



2023

# Infrastructure in 2023:

A horizon scan of the year ahead for civil engineering

**66** Civil engineers have a crucial role to play in helping society to meet the climate change challenge



# Foreword



**David Porter**  
ICE Vice President –  
Learning Society

**Infrastructure is hugely important because the whole of society relies on it every day. The work of civil engineers in operating and developing these assets is therefore crucial.**

Yet in a world that is working towards net-zero carbon, infrastructure poses some highly significant challenges – not least the amount of energy needed to power it, the emissions from its use, and the fact that the main construction products used generally contain steel, cement or bituminous materials, which are all currently carbon heavy.

Other trends, such as inflation, growing urbanisation, ageing populations and the emergence of disruptive technologies, emphasise the need for urgent action. In some cases, this requires a profound rethink about how society operates.

In response, last year the Institution of Civil Engineers (ICE) asked a vibrant and diverse group of members with specific skills and expertise to join our new Community Advisory Boards (CABs). We asked them to scan the horizon to identify the main issues facing infrastructure and the impact they were having on society.

This report builds on that work and includes case studies from around the world that demonstrate some of the advances being made. I would like to express my appreciation for the efforts of our CAB members and thank them for the time they have given to carry out this important work.

Given our reliance on infrastructure, and the fact that it accounts for half of all energy-related carbon emissions, civil engineers have a crucial role to play in helping society to meet the climate change challenge. However, many of the ICE communities have questioned whether civil engineers currently have the collective ability and skillset to deal with climate change while continuing to support growth in the global economy.

More extreme weather will require a greater focus on adaptation and resilience, and civil engineers can help with this. Their work can also help to ease some of the worst impacts of the cost-of-living crisis. At the same time, engineers must deliver business cases that are acceptable to clients. The ICE communities believe that these considerations are not mutually exclusive and that infrastructure can be both sustainable and economically viable.

This is the first ‘horizon scan’ report to include input on engineering fundamentals. It has been added to ensure that the ICE provides clarity on the expertise that is critical to all future engineers, such as competence, design capability, ethical behaviour, hazard avoidance, climate adaptation and future thinking.

I hope the findings outlined on the following pages will help to focus the activities of those involved in the infrastructure industry, and that all members of the sector will work collaboratively and smarter to tackle the big issues facing our world.

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## About this report

**In 2021, the ICE launched new CABs to drive trusted, authoritative, independent insights into the issues affecting our infrastructure.**

Each board comprises industry experts and representatives of supporting communities who help to build respective knowledge programmes. This year has also seen the creation of our Knowledge Networks: specialist topic-area groups that feed into the CABs.

This report assesses the current situation for each area of civil engineering represented by the CABs, and what is needed in 2023. The ICE thanks all members of those communities who have contributed:

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Find out more: [ice.org.uk](https://www.ice.org.uk)

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**Case study: Anglian Water's Strategic Pipeline Alliance**

**Anglian Water's Strategic Pipeline Alliance has seen the utility firm join forces with contractors Costain and Farrans as well as consultancy Jacobs and the Mott MacDonald Bentley joint venture on a £400m project to deliver 500km of interconnecting pipelines.**

The mammoth civil engineering programme is designed to allow water to be shifted from areas with a surplus to those in deficit, increasing the resilience of the East of England to climate-related drought.

As an adopter of the [Project 13 philosophy](#), the alliance has taken

a number of steps to promote forward-thinking, data-led, digital working. Commercial rewards are linked through contracts to overall project outcomes, while risks are managed as a team.

Information is made available to all parties and a [long-term digital transformation roadmap](#) has been created, moving from the set-up of data rules to the optimisation of aftercare.

The ICE Data and Digital community believes this scheme is an exemplar of progressive thinking and urges its lessons to be learnt and built upon across the industry.

**20%**

increase in properties served by the utility compared with the late 1990s

**58**

million litres per day – the predicted impact on water capture from climate change by 2045

**500km**

of pipelines are being laid to increase the East of England's drought resilience

# 01 Data and digital

**The need for an industry-wide national digitalisation strategy is clear – still, significant change is needed both in terms of engineers' skills and organisational cultures across the built environment if the potential of data-led, digital ways of working is to be realised**

A national strategy is needed to provide a roadmap for effective digitalisation of the built environment.

To date, progress has been on a project-by-project basis, driven by specific requirements, ambitions and technologies. There is no overarching vision to ensure that the industry moves forward in the most productive and useful way for society.

If civil engineers are to meet the challenges of climate change and the global economy, rapid improvements are needed in how we work. Getting the most from technology is critical, but this can only be achieved by outcome-focused, joined-up, systems-level digitalisation of the industry.

Creating a national strategy is the first step and there are several opportunities to take it in a meaningful direction in 2023.

**Industry workstreams**

The Construction Leadership Council (CLC) published its new strategy in September 2022. It highlighted "[next-generation delivery](#)" as one of four ambitions for transformational change. The ICE Data and Digital community supports this ambition but believes the industry needs to go further and galvanise the infrastructure sector behind a comprehensive roadmap.

The Data and Digital community is producing a paper on the importance of data and digital working, which it hopes will help the industry to move forward. However, both the community and the CLC group are relatively small panels of volunteers and a better-funded approach is what is really needed.

Bodies such as Nima (formerly the UK BIM Alliance) and the Government and Industry Interoperability Group are also undertaking important work on the industry's use of data and digital. There will be plenty of opportunities in the coming year to move forward and join all of these efforts up. Still, even the attempt to bring the industry together is itself fragmented.

The data and digital sector is worth billions of pounds and we need to have a clear focus on defining our shared goals and

developing a strategy to achieve them. Digital twins, robotics, artificial intelligence and virtual reality are real-world technologies now. However, siloes need to be broken down and a data environment connected by a golden thread of lifecycle information must be the goal if the benefits of such technologies are to be maximised.

**Investor appetite**

With inflation expected to remain high in 2023 and economic uncertainty being felt around the world, there could be more investor interest in the built environment – in particular, in civil engineering projects that offer an attractive return on investment over the longer term.

The ICE Data and Digital community sees a huge opportunity to deliver a roadmap that demonstrates to fund managers the return they could make on an industry that is looking to ramp up its productivity. A concerted effort to transform construction processes could significantly reduce the wasteful practices in evidence on many sites around the world.

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Getting the most from technology can only be achieved by outcome-focused, joined-up, systems-level digitalisation of the industry

Imagine if major clients such as the UK Government's National Highways and planned Great British Railways could come together to ensure that digital and data systems were linked not just within their own portfolio of projects but across the broader industry, beyond organisational limits. This would open up a new stream of efficiencies and shared practice as well as allowing suppliers to switch more smoothly between jobs and giving civil engineers access to the information they need to ensure project success.

Investors are critical to pulling the levers that can make such cross-industry collaboration happen. A national digitalisation strategy will be a crucial way to show investors the benefits and means of getting involved.

**Social change**

Focusing on emerging technologies is one thing, but society also needs to adapt to make the software viable. Big changes will be required both in terms of individual skills and organisational cultures across the built environment if we are to maximise the potential of data-led, digital ways of working.

In 2023, we can continue to drive this change by engaging with schools and universities about the kinds of skills future engineers will need – these will need to be far more sophisticated than those taught in the past. We also need to encourage boardrooms to embrace the new data and digital age.

Are graduates being equipped with the skills to use new software and the language needed to speak to technology teams rather than just surveyors and designers? Are there people progressing sufficiently high up within businesses who can talk truth to power about the importance of digital processes and promoting big-picture systems thinking?

Culturally, we need to define, recognise and reward the right behaviours that allow a focus on future processes and the role of digitalisation throughout the lifecycle of a built asset. Data agreements to allow information to flow throughout the industry will be vital to creating the most productive sector possible.

All of this needs to be set out in an industry-wide digitalisation strategy. Society and its challenges are rapidly evolving, and this presents an opportunity for further improvements in infrastructure performance with the goal of boosting nations' productivity.

**Five-year view**

Nothing should be done in a digital space in 2023 without an eye on 2028. Engineers need to start thinking more strategically about how new systems and technologies are implemented for the longer-term greater good.

The need for a national digitalisation strategy is clear. We also need to benchmark this so we can measure our progress on the journey over the next five years and beyond. Good practice needs

to be identified, shared and adopted so that it becomes much more widespread over the rest of this decade.

Looking at this concept from the other direction, there are targets set for 2030 – whether they be environmental, economic or social – which should be dictating how we operate in 2023. By understanding the vision of the future we want, the industry can see how much progress it needs to make in the coming year towards those bigger goals. Every organisation needs to get control of their data and start to manage it better. Reporting cost, carbon and a range of other metrics today can help us to manage these factors far better in the years to come.

**Further reading**

- [Centre for Digital Built Britain, KPMG, Atkins \(2021\) The value of information management in the construction and infrastructure sector](#)
- [Department for Business, Energy and Industrial Strategy, Construction Leadership Council \(2022\) Vision and leadership](#)
- [ICE \(2022\) A Systems Approach to Infrastructure Delivery: putting the principles into practice](#)
- [Schooling J et al \(2020\) Flourishing systems: re-envisioning infrastructure as a platform for human flourishing, ICE Proceedings: Smart Infrastructure and Construction 173, 1, 166-174](#)
- [UK Government's Integrated Rail Plan: the role of innovation in rail](#)
- [The current focus on the digital divide and the need for improved digital infrastructure to support levelling up could influence the ongoing Levelling-Up and Regeneration Bill going through Parliament](#)

**ICE Knowledge Hub: CPD content for members**

- [Explaining security-mindedness](#)
- [Understanding security-mindedness](#)

**UN Sustainable Development Goals (SDGs)**

Linking our work back to the [UN Sustainable Development Goals](#) is a core part of the ICE's plan and mission. This chapter ties in with the following SDGs:



**Case study: Digital transformation at ClearTech**

**Established in 2010, Ireland-based engineering company ClearTech Engineered Solutions delivers net-zero post-tensioning support to organisations across the world.**

As the global focus on sustainability has intensified, ClearTech has experienced growing demand for its services, with an increase in the number of tender estimation requests it receives. It found that most companies were using PDFs for releasing design information but that there was no easy way to quantify material measurements digitally.

Engineering and construction software company Bluebeam's Revu solution was recommended to ClearTech

for its digital estimations, with the following results:

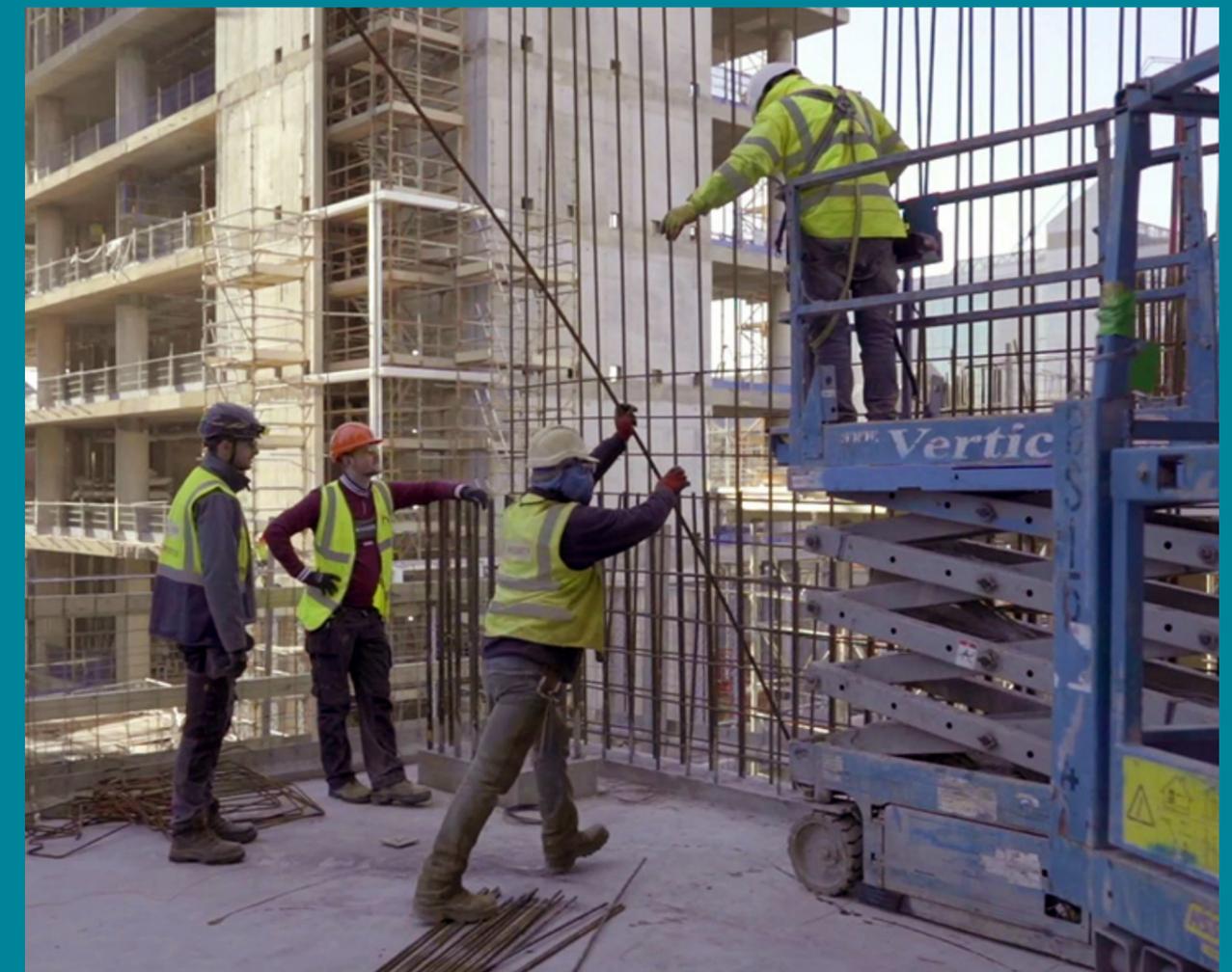
- ClearTech has won 50% more projects since implementing Revu by becoming more efficient overall.
- Its printing budget was cut by two-thirds, saving thousands of euros.
- Design reviews became 50% faster and quantity takeoffs and estimations were 80% faster, freeing up time to devote to new projects.

ClearTech then started using Bluebeam Revu whenever it could. Now the software is also used for tasks such as precise forecasting of materials, transparent

record-keeping and setting key performance indicators. It has enabled the company to cut waste and improve its communications.

ClearTech has completed work for clients including Amazon, Facebook, Google, HS2 and Salesforce. Its chief executive, Feargal Cleary, says: "We want to be a leading light in the industry, and we're pushing the likes of Bluebeam to demonstrate that there is an opportunity for innovation in the industry here in Ireland."

■ *To read more about ClearTech's digital transformation visit [www.bluebeam.com/uk/customers/cleartech](http://www.bluebeam.com/uk/customers/cleartech)*



## 02 Decarbonisation

**If the UK is to hit national carbon targets, huge strides will need to be made over the next five years. With infrastructure being a major contributor to emissions, the role of civil engineers in that task will be vital**

In 2013, the UK Government's Infrastructure Carbon Review set out the scale of infrastructure's carbon problem and the need for a decarbonisation agenda.

It determined that the construction, operation and maintenance of assets was contributing approximately 16% of the UK's total carbon emissions. This figure jumped to 53% when the use of infrastructure was included, and it was generally accepted that about 70% of emissions were directly caused or enabled by the existence of infrastructure. The challenge to the whole infrastructure and civil engineering profession was made abundantly clear.

In 2021, a follow-up report by the Green Construction Board acknowledged infrastructure's key role in the net-zero agenda and the need to recognise that as a system it was "critical in enabling deep decarbonisation across the nation".

If meaningful progress is to be made on infrastructure decarbonisation, the significance of whole-life carbon must become part of the mindset of civil engineers. Strategically, this means we must get our 'rules, tools and skills' right to embed decarbonisation in our daily activities.

### Rules

Whole-life carbon emissions remain a critical environmental concern for which there are no consistent rules or regulation, unlike those for clean air, noise, contaminated land or waste. The ICE Decarbonisation community believes that voluntary observance will not suffice. Instead, public-sector projects should operate within short-range carbon quotas or budgets, rather than long-term broad objectives, as this would highlight the need for a much faster pace of change. This would encourage private-sector supply chains to follow suit.

One step forward for 2023 would be the wider application of PAS 2080, the global standard for managing carbon in infrastructure, which applies to all stages of a project through intelligent design, construction and use. PAS 2080 is a key reference document in the Government's updated Construction Playbook and the associated Promoting Net Zero Carbon and Sustainability in Construction document, which was published in September 2022. This sets out policies and guidance for how public works projects and programmes should be assessed, procured and delivered. The forthcoming update to PAS 2080,

which the ICE is contributing to and is due to be published in early 2023, will broaden its application and encourage systems thinking rather than a standalone project approach.

HM Treasury's Green Book, which offers guidance on how to appraise policies, programmes and projects, has also been updated to include carbon in the earliest business-case stage for all relevant projects. A formal link between PAS 2080 and The Green Book would be a helpful next step, and the ICE will be pushing to widen the use of the Book's carbon values to encourage better decision-making.

The Department for Transport will soon publish quantified carbon guidance that will require Local Transport Plans to consider carbon in the appraisal process. This will direct more financial support towards plans that actively reduce emissions.

While public procurement influences private-sector practice, there are few regulatory requirements on the private sector to follow the decarbonisation agenda. That said, the desire to demonstrate environmental, social and governance credentials is growing and helping to reduce climate impacts.

### Tools

Engineers need better tools to help calculate carbon outputs consistently. There are numerous calculation tools but issues exist over quality, scope and alignment. The ICE's Civil Engineering

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**If meaningful progress is to be made on infrastructure decarbonisation then the significance of whole-life carbon needs to be part of the civil engineer mindset**

Standard Method of Measurement 4 (CESMM) is useful but is now a decade old. Coming soon is the Built Environment Carbon Database – while it is more buildings-focused, it is to be welcomed because a single database that is authoritative, transparent and regularly updated is preferable and offers potential for regular and consistent upgrades.

There are examples of good practice in Scotland and Wales. In August 2021, guidance was issued for managing whole-life carbon on the £5bn Scottish City Region and Growth Deals programmes. The second edition of the document includes emerging decarbonisation approaches, guidance on carbon benefits realisation, and a carbon checklist for business cases. Projects in the North Wales Growth Deal, meanwhile, are required to target a 40% reduction in embodied carbon and net-zero operational carbon.

**Skills**

The civil and infrastructure engineering industry has many highly competent people working in it, but few people in senior roles will have had any formal education on climate and carbon issues, unlike young engineers starting their careers.

In 2021, the Joint Board of Moderators (JBM) confirmed changes across the civil, structural, transportation and associated engineering disciplines in the built environment sector. These will mean it is no longer possible to complete a JBM-accredited engineering degree without studying mandatory content on sustainability, climate and carbon.

The ICE Decarbonisation community acknowledges that not everyone in the industry needs to become in-depth climate or carbon experts. Still, it firmly believes that all of those in the sector need to understand the direct links between climate action and their day job. The ICE should provide relevant, good-quality knowledge content on these topics and signpost where other good training materials are available.

The ICE’s Carbon Management in Infrastructure training course, which provides practical guidance on applying PAS 2080 to projects with the combined aims of cutting carbon, reducing cost and adding value, is one of many useful resources available.

**Five-year vision**

If the UK is to hit national carbon targets, huge strides in decarbonisation will need to be made over the next five years. The ICE Decarbonisation community is focused on two essential aspects of carbon management in this timeframe:

- Consistent, valid metrics to allow a common understanding of whole-life carbon impacts, aiding better decision-making
- Clear short-term budgets or goals for carbon reduction to build a stronger common understanding of the scale of change needed.

By 2028, private-sector developers must play a full part in such initiatives and we need to help them to understand that

decarbonisation is a growth opportunity rather than a burden as it can improve the engineering process. Carbon and cost should be considered together to ensure the most efficient solutions.

The civil engineer of 2028 should be confident in their decarbonisation role and challenge other stakeholders where projects will not work for the greater good of the country or the planet. It is also important to consider carbon minimisation in the wider context of sustainable development and whole-life, whole-system thinking. Understanding trade-offs is crucial – some projects could result in higher carbon emissions at earlier stages but this may be justifiable to ensure sustainable outcomes.

**Further reading**

- BSI (2016) [PAS 2080](#)
- [Built Environment Carbon Database](#)
- Green Construction Board (2021) [Infrastructure Carbon Review: seven years on](#)
- HM Government (2022) [Promoting net-zero carbon and sustainability in construction](#)
- HM Treasury (2022) [The Green Book](#)
- ICE Publishing (2012) [CESMM4: Civil engineering standard method of measurement, fourth edition](#)
- ICE Training: [Carbon management in infrastructure](#)
- Scottish Government (2022) [Scottish City Region and Growth Deals: carbon management guidance for projects and programmes](#)

**ICE Knowledge Hub: topics to be covered in 2023**

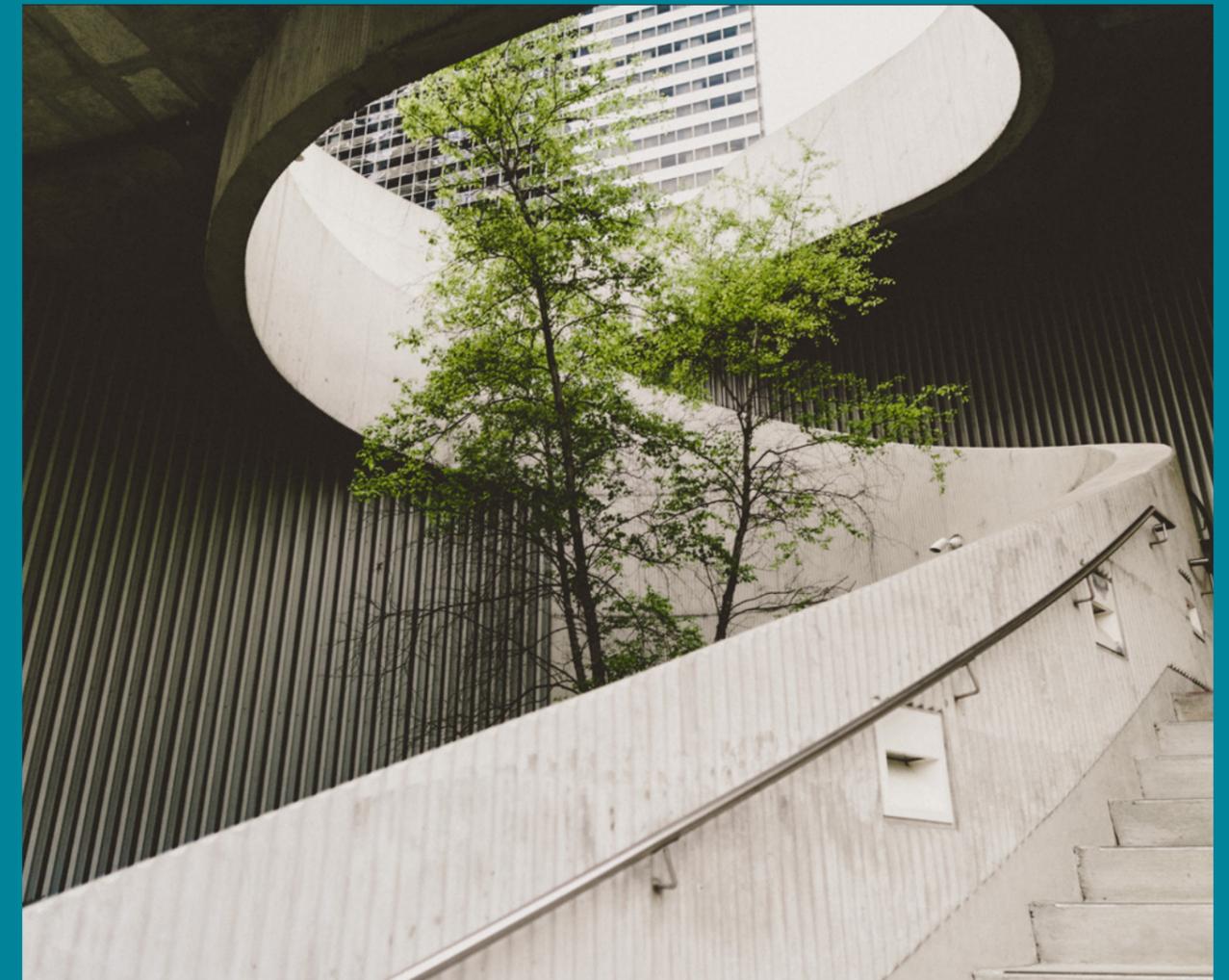
- Calculating and measuring carbon
- Creating a carbon-conscious business plan
- Low-carbon energy
- PAS 2080
- Understanding decarbonisation in the context of your role
- Understanding carbon targets
- Understanding materials

**UN Sustainable Development Goals**

This chapter ties in with the following SDGs:



**Case study: ICE Carbon Champions – recognising projects that make quantifiable carbon savings**



**Built environment professionals have a duty to address the problems that infrastructure causes for the Earth’s climate.**

The ICE Carbon Champions initiative was established to identify real-life examples of projects that have achieved, or are projected to achieve, quantifiable carbon savings compared with the ‘norm’ or a baseline.

Projects can be cross-organisational, be at any stage in the lifecycle of a project, be of any size, and be located anywhere in the world.

An expert panel puts applicants through a rigorous assessment, examining:

- What has been delivered to reduce carbon emissions

- The quantified carbon savings, with a clear and robust methodology of how this is calculated and compared with a baseline
- The period over which carbon savings have been calculated.

The programme has a [LinkedIn group](#) that now numbers more than 1,800 members, enabling the wider engineering community to collaborate.

Case studies of Carbon Champions projects are also published on the ICE website.

Find out more about the Carbon Champions programme [here](#).

To apply to become an ICE Carbon Champion click [here](#).

**14**

The number of projects so far given Carbon Champion status

**1,800**

The number of members of the Carbon Champions LinkedIn group

**70%**

The percentage of global carbon emissions estimated to be directly caused or enabled by the existence of infrastructure systems

## 03 Driving productivity

**A closer relationship between client and contractor and a willingness to change embedded ways of working are crucial to delivering better productivity – upcoming megaprojects provide an opportunity to take some positive steps**

Culture change will be needed if we are to boost productivity in the civil engineering industry and tackle the huge challenges society faces in 2023 and beyond.

The ICE Driving Productivity community believes that global pressures, major recent reports and forthcoming megaprojects will offer an opportunity to boost the efficiency and effectiveness of the sector next year.

### Global pressures

Global political and economic challenges have highlighted the importance of improving engineering productivity. The Covid-19 pandemic has been followed by war in Ukraine, floods in Pakistan and wildfires in Australia, leading to material shortages that have sent costs and workloads soaring. There is no way of meeting the urgent demand for civil engineering within the decimated budgets available without a serious rethink of how we deliver.

The energy sector is a clear example. The development of renewable production and cross-border connectivity capacity has become a priority globally to ensure security of supply and tackle soaring bills. A multitude of huge but previously unviable schemes could come to the table next year, but they will need to be planned, procured, designed and built in the most effective and efficient way possible.

Clients will need to realise that they won't be able to achieve their ambitions without cutting to the chase on procurement: getting the best people together quickly and motivating them to work collaboratively on scalable, repeatable solutions. Not only do engineers need to work together to realise efficiencies, clients must be open about their future pipelines of work and their budgets to ensure that the industry can do the planning needed.

Governments, for their part, will need to address planning processes so that designers have the freedom to build into applications the capability for the most productive methods of construction – taking more land if it is needed to set up onsite

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**Sharing digital models, work pipelines and component design must become normal practice at all levels of the global infrastructure industry**

manufacturing, for example – rather than taking the path of least resistance.

### Landmark reports

Improving productivity was the subject of the ICE's recently published State of the Nation 2022 report, and the institution's Driving Productivity community played a key role in its composition. The report called for engineering leaders to create a culture of open discussion that valued input in workplaces so that people at all stages and levels of a project would have the confidence to identify wasteful practices and help to eliminate them.

Eight foundations of productivity are identified in the report, which has been distributed to bodies and individuals throughout the industry, including clients, government departments, manufacturers and designers. These eight pillars are: vision; values; culture; systems thinking; collaboration; innovation; processes and tools; and leadership and management.

Clear priorities are listed under each heading, and the report also identifies practical tools for delivering enhanced

efficiency and effectiveness. The commitment to the issue of productivity in the State of the Nation 2022 report is seen as a major opportunity to influence key people and drive the agenda.

The ICE Driving Productivity community intends to maintain dialogue with government officials to maximise the impact of messages from State of the Nation and its wider work.

At the same time, it will seek to influence future updates to the Government's Construction Playbook, another critical document in changing construction culture.

**Big projects**

Critical work will be undertaken on several large projects in 2023, and the big players involved in them could set the tone for a step change in productivity.

Sizewell C nuclear plant (see case study, page 33), the Lower Thames Crossing and High Speed 2 phase 2a are among the multibillion-pound schemes that will continue development next year. These megaprojects offer a huge opportunity for the industry to learn lessons from the past, innovate effectively for the future and devise more efficient ways of matching resources with demand to deliver what is required.

For example, these schemes will include highways elements, so why not adopt common components that can be designed and honed, then repeated at scale across jobs? Clients should work together to demand this, and we as an industry need to collaborate and deliver.

One issue that needs to be tackled next year is the frequent slipping of procurement dates, particularly contract awards. The amount of resource tied up and waiting for the chance to bid on something, design a certain element or get onsite and build is not conducive to a productive industry.

This is related to the issue of global pressures discussed earlier. Uncertainty created by world events can harm confidence, leading clients to hold back jobs, which makes the industry less efficient and drives up prices. In turn, this further dampens confidence, creating a vicious cycle that has to be broken.

**Five-year vision**

Taking a longer-term view, from a global perspective, nations and project leaders will have to understand the market they are operating in. There will be ever more competition for engineering talent and resources with so much infrastructure work planned and no magic wand to deliver it.

To attract the right people and materials at the right prices, it will be imperative to share future pipelines of work in good

time and show a willingness to commit to decisions, to procure on favourable terms and to look after suppliers and workforces. In future, resource planning is likely to happen on an even grander scale as the world looks to meet the pressing challenges of climate change and economic development.

Sharing digital models, work pipelines and component design will need to become standard practice at all levels of the global infrastructure industry. This is the kind of change that will be necessary if we are to create the level of productivity that is required to meet society's needs. Engineers can start to promote this now with their words and actions.

**Further reading**

- Australian Government Productivity Commission (2022) [Five-year productivity inquiry: innovation for the 98% – interim report](#)
- Cabinet Office (2020) [The Construction Playbook](#)
- ICE (2022) [Procuring improved construction productivity: guidance note](#)
- ICE (2022) [State of the Nation: improving infrastructure productivity](#)
- Infrastructure and Projects Authority (2021) [Transforming infrastructure performance: roadmap to 2030](#)
- McKinsey Global Institute (2017) [Reinventing construction: a route to higher productivity](#)
- Nichols Group (2021) [Project SPEED: vision report](#)

- ICE Knowledge Hub: CPD content for members**
- [Flow bridge project](#)
  - [Understanding a systems approach to infrastructure](#)
  - [Delivery models – promoting a more collaborative approach to project delivery \(coming in 2023\)](#)
  - [Putting value at the heart of infrastructure \(2023\)](#)

**UN Sustainable Development Goals**

This chapter ties in with the following SDGs:



**Case study: Network Rail and Keltbray overhead railway wiring renewal**

**A change in procurement model helped a Keltbray-led team to slash 45 weeks and £18m from a project to refurbish 50km of overhead railway wiring between central London and Essex.**

Network Rail introduced a more agile model to allow the contractor to challenge design on the scheme and introduce opportunities for standardisation. The project, to replace 99 structures and renew 143 stretches of wiring between Fenchurch Street and Pitsea stations, was chosen as a pilot for the SPEED (Swift, Pragmatic and Efficient Enhancement Delivery) initiative run by Network Rail and the Department for Transport.

Keltbray's relationship with Network Rail was changed from an arms-length

contractor and client to a more collaborative model that created transparency and aligned cultures and behaviours.

Procurement of materials was rationalised and a production-line approach to offsite manufacturing was introduced, including the development of a logistics hub.

Keltbray developed an approach that allowed multiple teams to work in parallel, boosting delivery in a single access window by almost two-thirds.

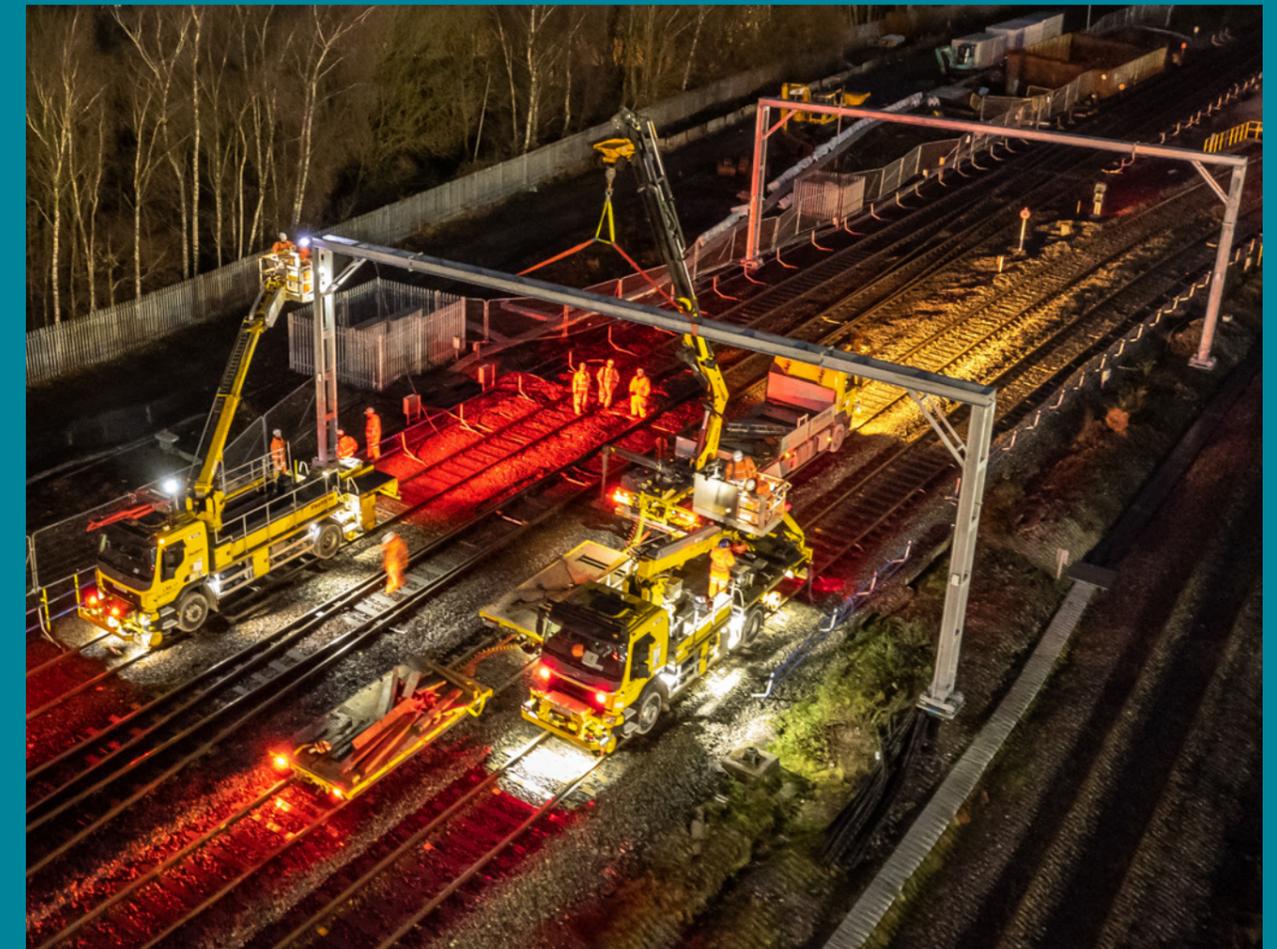
The ICE Driving Productivity community believes this project is an example of how refreshing procurement and contracting models can enable designers and contractors to re-imagine delivery techniques to boost productivity.

**99**  
structures replaced

**143**  
stretches of wiring renewed

**45**  
weeks cut from the programme

**£18m**  
of savings found



# 04 Engineering fundamentals

**The ICE's newest Community Advisory Board has a broad and vital remit – from ensuring members have the competencies they need, to addressing climate adaptation and hazard avoidance**

The ICE Engineering Fundamentals community has been established to learn and disseminate the lessons from design, engineering and other sectors. Its aim is to ensure that the ICE provides the education, guidance and direction that is necessary for developing expertise and the frameworks critical to all future engineers. This is the first 'horizon scan' report to include input from this community.

Key themes identified by the group include industry competence; the importance of design definition; the need to improve our contract and commercial environments; ethical behaviour; hazard and risk avoidance and risk mitigation; climate adaptation; and future-proofing our current approaches and thinking.

Much of the Engineering Fundamentals community's work in 2023 will centre on planning and testing interventions through collaboration and communication with others. It will also provide advice on urgent issues such as the changes required in the industry following the Grenfell Tower tragedy.

## A learning community

One of the first tasks will be to review the implementation of recommendations in the ICE's 2018 report, *In Plain Sight: Assuring the Whole-life Safety of Infrastructure*.

It is hoped that this work will help to align the efforts of the construction industry as it adapts to the requirements of the Building Safety Act. The Act establishes a building safety regulator and a construction products regulator to maintain standards across the building sector. It applies mainly in England and Wales but contains important provisions that could be applied elsewhere.

A number of key priorities will be progressed in this area, including the expansion of [Collaborative Reporting for Safer Structures UK \(CROSS-UK\)](#).

Construction can also learn from the aviation and rail industries, which publish near-miss reports after serious incidents once the salient facts are known. The Engineering Fundamentals community will pursue coordinated ways to encourage the profession to embrace this approach – endeavours so far in this area include the launch of a new annual ICE event, [Inspiring Engineering Excellence](#), which made its debut on 6 December 2022.

Elsewhere, the community will promote best practice on managing hazards, bringing all relevant resources together and building on the '3Ps' tool – this highlights strategies for managing people, process and product to identify errors in cases of failure and to minimise potential error. Tools will be developed to help the profession become more adept at recognising and preventing hazards at source – acknowledging, too, the importance of cultural change.

## Championing the right design

In 2020, the National Infrastructure Commission (NIC) called for all nationally significant infrastructure projects to feature board-level 'design champions'. The ICE has committed to working with the NIC Design Group and other industry stakeholders to publish guidance for this role.

The Engineering Fundamentals community believes engineers should take on the design champion role for major infrastructure project boards. In doing so, they could ensure important goals such as decarbonisation, climate resilience, biodiversity protection and social value are being pursued, while keeping a focus on programme, budget and delivery in line with the brief.

Design champions need to be able to understand the detail of a project while also having the communication and influencing skills to promote the right approaches in high-level discussions.

Ensuring civil engineers have the necessary competencies and confidence is an important focus. In 2023 there is an opportunity

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Understanding the need for adaptation will quickly become a fundamental requirement for all engineers

to build on the NIC’s recommendation and the Infrastructure and Projects Authority (IPA)’s [Transforming Infrastructure Performance: Roadmap to 2050](#) to have an informed debate about the way forward – focusing on outcomes that flow from projects. If key stakeholders share a common vision, there will be less likelihood of subsequent changes, allowing the industry to concentrate more on effective delivery. Initially, the community will listen to the different voices and bring together a consensus view.

**Addressing infrastructure adaptation**

The Engineering Fundamentals community believes it has a role to play in ensuring a focus on the adaptation or repurposing of existing infrastructure to meet the challenges of climate change. While new projects must consider ways to mitigate and prepare for climate change and all of its effects, there is also a pressing need to think about how severe weather events could affect existing infrastructure.

Global changes in weather patterns are clear. The potential for catastrophic failure of infrastructure systems caused by higher temperatures is increasing – in part because of our reliance on ever more sophisticated digital systems.

Protecting rail and road links from flooding may seem more logical than ensuring communication rooms and data centres for critical infrastructure can cope with prolonged operation when external temperatures hit 45C. Still, failure to protect the latter could be more catastrophic if there is disruption to the critical services delivered by, for example, hospitals, police stations or power plants.

Understanding the need for adaptation will quickly become a fundamental requirement for all engineers. What education and training will ICE members need to deliver this? How do we help clients with their systems? These are among the questions the community will be asking next year as it looks to shape this agenda.

**Five-year view**

Most engineers understand the importance of decarbonisation to society. However, the projects we create must also respond to a host of other pressures – principally, biodiversity impact and the levelling-up agenda – both nationally and globally.

It is important that engineers in the coming years understand the dynamics of society’s challenges and weigh up the importance of different goals and interventions. Cutting carbon is always positive, but if it is the only focus then other opportunities to add social value or improve biodiversity and achieve environmental net gain could be lost.

One important area to explore is how systemic design and engineering issues affect productivity and efficiency. For example, a more structured approach at the start of projects could help engineers to understand the key outcomes clients are seeking.

This will then enable all of the important goals to be considered earlier and should mean less need for changes later in the process.

In turn, this should bring opportunities to improve productivity, utilising the more focused delivery models identified in the Government’s Construction Playbook: unleashing the power of modern methods of construction (MMC) and other innovations to create a leaner industry where ‘right first time’ is the norm.

The Engineering Fundamentals community is looking to understand the challenges raised in other chapters of this report and learn lessons from as many areas as possible to help shape its own contribution and steer engineers and clients forward.

**Further reading**

- [Building Safety Act 2022](#)
- Carpenter J (2021) [Designing a safer built environment: a complete guide to the management of design risk](#), ICE Publishing
- ICE (2022) [Defining and developing the design champion role](#): Insights working paper
- ICE (2018) [In plain sight: assuring the whole-life safety of infrastructure](#)
- Kremmyda G (2021) [Humanitarian civil engineering](#), ICE Publishing

**ICE Knowledge Hub: CPD content for members**

- [Explaining engineering ethics](#)
- [Understanding the Swiss Cheese model](#)
- [Understanding design risk management](#)
- [Delivery models: promoting a more collaborative approach to project delivery \(coming in 2023\)](#)
- [Fairness, inclusion and respect in the engineering sector \(2023\)](#)
- [Keeping the public safe \(2023\)](#)
- [Putting value at the heart of infrastructure \(2023\)](#)

**UN Sustainable Development Goals**

This chapter ties in with the following SDGs:



**Case study: New Hospital Programme**



**The New Hospital Programme (NHP) in England plans to deliver 40 new hospitals or extensions by 2030, with each cohort of projects improving by learning from its predecessors.**

This can be achieved by employing the best MMC (modern methods of construction) concepts to ensure that hospitals are delivered better, faster and greener – as well as offering better value for money and providing improved treatment processes and health outcomes for patients. Staff will be able to work more efficiently in spaces that can be adapted for future needs, and respond better to crises such as the Covid-19 pandemic.

The NHP acts as a knowledge repository to drive and create a consensus around best practice to stimulate innovation

and ensure goals can be met. One of the mindsets it needs to challenge is that public infrastructure can only be delivered via standalone projects. It would be better for these to be part of a learning ecosystem where best practice is more rigorously and universally applied, albeit with any specific local needs considered as part of the design.

The Engineering Fundamentals community believes this type of radical change in delivery style, with a standardisation mindset, will lead to more cleverly designed hospitals that are fit for modern clinical practices; progressively faster and more cost-effective projects; and higher levels of staff and patient wellbeing.

In doing so, the NHP can serve as a model for other parts of the infrastructure industry.

**40**  
The number of hospitals or extensions to be delivered by 2030

**£1bn+**  
The estimated cost of eight hospitals in Cohort 3 alone



**Case study: Stormwater management in Cumbria**

**With an increasing number of residential developments being built on brownfield sites, ensuring there is robust stormwater management is vital.**

When retirement community developer McCarthy and Stone began developing a 46-bed apartment complex on one such site in Kendal, Cumbria, getting the right system was crucial. To ensure an effective solution was in place, contractor Civils and Construction Solutions worked with plastic pipe system supplier Wavin and its StormForce team.

The potential risks of environmental contamination during heavy rainfall mean brownfield locations can present a challenge for those delivering below-ground drainage. Effective stormwater management is therefore critical to any build of this kind – a challenge that on

this project was compounded by Kendal's history of flooding. While plans are in place to strengthen the town's flood defences, its geography means heavy rain is common, and drainage and stormwater systems must be specified accordingly.

It was vital that Wavin's StormForce team streamlined the stormwater management supply chain, taking care of the various facets of surface water infrastructure, including the design, supply and installation of its sustainable drainage systems (SuDS).

Wavin's solution was to integrate several AquaCell attenuation tanks underneath key areas of the development. These SuDS play an important role in protecting urban infrastructure, offering an effective – and sustainable – approach to mitigating the effects of heavy rainfall.

Natural landscaping such as ponds, swales and soakaways offer some protection, but to make SuDS as effective as possible, it is important to install these types of below-ground solutions as well. These innovative storage tanks release water back into the surrounding environment at a controlled rate, working out of sight and out of mind while protecting surrounding infrastructure from flooding.

Mike Rose, technical sales manager at Wavin UK, says: "Attenuation tanks are pivotal to the ongoing hydraulic capacity of SuDS, so when Civils and Construction Solutions approached us saying it needed products that provided easy access and high strength on a brownfield site, we had no hesitation in recommending AquaCell. The units fit the brief perfectly, as they are designed for use in deep applications and underneath roads."

# 05 Flooding

**Engineers have a crucial role to play in addressing flooding and flood risk management – with recent weather events showing the urgent need to ramp up efforts to boost resilience**

A number of key reports from the past 12 months offer a glimpse of the future for flood management in the UK. They include studies from the Environment Agency, the Department for Environment, Food and Rural Affairs (Defra), the devolved administrations, the Greater London Authority (GLA), the ICE and other bodies such as the Construction Industry Research and Information Association (CIRIA). Ensuring lessons are learnt from these works is a major task for the sector next year.

With tightened budgets, rising costs and the ever more apparent impacts of our rapidly changing climate, we simply won't be able to manage future flood risk using the techniques of the past. While sections of the industry have long advocated a move away from alleviation targets towards flood risk management strategies, recent weather events show the urgent need for this to take place at greater scale.

Big changes are needed and in 2023 civil engineers should continue to play their part in driving through action.

**Natural flood management**

More implementation of natural flood management schemes on the ground will be important if the UK is to move forward in its attempts to tackle and cope with climate change.

The Natural Flood Management Manual, published by CIRIA in May 2022, sets out possible options for working with the landscape to create a range of benefits and ultimately reduce the risk of damaging water ingress. It is hoped that this document will help to give project clients the confidence and, critically, the justification to press ahead with progressive solutions that will benefit communities and the environment.

The CIRIA guide urges decision-makers to protect, restore and mimic the natural environment and its hydrological processes. It sets out five steps for delivery, starting with understanding a catchment area and ending with a management plan.

As well as preventing water from damaging the built environment, natural flood management can have many

complementary benefits. These include habitat creation, carbon storage and water quality improvement, as well as the provision of recreational amenity and boosting wellbeing. Highlighting tangible benefits will be crucial in persuading politicians and other gatekeepers of the merits of a scheme, as metrics that are based purely on flood risk reduction do not always achieve this aim.

**Sustainable drainage**

Defra's Storm Overflows Discharge Reduction Plan, published in August 2022, sets water companies a target of eliminating sewage discharges that cause ecological harm or happen outside "unusually heavy rainfall" by the middle of this century.

The report states that better rainwater management is key to reducing storm overflows and reducing flood risk. Government ministers have pledged to decide on the long-called-for implementation of Schedule 3 of the Flood and Water Management Act before the end of 2022. If, as many hope, this clause is enacted, it will remove developers' automatic right to connect to public sewers, and create a body to approve sustainable drainage systems (SuDS).

**66**  
Not only do we have to reduce the carbon footprint of our interventions, we also need to build in capability to cope with extreme weather events

There are various measures in the Government’s National Planning Policy Framework to promote the use of SuDS in new schemes. However, the powers in the Flood and Water Management Act are critical if we are to harness the full power of blue-green infrastructure to protect homes and businesses from flooding while reducing our climate impact.

Defra urges property owners to make sustainable changes to their estates regardless of the decision over Schedule 3. Either way, engineers will have a critical role next year in helping developers and landowners to find the most efficient ways of using SuDS to their and the community’s advantage.

**Risk management in London**

This year the GLA published a progress report from a roundtable group looking at lessons learnt from the flash floods in the capital in the summer of 2021. This study laid bare the devastating impact of extreme weather on critical infrastructure. Some 30 Underground stations were fully or partially closed, hospital wards were evacuated and some schools were unable to take students back for several months.

The report identifies that London boroughs have established a multi-agency floods body to examine options to improve resilience. It recommends that partners including the GLA, the Environment Agency and Thames Water establish a strategic surface water flood risk management group by the end of 2022.

The London Flood Review, chaired by water strategist Mike Woolgar, reflected on the same weather events. It found that boroughs had been affected by flows beyond their borders and called for the creation of a body with a strategic view and governance to ensure future investment was “designed to optimise outcomes across different organisational boundaries”.

A city-wide approach is clearly needed to manage flood risk in the most effective manner – and this approach also applies to other regions of the UK, and to the country as a whole.

In seeking to manage flood risk in a changing climate, it isn’t only geographical boundaries that need breaking down. Too often we plan and develop infrastructure in silos, such as deciding which schools are to be replaced without considering flood risk and then having to close facilities when flooding occurs.

**Five-year vision**

Climate resilience will be a huge topic for the rest of this decade. Not only must we reduce the carbon footprint of our flood management interventions, we also need to build in capability to cope with more extreme weather events. The ICE Flooding community believes that resilience should be a more significant part of the funding and planning approval process for flood projects. Designers should be encouraged to think about how their projects would withstand potentially larger future weather

events. Acknowledging construction cost inflation and the pressures this is putting on funding decisions, the community advises that adaptive planning should become the norm so that schemes can be signed off to progress in stages as budgets and climate reality allow.

Engineers can help to raise aspirations and identify roadmaps for leaders. Clients are publishing a range of targets, often without a clear idea of how they will be achieved. Engineers could start to ‘carbon-cost’ existing flood projects to show that doing things differently is possible and that these alternatives can achieve the desired results.

Big, bold engineering projects are needed, but they should be carefully thought out to make them even more sustainable – for example, using plastic sheet piles instead of steel, or natural resources instead of traditional concrete. New skills will need to emerge quickly to tackle these challenges over the next five years.

**Further reading**

- Department for Environment, Food and Rural Affairs (2022) [Storm overflows discharge reduction plan](#)
- London Flood Review stage 4 report (2022)
- Mayor of London (2022) [Surface water flooding in London](#)
- Ministry of Housing, Communities and Local Government (2021) [National Planning Policy Framework](#)
- Thorne C R (2020) [Blue-green cities: integrating urban flood risk management with green infrastructure](#), ICE Publishing
- Wren E et al (2022) [The natural flood management manual](#), CIRIA

**ICE Knowledge Hub: CPD content for members**

- [Case studies: digital trends for water](#)
- [Understanding bathing water for rivers](#)
- [Climate change \(coming in 2023\)](#)
- [Nature-based solutions to flooding \(2023\)](#)

**UN Sustainable Development Goals**

This chapter ties in with the following SDGs:



**Case study: Nature-based interventions in west Wales**

**The Welsh Government has worked with Natural Resources Wales over the past five years to deliver a series of nature-based interventions on the Afon Merin in the west of the country.**

The CIRIA Natural Flood Management Manual says the project has demonstrated that “low-cost, nature-based solutions” can deliver “multiple benefits”, including flood risk reduction.

After identifying that the course of the river had been severely modified by agriculture, forest plantation and land drainage, and was disconnected from its flood plain under all but extreme flood events,

the project aimed to restore a more natural river system.

This involved tree felling to block ditches and create 15 leaky barriers to attenuate flow and elevate water levels. Notches were made in the riverbank at some locations to assist overspill.

A second phase reinforced some of the phase one dams, added deadwood buffers into channels and placed new dams in the river further downstream, among other measures.

Long-term monitoring is under way to prove the success of the project, but CIRIA says it has been well received “internally and externally”.

**3km**

The stretch of river that interventions were delivered on

**15**

leaky barriers were created from felled timber

**£30k**

The approximate total cost



## 06 Low-carbon energy

**Amid the energy crisis, the challenge for civil engineers is to maintain focus on low-carbon solutions and outcomes – still, economic slowdown and rising bills present a clear and present danger to this goal**

Energy has emerged as a major geopolitical force in the past 12 months, allied to an increasing realisation that security of domestic sources is critical. Voters are unlikely to forget or forgive an administration that lets the lights go out. Throw in its role in tackling climate change and low-carbon energy becomes even more important.

Last year's [Infrastructure in 2022](#) report warned that "renewables could be seen as a panacea to all of our energy problems and politicians may be overplaying that card without realising how change will be achieved". This remains a significant concern and engineers working in the energy sector should ensure that balanced decisions are being taken by those in positions of authority.

The report was also far-sighted in discussing future jumps in energy prices and how these would "act as a catalyst for people and businesses to take ownership of their own electricity generation and embrace renewables". Without doubt, this remains a valid statement given recent price volatility.

Still, the timescale for transitioning to natural power sources is long and such technology will not provide immediate relief from today's pressures. Civil engineers have a huge role to play in driving forward a broad range of energy decarbonisation solutions in 2023.

### On message

As energy bills rise, there is a danger that people will lose confidence in the move to net-zero carbon. Whether or not they understand the target, or how to get there, individuals have much on their plates and the ICE Low-Carbon Energy community believes there is a significant risk that they may become distracted. Engineers therefore need to work to ensure that the focus on this critical mission is maintained.

Next year, the ICE should build on existing relationships with organisations such as the Translational Energy Research Centre (TERC). Based at the University of Sheffield, TERC is one of the largest research and development facilities in Europe for zero-carbon power and related matters. It secured government funding in 2022

## 66

As energy bills rise, there is a danger that people will lose confidence in the move to net-zero carbon. Engineers should work to ensure that the focus on this critical mission is maintained

to investigate the integration of biomass into the production of high-purity hydrogen. Such projects support ICE aspirations and will help civil engineers to deliver low-carbon energy generation.

New hydrogen technology will be essential, but policy-makers need to understand the challenges. Such technology cannot be developed overnight and how we get from where we are to where we want to be is not yet clear or understood by the wider public. The Low-Carbon Energy community believes it can help with this during 2023.

### Planning matters

The UK Government recently committed to streamlining the planning system for major infrastructure projects. The Low-Carbon Energy community plans to press for a framework that will reduce red tape and help organisations to move through the consenting process with greater speed and efficiency, while retaining the opportunity for objectors to have their voice heard.

Offshore wind remains a big market that needs fresh impetus. Several UK ports view support for offshore infrastructure as a regenerative opportunity. Usually investment is raised by the private sector, but the Government could also provide seed funding to back it. While entrepreneurs may believe in low-carbon energy, they also have to make a return on their investment. If projects are too risky, they will not be attractive and will not be funded.

All stakeholders need to share in low-carbon goals. Stories abound of housing developers meeting planning conditions by incorporating single solar panels on homes. Far better systems must be delivered in 2023, and aspirations raised.

We should also learn from best practice around the globe. In Denmark, for example, a major drive to decarbonise homes with better insulation is well under way. Contractors are removing the outer skins of buildings and replacing them with better-insulated alternatives. With the right incentives and greater public awareness of the possibilities, this can be achieved elsewhere.

**New skills**

The increasing need for low-carbon energy is a huge opportunity for civil engineers – still, new skillsets will need to be developed. Those experienced in complex projects may be aware of the overall challenges they present, but specific knowledge and skills are still needed to deliver low-carbon energy infrastructure. They will also need to engage more closely with employers, contractors and consultants to ensure these projects are delivered at pace.

Floating offshore wind farms are an example of the challenges that need to be overcome. Platforms twice the size of a football field that can float allow huge turbines to be installed in deeper water. The teams involved face a steep learning curve to deliver this type of new technology, so it is important that those working on such projects can share their knowledge.

The ICE can facilitate this next year, including developing training programmes to make civil engineers more energy-literate. Hydrogen will play a significant role in the shift to low-carbon energy as it becomes more mainstream and, again, training will be required to ensure this is achieved.

It is the role of the ICE, with its passion, commitment and insight, to help civil engineers to appreciate the issues involved and, through knowledge transfers, help them to engage in new, challenging areas. The Low-Carbon Energy community's plans for 2023 include making such learning more widely available.

**Five-year vision**

The community believes that the contribution of renewables to UK energy supply will double from about 40% today to about 80% by 2028 given that the British energy security strategy set out in April 2022 expects that [by 2030, 95% of British electricity could be low-carbon](#). The Low-Carbon Energy community hopes

that the energy economy will become much more self-sufficient over the next five years.

Heat pumps will become more widespread, although space within existing domestic housing stock – as well as the capital costs – are significant challenges to be overcome. Society will become more flexible over its energy sources, with greater use of community schemes. Those with available space could accommodate the infrastructure for ground source heat pumps, promoted by local authorities and shared with neighbours.

Alternative funding models could include up-front cash from the Government, town halls or private sources, with householders or businesses paying rent or fees to benefit from the technology.

**Further reading**

- Crossland A F (2020) [Decarbonising electricity made simple](#), Routledge
- Hammond G P (2022) [The UK industrial decarbonisation strategy revisited](#), ICE Proceedings: Energy 175, 1, 30-44
- [ICE response](#) to the Department for Business, Energy and Industrial Strategy net-zero review (2022)
- Thiruselvi D (2021) [A critical review on global trends in biogas scenario with its up-gradation techniques for fuel cell and future perspectives](#), International Journal of Hydrogen Energy 46, 31, 16734-16750
- Wang Y et al (2022) [Development of efficient, flexible and affordable heat pumps for supporting heat and power decarbonisation in the UK and beyond: review and perspectives](#), Renewable and Sustainable Energy Reviews 154, February

**ICE Knowledge Hub: CPD content for members**

- [Renewable energy and the incorporation of zero-carbon systems \(heat exchangers\) into designs](#)
- [Coastal and offshore energy \(coming in 2023\)](#)
- [Enabling hydrogen use \(2023\)](#)

**UN Sustainable Development Goals**

This chapter ties in with the following SDGs:



**Case study: Electricity access in Kenya**



The energy mix in Kenya is almost wholly based on renewables, an achievement that is celebrated on its 50 shilling bank note. The government wants every citizen to be able to access electricity by 2026 – it hit 75% access in 2021, up from 53% in 2016.

The not-for-profit Global Infrastructure (GI) Hub, established by the G20, highlights that providing households with electricity in remote rural areas has been a notable challenge.

Kenya's Last Mile Connectivity Programme installs new transformers and extends the low-voltage network to all households within 600m of a transformer.

The connection cost to individual households has been lowered from KSh35,000 (£260) to KSh15,000 (£110) with the help of subsidies.

The scheme reportedly stalled because it proved to be unprofitable for state-owned utility Kenya Power and politicians became concerned at the ongoing cost.

As a result, off-grid Kenyans are improvising. For example, an isolated police station is reported as getting its electricity from solar panels wired to car batteries.

Sometimes, our solutions may be too technical: the police station example proves that, as the saying goes, necessity is the mother of invention.

**75%**  
of Kenyans had access to electricity in 2021

**100%**  
is the target for 2026

**74%**  
of the power generation mix in 2021 was from geothermal and hydropower

# 07 Structures and geotechnical

**New materials and processes will be key to improving the efficiency and sustainability of infrastructure assets. To this end, civil engineers will need to be proactive in shaping codes and legislation and in broadening their skills base**

Almost 150 organisations, including Aecom, Arup, Atkins, Jacobs, Mott MacDonald and WSP, have now signed the civil engineering industry's [climate emergency declaration](#).

These industry leaders have recognised that infrastructure systems account for half of energy-related carbon emissions while also having a significant impact on our natural habitats. They have pledged to evaluate all future projects against the need to “contribute positively to society... while averting climate breakdown”.

Central to this mission is shifting engineering practices to be carbon-conscious while still meeting client requirements.

The ICE Structures and Geotechnical community believes that engineers need to be proactive in their use of Eurocodes and in endorsing new technologies, and recognise the need for ever-improving technical and engagement skills.

Fresh ways of working are urgently needed to maximise our ability to serve society effectively in a changing world. Civil engineering must attract people who can develop techniques to address the issues of the day, and those who are skilled at engagement. There are several key ways to work towards this in 2023.

## **Eurocode review offers opportunities**

Overspecification due to conservative design costs more, often takes longer to build, embodies more carbon and can have a negative impact on communities and the environment. As a result, it can also lead to funding issues and cause delays in planning processes, frustrating the very people it was designed to please.

For some time, progressive civil, structural and geotechnical engineers have been encouraging clients to use different materials and techniques that make schemes more acceptable to society. The big barriers to this approach are the often seemingly inflexible and out-of-date codes of practice and their knock-on impact on design and behaviours.

Under a European Commission mandate, certain Eurocodes will be updated in 2023. This offers an opportunity for UK engineers

## 66

Engineers need to be proactive in their use of Eurocodes and in embracing new technologies, and should recognise the need for ever-improving technical and engagement skills

to influence the text of these documents, which determine how many projects will be delivered.

It could be a decade before these standards are up for discussion again, so it is vital for engineers to put forward coherent arguments for the inclusion of provisions to improve the economic, environmental and carbon outputs of projects. Even minor changes to certain elements of the codes could make a huge difference to the way projects are delivered in the coming years – for example, the possibility of managing water ingress in underground tunnels rather than needing to wholly prevent it.

## **Shifting pipeline of work**

After decades of concurrent megaprojects, the transport infrastructure pipeline in England is showing signs of starting to stall. With Crossrail complete and High Speed 2 (HS2) phase one design work at its peak, the industry needs to understand where the next projects will be – particularly those that will utilise tunnelling, road and rail design skills that have been developed in recent years.

There could be quite a gap before the main northern section of HS2 comes to fruition – and that has already been significantly downsized. The pandemic and the associated shift in working patterns, alongside growing climate awareness, has undermined the business cases for some follow-on projects.

It is positive that there is a raft of water and energy projects coming on to the horizon, including the Sizewell C nuclear plant in Suffolk (see facing page) and Scotland’s Coire Glas and Cruachan 2 hydro storage schemes. These are the types of schemes society needs for a net-zero future and engineers will need to pivot quickly to put themselves in a position to deliver them.

There is a huge opportunity for individuals who are open to acquiring new skills to work on exciting, meaningful projects, and to put our profession at the global cutting edge.

**Building Safety Act**

Passed into law in June 2022, the Building Safety Act sets out new obligations in response to the Grenfell Tower tragedy. The construction sector will have increased obligations placed on it by the new Building Safety Regulator, which will establish a competency committee to drive standards, including guiding clients on how to assess whether someone is competent to do the job safely.

The civil engineering profession needs to understand the implications of this in 2023. The ICE Structures and Geotechnical community needs to work with other institutions and bodies to develop a single competency framework and accreditation system to simplify the process of proving and verifying engineering ability.

This is an opportunity to provide leadership and build relationships with different bodies, as well as offering a chance for civil,

structural and geotechnical engineers at all levels to deepen and broaden their skills base.

Ensuring competency to build safely is a fundamental exercise that should not be limited by the precise wording of the law. Regardless of whether the Building Safety Act could one day be extended to cover other infrastructure or low-rise buildings containing hazardous materials, the abilities required for signing off residential towers safely are mainly solid base skills that all engineers should seek to acquire.

**Five-year view**

On an even broader scale than the Eurocode review, the industry needs to progress boldly over the next few years to introduce new materials and techniques where it is safe to do so.

We can start by working with clients to use these game-changing components and processes safely in non-critical situations to build up knowledge of how they behave. An open, collaborative, no-blame culture will be necessary for clients and suppliers to discuss risk and reward without fear.

For example, a local authority might specify a 120-year design life for a new bridge, but an informed designer could help it to understand what this means in practice. Such knowledge would enable informed decisions to be taken, which would mean the structure could be delivered using a more environmentally-friendly design solution at a lower whole-life cost.

Emerging materials are increasingly being used as pilot studies on low-risk applications. Over the next five years, will we reach a tipping point and start using them more widely? And, if so, what knowledge, data and experience do we need to do so safely and responsibly?

Engineering judgement will become more important than ever, making it an exciting time to be entering the profession. A key challenge will be to provide clear career paths for new recruits to give the industry the capacity and capability to progress in the direction it needs to go.

**Further reading**

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- Orr J J et al (2021) [Design for zero](#), Institution of Structural Engineers
- Steering Group on Competence for Building a Safer Future (2020) [Setting the bar: a new competence regime for building a safer future](#) – final report

**ICE Knowledge Hub: CPD content for members**

- [Podcast: Structural resilience](#)
- [Tech Talk: Structural resilience](#)
- [Understanding design risk management](#)
- [Understanding the role of the principal designer](#)

**UN Sustainable Development Goals**

This chapter ties in with the following SDGs:



**Case study: Sizewell C nuclear plant**

**EDF is already working to build its supply chain for the £20bn Sizewell C nuclear plant in Suffolk, which it expects will start generating power in the early 2030s.**

The French-owned developer is working with the Suffolk Chamber of Commerce to register local companies and individuals interested in working on the follow-up to Somerset’s Hinkley Point C.

Despite the 200-plus miles that separate the two projects, many of the skills and lessons are expected to be transferred from the South West to East Anglia.

At the same time, with a job of this size – Sizewell C is expected to support some 70,000 jobs – there is plenty of opportunity for civil engineers nationwide. There is also time for those working on soon-finishing transport schemes to pivot across to the energy megaproject of the future.

EDF says Sizewell C will generate enough electricity to power 6 million homes and save 9 million tonnes of carbon emissions compared with a gas-fired power station. The Structures and Geotechnical community believes the project will be a valuable source of work and learning for the industry in the coming years.

**6m**

The estimated number of homes that will be powered by Sizewell C

**9m**

The estimated number of tonnes of carbon emissions to be saved

**70,000**

The number of jobs the plant is expected to support

BUILDING CONTROLS INDUSTRY ASSOCIATION



# 08 Sustainable, resilient infrastructure

**Infrastructure faces multiple threats – and not just from climate-related events. Building in resilience is therefore crucial if assets are to be fit for purpose for the long term**

Floods in Pakistan, record high temperatures in Europe, hurricanes in the US and soaring energy prices have all been stark reminders this year of the need for sustainable, resilient infrastructure (SRI).

As a result, public awareness of immediate climate risks is high. Less well understood, perhaps, is the threat to services such as roads, rail, pipe networks, bridges and tunnels. Civil engineers need to help society, as well as other built environment professionals, to understand the consequences of not improving the resilience of our infrastructure.

In his address at the ICE's 14th Brunel International Lecture Series opening event in September 2022, ICE President 2021-22 Ed McCann said there was an opportunity to embed resilience in infrastructure projects, ensuring adaptation was on an equal footing with mitigation. "Engineers have a big role to play, as facilitators between local communities, organised groups and government, in bringing practical solutions, building relationships and maintaining them over the whole lifecycle of infrastructure," he said. So how can this be achieved in 2023?

## Coherent guidance

Economic uncertainty could mean that other pressing needs push sustainable, resilient infrastructure down the priority list. This must be resisted, and clear guidance is needed so that decision-makers understand the importance of resilient assets.

The ICE has established links with the UN Office for Disaster Risk Reduction (UNDRR), which has been developing a strategy framework and has asked the institution to contribute towards an ISO standard for sustainable, resilient infrastructure. The UN Sendai Framework for Disaster Risk Reduction 2015-2030, which looks to prevent new, and reduce existing, disaster risks, is being updated by the UNDRR, and for the first time the ICE SRI community is contributing to this key policy paper.

The ICE's work on the Sendai Framework is linked to the International Coalition of Sustainable Infrastructure, whose Race to Resilience global campaign provides good guidance for next year.

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**Infrastructure sustainability must be seen as a societal issue – communities will quickly break down if people are without water or power or cannot move around**

The World Federation of Engineering Organisations also works to support training and education in sustainable development.

The key themes at November's UN Climate Change Conference (COP27) in Egypt were resilience and adaptation. The event was extended beyond the scheduled closing time to establish 'loss and damage' funding for vulnerable countries hit hard by climate disasters. Headway on a 'global goal on adaptation', a two-year work programme first started at COP26 in Glasgow, was less pronounced, with participants agreeing to develop a framework for delivering the goal and tracking progress towards it.

A final communiqué "recognised" that adaptation was "a global challenge faced by all" and that it was "a key component of and makes a contribution to the long-term global response to climate change to protect people, livelihoods and ecosystems". The ICE will produce a paper on the direction of travel set at COP27.

### Equipping engineers

A top priority for the ICE SRI community in 2023 is the provision of coherent guidance for engineering teams on the support available. The CAB's chair, David Smith, says: "We need to work on the concept of 'net resilience gain', a core part of the UNDRR work, to show how a project has increased resilience to withstand climate change because of the solutions created by project engineers. Stress testing is also important because there are many scenarios that cannot be predicted with certainty but need to be considered."

Some engineers say design codes do not adequately address the need for a resilient future. It is important for such standards to keep up with the evolving approach to sustainability, resilience and adaptation. Still, flexibility is needed and engineers should avoid sticking rigidly to a code or standard if they can go further. This should not be taken as consent to ignore well-established standards and codes but rather as encouragement to see them as a minimum.

Lastly, engineers should partner with environmental specialists, planners, urban designers and others to devise more systems-based solutions and wider thinking. Such an approach encourages innovation, including adopting new technologies and nature-based solutions that can help to make our infrastructure more resilient.

### Resilience champions

The various challenges ahead for the wider engineering community have prompted the ICE to consider how it can support 'resilience champions' to encourage the building of resilience into projects. Resilience champions have the skills to communicate and demonstrate best practice to help others future-proof their work.

Government policy is also an opportunity to embrace resilience. For example, New Zealand has published its first [national adaptation plan](#), which includes specific 'supporting actions' for infrastructure. In the UK, a similar adaptation plan is expected to support the actions needed in response to the UK Climate Change Risk Assessment. With resilience forming an increasingly important part of governments' investment decisions, engineers need to grasp the opportunity to drive this theme forward next year.

Community involvement is critical, particularly in showing people how they can help. That could be in terms of changing behaviour, such as using public transport more, or responding in emergencies such as floods. Such an approach acknowledges that there may well be disruption but shows how community participation can lessen the impact. Washington DC's resilience plan, [Resilient DC](#), is an example of a strategy that is thriving in the face of change.

### Five-year vision

As well as climate change, the biggest threats to resilience this year have been the consequences of pandemic and conflict. Cybersecurity is another significant issue. All can have significant knock-on effects on resilience, notably in supply-chain disruption. Such threats will require wider thinking in the coming years.

Infrastructure sustainability needs to be seen as a societal issue: communities will quickly break down if people are without water or power or cannot move around. A resilient society, on the other hand, maintains continuity or recovers quickly from catastrophic events (see case study, facing page).

We also need to consider how equity in infrastructure services can be achieved globally through inclusive engagement with the public. Engineers must work as facilitators, building relationships and maintaining them over the lifecycle of a project. The UK Government is revising the Green Book, its guidance on how public spending proposals should be appraised and evaluated, to include adaptation, social equity, nature and longer-term outcome thinking.

Lastly, we should see more progress on retrofitting existing infrastructure and extending asset life, particularly in developed societies and economies.

### Further reading

- [The Cabinet Office's National Resilience Strategy is planned to be issued by the end of 2022, following on from the UK Parliament Joint Committee report](#), which included recommendations to government on critical national infrastructure in an age of climate change
- Hay A H (2021) [Planning resilient infrastructure systems](#), ICE Publishing
- UN Office for Disaster Risk Reduction (2022) [Principles for resilient infrastructure](#)
- Van Alphen S (2020) [Room for the river: innovation, or tradition? The case of the Noordwaard](#), in Hein C (Ed) [Adaptive Strategies for Water Heritage](#), Springer

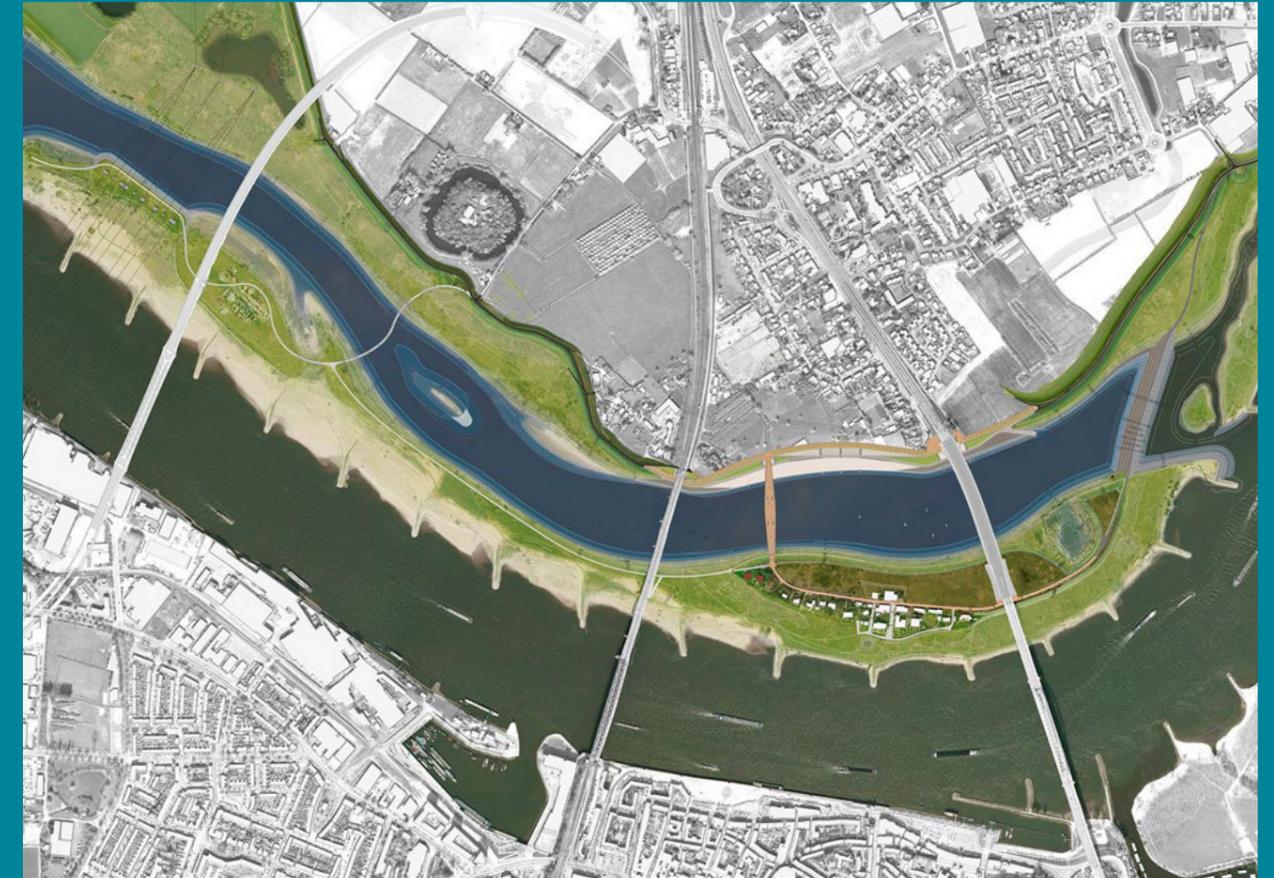
- ICE Knowledge Hub: CPD content for members**
- [Podcast: Structural resilience](#)
  - [Tech Talk: Structural resilience](#)
  - [Design and adaptation for resilience \(coming in 2023\)](#)
  - [Weather resilience, climate adaptation, decarbonisation \(2023\)](#)

### UN Sustainable Development Goals

This chapter ties in with the following SDGs:



## Case study: Flood preparedness in the Netherlands



**In July 2021, parts of western Europe were devastated by floods following intense rainfall. Authorities in Belgium and Germany reported more than 200 deaths.**

In the Netherlands, the impact of the flooding was less. While it is difficult to make direct comparisons in terms of weather event impact, it is clear that government investment in flood preparedness played an important role in the Netherlands mitigating the effects.

The Dutch government's wide-ranging 'Room for the River' infrastructure strategy between 2006 and 2015 included widening and deepening river channels, ensuring a high level of protection for dams, dykes and levees.

Evacuation schemes, meanwhile, meant residents could quickly be moved to safe places.

Henk Ovink, special envoy for international water affairs for the Netherlands, identified three approaches to the country's flood preparedness:

- Take climate change into account in everything you do.
- Think about nature's capacity to build resiliency and adaptive capacity.
- Do this with all stakeholders, from the community level up.

Authorities globally should review the locations of vulnerable infrastructure such as emergency services, retirement homes and hospitals to make sure they are not located in at-risk areas. They should also involve a new generation of urban planners and architects who may have an increased awareness of climate-related risks.

For more information see "[What the Dutch can teach the world about preparedness](#)" (CNBC, July 2021).

# 16,000

cubic metres per second – the discharge volume accommodated by branches of the Rhine without flooding

# €2.2bn

Flood protection budget

# 39

individual schemes in the project



## 09 Transport and mobility

**The challenge facing engineers is delivering infrastructure that encourages more active travel to help meet local and national net-zero targets – and they need to do it at a time when budgets are shrinking and costs are rising**

There will be significant developments in the way that UK rail and road networks are managed and used in the coming years. Great British Railways is set to come into being with a mandate to make track works easier and cheaper and to create a “modern, green railway”.

Meanwhile, the policy environment for electric and autonomous vehicles is expected to improve, resulting in better use of UK highways. The [Levelling-Up and Regeneration Bill](#) is also anticipated to come into force, introducing an infrastructure levy to replace section 106 agreements for all but the largest developments. It will also contain other measures to improve regional connectivity and “restore local pride in places”.

Despite all of this specific activity, transport and mobility engineers are likely to see even greater change driven by bigger-picture issues such as climate change and inflation.

### Cost of living

One of the biggest challenges in all of our lives next year, both personally and professionally, is likely to be inflation. Energy price increases are far higher than we are used to, basic goods will continue to cost more and paying for construction materials and labour will require a calculator and a packet of paracetamol.

The crisis will continue to squeeze engineers between plummeting client budgets and rising input costs, requiring innovative approaches to keep projects viable. As well as technical and technological advances, different funding mechanisms will be needed, in particular to ensure that maintenance work does not fall victim to inflation.

Despite such challenges, transport and mobility engineers have an opportunity to make a difference to society by introducing infrastructure that can help to ease the cost of living for those people most affected.

A strategically placed cycle lane, for example, could encourage people to leave their cars at home, saving them money as well as reducing carbon emissions. They may even

be able to do away with their car altogether if the active travel options are effective.

UK Government funding streams allowing councils and other network providers to take a holistic view of transport investment, rather than being constrained by modal siloes, would offer engineers the best chance of tackling these challenges.

### Climate change

Almost two-thirds of local authorities in England have pledged to hit net-zero carbon emissions from their operations by 2030. They are planning far greener transport systems as they look to the UK’s legally binding pledge to become carbon neutral by 2050.

The ICE Transport and Mobility community believes that the true scale of the challenge is enormous and will become clearer in 2023. The window for making engineering interventions towards this goal is rapidly closing and far more will need to be done over the next 12 months.

Supporting active travel through improved walking and cycling infrastructure; making bus services more accessible, reliable and

**66**  
As the cost-of-living crisis bites and net-zero commitments loom large, active travel will have a huge role to play in the years ahead

affordable; and ramping up infrastructure to support the switch to greener vehicles will become critical if the UK is to avoid more drastic mass behaviour changes down the line.

On the other side of the climate coin, the focus will sharpen next year on resilience. Following the summer heatwaves, and any extreme weather over the winter, engineers will need to look for opportunities to prepare the country for the effects of baked-in weather change.

As well as ensuring transport systems can function effectively during extreme weather events, work should ensure that the sector's networks do not have consequences for other areas in times of crisis. Using sustainable drainage systems (SuDS) on roads is one example of an intervention that could prevent urban flooding, as well as reducing sewage discharges on to UK beaches.

### Policy developments

Within its own modal silo, the Transport Bill expected to bring Great British Railways into being has the opportunity to provide much of the systems thinking desired by the ICE community, although the recently announced delay in implementing it is disappointing. Under existing plans, a new body would replace franchised operating companies working sometimes in conflict with the network owner. It would take a holistic view of how to meet its objectives, potentially making works more effective and efficient. A key consideration, however, will be the extent to which this national behemoth can be fleet of foot locally, respecting devolution and rising to the aspirations of local communities.

The Levelling-Up and Regeneration Bill offers some clear and less obvious benefits for transport planners and engineers. The key will be to do more to reduce the need for travel by strengthening links between land use planning and the transport network. It is hoped that Prime Minister Rishi Sunak will support the levelling-up agenda in its purest form – using planning tools to reduce inequality wherever it exists.

On the roads, new laws for the safe rollout of self-driving vehicles by the middle of the decade are expected to be brought forward in the coming months. If this shift becomes clearer next year, there will be huge implications for the planning of transport schemes. Business cases will be affected as drivers become capable of more flexible activities when they are travelling on roads. Hopefully, roads will become safer, more efficient and greener. Electric vehicle charging infrastructure is also set to increase in 2023.

### Five-year vision

The ICE Transport and Mobility community believes the reign of the car in urban areas must come to an end if the UK is to meet its future carbon and air quality targets. Getting people out of private vehicles and on to public transport is important, but cycling and walking remain the cheapest, greenest, healthiest

ways to get around and, where possible, these modes should be given equal attention.

As the cost-of-living crisis bites and net-zero commitments loom large, the ICE believes that active travel will have a huge role to play in the years ahead. The institution is pleased to see that Active Travel England, headed by Olympic gold medallist Chris Boardman, has been given funding and a role in planning decisions. It is hoped this will make a material difference over the next five years as we take bold steps to change behaviours.

Engineers will have a big part to play in thinking holistically about the infrastructure needed for the mission to succeed.

### Further reading

- Chartered Institution of Highways and Transportation (2020) [Improving local highways: the route to a better future](#)
- Department for Transport (2021) [Decarbonising transport: a better, greener Britain](#)
- ICE Policy discussion paper (2021) [Public transport funding post-Covid](#)
- UK Government's [Integrated Rail Plan: the role of innovation in rail](#)
- Zhang X (Ed) (2021) [Cities for driverless vehicles](#), ICE Publishing

- ICE Knowledge Hub: CPD content for members**
- [Discussing a systems approach to transport](#)
  - [Understanding design for active travel](#)
  - [Decarbonisation in transport: what can be done practically to make a difference \(coming in 2023\)](#)
  - [Designing for freight: exploring the critical movement of goods and the impact for infrastructure design \(2023\)](#)
  - [Inclusive travel design: challenging how we design systems – putting the user first \(2023\)](#)

### UN Sustainable Development Goals

This chapter ties in with the following SDGs:



## Case study: Systems thinking at the Silvertown Tunnel

**Transport for London says that the 1.4km twin-bore tunnel planned to link Silvertown and Greenwich from 2025 will be used to improve the reliability and resilience of the wider road network.**

As well as slashing delays at the Blackwall Tunnel, the London scheme is designed to improve air quality by reducing congestion on nearby roads. It will also take cars off the road by creating new routes for zero-emission, cross-river buses.

In addition, road user charging will be introduced at both Silvertown and

Blackwall tunnels, incentivising use of public transport.

Regeneration is also expected to take place, including measures to boost walking and cycling in this part of the capital.

The ICE Transport and Mobility community believes that some of the innovative mitigation measures to manage demand that are being brought in alongside the Silvertown Tunnel indicate how large civil engineering projects can still be viable agents for positive change.

# 1.4km

Length of the tunnel

# 12m

Diameter of the tunnel boring machine

# 60,000

The number of tonnes of excavated material to be removed by river



# 10 Water and sanitation

**The water industry's challenges – among them climate change, ageing infrastructure and image problems – were brought into sharp focus in 2022. The coming year presents a significant opportunity to tackle them**

Early in 2022, the Environmental Audit Committee published its [Water Quality in Rivers](#) report, which said water companies had “grown complacent” and “seem resigned to maintaining pre-Victorian practices of dumping sewage in rivers”.

Then, following five consecutive months of below-average rainfall across all regions of England, in August the Environment Agency placed nine of its 14 areas into drought status. With water supply constrained, record temperatures – including parts of the UK hitting 40C – caused a huge spike in demand, piling further pressure on already hard-pressed utilities. Hosepipe bans had to be introduced in some parts of the country.

For some time, water companies' to-do list has been challenging. They are being asked to eliminate overflows from sewers, improve river quality, reduce leakages and increase the rate of asset replacement for water and sewer networks – all while reducing carbon and maintaining low prices. The pressure is ramping up in all of these issues, but this may in fact present a significant opportunity for civil engineers in 2023.

## Innovation nation

The glaring need for change prompted regulator Ofwat to launch a £200m [Innovation Fund](#) to support initiatives that deliver significant benefits for customers, society and the environment. Different funding rounds will run over the next three years. The £4m Water Discovery Challenge will open for entries in January 2023, aiming to accelerate the development and adoption of new ways of working.

The Innovation Fund has also been set up to promote collaboration, which the ICE Water and Sanitation community believes has not happened nearly enough since privatisation. The UK 2050 [Water Innovation Strategy](#) suggests that huge gains could be made by joint working on key issues. Subsequently, the [Spring platform](#) has emerged to encourage this by connecting, integrating and augmenting existing excellence in the sector.

Civil engineers have not always been seen as leaders in the use of information technology, but this is changing with the imperative to

## 66

**We need to understand the whole water cycle – capturing it, using it intelligently, treating it and recycling it**

collect, analyse and intelligently use data to optimise asset performance. The sector increasingly understands the benefits of blue-green infrastructure, such as porous surfaces on streets and the use of retention ponds, and traditional concrete tanks no longer being identified as the preferred solution.

## Systems thinking

In the coming year, the ICE Water and Sanitation community plans to encourage engineers to look beyond familiar networks and collaborate with architects, town planners, municipal engineers and others to think more broadly about challenges. We need to take a systems-led approach that takes the whole water cycle into account: capturing it, using it intelligently, treating it and recycling it.

There are opportunities to learn from exemplar projects, such as the Anderson Road grey water treatment plant in Hong Kong, which won the [ICE 2021 Chris Binnie Award for Sustainable Water Management](#). The plant treats water collected from showers, sinks and other sources for use in toilet flushing and other non-potable purposes. It saves fresh water for potable purposes, reduces sewage discharge and minimises water conveyance costs and carbon. It is the sort of whole-system approach the Water and Sanitation community wants to see more of next year.

The preparation of business plans can enable the whole-system approach to move forward ahead of Ofwat setting price controls covering the water and sewerage sector for the latter half of this decade. In a consultation in 2022, Ofwat proposed that utilities set their five-year plans within a 25-year vision, providing opportunities for engineers to drive lasting change with designs and innovations proposed next year.

**Image problems**

In recent years, headlines about water companies have often focused on leaks, discharges and hosepipe bans. Too often the sector has been criticised without consideration of how it has kept ageing assets working, serving the population during unprecedented climatic and economic times.

Showcasing success and innovation is a significant opportunity for the industry to change public opinion next year. Being seen as an inefficient, prehistoric, dirty place to work is also hampering recruitment of the much-needed next generation, while disillusioning experienced people who need to be retained. Engaging with the public more positively can turn this around and help to build the workforce the sector needs for the future.

Civil engineering is competing for staff with other industries that are often offering higher salaries for the skills it needs to attract. As such, the Water and Sanitation community believes the water industry needs to showcase its environmental credentials and get

positive stories into the public domain. In 2023 the community will be looking for opportunities to invite people to visit water infrastructure to understand the complexity of what the industry does in waste and water treatment. There is an imperative to promote better understanding of the sector.

Technology and recruitment is a chicken-or-egg dilemma. The water industry still repairs pipes in much the same way as the Romans did – digging holes, fixing and reinstating. Highlighting the exciting technology the sector uses might attract different people, but it needs the right people to develop the tools that will change the industry. Are there ways to showcase some of the more exciting innovations being developed, and to compete with above-ground infrastructure projects for the limelight?

Work is under way to identify the obstacles hindering the sector in adopting modern methods used elsewhere, and there is an opportunity to progress with this agenda in 2023.

**Five-year vision**

As the UK moves closer to its 2050 net-zero carbon target – with the water industry aiming for net-zero operations by 2030 – the incentive to find different ways of working will increase.

The water industry will have to make even more use of existing assets with smart interventions to tackle challenges without exceeding ultra-tight carbon and cash budgets.

Organisations will need to think in broader geographic terms, coming together regionally and perhaps nationally to deliver systems-based solutions and look at water lifecycles.

The Water and Sanitation community expects discussion around ownership of customer supply pipes, more separation of surface water and sewage, and far more metering of supply using remote real-time reading. The latter will incentivise customers to save water as well as enable greater collection of data. As water companies build up information on leaks, they can use modelling and smart interventions, which may not be the same as traditional methods. Much will need to evolve over the next five years.

**UN Sustainable Development Goals**

This chapter ties in with the following SDGs:



**Further reading**

- Environment Agency (2022) [Water and sewerage companies in England: environmental performance](#)
- McMillan L, Varga L (2022) [Towards self-healing in water infrastructure systems](#), ICE Proceedings: Smart Infrastructure and Construction, June
- National Infrastructure Commission (2022) [Reducing surface water flooding risk in England](#)
- Sohail M et al (2018) [Transformative technologies for safely managed sanitation](#), ICE Proceedings: Municipal Engineer 171, 2, 78-85
- Water Resources South East (2022) [Draft regional water resilience plan](#)

**ICE Knowledge Hub: CPD content for members**

- [Case study: the River Wharfe at Ilkley](#)
- [Tech Talk: Digital trends for water](#)
- [Understanding bathing water for rivers](#)
- [Enabling effective water infrastructure globally \(coming in 2023\)](#)
- [How does water infrastructure provide wider benefits to society? \(2023\)](#)
- [Improving water quality \(2023\)](#)

**Case study: Bin the Wipe campaign, north-east England**



**Analysis by Northumbrian Water discovered that flushing of wet wipes caused 64% of sewer blockages in the North East in 2019. Previous attempts to tackle this had failed so the utility took a more proactive approach.**

At the start of 2020, it introduced the 'Bin the Wipe' campaign and gave away bins in parts of Redcar. This resulted in a 43% reduction of blockages caused by wipes in the area.

As the campaign evolved, a new approach was trialled in Stockton, with even greater success, and was rolled out in wet-wipe flushing 'hot spots' across the region. Northumbrian Water developed a series of 'spiky' gadgets, including the 'Porcupine' and

the 'Barbarian'. These were put into sewers to collect wipes and track where they were flushed. The firm delivered notices explaining that a team would be monitoring the area's sewers, finding flushed wipes and tracking back up the network to the properties from which they came.

As the team closed in on streets, or even individual homes, further letters and doorstep conversations were used to reinforce the need for people to stop using their toilets as bins.

The ICE Water and Sanitation community believes this initiative highlights many of the attributes civil engineers need, including innovative thinking, the use of technology, and 'soft' skills such as community engagement.

**64%**  
of sewer blockages in the North East in 2019 were caused by the flushing of wet wipes

**43%**  
The reduction in such blockages after targeted 'Bin the Wipe' campaign and free bathroom bins

**6,000**  
homes in Billingham were targeted by letters and an innovative tracking tool

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