



UKCRIC™

UK COLLABORATORIUM
FOR RESEARCH ON
INFRASTRUCTURE & CITIES

**Delivering a
resilient and
sustainable future
2022-23**



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About UKCRIC

UKCRIC is transforming infrastructure and cities research and development. Its vision is to connect policy and practice with internationally leading, systems-based transdisciplinary research for the transformation of infrastructure and urban systems to enable safe, resilient and sustainable living, and to generate wellbeing and prosperity for all.

Its mission is to use its integrated research facilities to underpin the renewal, sustainment and improvement of infrastructure and cities in the UK and elsewhere. By engaging academia, government, practitioners and end users, UKCRIC de-risks, helps to prioritise, and provides evidence, analysis and innovation for infrastructure and urban investments for a safer, more resilient and more sustainable future.

**Connecting research with policy
and practice in infrastructure and
urban systems**

FOREWORD

from the Chair of the International Advisory Board



Infrastructure comprises the roads, rails, utilities, green spaces, buildings and more that touch every aspect of our lives. As the world grapples with the impacts of climate change, how we finance, commission, build, use, maintain, repurpose and decommission infrastructure is critical to sustainability and for improving people's lives. In short, infrastructure and its advancement are vital contributors towards addressing global challenges. The value of those that work in this sector, whether researcher, practitioner, or policy maker, is often underestimated.

This is why UKCRIC and its systems-based approach to finding solutions is so valuable. Its multiple institutions and multiple disciplines can tackle challenges in more innovative ways than if they were tackled in silos.

There has been much progress. I am very pleased to see that UKCRIC has published its five-year plan for growth in the form of the UKCRIC Roadmap which sets out the objective of becoming an influential, independent, and global expert source in the fields of infrastructure and cities and outlines an ambition to become an Institute. UKCRIC aims to do this with increased engagement with its stakeholders, bringing together researchers from across the network as well as practitioners and policy makers to tackle infrastructure and urban systems challenges. It is great to see, for example, that the newly established UKCRIC Limited, which provides organisations with an easy route with which to engage expertise from across UKCRIC's member institutions, is already delivering successful projects. The achievements from UKCRIC-funded projects from 2021 are also reported on here.

There is more to be done, however. The UK lags behind other countries in effectively bringing cutting edge research, such as that undertaken in UKCRIC's facilities, into policy and practice. As UKCRIC moves into its next operating year this must form a key pillar of its work. I am encouraged, as I hope you are too, by the milestones reached. I very much look forward to UKCRIC building on these successes and to seeing existing partnerships grow and new collaborations form.

Lord Robert Mair

Emeritus Professor of Civil Engineering, University of Cambridge and Chair, UKCRIC International Advisory Board.

LETTER from the Convenor

When I look back over the period covered by this review (April 2022 - March 2023), both in the context of UKCRIC's achievements and the global events that have defined it, I realise that while problems might be independent in their genesis, in their solution they are not. Long-term solutions require significant collaborative effort. Russia's activities in Ukraine, for example, have sent global energy prices and inflation soaring. In response, nations have collaborated on new energy agreements and intensified the search for domestic renewable and secure energy solutions.

2022 saw the first recorded temperature of 40°C in the UK and has been the warmest on record since 1884. Similar extremes were reported across the globe. Climate change and sustainable adaptation to it remain the defining issues of our time, overlain by natural disasters. In response to the devastating earthquakes in Turkey and Syria, international communities have come together to discuss concerns over outdated building methods and the need for rebuilding to consider worsening climate impacts. The UK's perceived position on the world stage has been tested with the passing of Queen Elizabeth II and three different prime ministers in rapid succession. Both these events have influenced how other nations perceive us as a trusted and investible partner having continuity and a clear national identity. Within this context, UKCRIC has much to offer and is engaging in conversations at the highest levels. UKCRIC is clear about its need to remain agile and responsive to

global challenges while at the same time responding to the needs of industry and society, helping to address the skills gap and advancing the research agenda. Our focus continues to be on sustainability, resilience, equity and collaboration, building partnerships both domestically and internationally.

Through our ground-breaking collaborative framework agreement with HS2 Ltd, which enables HS2 to efficiently commission research from UKCRIC members, we jointly hosted a workshop that generated a number of exciting projects. We have established a trading company for UKCRIC, UKCRIC Limited, which gives collaborators the opportunity to access engineering-related scientific and technical consulting services across UKCRIC member institutions through a single organisation. As a testament to its early success, UKCRIC Limited has already completed two projects, which you can read about in this report.

This year our strategy for growth and our ambition to become an Institute has been underpinned by the launch of a comprehensive UKCRIC Roadmap, which will shape our vision and priorities over the next five years. Related to this is our desire to increase our engagement and consult with professional practitioners. In November 2022 we held the first meeting of our Stakeholder Advisory Group. Formed of leading industry representatives, the Group is providing critical insights into the challenges facing the sector.

We continue to engage all of our stakeholders. With the increased optimism and confidence following the COVID vaccine rollout, we have started to hold more in-person meetings in addition to our online seminars. We jointly hosted events with the Data & Analytics Facility for National Infrastructure (DAFNI) in Harwell, Oxford and the National Distributed Water Infrastructure Facility (NDWIF) at the University of Sheffield to highlight research capabilities and opportunities for collaboration. UKCRIC also partnered with the University of Sheffield to exhibit at New Scientist Live, showcasing our research activities to the public. Our presence at Futurebuild introduced industry attendees to UKCRIC's Person-Environment-Activity Research Laboratory (PEARL) with a seminar on 'Rethinking infrastructure for our health and wellbeing'. As a founding member of the ISNGI symposium series, which provides a biennial platform for infrastructure systems research and practice, a number of UKCRIC academics featured prominently on the programme. I am especially pleased that UKCRIC will be responsible for the management and delivery of the symposium in 2024 and beyond.

UKCRIC has unrivalled knowledge and capability to deliver bespoke solutions for infrastructure and urban systems practitioners as well as helping to address nationally and globally significant research challenges. We also recognise that we have much value to add for our members and partners by providing a voice into Government to help address these challenges. As such, UKCRIC is increasing its visibility with

policy makers, providing, for example, written responses to Government Reviews such as Mission Zero, the independent review into Net Zero by Chris Skidmore, MP.

We continue to nurture early career researchers and future infrastructure professionals. Following the launch of UKCRIC's Doctoral Skills Network last year, I am pleased to see that it remains popular with more than 200 members now benefitting from its comprehensive skills development programme.

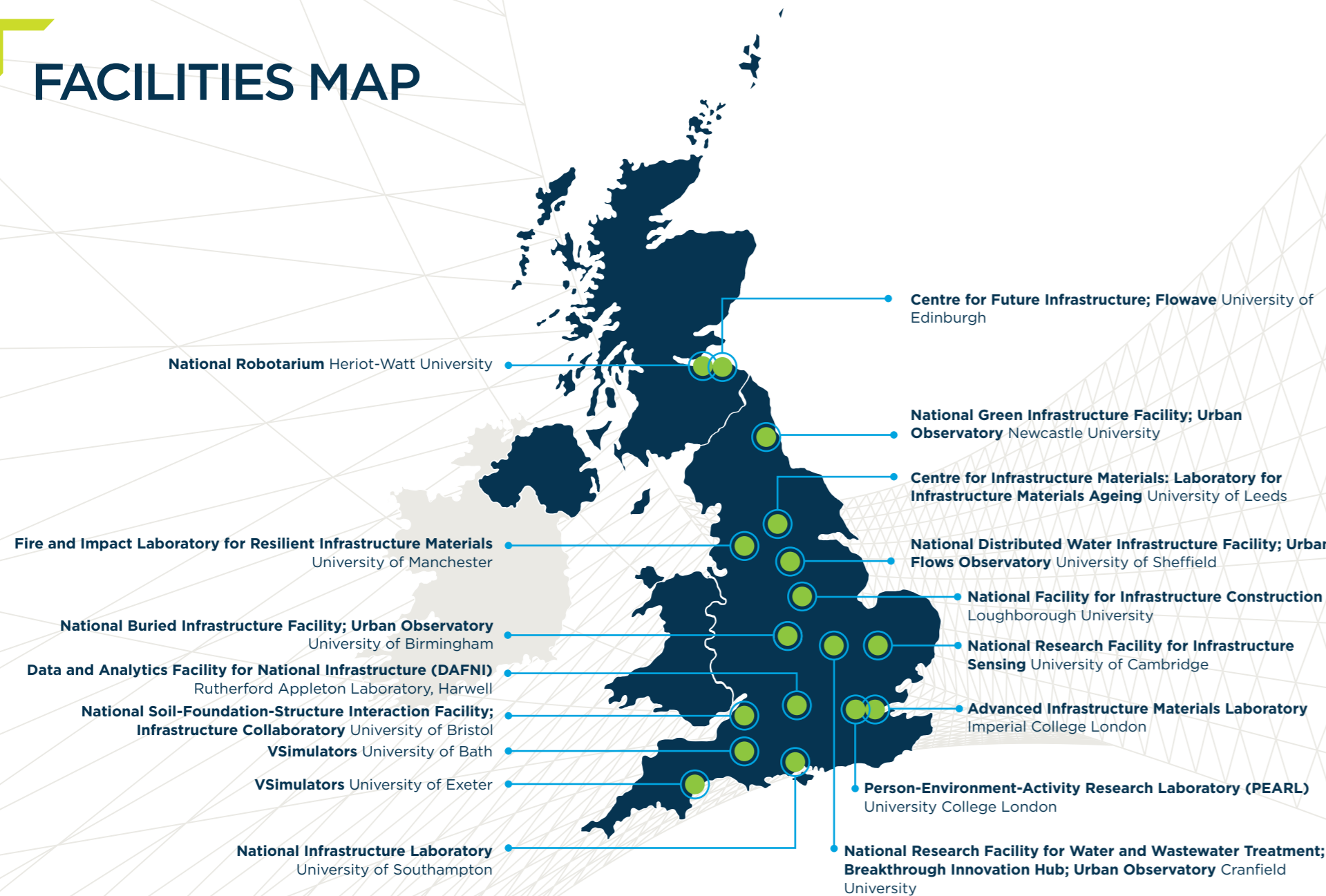
Our vision for the transformation of infrastructure and urban systems that enables safe, resilient and sustainable living underpins an ambition to deliver impact internationally as well as nationally. In February 2023, UKCRIC representatives joined a Department for International Trade (now the Department for Business and Trade) delegation to Malaysia, designed to strengthen links between Malaysia and the UK's Midlands region with a mission theme of 'sustainable smart cities'. UKCRIC also participated in a conference and high-level round table organised by the Royal Society focussed on rebuilding Ukraine's economy and planning for green recovery.

Having established our facilities, UKCRIC is now firmly on its journey to become a self-sustaining entity. The examples in this report reflect this ambition and I invite you to take a look.

Professor William Powrie, UKCRIC Convenor



FACILITIES MAP



IMPACT 2022 - 2023



DEVELOPING TALENT, NURTURING CAREERS

UKCRIC Doctoral Skills Network

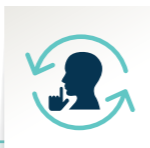
The UKCRIC Doctoral Skills Network offers an opportunity for postgraduate researchers from UKCRIC institutions to meet and exchange ideas, support each other and gain skills to develop their careers as engineers of the future. Officially launched in January 2022 as part of UKCRIC's coordinated training activities, the aims of the Doctoral Skills Network are to:



Offer developmental opportunities to doctoral researchers based in UKCRIC institutions focusing on research in infrastructure and cities



Create a vibrant doctoral community and promote collaborations and idea exchanges



Combine the collective expertise and capabilities of the UKCRIC universities and partners in support of the activities of the doctoral network



Support the development of research-minded leaders that can address national and international priorities

By March 2023 the Network had more than 200 members from across 15 universities. Four conferences and 16 webinars were hosted in collaboration with UKCRIC Centres for Doctoral Training (CDTs), the Energy Research Accelerator, C-DICE Network and other collaborative partners. The Water-WISER Early Career Researcher Conference, for example, was a joint collaboration between the CDTs of The University of Leeds, Loughborough University and Cranfield University. These events addressed contemporary themes such as Net Zero, renewable energy, water and waste, and health and wellbeing. In partnership with VOX coaching the Network delivered a training workshop tailored to postgraduate and early career researchers on communicating research through film.

To support managers and investigators of CDTs that are based in UKCRIC institutions, a dedicated LinkedIn Group has been established to share experiences and knowledge of running successful CDT programmes as well as to provide information about upcoming collaborative opportunities.

“Our doctoral students are the lifeblood of future innovations in infrastructure and urban systems, and as such providing opportunities for development is a critical component of UKCRIC activity.**”** Jenny Knight, UKCRIC Skills Manager

BESPOKE SOLUTIONS FOR INFRASTRUCTURE AND URBAN SYSTEMS PRACTITIONERS

UKCRIC Limited

UKCRIC Limited is the trading company of UKCRIC, giving collaborators the opportunity to work with UKCRIC member institutions through one organisation. Officially trading since April 2022, the work of UKCRIC Limited complements UKCRIC's Scientific Missions to underpin the renewal, sustainment and improvement of infrastructure and cities in the UK and elsewhere.

From expert consultancy and collaborative research, to custom programmes and developing framework agreements, the combined expertise of UKCRIC Limited member institutions provides unmatched knowledge and capability able to deliver bespoke solutions for infrastructure and urban systems practitioners across industry, government, non-profit and public sector organisations.

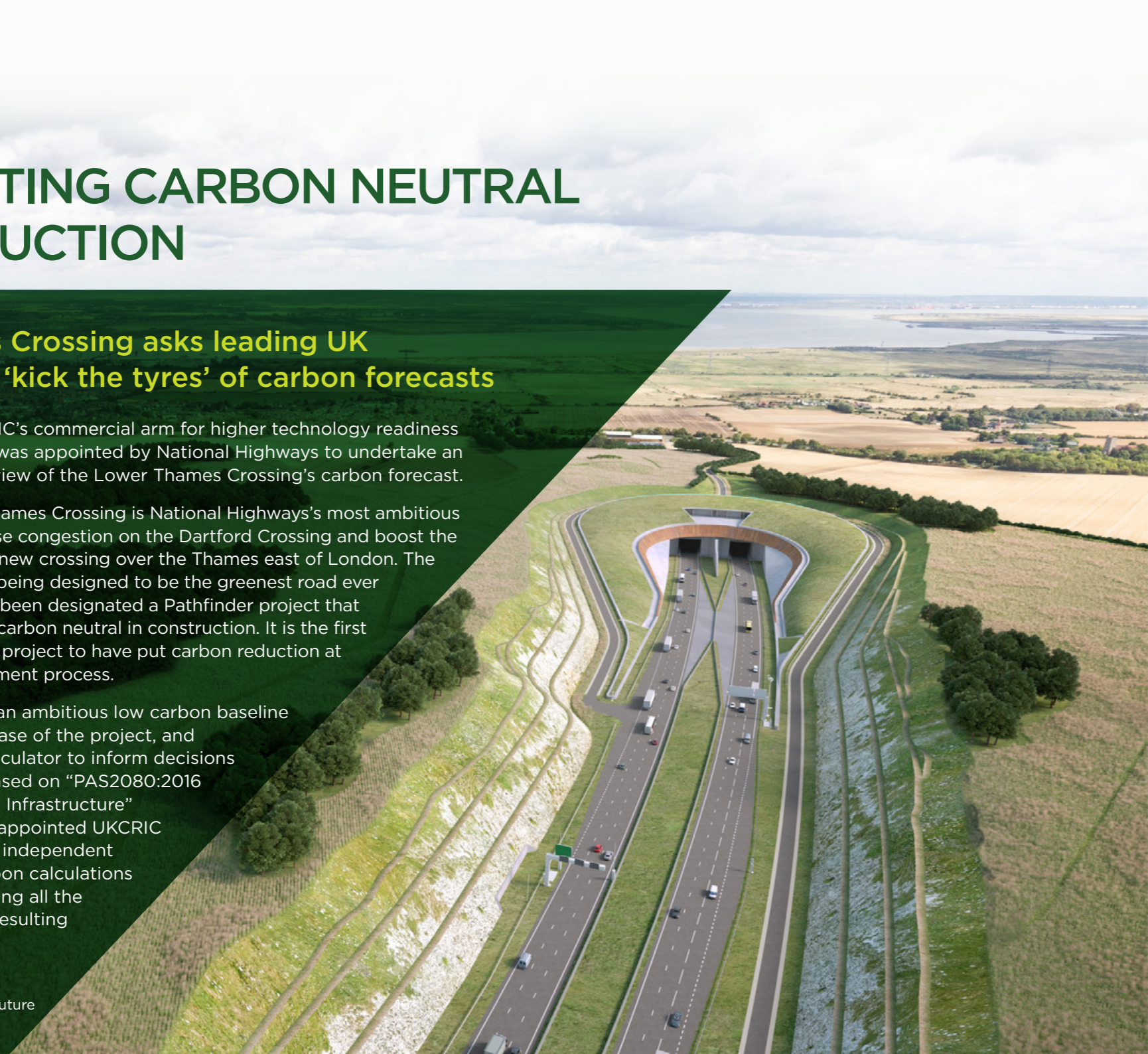
SUPPORTING CARBON NEUTRAL CONSTRUCTION

Lower Thames Crossing asks leading UK universities to 'kick the tyres' of carbon forecasts

UKCRIC Limited, UKCRIC's commercial arm for higher technology readiness collaborative projects, was appointed by National Highways to undertake an independent expert review of the Lower Thames Crossing's carbon forecast.

The proposed Lower Thames Crossing is National Highways's most ambitious project, designed to ease congestion on the Dartford Crossing and boost the economy by creating a new crossing over the Thames east of London. The new road and tunnel is being designed to be the greenest road ever built in the UK, and has been designated a Pathfinder project that will explore ways to be carbon neutral in construction. It is the first major UK infrastructure project to have put carbon reduction at the heart of its procurement process.

National Highways set an ambitious low carbon baseline for the construction phase of the project, and developed a carbon calculator to inform decisions on carbon reduction based on "PAS2080:2016 Carbon Management in Infrastructure" standards. The project appointed UKCRIC Limited to carry out an independent assurance that the carbon calculations were accurately capturing all the substantive emissions resulting from the project.



UKCRIC Limited assessed compliance with PAS2080:2016 processes; whether the assumptions made reflect wider good practice for carbon assessment; the quality of data and accuracy of data processing; and whether the indicative results of the carbon calculator for carbon savings compare with low carbon good practice in the construction industry.

Seraphine Appel, UKCRIC Research Fellow and Project Manager for the carbon calculator evaluation, said,

"Helping the UK meet its carbon targets and decarbonising infrastructure through more efficient sustainable design is a key element of UKCRIC's research agenda. We are delighted to be working with National Highways on the Lower Thames Crossing; making a valuable assessment of their carbon calculator and contributing to the carbon reduction planning of such a nationally significant infrastructure project."

Andrew Kidd, Director of Solutions & Outcomes, Lower Thames Crossing, said,

"As a Pathfinder project, we are exploring new and innovative ways to achieve carbon neutral construction. We have effective tools that we're using to understand the potential emissions from the scheme and help us focus on the areas where we can deliver the greatest reductions in emissions. We are committed to transparency and to sharing what we learn and are pleased to have appointed UKCRIC Limited to provide an independent review of our calculations."

The assessment of the carbon calculator was completed by UKCRIC Limited via a collaborative project with six UKCRIC partner universities including University of Cambridge, University of Manchester, Cranfield University, University of Edinburgh, Loughborough University, and University College London.



“We are committed to transparency and to sharing what we learn and are pleased to have appointed UKCRIC Limited to provide independent review of our calculations.”

Andrew Kidd, Director of Solutions & Outcomes, Lower Thames Crossing

SUPPORTING MAJOR NATIONAL INFRASTRUCTURE PROJECTS

“ It is clear that the research that you have conducted so far has produced very encouraging results and this definitely bodes well for the final report. ”

Richard Page,
Waste and Excavated
Materials Manager,
Mace Dragados

Investigating the repurposing of London Clay for landscaping projects

UKCRIC institutes the University of Birmingham and Heriot-Watt University have collaborated with HS2, in a project to demonstrate that excavated London Clay can be used as a growing medium for landscaping and remediation.

The paused construction of HS2 at Euston Station involves the excavation of one million cubic metres of material, the majority of which is London Clay. These clays are beneficially reused for flood protection and landfill capping. Recent developments within the industry have led to greater consideration of how waste materials from construction can be best employed to maximise environmental benefit and aid transition to a circular economy. HS2, in collaboration with Mace Dragados, commissioned a project to investigate the potential for the excavated London Clay to be ameliorated and used as a growing medium capable of supporting plant growth for use in local landscaping and remediation projects.

The aim of the work was to determine whether the addition of compost and sand to the clay can support plant growth either with or without the use of added fertiliser. The desired outcome is to reuse excavated material locally, to minimise excavation waste and maximise resource efficiency.

Greenhouse trials were carried out at the University of Birmingham and outdoor growth experiments were also undertaken at Heriot-Watt University.

Physical and chemical properties of the growth media were determined before being planted with three grass species (*Lolium perenne*, *Panicum virgatum* and *Festuca arundinacea*). Plant growth was measured, together with chemical and microscopic analysis of the aboveground biomass, to understand the limitations on plant health and vigour in the ameliorated clay growth media. Chemical analysis of the growth media indicated that the ameliorated clays had high pH and were low in available nitrogen and

phosphorus, but relatively sufficient in most micronutrients.

Germination and growth of grass species after the first month was limited without additional fertilisation, primarily because of low availability of nitrogen and phosphorus. Fertilisation alleviated limitation to growth in the greenhouse experiment, indicating that the ameliorated clays are suitable for repurposing as a growth media with appropriate ongoing fertiliser management.

Both the greenhouse trials and the outdoor experiments indicate that the London Clays can be sufficiently ameliorated to support plant growth and would be suitable for repurposing in landscaping projects, subject to appropriate amelioration and fertilisation. Key considerations for amelioration are a reduction in compaction and an increase in coarse particle content to improve drainage and permit root growth. This can be achieved with the addition of compost alone, as in the case of Heriot-Watt University's outdoor experiment, or a combination of compost and sand as shown by the greenhouse experiment at the University of Birmingham.

The successful growth of three species of grass under both greenhouse and outdoor experimental conditions indicates that ameliorated clay from under Euston Station is suitable for repurposing in landscaping projects. Successful planting will depend on the addition of compost and possibly sand to alleviate drainage and compaction and to provide some of the essential plant nutrients. The addition of compost alone or compost and sand may not be enough to sustain good vegetative growth in the initial stages of plant establishment and any landscaping project should also include fertilisation with a management plan for these ameliorated and repurposed clays. Full-scale trials should be undertaken in preparation for the resumption of work at Euston Station, to achieve cash savings and environmental benefit.

BUILDING CAPACITY, ENHANCING IMPACT

Automating Scope 3 environmental assessment in small-scale construction projects

PorthouseDean, specialists in providing structural calculations for the small-scale residential market in the UK, partnered with UKCRIC Limited to develop a bespoke software with an Application Programming Interface (API) to measure the environmental implications of construction projects.

PorthouseDean operates as a dynamic engineering company that embraces a youthful entrepreneurial ethos. With a close-knit team hailing from six different cultural backgrounds, the company prides itself on its diversity and inclusive work environment. Through recent years, the company has undergone transformative changes, optimising its processes and enhancing technological capabilities. Noteworthy innovations include the implementation of an automated multinational engineering workflow, enabling engineers to concentrate on their core expertise.

In response to the growing demand for environmental sustainability in the construction industry, and mandatory Green House Gas reporting in the UK, PorthouseDean faced a pivotal challenge – the need to calculate scope 3 emissions. Scope 3 emissions are the indirect emissions that occur in the value chain of an organisation, such as the emissions from suppliers, customers and logistics. Scope 3 emissions, while critical for a comprehensive environmental assessment, lacked a defined framework within PorthouseDean's projects. The hurdles to overcome were twofold. First, extracting precise data on specified materials and quantities from their output

product proved challenging. The intricacies of this process required a level of expertise beyond their in-house capabilities. Second, the variability in methodologies calculating scope 3 emissions and lack of standardisation posed another hurdle. To address the first challenge, PorthouseDean sought assistance from Innovate UK EDGE, who sponsored a project in partnership with UKCRIC Limited, the trading company of UKCRIC. This collaboration not only brought essential technical skills to the table but also provided extensive domain knowledge specific to the industry.

UKCRIC Limited's specific contribution was completed by its collaborative member, the Centre for Smart Infrastructure and Construction (CSIC) at the University of Cambridge. A custom software with an API interface was developed that takes engineering outputs produced by PorthouseDean, in the form of structural calculations reports and technical drawings, and computes the number and type of structural elements used. The value of this API is that it can be automated and is infinitely scalable. PorthouseDean works on more than 100 structural projects a year and the API allows them to add an environmental study service to their projects at marginal cost, requiring only a small investment of an engineer's time. In addition to providing a new stream of income, this project also raises the company's and customers' awareness of the environmental consequences resulting from construction projects. Moreover, this initiative marks a paradigm shift in the small-scale structural engineering industry. Traditionally, customers in this segment are presented with trade-offs between speed, cost and aesthetics. Now, a fourth dimension enters the equation, offering customers a comprehensive understanding of the environmental implications, thus reshaping the decision-making landscape. Lastly, this capability opens the door for PorthouseDean to collaborate with a wider

pool of architectural partners who focus on sustainability and were previously frustrated by the lack of environmental consideration from engineers.

Saleh Alhuraybi, R&D Manager, PorthouseDean said,

“From a simple idea aimed at expediting engineering tasks, our collaboration with the Centre for Smart Infrastructure and Construction at the University of Cambridge led to us considering a new product offering unique to our market. We were initially looking for a way to comb through our projects and identify ones suitable for training and reference through a centralised database ready for data analysis. However, the tool evolved to calculate the amount and type of structural material used, partly enabling us to assess our scope 3 emissions and allow us to answer questions we couldn't ask yet like “how much embodied carbon did PorthouseDean specify in Q3 2022?”. This is a game-changer for us and the industry.”

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Saleh Alhuraybi, R&D Manager, PorthouseDean

INFLUENCING POLICY

Establishing a Competencies Framework for Infrastructure Policy Professionals

Researchers in UCL's Department of Science, Technology, Engineering and Public Policy published a report from their UKCRIC funded project - Establishing a Competencies Framework for Infrastructure Policy Professionals.

Through intensive engagement activities with experienced professionals across public, private and third sector organisations and academic researchers, the resulting 'Competencies Framework' provides the potential to directly inform practice, and improve higher education and workplace training.

Taking a broad view of the infrastructure policy 'sector', encompassing traditional infrastructure areas (including water, waste, energy, green infrastructure, transport and digital) and professionals and organisations involved in decision-making across the public, private and third sector, the project sought to answer the question - 'What specific competencies and types of expertise are required from infrastructure policy professionals as they address complex global challenges?'

Credit: Samuel Regan-Asante reganography

“As infrastructure policy becomes increasingly important to respond to the climate crisis and improve societal wellbeing, this research contributes to UKCRIC's missions by synthesising insights on the key competencies required for policy professionals.”

Dr Jenny McArthur, Lead Investigator, Establishing a Competencies Framework for Infrastructure Policy Professionals, UCL

The project combined a review of existing competency frameworks with interviews with experienced professionals. Discussions are summarised under the following areas:

- Core skills (communication and translation, reflexivity and strategic thinking),
- Knowledge (generalist and specialist, contextual knowledge and awareness)
- Behaviours (working collaboratively across disciplines, critical thinking and willingness to challenge the status quo, initiative and emotional intelligence)
- The importance of institutions creating an enabling environment in which to develop professional competency is also highlighted (paradigm change, workplace culture, leadership and mentoring, suitable metrics for skills, knowledges and behaviours).

Key takeaways include:

- Emphasising the development of behaviours within professional competency—which have been underrepresented/undervalued in competencies frameworks to date in comparison to knowledges and skills
- Awareness of methods and tools to plan for an uncertain future—being able to understand and respond as best as possible to short and long-term social and environmental changes
- Recognising the complementary value of generalist and specialist backgrounds—appreciation of the need for diverse, cohesive and highly competent teams, as well as talented individuals
- Evolving the recognition of professional accreditation as a license to operate—with a focus on understanding and developing professionals' environmental and social licenses to operate

ENGAGING THE PUBLIC

Exploring public perceptions and support for green infrastructure funding mechanisms

A study led by researchers at Cranfield University and the University of Leeds, and funded by UKCRIC, investigated the extent to which residents of the Oxford-Cambridge Arc support alternative green infrastructure funding mechanisms and where they believe these sources should come from.

Green infrastructure refers to natural and semi-natural features designed to deliver ecosystem services. It can contribute to achieving climate change adaptation and mitigation goals and can help address issues related to flooding, air quality, biodiversity and health and wellbeing. Despite the benefits of green infrastructure, uptake is hampered by lacks of access to financing and clarity over how it should be funded and by whom.

Local authorities are beginning to examine whether they can effectively fund green infrastructure by drawing on combinations of public, private and community funding sources. Understanding the public's perceptions of potential funding mechanisms is a foundational step in developing funding measures.

An online survey was designed and distributed to residents of the Oxford-Cambridge Arc to better understand the extent to which

support for funding mechanisms is associated with attitudinal, contextual and personal capability variables.

Results indicate that respondents prefer infrastructure funding to be covered by developers and oppose funding requiring financial obligations from citizens. Support for using business levies, developer levies and green bonds did not change with the scale of the project. When it came to council tax increases and community investment bonds, support decreased when used to fund large-scale projects. This suggests that respondents are more likely to support these mechanisms to fund small-scale projects. Altruistic-biospheric values, pro-environmental behaviour and trust in the government significantly affected support for most of the funding mechanisms. Pro-environmental engagement attitudes along with trust in the government were associated with increased support. This suggests that while citizens may prefer the use of some mechanisms over others, support for most mechanisms could be increased by engaging with an individual's desire to improve the environment and by improving their perceptions of the government.

The research will inform policy makers and aid local authorities to identify suitable mixes of funding mechanisms that can be implemented to fund different types of green infrastructure and develop strategies to increase support and reduce barriers to implementation.

The study is part of a wider project funded by UKCRIC to accelerate progress of UKCRIC Mission 3: to develop improved understandings of how infrastructure ownership, governance and business models can be improved to deliver infrastructure that it is more responsive to innovation and change.

UKCRIC is also supporting a further study co-funded with C-DICE that will explore user willingness to change their behaviour by shifting heat pump and electric vehicle use to periods of low local emissions.

Image caption. Credit:

“
Whilst there are existing studies and literature on the perceived benefits and value of green infrastructure projects there was very little evidence of stakeholders' perceptions of who and how these projects should be financed. This study is an important contribution towards that goal.

Prof Paul Jeffrey, Lead Investigator for Accelerating UKCRIC Mission 3 and Professor of Water Management, Cranfield University

FACILITATING CROSS-INSTITUTIONAL COLLABORATION

“ PLEXUS PLUS aims to achieve a step change in understanding the seasonal bridge-abutment interaction through the combined application of large-scale testing, state-of-the-art modelling and in-soil monitoring.

Prof Anastasios Sextos,
PLEXUS PLUS Lead Investigator,
University of Bristol

Multi-scale soil scanning for evaluating abutment-soil interaction in integral abutment bridges

The UKCRIC-funded project PLEXUS PLUS was the first experimental campaign in the UKCRIC Soil-Foundation-Structure-Interaction Laboratory (SoFSI) lab. It was led by the University of Bristol and co-led by the University of Birmingham and the University of Southampton.

PLEXUS PLUS emerged from the successful experience of collaboration pioneered in the EPSRC project “UKCRIC - PLEXUS - Priming Laboratory experiments on infrastructure and Urban Systems”; a pump-priming project designed to establish the collaboration and practice frameworks needed for long-term, successful, collaborative UKCRIC laboratory environments.

The PLEXUS PLUS project had two objectives: (1) understanding soil-structure-interaction phenomena on abutment-backfill ensemble of integral bridges due to deck thermal expansion, and (2) employing several monitoring systems necessary to map settlements, strain and pressure characteristics behind the abutment and within the soil pit.

The setup of the PLEXUS PLUS test consisted of a hinged at the base reinforced concrete flap contained between two towers of concrete Lego blocks and connected to a 1MN static actuator.

The backfill comprises approximately 50 tonnes of silica sand. The wall was monitored by means of strain gauges, optical fibre, pressure cells, and a digital image correlation. The sand was instrumented with non-contact LVDT to measure settlements, a Ground Penetrating Radar to monitor density throughout the different phases of the test and arrays of accelerometers to measure site conditions based on ambient noise induced by the nearby 6x5m shaking table. A pseudo-static experiment of 100 constant cycles was performed mimicking the life-cycle thermal variation of integral bridges.

The first results obtained offered a quality benchmark case, within a well-controlled soil-structure interaction environment, that enhances our understanding of the long-term performance of integral bridge abutments. It also paves the way to even larger scale soil-structure interaction tests to reduce the epistemic uncertainty associated with the behaviour of such bridges and ultimately reduce unnecessary conservatism in design codes and guidelines.

Prof Anastasios Sextos, PLEXUS PLUS Lead Investigator, University of Bristol said,

“PLEXUS PLUS aims to achieve a step change in understanding the seasonal bridge-abutment interaction through the combined application of large-scale testing, state-of-the-art modelling and in-soil monitoring. With the support of UKCRIC it will enhance cross-institutional, interdisciplinary collaboration, data sharing and joint cutting-edge research paving the way for real-time hybrid testing among its facilities.”

IMPROVING EFFICIENCY

Is Demand Responsive Transport integrated with parcel delivery a viable future?

A pilot study led by researchers at Heriot-Watt University and funded by UKCRIC showed that carbon reduction and financial cost savings can be achieved by combining mobility, such as a demand response bus service, with parcel delivery.

A significant proportion of the UK's population lives in low-density, car-dependent housing – and we keep building more such car-dependant housing. In the UK and across the world's city centres and densely populated urban places, road congestion has driven the need for people to share modes of transport. This includes bus, tram, light rail, overground and underground rail services. This 'congestion driver' towards shared transport does not work in low density places. The shared transport in these areas needs to attract car drivers out of their cars. Decarbonisation is achieved by sharing transport and is further achieved by decarbonising the shared transport vehicle itself.

Most houses in the UK are being serviced by one or more parcel delivery services, services which have increased considerably in recent years due to stimulation by the restrictions of the Covid19 pandemic. If parcels and passengers share destinations and origins, it could be possible to further improve vehicle fill (maximising use of the vehicle's capacity) – reducing carbon emissions and reducing the overall costs of the combined operation. Although there have been a number of Demand Responsive Transport pilot schemes, they focus on the transportation of people as passengers and not on the vehicle as an asset which could be more efficiently utilised.

The 'Suburban-fringe 'On-demand' Algorithm based Shared Transport' project (SOAST) analysed the viability of providing Demand Responsive Transport from any postcode to any other postcode in a low to medium density region, integrating people mobility with parcel delivery, and incorporates last mile parcel delivery from locker stations to front doors.

As part of the project, a virtual model was built and run for South Lakeland District. The model can also run simulations for any area of the country with a multitude of input variables. The SOAST system demonstrated an overall cost reduction in the range of 12-35% shared between operators and passengers.

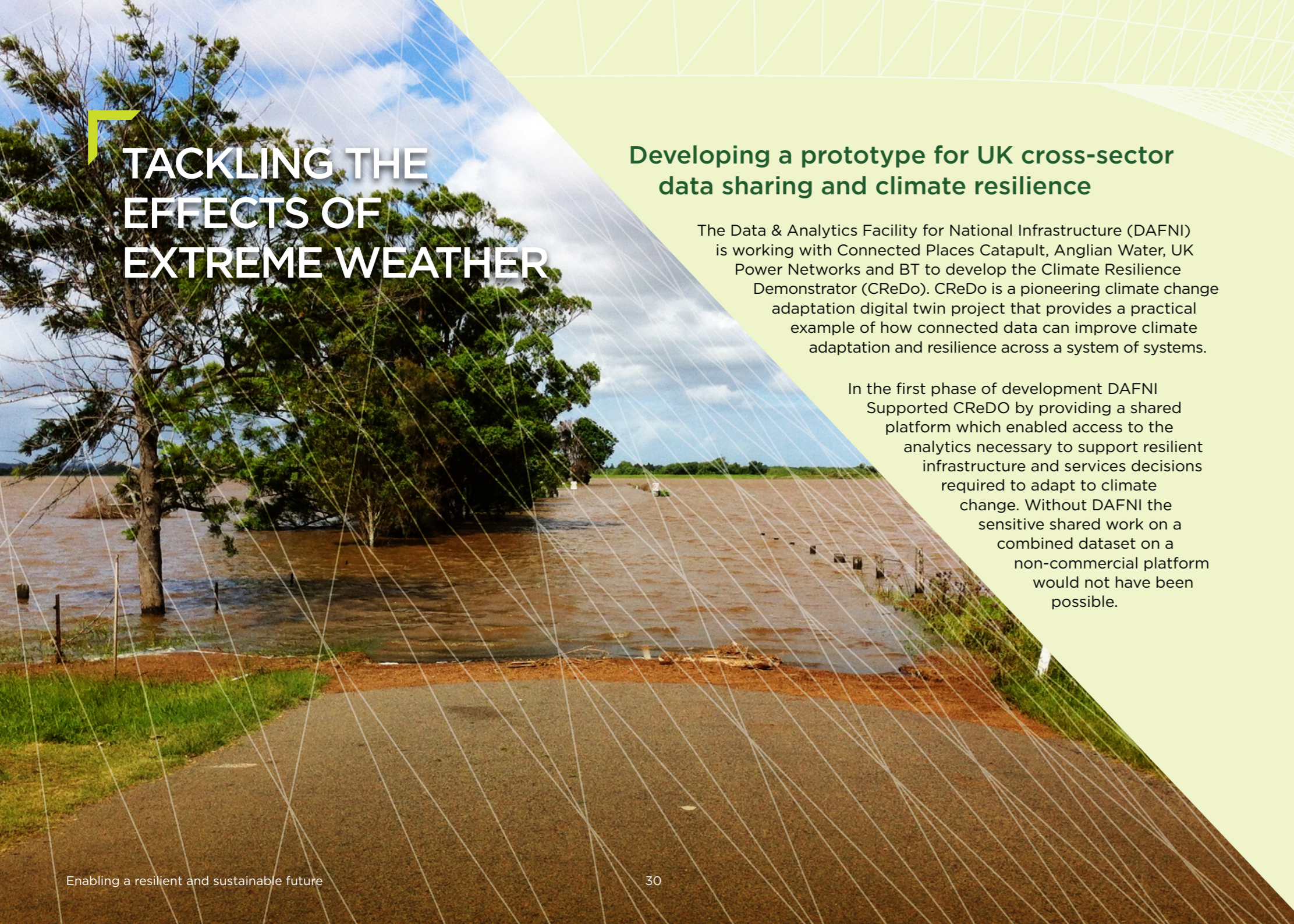
The research team's analysis showed that pooling passenger and parcel delivery can potentially deliver economic benefits across the combined operation, reducing the cost of rural public transport and parcel deliveries whilst maintaining service levels and also improving the utility of public transport. The team at Heriot-Watt University intend to extend the research by setting up pilot projects across the country to test bespoke modelling scenarios and to fully evaluate the SOAST system.

“ Demand responsive transport with attractive vehicles can improve communities and make a major contribution to decarbonising the transport of people and parcels.

Dr Roderick Macdonald, Institute for Infrastructure and Environment, Heriot-Watt University

Credit: Markus Winkler





TACKLING THE EFFECTS OF EXTREME WEATHER

Developing a prototype for UK cross-sector data sharing and climate resilience

The Data & Analytics Facility for National Infrastructure (DAFNI) is working with Connected Places Catapult, Anglian Water, UK Power Networks and BT to develop the Climate Resilience Demonstrator (CReDo). CReDo is a pioneering climate change adaptation digital twin project that provides a practical example of how connected data can improve climate adaptation and resilience across a system of systems.

In the first phase of development DAFNI Supported CReDO by providing a shared platform which enabled access to the analytics necessary to support resilient infrastructure and services decisions required to adapt to climate change. Without DAFNI the sensitive shared work on a combined dataset on a non-commercial platform would not have been possible.

Trying to predict and mitigate the effects of climate change when you can only see a small part of the bigger picture is almost impossible, therefore connected data is the key to building climate resilience.

Professor Kate Royse, Director, STFC Hartree

CReDo looks specifically at the impact of flooding caused by climate change on energy, water and telecoms networks, but its longer-term aim is to capture new sectors to realise an integrated infrastructure innovation ecosystem that delivers an even greater level of resilience. As the project enters phase two, DAFNI and the Hartree Centre, supported by the UK Research and Innovation (UKRI) Science and Technology Facilities Council (STFC), continue to provide the project with crucial data and cybersecurity expertise and provide secure hosting for the system.

Phase two sees the Connected Places Catapult take over as lead organisation with Computational Modelling Cambridge Ltd (CMCL) as the development partner. CMCL are using semantic knowledge graph technology to help build core functionality to support cross-sector data sharing, system-wide impact modelling and decision support. This six-month work programme will combine data and insights across sectoral and organisational boundaries to improve coordination of operational and investment decisions, mitigate the effect of flooding on network performance, and ensure reliable service delivery to customers.

Professor Kate Royse, Director, STFC Hartree Centre said:

“Trying to predict and mitigate the effects of climate change when you can only see a small part of the bigger picture is almost impossible, therefore connected data is the key to building climate resilience. We’re excited to be continuing our collaboration with the network of CReDo partners by providing our data science expertise to explore how to work across sectors and systems to address climate change challenges.”

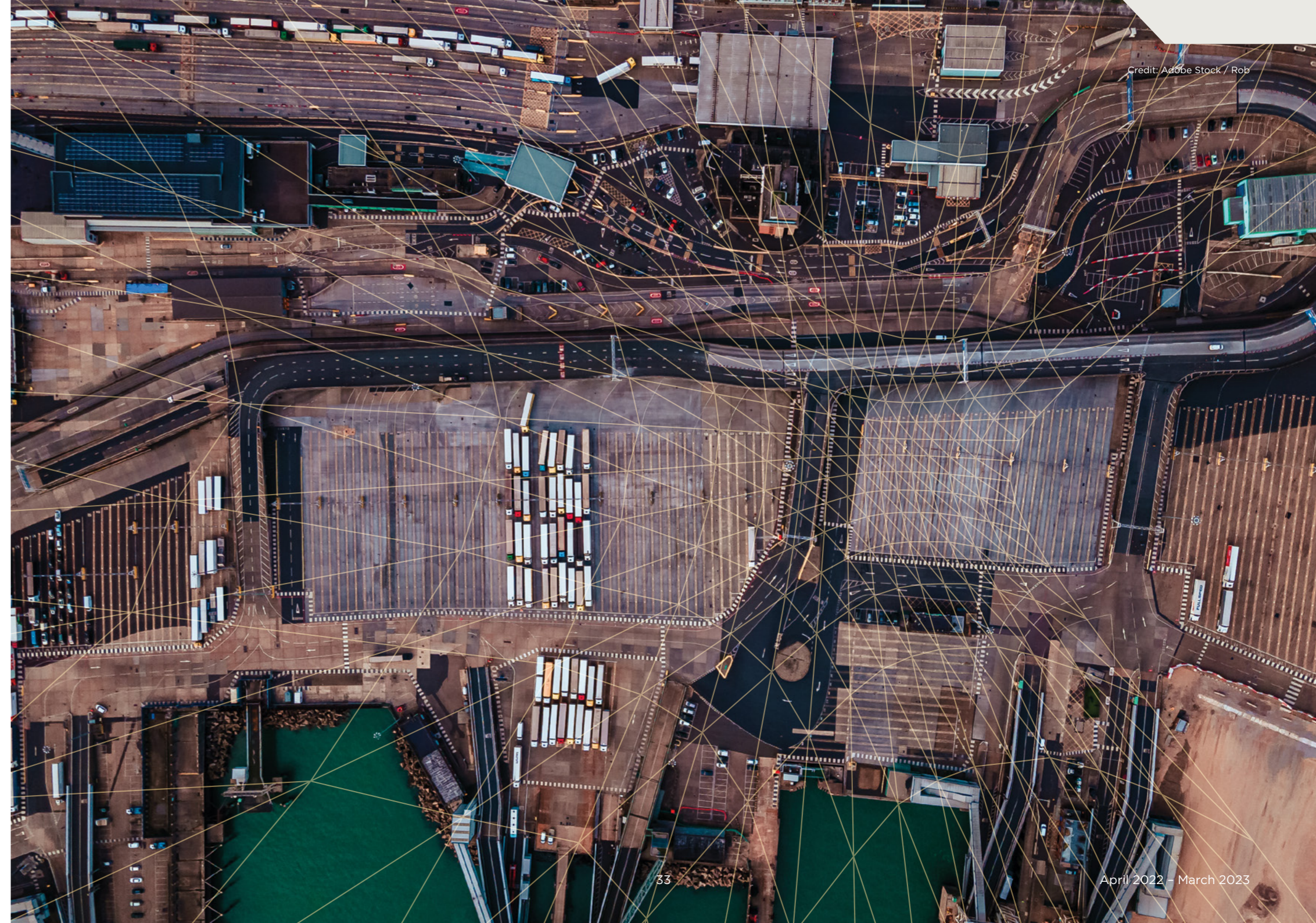
STFC Scientific Computing’s Dr Brian Matthews, who leads DAFNI, said:

“I am delighted to continue to work with the innovative CReDo partnership. Using the secure collaboration space that DAFNI provides, the CReDo partners can work together and share data safely, and so explore the impact of floods on our vital utility networks. This digital twin will help partners to provide rapid responses to emergencies and inform planning decisions, and so it will enhance the resilience of our society as we face the challenges of extreme weather as a result of climate change.”

PARTNERS



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