 110km of track between St Pancras International and the Channel Tunnel, HS1 has a concession to operate, renew and maintain its rail line, but is not part of the national rail infrastructure. We are, however, regulated within price control periods and are just about to enter our next price review, which is a great time to think about how we can price in infrastructure resilience.

But funding is restricted. This means we must be very careful of the money we spend and how we articulate and justify it. In order to do

this effectively, we must deliver a compelling business case that is based on evidence, while considering efficiency and economies of scale. This means building resilience measures into interventions that are already planned.

Another consideration is around the evidence we provide within our business case, which must always consist of three key elements: it must be applied to the asset and product in question; it has to be relatable; and, most importantly, it must be accessible to those who are investing in the infrastructure.

The importance of accessibility – or the ability to translate what needs to be done to an asset and why – cannot be overstated, and when combined with these additional elements is a key component to unlock funding.

Richard Thorp
Engineering director, HS1

Partnerships to unlock private capital

Stimulating investment in both net-zero and resilience objectives requires a marriage of short-term and long-term strategies.

How can we increase investment in climate resilience? With £22bn to invest in infrastructure, the UK Infrastructure Bank (UKIB) is focused on achieving this, but there are a number of things we must consider.

One of our investment principles is to unlock private capital, something that relies on increased collaboration between the public and private sectors and the development of public/private partnerships.

There is a lot of capital out there waiting to be deployed into building resilient infrastructure and achieving net-zero, but it can't be done just by public or private investors alone. Developing more innovative financial instruments to help us work together would be a good place to start boosting collaboration.

From an investor point of view, transparency is also key, as well as understanding how risks can be clearly quantified and measured to improve valuations. Infrastructure assets are long-term by nature, so if you're only conducting an appraisal at the beginning, it's hard to marry the investment you're making in resilience today, with how it's going to improve your value down the road. And it is only by combining short-term with long-term strategy that we can meet the needs of both net-zero and resilience.

Iliana Lazarova

Head of ESG, UK Infrastructure Bank



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It can't be done by public or private investors alone. Developing more innovative financial instruments to help us work together would be a good place to start boosting collaboration.



Using systems
thinking to
deliver resilience

Connected digital twins to model system impacts

Combining data from different
sectors with scenario modelling
will power up resilience planning.

Reports released by the Committee on Climate Change and its Adaptation Committee have been saying for some time that we have a poor understanding of our nation's infrastructure interdependencies. A continuing lack of data on asset vulnerability to extreme weather is a problem that CReDo is now trying to change.

CReDo (Climate Resilience Demonstrator) is a climate change adaptation digital twin, which brings together data from across energy, water and telecoms networks to create a bigger picture of the infrastructure system. It allows us to see how the different assets connect up and what the overall system looks like. It also can help us to understand how we increase resilience and how we can adapt to changing conditions in temperature and weather.

Combining asset data with future flooding scenarios, for example, we can see where assets may fail and what the impact will be across the entire system. In some cases, things like electricity substations going down may have

an impact well beyond the flooded areas and may affect other assets such as telecoms exchanges and water pumping stations.

This allows us to prepare for and respond to flooding events and by using live data we may be able to improve our emergency response. By analysing the data, we can also plan future networks and report on resilience within the system.

It also demonstrates that one company investing in another company's resilience is actually a more effective way to protect themselves because of the interdependencies, and this will prove to be an important driver for increased collaboration.

Scenarios modelled within CReDo can help decision makers such as asset owners and local authorities gain understanding of the impact of differing interventions. It demonstrates crucially that collaboration is key to both building resilience in infrastructure, and responding to the worst effects of climate change.

Sarah Hayes

Strategic engagement lead of CReDo,
Connected Places Catapult





Helping Glasgow City Region to flourish whatever the weather

The Scottish region has presented a bold and ambitious statement of the desired future.



Our plan aims to be a catalyst and a call to action for all organisations, communities and businesses to step forward, step up and collaborate.

Climate Ready Clyde is a cross-sector initiative to create and deliver a shared vision, strategy and action plan for the Glasgow City Region. By working with partners from across government and business, we have delivered a number of key outputs, including our 2019 climate risk and opportunity assessment which identified 67 climate risks and opportunities across the region.

But it is our 2021 Climate Adaptation Strategy and Action Plan that is our most bold and ambitious statement of the future we want, attempting to deliver on a Glasgow City Region that flourishes in a future climate.

Its aim is to be a catalyst and a call to action for all organisations, communities and businesses to step forward, step up and collaborate. It is focused on transformational adaptation, not just doing things differently, but also different things. That means structural changes to regional systems – be that governance, finance, economic or ecological.

The Strategy and Action Plan has been recognised by the Climate Change Committee as a leading example in the UK of addressing climate risk at a regional scale. It consists of three parts: the vision that sets out the case for why we need to adapt over the long term; the strategy to 2030, including recommendations for 11 interventions and 42 subinterventions; and an action plan to 2025, with 16 flagship actions to kickstart the process.

We are seeking a co-ordinated, combined net-zero approach to transformational adaptation so that we deal with the costs together and put in place measures that prioritise securing resilience of the most vulnerable, protect homes and build a just resilience.

Catherine Pearce

Innovation manager, Sniffer, and programme manager for Climate Ready Clyde

Metrics help plot a robust water supply system

A systems-based approach is crucial to building resilience in our water supply infrastructure.

Water Resources South East is an alliance of six water companies who are making a multi-sector resilience plan for 2025-2100, based on data from agriculture, power and other sectors, bringing them all together to work on the bigger picture.

To develop this plan, we created a schedule of metrics that reflect the performance of the water resource system as a whole. These metrics informed the system modelling and the design of an integrated portfolio of interventions to improve resilience of water supplies across the region.

We used a system mapping approach to show how infrastructure design, environment and human factors all contribute to resilience. For example:

- designing a pipeline to pump in both directions would create an adaptable system that could respond to drought in different parts of the region;

- improving soil health reduces the impact of drought and improves water quality;
- good customer relations improve the potential of demand management in acute droughts and in the uptake of long-term demand management.

When we had developed the metrics, we then scored the interventions to show the contribution that they make. The scoring is enabling us to assess different combinations of interventions to create a 'best value' resilience plan for the region as a whole.

Our use of system mapping to identify metrics which inform modelling and the development of a wider strategy has set a precedent. The OxCam Arc Integrated Water Management Framework and the Subregional Integrated Water Management Strategy for London are both being developed with the same approach. It shows a new way forward for more integrated planning of infrastructure and environmental systems.

Brendan Bromwich

Principal civil engineer, Mott MacDonald





Beating flooding in Bangkok

The smart use of data underpins the Thai capital's flood warning system.

Urbanisation coupled with the severe impact of climate change is placing increasing pressures on our cities' infrastructure and services. From air pollution and traffic, to flooding and waste management, there are a number of challenges that cities must now grapple with.

In Bangkok, one of these issues presents a very real and urgent risk: flooding. Located along a flood plain area along the Chao Phraya River, the capital sits on average just 1.5m above sea level, with parts of the city even lower than sea level.

With the ground sinking at a rate of 2cm a year, the rising sea level threatens to exacerbate this risk; upstream water, rainfall and high tides are the main sources of flooding.

Finding a solution to this very immediate problem became the focus of the UK-funded Global Future Cities Programme in Bangkok. Overall, the programme has three focus areas – data for city planning, resilience and transport – and has been implemented in 19 cities in 10 countries around the world. Bangkok, however, is the only city where all three focus areas have been implemented at the same time.

The team has been working to find a digital solution for flood management. As part of this, they selected a 14km² urbanised area of Bangkok to pilot a digital decision support system.

2cm

The amount the ground in Bangkok lowers against sea level each year

The system collects data on rainfall to give accurate forecasting, which enables the city to predict where floods may occur. This proactive evidence-based approach then bolsters preparation and response to flood events.

This digital solution is also scalable and offers one example of how a major city is adapting to climate shocks. With flooding events likely to affect major cities around the world, this data-led approach is an important tool in our response to the increased risk to both lives and infrastructure.

Natee Thongchan

Future cities advisor, Prosperity Fund Programme at British Embassy Bangkok

Proactive resilience for our rail system

Flood protections installed on a line in Wales demonstrate how such investments can pay for themselves.

We want to build a better, smarter and greener railway for everyone in Britain, which is why we're developing a long-term strategy for the future of rail.

A core focus of this is climate change adaptation. As an organisation our objectives span improving train times and costs, to boosting economic growth and levelling up through better connectivity, all the while decarbonising the railway. However, delivering these objectives will be severely impaired by an inability to keep the railway open because of bad weather.

One of the major ways we can respond to this challenge is by proactively investing in resilience around our infrastructure and rolling stock.

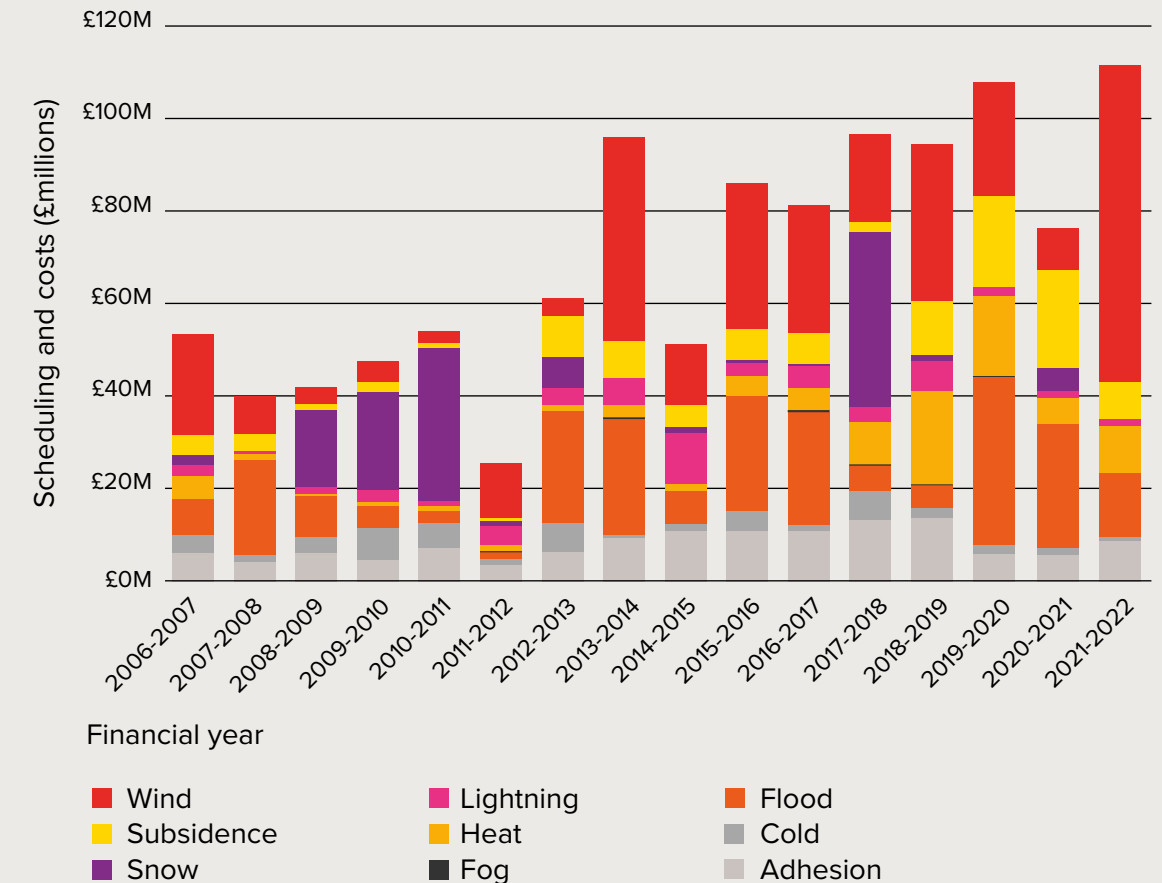
An example of this in action is a railway line running through the Conwy Valley in Wales, which was severely affected by flooding in 2015 and 2019, leading to prolonged line closures. In the first instance we rebuilt the rail line like for like, but it washed away in similar conditions a few years later. After the second time we installed rock armour, essentially a series of rocks down the side of the track, to create resilience. This was not an easy cost to justify as it doesn't instantly appear to be doing anything.

Since that installation the railway has flooded four times but has not seen anywhere near the same level of damage. The cost of the resilience measure was £6M but the loss avoided due to the added resilience has totalled £8M, meaning it has paid for itself in less than two years. This shows how quickly return on investment can be achieved with effective future resilience planning.

Lisa Constable

Climate change resilience lead – long term strategy for rail, Great British Railways Transition Team

Baseline and reference case



Helping you on your climate change journey

Wherever you are on your journey towards net-zero and climate resilience, Mott MacDonald has the expertise, tools and know-how to support you along the way. Here are some resources that can help.

Thought leadership

[‘Net-zero: winning strategy or false sense of security?’](#)

Net-zero is powerful as a rallying message but we must be more aware of who gets to make use of the ‘net’, writes Clare Wildfire, our global practice leader for cities.

[‘How to develop a net-zero plan: lessons from the Water UK routemap’](#)

Infrastructure owners need routemaps that will guide them to net-zero carbon – and their journeys need to start now, writes Priyesh Depala, Mott MacDonald’s investment planning advisor.

[‘Transporting you to a low-carbon future’](#)

Transport is the largest source of carbon dioxide emissions in the UK. The sector needs to lead the way in moving the UK, and the rest of the world, to a greener future. By Katie Chesworth, our principal transport planner and transportation unit sustainability lead.

Online resources

[Combating the causes and effects of climate change. Together.](#)

Our climate change web pages.

[Reducing emissions to net-zero](#)

Learn more about how we can support you during the climate transition.

[‘Less is more’](#)

Our carbon management brochure.

[FUTURES Toolkit](#)

Our FUTURES approach helps you to implement vision-led planning for net-zero and resilience that takes account of future uncertainties.

[Moata Carbon Portal](#)

Our carbon monitoring solution for the built environment, enabling a net-zero future.

[‘A place-based approach to net-zero’](#)

How local insight, capability and connectivity can help the UK towards a better, faster, cheaper net-zero (produced by the Net-Zero Infrastructure Industry Coalition).

A leader in addressing climate change

Nobody knows infrastructure climate change issues like we do. We have been working with our clients to cut carbon for nearly a quarter of a century, helping them to reduce their environmental impact, drive efficiency and become more sustainable. We co-authored the Infrastructure Carbon Review in 2013. In 2015, we co-authored PAS 2080, the international standard for managing infrastructure carbon, and are accredited to PAS 2080 globally.

In 2020, we became the first company of our kind to be certified as carbon neutral and we have pledged to become a net-zero organisation by 2040 or earlier. We have joined the UN Race to Zero campaign, are a partner to the Coalition for Climate Resilient Investment in developing the Physical Climate Risk Assessment Methodology, and support the Powering Past Coal Alliance to advance the transition to clean energy.

Videos



What does it mean for development to be climate-smart?



Leaving a social legacy from infrastructure



The path to zero carbon heat



Pour into the fire by Awa Ndiaye



A place-based approach to net-zero



Leaving a social legacy from infrastructure

**Opening opportunities
with connected thinking.**