



Innovate
UK

Clean Growth and Infrastructure

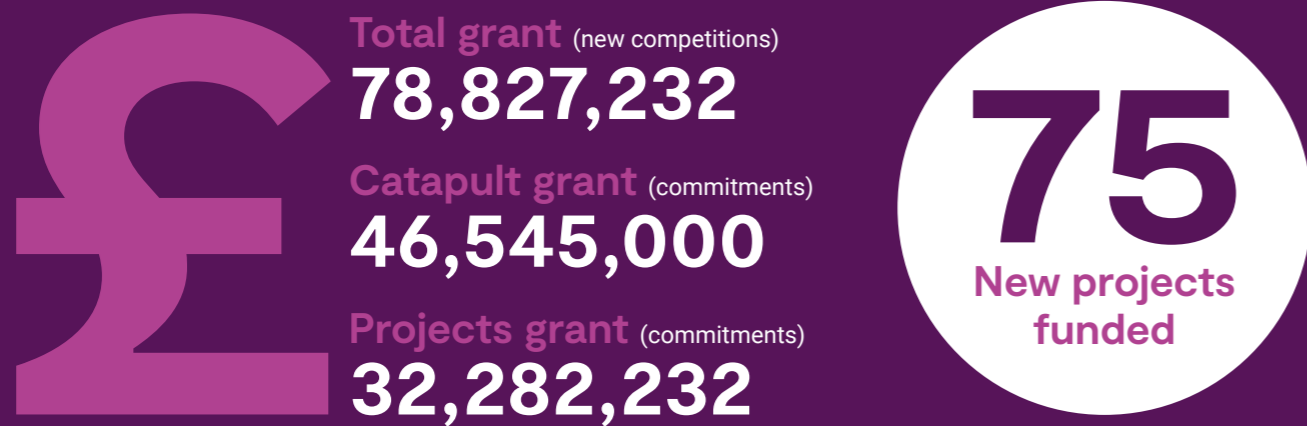
Annual Review 2020



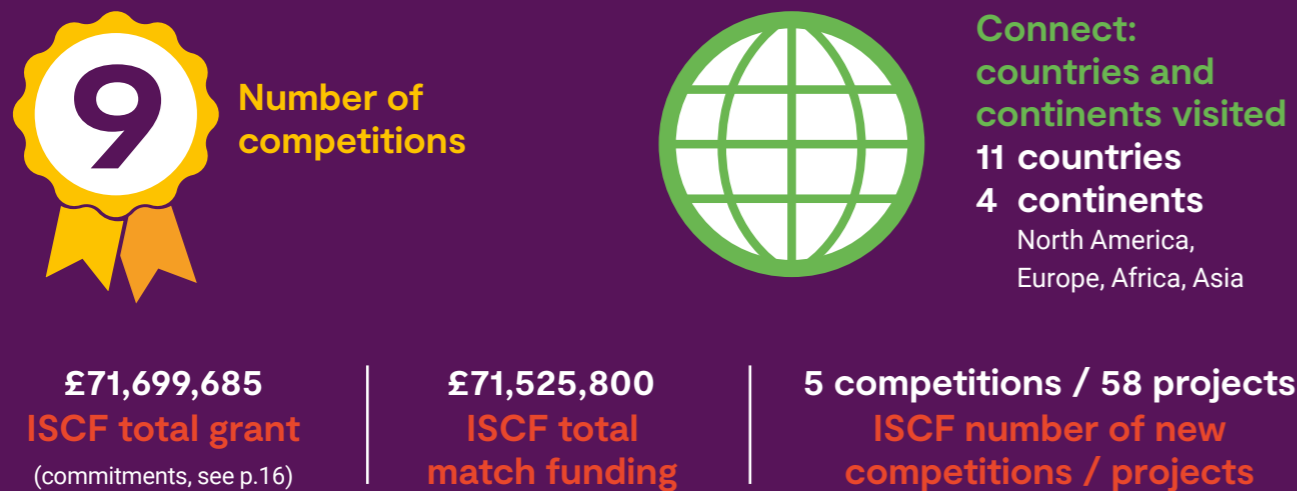
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Facts and figures for 2019–20



SME match funding £21,730,873



*This funding is private investment from companies supported by Innovate UK. The figure quoted was calculated via Beauhurst's database. The actual amount of further funding could be more than stated.

Welcome

Innovate UK, part of UK Research and Innovation, drives productivity and economic growth by supporting businesses to develop new ideas. We fund business innovation and collaboration with researchers in all economic sectors, value chains and UK regions to accelerate growth.

The UK aims to be net-zero by 2050. This provides opportunities for UK businesses to be in a first-mover position as the world transforms, opening up opportunities while other countries develop their decarbonisation plans. Our aim as the Clean Growth and Infrastructure team is to use our convening power, expertise and funding support to help UK businesses lead in the development of solutions that accelerate the global shift to clean growth.

The scale of the global decarbonisation challenge is immense but fundamental to our futures. It requires all sectors to adopt carbon abatement and sequestration technologies, improve energy efficiency, and adopt climate mitigation and resilience measures, in addition to wider behavioural change to control demand.

The solutions required to meet this challenge are new and innovative, multidisciplinary and interdependent. We work with policymakers, industry and the research base to understand and establish future needs, and run innovation programmes to deliver against these needs.

Our focus has been on:

- Carbon and Cost Reduction of Energy Generation, including offshore renewables, nuclear supply chain, hydrogen, solar and carbon abatement
- Transforming Energy Supply and Demand Markets and Systems, including energy system and network efficiency, storage, and efficient buildings
- Cities and the Built Environment, optimising city functions and services, and improving construction and the built environment.

There has been good progress. The UK has the largest installed capacity of offshore wind in the world, which is now the UK's cheapest form of at-scale power generation and has integrated flexible generation onto the electricity grid. Per capita emissions in the UK's 10 largest cities reduced by 40% between 2007 and 2017, and five UK cities are rated in the world's 40 most sustainable, smart, connected cities, with two in the top three¹. Internationally we have built collaborations across 28 countries in Africa and Asia to help the 1.1 billion people without access to modern energy services.

'Our aim is to help UK businesses lead in the development of solutions that accelerate the global shift to clean growth.'

However, there is much still to do. We must continue to decarbonise our cities and energy systems, develop exploitable solutions to ensure urban systems can be resilient to shock, and maximise the exploitation of UK clean growth expertise. Our approach is systems-focused and includes funded programmes, initiatives to catalyse innovation such as entrepreneur missions, and support to centres of excellence including the Catapult Network. This document provides details of this approach, highlights the impact this can have on individual companies, and outlines some of our plans.

The COVID-19 pandemic has affected all aspects of society and the economy. It has also demonstrated that when people work together towards a common goal great achievements are possible. Meeting net-zero in the UK by 2050 – and wider global targets – presents exceptional challenges. However, by working collaboratively to pioneer new approaches to developments in urban, energy and infrastructure systems we can address these challenges.

By supporting the development of the most promising decarbonisation solutions, we provide the opportunity for the UK to take the lead in advanced, low-carbon, sustainable solutions for the UK and beyond.

Funded programmes

Our investment is enabling the UK's shift to clean growth by supporting the development of forward-thinking companies and technologies.

We face a number of challenges as a society in the pursuit of the UK's 2050 net-zero target. By investing in innovative and disruptive projects and businesses we can address these needs – among them cheaper, cleaner, smarter energy, the achievement of cleaner air, and the pursuit of safer streets – while also driving UK economic growth.

In this section we'll showcase the impact of a number of funded programmes, including the Energy Catalyst, Geospatial Commission, Clean Air programme, Industrial Strategy Challenge Fund, Smart grants and Innovate UK's investment accelerator programme in partnership with energy and services business ENGIE.

Energy Catalyst

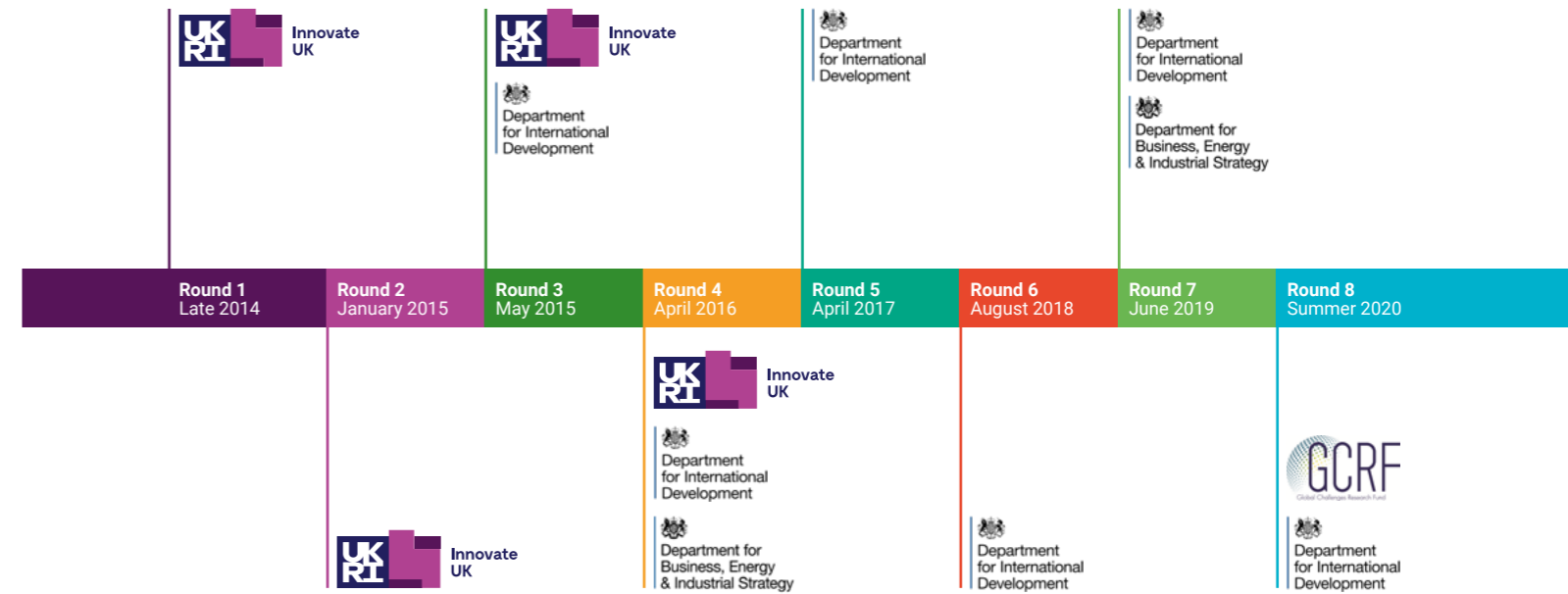
This programme supports businesses in developing innovative, sustainable energy technologies to accelerate the clean energy transition in developing and emerging economies.

Reliable energy services are crucial to human wellbeing and to a community's economic development. Yet 1.1 billion people globally go without access to modern energy services, and a further billion experience intermittent access. Most of these people live in Sub-Saharan Africa and South Asia.

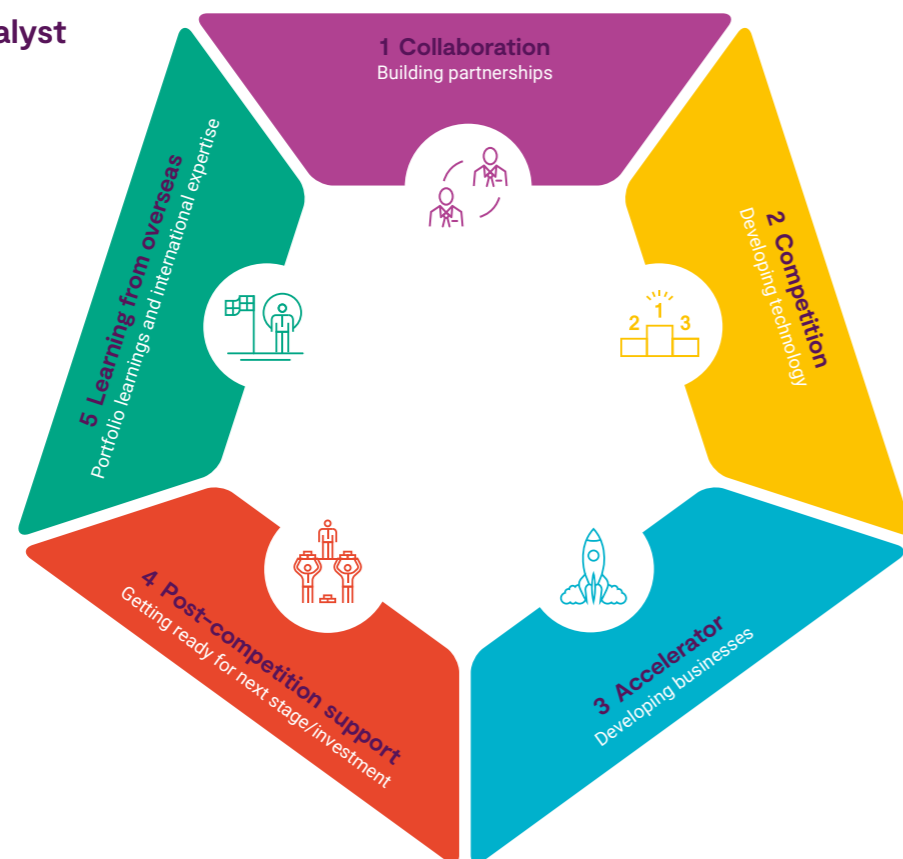
This is about improving lives. Despite global investment in the power sector increasing by almost 2.5 times during the past 15 years, generation capacity struggles to keep up with growing demand, let alone meet the needs of low-income communities. In many situations traditional, centralised grid-based technology solutions are neither feasible nor affordable for the majority of unserved poor households.

That's where Innovate UK's Energy Catalyst programme comes in. By helping UK and overseas organisations bring knowledge, experience and thinking to tackle energy access challenges in developing countries, progress is being made. Highly innovative, market-focused energy technologies, services and business models all receive programme support to enable vital energy access in Sub-Saharan Africa and South/South East Asia.

With world-class expertise in renewables and decentralised energy, UK businesses have a role to play in developing and commercialising innovative products and services to meet these challenges. The Department for International Development (DFID) has been working with the Energy Catalyst programme as part of the Transforming Energy Access (TEA) scheme since 2015, with the Global Challenges Research Fund and International Climate Finance through the Department for Business, Energy & Industrial Strategy joining in 2019.



Energy Catalyst programme



Project funding

To date, Energy Catalyst has provided £140 million of public grant funding to 317 projects delivered by 1,040 organisations supporting innovators through seven rounds of the programme. This year, Energy Catalyst has committed £37.5 million worth of funding split over 72 projects.

This is long-term funding designed to create real impact. As highlighted by the timeline above, the programme started in 2014 with an aim to stimulate innovation in low-cost, low-carbon and secure UK sustainable energy technology. This one-stop competition could fund technology from an early stage (TRL 2 or 3) to pre-commercial demonstration (TRL 8). This has evolved over time with the introduction of Official Development Assistance money via DFID's TEA programme to focus on energy access.

Currently, we have funded 116 international organisations and 81 projects with international application in Sub-Saharan Africa and South/South East Asia.



2019-20 transformation

This year has seen a shift in Energy Catalyst, which has predominantly been a competition that enables grant funding. However, with the increased complexity of tackling international challenges and feedback from grant recipients, we have developed a five-part programme package to bolster grant recipients with additional support.

- 1 Collaboration building**: focusing on building partnerships to apply into the grant competition through brokerage events (Myanmar, Ethiopia and Kenya visited this financial year).
- 2 Competition**: grant funding and assisting the development of technology.
- 3 Accelerator programme**: incubation support offers one-to-one support through mentoring and intense 'boot-camp'-style weeks.
- 4 Post-competition support**: follow-on support to accelerate commercialisation overseas.
- 5 Learning from overseas**: bringing partners together from SSA/SA to the UK to further understand the landscape.

Collaboration-building helps UK businesses understand the international landscape before embarking on a project, and it is now a major focus for Energy Catalyst. This year, out of the 47 organisations who attended the three brokerage events, 36 applied for Round 7 funding with 23 unique organisations successfully gaining a combined 26 projects. This means that while the success rate for Round 7 overall was 32%, 64% of those who attended and went on to apply were successful. 11 international brokerage events were planned for the launch of Round 8 due to the success of Round 7 and feedback from grant recipients. Following the restrictions in place due to COVID-19, these will now be held virtually.



PyroGenesys CEO Simon Ighofose (left) and Claudio Amorese of specialist manufacturer ICMEA-UK with the PyroPower prototype

“PyroPower turns agricultural waste materials into renewable heat and electricity using advanced thermal technologies, meaning no more fossil fuels.”

Now, PyroGenesys leads a consortium that includes the University of Leicester, African Agricultural Technology Foundation (AATF), Mobinet, Babban Gona Farmer Services, ICMEA-UK and Koolmill Systems.

Simon says: “Working with the consortium, we’ll test the case for installing our first PyroPower pilot plant in Nigeria, using satellite geo-spatial data analysis to identify suitable locations for future PyroPower installations.”

“We’ve set an initial target of installing 100 commercial systems to generate clean, low-cost electricity over the next two years. We’re also looking at selling electricity using Mobinet’s SIMPAY mobile payment system in Nigeria for cashless transactions.”

In 2019, PyroGenesys won a £46,342 Innovate UK grant as part of Energy Catalyst Round 6. The total grant to the consortium was £224,697. PyroGenesys has also submitted two Round 7 applications for a feasibility study to evaluate site deployment in Ethiopia and Liberia.

The company is in discussions with a major blue-chip Nigerian PLC to roll out the PyroPower technology to 100 sites across Nigeria. They are also working with Koolmill to provide off-grid high-quality rice milling.

Simon says: “The Innovate UK grant allowed us to work with our manufacturing partner ICMEA-UK to redevelop the technology to fit waste conversion and power generation inside one container. Containerisation means that we can put it on a ship and send it anywhere in the world, so it’s quick and easy to deploy.”

“We now expect to generate 100 jobs in the UK as well as multiple on-the-ground teams in Nigeria within two years. We also intend to provide PyroPower training programmes in Nigeria specifically targeting women to encourage more of them to access skilled positions.”

PyroGenesys

Using advanced thermal technology, a start-up business has developed pioneering waste-power electricity generation for off-grid rural use in sub-Saharan Africa.

Globally, nearly two-thirds of those without electricity access live in sub-Saharan Africa. While Sub-Saharan African communities can use solar power, it is expensive and many people who live there are not able to afford a solar home kit.

Clean energy start-up PyroGenesys is developing low-cost, environmentally-friendly technology to transform the way off-grid communities in Nigeria receive electricity with its innovative PyroPower technology.

PyroGenesys’ chief executive officer, Simon Ighofose, says: “PyroPower turns agricultural waste materials into renewable heat and electricity using an advanced thermal technology called pyrolysis, meaning no more fossil fuels.”

“Waste agro-residues are converted into biochar smokeless fuel briquettes for cooking, replacing firewood and wood-derived charcoal use, a cause of severe deforestation and human health issues.”

Nigerian-born Simon had the idea on a visit to Nigeria in 2011 after experiencing the electricity supply issues. An Aston University research paper on the effectiveness of pyrolysis as an energy conversion technology using agricultural waste inspired Simon to study chemical engineering to create an affordable, sustainable solution.



COMPETITIONS OVERVIEW

Geospatial Commission

This impartial, expert committee partnered with Innovate UK to encourage organisations to identify new ways to use location-linked data.

In November 2018, a government competition opened, designed to explore the advantages and challenges of using crowdsourced data. Its specific aim was to showcase the importance of geospatial data for improving public services while delivering public benefit.

The competition asked different organisations to work together to identify new ways for crowdsourced data to:

- improve the delivery of public services
- support the third sector
- enhance the quality of open public datasets.

Among the 10 winning schemes were Routing Innovation through Data Engineering (RIDE), a London-based project to help cyclists find the safest routes around cities, and StreetFocus, a project that will enable communities to automatically identify areas that need improvements to street infrastructure.

RIDE

To help find the safest routes around cities, the Routing Innovation through Data Engineering (RIDE) research, via project partner Beeline, has developed new route optimisation technology. Combining live street-level feedback data with multiple open datasets, the project uses physical buttons on Beeline's on-bike device to allow users

to provide feedback about routes as they cycle. A neural network then accurately interprets feedback from each section of road and adjusts the external dataset weightings, helping Beeline to understand cyclists' opinions of routes. beeline.co/pages/beeline-velo

"This funding has allowed us to complete this project and prioritise this valuable R&D, even though it does not generate any revenue yet. Without the funding we would have had to do this work very slowly, less rigorously and potentially not at all."

Mark Jenner, co-founder, Beeline

StreetFocus

Street Focus enables Local Authorities and communities to make vital changes to their streets by automatically identifying where necessary improvements can be funded by developers, to mutual benefit. This web-based research project successfully works by combining Local Authority planning application data with Cyclescape, a website that enables local people to crowdsource improvements to street infrastructure. www.streetfocus.uk

"As a not-for-profit micro SME, the funding has unlocked significant amounts of work. We believe what we have achieved has been done at a very efficient rate compared with the likes of large national consultant companies.

"We feel proud and excited to have created a new piece of national data infrastructure – one which dovetails and backs up other work going on within national and local government." Martin Lucas-Smith, co-founder, StreetFocus



Highview Power

This Innovate UK-funded company uses air as a form of energy storage, mixing eco credentials with commercial potential.

The worldwide commercial potential of a novel liquid air energy storage system developed by London-based Highview Power convinced Sumitomo Heavy Industries to take a £35 million minority stake in the company early in 2020. That investment from the Japanese-owned global industries group has allowed Highview Power to press ahead with ambitious plans to build 20 liquid air bulk storage plants of 100MW.

It is eight years since the business received its first grant from Innovate UK, just under £20,000 towards a proof-of-market study. Further grants from Innovate UK have helped to accelerate growth and development of the company's liquid air energy storage technology, now called the CRYOBattery.

The grants included £1.87 million to help convert a 5MW demonstrator into the world's first commercial-scale full liquid air energy storage system, capable of rapid response and qualifying as a supplier to the National Grid. This allowed Highview Power to gauge the commercial benefit from such an arrangement as well as the demand for similar systems and services around the world. It also reinforced investor confidence.

Highview's cryogenic energy storage technology sprang from engineer Peter Dearman's liquid air engine, which he invented some 15 years ago. Working with researchers at the University of Leeds, Peter developed the concept of using air as a form of energy storage, once compressed and liquefied at -196°C.

Energy Research Accelerator (ERA), an energy research hub, also funded by Innovate UK, and made up of eight internationally-renowned Midlands universities, played a key role, too: its institutions helped pioneer the large-scale energy storage technology that is now being scaled up by Highview Power.

Highview Power now employs 45 people at its Charing Cross Road headquarters, plus six staff in its New York office and another in Spain. This year the company will begin construction of its first truly commercial-sized liquid air energy storage plant at a site yet to be announced.

Edward Scrase, project engineering manager at Highview Power, says: "We are actively developing projects in the UK and the US. The Sumitomo investment has helped to move those along quite considerably."

SHI's technology centre will become a hub for the CRYOBattery business, expanding the technology's footprint in Europe, Asia and the Americas.

Increasing use of renewable power opens up a big market for the CRYOBattery, which is emissions-free. If hooked up to a wind farm, it can become more viable in periods of low or fluctuating demand. Liquid air is stored in a large insulated tank until there is a demand for that stored energy.

When the call comes, the process uses stored waste heat from the electric compressors to turn the refrigerated air back into gas at an even higher temperature. The 700-fold expansion in volume is used to drive a turbine and generate emissions-free electricity for up to five hours.

Highview Power's innovation lies mainly in the way that waste heat generated in the compression process is managed for reuse in the eventual discharge of the stored energy.

Edward Scrase added: "We are effectively emissions-neutral. There's no combustion in our products and we are as green as the electricity we use in our process."



COMPETITIONS OVERVIEW

SBRI: public sector-led innovation

To move towards solutions for societal challenges, such as air pollution and nuclear decommissioning, we are connecting government organisations with innovative businesses, creating real impact.

Clean Air: analysis and solutions

Atmospheric pollution in the UK is responsible for approximately 40,000 early deaths and has a cost of around £20 billion to health services and business per year. While the UK is entering a transformative period in air quality, as transport, heating, energy, solvent use and agricultural emissions change, we must develop robust solutions that reduce emissions and impacts of atmospheric pollution. Effectively, we must develop cleaner air. And so, to achieve our clean air goal, this new programme champions multidisciplinary research and innovation to stimulate practical and usable solutions for clean air creation. Doing this requires vital elements: predictive understanding of future air-quality challenges, a systems approach to analysis, new technologies, and innovative policy and practice interventions to benefit vulnerable groups, all improving public health and supporting clean growth.

The funding for this programme is part of the Strategic Priorities Fund (SPF). It is delivered by UKRI to drive an increase in high-quality multi- and interdisciplinary research and innovation, and, importantly, the programme helps connect UKRI's investment effectively with government research priorities and opportunities.

This is impactful collaboration in action. The programme is a £19.6 million partnership led by NERC and the Met Office, with the Engineering and Physical Sciences Research Council (EPSRC), Economic and Social Research Council (ESRC), Innovate UK, Medical Research Council (MRC), National Physical Laboratory (NPL) and Department for Environment Food & Rural Affairs (Defra).

And as part of this SPF Clean Air programme, Innovate UK will also run three Small Business Research Initiative (SBRI) competitions, ensuring connection is at the core.

Wave 1 competition

During 2019-20, Innovate UK worked with stakeholders and partners to define a £4.5 million SBRI innovation competition looking at tackling non-exhaust and non-road vehicle causes of air pollution. The competition was well received. There were 37 viable applications: six were supported through a three-month feasibility phase, with three then funded into a more comprehensive 18-month R&D phase launched in March 2020. Two of these supported projects are currently in early discussion with the Department for Transport regarding the development of regulations and technical standards to facilitate and increase the impact of their products.

The Cool Run Pod is one of the successful Wave 1 projects. Developed by Hubl with support from the University of Lincoln, the Cool Run Pod links several existing and emerging technologies to create the world's first non-diesel, last-mile, independently-monitored refrigerated delivery system. The system can operate as a fully independent system or as part of an automated distribution network with high component recyclability and reparability, and it also reduces the harmful non-tail-pipe emissions from transport refrigeration units.

'This is impactful collaboration in action.'

The impact so far is strong. Studies to date have identified that the Cool Run Pod could lead to the removal of all refrigeration units from vans and lorries in urban areas, saving an estimated 120 million kg of CO2 and associated NOx emissions per annum in the UK in line with the Clean Air Strategy Chapter 5 – 'Action to reduce emissions from transport'.

Wave 2 competitions

In this wave, Innovate UK will lead two innovation competitions related to indoor air quality. The first competition, launched in February 2020 and closed in May 2020, was run as a £1 million SBRI focused on monitoring indoor air quality, providing actionable feedback to householders to preserve their health. Meanwhile, the second innovation competition, launching November 2020, focuses on new technology to mitigate/sequester pollutants in the domestic environment.

The CAGE (Clean Air Gas Engine) project is a Wave 2 entrant achieving great success and collaboration. The project aim is to integrate the CAGE product into Non Road Mobile Machinery (NRMM) typically powered by red diesel engines on construction and demolition sites. Bringing together the gas engine development expertise of project lead OakTec with leading industrial partners Autocraft Drivetrain Solutions – all supported by a global vehicle OEM – the CAGE project has huge benefits. With the inherent low-emission benefits of gas fuels well documented, CAGE applies OakTec's low-emission gas engine combustion and control to the state of the art automotive engine platform. There, it optimises performance to suit a range of industrial applications used in the construction industry.



Nuclear Decommissioning, Sellafield

The UK nuclear-decommissioning industry generates more than £1.7 billion of business per year for UK PLCs, with over 21% spent with SMEs. However, there are challenges. Overcoming the conservative nature of the sector, introducing new innovation, cost reduction and lessening the use of humans are just some of the issues ahead.

The nuclear decommissioning competition, therefore, was developed in collaboration with Sellafield to enable operators to perform tasks more safely, quickly and cheaply while feeling protected in their working environment. Sellafield was looking for integrated solutions to solve or alleviate challenges for people operating in radioactive environments.

Now, following the successful completion of two SBRI-funded projects for robotic decommissioning of nuclear facilities, two consortia led by Barron and Wood have each been awarded £1.5 million in commercial contracts to deploy their technologies on the Sellafield site. This will be the first time integrated robotics and AI and VR systems of this kind have been deployed at Sellafield. Their target is ambitious: 20% cost reduction in decommissioning,

with no humans in hazardous environments. However, the programme's success is in its business innovation connection. It has brought together several SMEs that are new to the nuclear sector who would not usually have been able to gain market entry – these include Cambrian Intelligence, Structure Vision, Damavan Imaging, Clicks And Links (now named PixelMill), Digital Concepts Engineering, IS-Instruments Ltd and i3D Robotics – and these associations have helped shape progress and growth, with others also receiving contracts in North America and Japan to advance the essential work.

SBRI also displays the adaptability of business innovation. Take, for example, a virtual-reality training tool developed in an SBRI project (completed in March 2020). This lateral-thinking project, led by Cineon Training and the University of Exeter, was originally created to target the protection of nuclear operators, and now it's being redeployed to train NHS workers in the use of personal protective equipment. The innovative project is now remotely training an initial batch of 5,000 frontline workers in the South West of England in the use of PPE to tackle COVID-19.





COMPETITIONS OVERVIEW

© Colin Keldie, courtesy of Solo Energy



Transforming Construction Challenge (TCC)

The Transforming Construction Challenge (TCC) is reshaping the construction sector. By embracing the latest digital manufacturing techniques, the sector can produce safer, healthier, more efficient buildings. TCC is also working to eliminate the productivity gap between construction and the rest of the economy to better deliver the UK's national infrastructure pipeline of £650 billion worth of projects by 2025. Moving away from building the cheapest asset, the aim is to deliver the greatest whole-life value from a construction project.

The TCC programme offers strong support – to the construction sector in shifting its working practices towards a 'platform' approach (as used by manufacturing industries), and to the government in fulfilling its preference for off-site construction of nationally-procured buildings and infrastructure.

Backed by the Sector Deal and the Construction Leadership Council, the investments within the £170 million programme are accelerating innovation in the UK's world-leading construction sector, which employs over three million people.

During 2019-20 the challenge funded a second wave of collaborative R&D projects and a number of scale-up demonstrator projects. Transforming Construction has also established the Construction Innovation Hub to put in place the digital and manufacturing processes and standards required, while the Active Building Centre accelerates the commercialisation of integrated energy generation components in buildings.

The challenge has ambitious objectives for construction to be 50% faster, 33% cheaper and with half the lifetime carbon emissions, as well as boosting productivity. Early results show these targets are being met for real-world projects delivering into schools, offices and homes. Through 2020-21 these exciting projects will showcase further results and demonstrate the role the built environment will play in achieving net-zero for the UK.

Case study: Hiper Pile
UKRI.org/hiperpile



Industrial Decarbonisation Challenge (IDC)

The IDC is a £170 million investment of public money. It aims to accelerate the cost-effective decarbonisation of industry by developing and deploying low-carbon technologies, enabling infrastructure at scale in one or more clusters. This will boost competitiveness in key industrial regions and drive inward investment, creating and protecting jobs for a low-carbon global economy.

The IDC launched in summer 2019 and runs until 31 March 2024. So far, there is much success. It entered delivery phase in July 2019 after passing through UKRI internal governance structures. Since then the challenge has initiated and concluded a pathfinder competition in both Activity 1 (Industrial Demonstrators and Shared Infrastructure – Deployment) and Activity 2 (Cluster Decarbonisation Roadmaps) up to a value of £1 million. It has also appointed a centre champion to compile a proposal advancing Activity 3, the Research and Innovation Centre. Deployment and Roadmaps competitions have also both opened involving all clusters.



Industrial Strategy Challenge Fund

This multi-billion pound investment delivered by UKRI brings together leading businesses and researchers to tackle the biggest societal and industrial challenges we face today.

Prospering from the Energy Revolution (PFER)

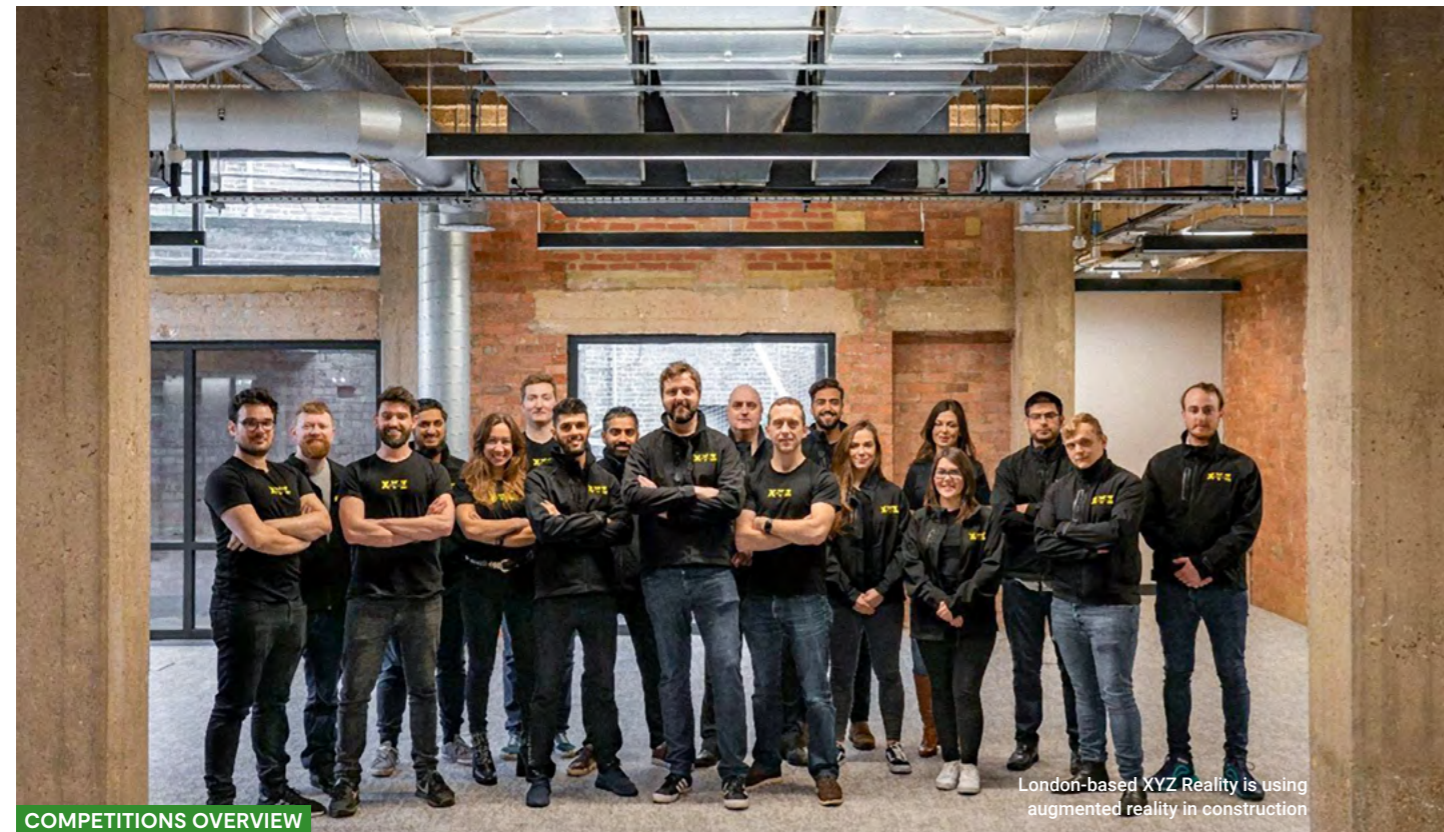
Smart energy systems can dramatically improve efficiency by intelligently linking energy supply, storage and use, and passing on these gains in efficiency to power heating and transport. It's a huge market opportunity. An estimated \$2 trillion a year is set to be invested in global energy infrastructure. In the UK, the government is funding industry and researchers to create new systems, which will provide cleaner, cheaper energy while generating high-value jobs for the UK.

To illustrate how integrated intelligent local systems can deliver power, heat and mobility to users in new and better ways, four local energy demonstrators were launched in 2019-20. These will be built over the next three years.

Alongside this, Phase 1 of PFER's Concepts and Design competition recently concluded successfully. 11 projects were selected, showcasing the ambitious energy systems across the country. These projects will develop concepts for rural, urban, domestic, industrial, commercial and mixed energy systems. Phase 2, Detailed Designs, launched in March 2020 and focuses on developing the ideas demonstrated during the Concepts and Designs competition.

In addition, PFER also ran Key Technology Components for Local Energy Systems. This £3 million competition is set to fund 17 projects – including Hypervolt, which aims to develop an end-to-end smart electric vehicle charging solution – to devise technology components that help improve the efficiency of local energy systems.

Case study: Energy Superhub Oxford
UKRI.org/energysuperhub



COMPETITIONS OVERVIEW

London-based XYZ Reality is using augmented reality in construction

Smart grants

Grant funding provides an opportunity to turn cutting-edge ideas with a high potential for commercial success into a reality, whatever the sector.

Innovate UK's Smart grants programme invests in the most ambitious and disruptive commercially viable ideas. Whether it's a particular technology or concepts rooted in a certain sector, or more traditional disciplines like science and engineering and creative industries such as film-making or design, this is focused funding with impact.

27 of the Smart grant projects, amounting to £6.9 million, were Clean Growth focused during 2019-20. One of these is XYZ Reality, which is using augmented reality to revolutionise the construction sector.

Success Story: XYZ Reality Limited

This UK start-up is currently developing its patent-pending HoloSite headset, the world's first engineering-grade augmented reality (AR) device. The AR head-mounted display allows contractors to position and view holographic building information models (BIMs) on-site, in real-time, and to work within engineering tolerances. This

enables construction workers to build straight from BIMs without the need for a 2D conversion, resulting in improved efficiency and lower costs.

XYZ Reality has received £700,000 in total of grant funding through two successful applications into two 2019-20 Smart grant funding rounds. This led to them securing a further £5 million from Tier 1 venture capital investment.

Phase 1 of the programme was to build a first-generation prototype. This included developing an AR hard hat with 5mm-accurate viewing while beginning trials and seeking full certification for construction. Following the successful completion of this first phase, XYZ Reality received a second round of funding for Phase 2. Here they will collate feedback from the initial trials and conduct R&D to update the prototype design to the next generation. Doing this will enable the company to meet the value proposition its customers need and to prepare for scaling. A third and final phase is currently scheduled for late 2020, which will explore manufacturing and commercialisation of the final product.



COMPETITIONS OVERVIEW



Ian Meikle, Director of Clean Growth and Infrastructure at Innovate UK

Investment Accelerator Programme

By partnering with ENGIE, Innovate UK will enable a cleaner future through funding innovative projects that decarbonise, digitise and decentralise energy.

2019-20 saw Innovate UK team up with energy, services and regeneration company ENGIE to support projects enabling the zero-carbon transition. Over a three-year period this partnership will fund UK SMEs to develop new solutions, technologies and business models that facilitate a cleaner, smarter, fairer and more accessible energy system.

Successful projects will receive a combination of grants from Innovate UK and private investment from ENGIE. For the first time in an Innovate UK programme, the private funding will be from overseas, creating a portfolio of invested UK companies for ENGIE. At the same time, the funding will support Innovate UK in stimulating inward investment in UK research and development.

Best of British ideas

Ian Meikle, Director of Clean Growth and Infrastructure at Innovate UK, says: "We are seeking the very best of British ideas in clean growth innovation. By teaming up with ENGIE we can multiply our funding and do even more to grow the industries, businesses and jobs of tomorrow by bringing in the private sector at an earlier stage through this investment accelerator programme."

Nicola Lovett, CEO of ENGIE UK & Ireland, says: "We are delighted to be working with both Innovate UK and ENGIE's Paris-based New Ventures team to directly assist innovative UK companies in the clean growth sector – in areas such as renewables, energy services and e-mobility. This initiative also supports our own ambition to be a leader in making zero-carbon transition possible for businesses and local authorities."



Nicola Lovett, CEO of ENGIE UK & Ireland

Catalysing innovation

SMEs can gain valuable market knowledge and industry insight by engaging in strategic partnerships, both in the UK and overseas.

Finding a route to market for SME products and technologies can be made easier and more efficient by taking advantage of strategic partnerships. By fostering these new relationships, we help innovative new businesses discover potential partners, customers, investors and markets, both domestically and internationally, including larger businesses, innovation hubs, academic institutions, local authorities and societies in need. These connections offer all parties the opportunity to share knowledge, experience, thinking and learning for mutual benefit.

The opportunities we'll explore here include Global and Domestic Missions – which incorporate further business support from Enterprise Europe Network (EEN) and innovation agency Stronger Stories – as well as events and exhibitions and the Innovation Exchange, a cross-sector alignment programme delivered by the Knowledge Transfer Network.



Missions programmes

Innovate UK's Missions programmes help ambitious businesses build connections and capitalise on opportunities in new markets, globally and domestically.



Domestic Missions

The aim of the Domestic Missions programme is to connect innovative SMEs with local authorities to address some of the major challenges faced by UK cities. In early March, the first of these events was held in Derry and ran as scheduled. It was a great success. When the lockdown was put in place due to COVID-19, four of the programme's face-to-face Missions events in Bristol, Cardiff, Exeter and Nottingham were unable to go ahead as originally planned. However, these were subsequently held as successful virtual events.

The Missions programme has delivered valuable feedback and insight, and an evaluation report was published in June following final online Missions activities. Despite the disruption caused by lockdown, feedback from participants has been positive:

"The process completely changed my thinking around how we engage with our local SME base and our procurement around problem areas. We're very traditional; we think we know what's wrong and we set up terms of reference. Through the Domestic Missions process we were able to bring new people on board with new ways of working. It changed our practices for good. Once we get back, we will have a more challenge-based approach to come up with solutions – a more strategic approach to procurement based on the model we worked through with Innovate UK."
Derry City Lead

"100%Open [the management consultancy that facilitated the Derry Missions event] and Innovate UK were brilliant in the process. I have nothing but good words on how they helped us."
Derry Mission event attendee

Global Business Innovation Programme (GBIP)

This programme typically supports up to 15 high-growth innovative businesses to explore and exploit opportunities in specific markets, technologies and innovation areas. GBIP provides detailed market knowledge, introductions and cultural insight that small companies would find difficult to generate themselves. So, by accessing GBIP, companies can find partners, build collaborations and explore vital R&D and innovation opportunities for growth.

Global Expert Missions

Led by the Knowledge Transfer Network (KTN), Innovate UK's Global Expert Missions play an important role. They build strategic partnerships, provide deep insight into the opportunities for UK innovation, and shape future bilateral collaboration programmes. The Expert Missions also spearhead the UK's innovation engagement with key economies, including Canada, USA, Israel, India, China, South Korea, Japan and Australia.

Innovate UK's Global Expert Missions programme is crucial in meeting the Industrial Strategy's Grand Challenges and will be further supported by the launch of a new International Research and Innovation Strategy.



This GBIP connects SMEs with business opportunities in India

India – Future Cities

By assembling diverse stakeholders, this mission aimed to exploit opportunities for businesses, economic growth and an improved quality of life for citizens.

Over the next five years, some 400 million people are expected to move into towns and cities in India. This presents major challenges but also huge opportunities. The aim of this Global Business Innovation Programme (GBIP) was to help companies gain a better understanding of opportunities for doing business in India in this important area, as well as drive economic growth and improve people's quality of life.

The visit to India was just one element of the GBIP. Participants also received bespoke one-to-one support from Enterprise Europe Network advisers to help them exploit the opportunity before, during and after the visit as part of the full programme.

Our SMEs meet with businesses, innovation hubs, academic institutions and other stakeholders, gaining valuable market knowledge and industry insights. They also meet with potential collaboration partners. The main areas of focus for this GBIP were:

- city management and operations systems, including urban planning and city system integration solutions
- smart infrastructure, such as water, waste, energy and mobility
- enriched urban environments, including recreation, community, education, green/blue resources rehabilitation and enhancement, urban health solutions, public safety and security, air quality and pollution management.

Members of the GBIP alumni have already seen successful impacts from this mission, with collaborations being formed to use and develop their innovations in-country. Other alumni members are scheduling a return trip to consolidate the talks and ongoing discussions they had with relevant parties. For many, these partnership development activities will be achieved through pilot studies and product trials to demonstrate the possibilities of commercialising UK-based technologies in the Indian market.

"This initiative is a great connect point to put us in front of the right audience. The kind of focused engagement we got in this week has helped us make connections that will keep us busy for quite a few months and develop long-term business goals."
Abhishek Srivastava, Teknobuilt

"We found that there is a great appetite for our technology, something we would never have actually experienced if we had not come here and found out for ourselves... Without being able to come to the country and realise the opportunities that are out there, it's almost impossible to make a sensible decision. I strongly recommend coming on such a mission."
John Griffiths, Secure Sensor Innovative Design

MISSION

Energy Catalyst

International brokerage missions help Energy Catalyst Round 8 funding applicants understand the local energy landscape and forge important connections.



The Energy Catalyst international brokerage events were created to help applicants gain an understanding of the energy access issues in a particular country. They also provide an opportunity for organisations to find links to potential partnerships.

The brokerage trips typically last one week. There are a mix of B2B sessions and meetings with government, NGOs and relevant academic institutes as well as key industry players. Site visits are also arranged where possible.

The focus is on SMEs interested in applying to the next round of Energy Catalyst funding. Brokerage trips have three main aims, which are to:

- get an understanding of the energy access issues on the ground
- meet potential partners
- promote the Energy Catalyst to in-country organisations.

For Round 7 we ran three events in Myanmar, Ethiopia and Kenya. There were 47 representatives from UK organisations attending, with the following outcomes:

- Out of the 47 organisations in attendance, 36 applied for Round 7 funding, with 23 unique organisations successful in gaining a combined 26 projects. This means that while the success rate for Round 7 overall was 32%, 64% of those who attended and went on to apply were successful.
- 46 out of the 47 companies added that they were very likely to recommend an Energy Catalyst mission to another organisation, with the other company responding with somewhat likely.
- 92% of attendees over the three missions stated they were very satisfied that the missions helped further the understanding of energy access issues in-country, with the other 8% somewhat satisfied.

Brokerage events for Round 7 in Myanmar and Ethiopia received successful applications, with Myanmar gaining two in-country projects and Ethiopia three.

Attendee testimonials

“The Energy Catalyst Round 7 mission to Myanmar was a great source of information about the situation and the opportunities in Myanmar, and it has helped us to find partners in the country for our project proposals. The support from the BCCM [British Chamber of Commerce Myanmar] was outstanding!”

Dr Dirk Klugmann, S&AO Ltd

“As a result of attending the Energy Catalyst Round 7 market visit to Ethiopia, PyroGenesys has finally found African technical partners that will provide the minigridd design, installation and operational capability that we previously lacked. We have also made contact with a number of project developers and companies with supply chains that we hope to participate in. PyroGenesys is now poised to capitalise on the immense growth taking place in the Ethiopian renewable energy sector.”

Simon Ighofose, PyroGenesys

“Thank you so much for this opportunity. It has been a unique chance to meet the main decision makers in energy projects, the most knowledgeable people to help us expand to developing countries, and passionate participants that represent thrilling opportunities for such an early stage start-up like us.”

Sara Ramos Colmenarejo, Greenvest

“As a small innovation-led company, the environment of a week’s market visit provided us invaluable exposure to ministers, top-level executives and experts from the market we were interested in, but also multiple opportunities to reflect on, discuss and brainstorm possible collaborations in the margins of meetings and travel. I am convinced that there are partnerships that began chatting in the aisle of the aircraft, sketching out details on scraps of paper in the hotel coffee shop, and kicking ideas around on the back seat of the minibus that will be as valuable as any our company has ever forged.”

Dr Bernie Jones, Smart Villages Research Group

“By attending the Energy Catalyst mission to Kenya in 2019 we gained valuable insight into the Kenya renewable energy market, policy and key players in the market, and identified potential partnerships with local companies. Without visiting Kenya and attending an organised trip like this it would have cost our business significant time and money. An incredibly valuable event that will have huge impact for our business.”

Dr Faisal Ghani, SolarisKit

“By attending the Energy Catalyst mission to Kenya in 2019 we gained valuable insight into the Kenya renewable energy market, policy and key players in the market, and identified potential partnerships with local companies.”

BuffaloGrid

This smart energy business supported by Innovate UK aims to power a smartphone revolution that will help drive wealth and wellbeing in the developing world.

We rely on mobile phones in the developed world. We do business with them, pay for goods and services, connect with culture and promote our wellbeing. And yet it goes much further. The United Nations sees improved mobile connectivity as key to ending poverty, halting climate change and fighting injustice and inequality across the world by 2030.

Increased smartphone use is having a major impact in the developed world, helping to create and power new business services, improving communication in remote areas, and connecting people to education and health services. But smart devices rely on power and it is estimated that 700 million people with access to a smartphone do not have power, including 300 million in India alone.

“Connectivity is the stepping stone to a more productive, healthy and enhanced life.”

Daniel Becerra, founder of BuffaloGrid, says: “The mobile phone is the most significant tool for people living in developing regions. They are known as ‘smartphone-first users’. They don’t have laptops, they don’t have PCs. All their work, all their entertainment, everything goes through their mobile device. The first barrier to internet adoption is power.”

BuffaloGrid has developed a smartphone charging hub with support of Innovate UK funding. The device has an internet connection and can charge many phones at one time with power supplied by solar panels.

The prototype BuffaloGrid hub is being used in mobile operator shops in rural parts of India where electricity is unreliable and intermittent, meaning customers can charge their phones for free when the electricity supply is down. The company is planning to commercially supply hundreds of new hubs in the next 12 months.

BuffaloGrid also won support from Innovate UK’s Energy Catalyst to prototype a portable version of the hub, the



The BuffaloGrid hub is currently on trial in rural India

Buffalito, that users can take home. A further Energy Catalyst project is now helping the company to take the Buffalito through to commercialisation.

Daniel added: “We are starting to look at different markets. We are working with the High Commissioner for Refugees for an incoming trial in a refugee camp in Uganda. We also have interest from Papua New Guinea, Haiti and Rwanda.

“Working with Innovate UK has been very effective for us. It has given us the opportunity to keep innovating

and developing our technology. We started with a bicycle generator and now have an internet-enabled solar-powered hub that works on a subscription model paid for by network operators and is free to the user.”

Daniel started BuffaloGrid in 2011 and the company now employs people in the UK and India. He says: “What we often forget is that one in two people in the world do not experience the internet. Our vision is to connect the next one billion people. Connectivity is the stepping stone to a more productive, healthy and enhanced life.”

Clean + Cool

UK entrepreneurs represented some of the nation's most forward-thinking new cleantech companies at the Silicon Valley event in January 2020.



Juan Pablo Cerda, Zeigo CEO and Clean + Cool Mission alumnus

Since 2010, Innovate UK has been running the Clean + Cool Mission in partnership with Stronger Stories and Enterprise Europe Network. Over the past decade this mission has selected some of the most exciting and ambitious early-stage companies in clean and sustainable technology, helping them engage with potential partners, customers, markets and investors.

For 2020, the Clean + Cool Mission returned to the San Francisco Bay Area, welcoming 15 CEOs from a selection of the UK's most exciting cleantech SMEs. This week-long mission presented the opportunity to network with influential businesses at the Cleantech Forum, as well as visiting and engaging with multiple early-stage investors, accelerators and corporate-innovation platforms.

One of the 2020 Clean + Cool Mission alumni was Juan Pablo Cerda. He is the founder and CEO of Zeigo, an innovative energy tech platform that connects corporate energy buyers with renewable energy generators and suppliers. Since the mission, Zeigo has successfully closed an £800,000 equity funding round as well as a commercial contract with a large US energy supplier.

As a result of Zeigo's rapid growth and the increased interest in its disruptive innovation, the company will be moving to larger premises to house its expanding team.

Juan says: "These kinds of opportunities do not come along every day. It was a life-changing experience that opens your eyes to what is out there and what can be achieved. The Clean + Cool Mission helped Zeigo to redefine our strategy on how we approach investors and how to pitch successfully to the right audiences. Our time on this mission played a crucial part in Zeigo securing the increased equity funding and winning our largest commercial contract to date."

Zeigo has also welcomed Peter Gutman, an active individual investor in the energy sector and an advisor to leading digital-energy venture firm Blue Bear Capital, as a shareholder. Paul Massara, former CEO of Npower, has also recently joined Zeigo's board.



Innovation Exchange

By matching innovative companies to industry challenges, large businesses can overcome technical challenges with radical and disruptive solutions.

While the UK benefits from a strong academic base and R&D ecosystem, a key issue encountered by developers and innovative companies – particularly SMEs – is finding a route to market for their innovations. At the same time, many large corporates need to find solutions for an increasing range of challenges across the energy and urban infrastructure sectors.

The Innovation Exchange (KTN-iX), delivered by the Knowledge Transfer Network (KTN), provides pivotal support. The programme boosts the innovation transfer by linking the technical needs of large organisations with leading solutions from other sectors, with innovation challenges set by the large organisation through a competitive call for ideas. Promising solutions are then selected by the Challenge Owner and companies are invited to pitch to the Challenge Owner through a managed process. No project funding is provided but a strong business-to-business relationship is brokered.

Next steps

The interaction and collaboration between energy system and infrastructure sectors and innovators is vital to decarbonisation. The Innovation Exchange provides access to a wide range of enabling technologies to challenge holders seeking to deliver a decarbonised urban infrastructure. Similarly, the initiative will consolidate what is currently a fractured market for innovators, especially SMEs.

The Energy Systems challenge, run with Associated British Ports, identified the need for a programme that supports the decarbonisation in the sector. From discussions with industry stakeholders, KTN proposed and has subsequently launched the Decarbonisation of Ports & Harbours Special Interest Group (SIG). This new group will sit alongside SIGs on cross-sector battery systems and hydrogen economy and will, in turn, directly support the broader clean growth and infrastructure agenda.

Moving forward, the collaboration with the KTN will continue for a further three years. We will target innovators from outside the energy sector to find solutions to specific challenges set by major offshore wind, nuclear, energy systems and urban authority stakeholders.

| | Total | 2017-18 | 2018-19 | 2019-20 |
|--|------------|------------|---------|----------|
| Number of challenges launched | 43 | 8 | 7 | 28 |
| Number of companies entered | 351 | 65 | 72 | 214 |
| Number of companies pitching to Challenge Owners | 181 | 21 | 44 | 116 |
| Number of trials | 63 | 8 | 10 | 45 |
| Number of contracts | 15 | 7 | 4 | 4 |
| Value of contracts (estimated) | £1,645,000 | £1,500,000 | £40,000 | £105,000 |

The number of trials indicates how many of these relationships have progressed to testing and demonstrating the innovative solution (either via a grant application or through private sector investment). The number of contracts indicates the approximate value of commercial contracts that have been won by the solution provider as a direct result of the brokered relationship. The value of contracts lags behind involvement in the Innovation Exchange programme. We therefore expect the value of contracts to increase as we track it.

Events

From renewable energy to city planning and housing challenges, Innovate UK is working with a diverse portfolio of events to promote opportunities for change.



All-Energy

Held annually since 2001, All-Energy is the largest renewable and low-carbon energy and clean growth exhibition and conference in the UK. While providing a platform to connect suppliers and policymakers with developers, investors and buyers from around the world, All-Energy supports the United Nations' Sustainable Development Goals (SDGs), which address global challenges to achieve a more sustainable future for communities worldwide by 2030.

UKRI and Innovate UK contribute to the event with an extensive programme that supports information and business exchange within the clean growth community, presenting a range of sessions across the two-day event.

Among these sessions is the Clean Growth and Infrastructure Innovation Showcase, which provides a hand-picked selection of innovative energy and infrastructure companies with an opportunity to pitch for new partners, customers and further investment. ACT Blade, developer of a lightweight, textile wind turbine blade, was among the companies featured in the 2019 Showcase (see case study on page 40).



Dcarbonise, co-located with All-Energy, showcases low-carbon heat, energy efficiency and low-carbon transport solutions. It was first held in 2019 and is sponsored by the Scottish Government, Energy Saving Trust and Zero Waste Scotland.

All-Energy 2019 and Dcarbonise 2019, held at Glasgow's SEC in May 2019, attracted a total attendance of 7,871, an increase of 12% from 2018, with over 250 exhibiting companies from the UK and overseas, and over 500 speakers taking part.

Addressing over 600 people in the packed Lomond Auditorium at the SEC was Chris Stark, CEO of the Committee on Climate Change (CCC). He urged policymakers to be hugely ambitious so the UK can meet the CCC's 2050 net-zero emissions target, as outlined in the Committee's report on 2 May 2019. Councillor Susan Aitken, Leader of Glasgow City Council, then spoke of her city's achievements and plans. She was followed by Professor Karen Turner, Director of the Centre for Energy Policy at the University of Strathclyde, who highlighted new research findings that reveal electric vehicle system investment could fuel more than 3,000 new jobs.

Festival of the Future City

In October 2019, we sponsored a panel as part of the Festival of the Future City in Bristol. The panel, entitled Making Planning Work, asked: is the planning system fit for the needs of 21st century cities? The discussion centred around technology versus people, inclusion and exclusion, the role of data and digital twins, skills, planning for climate change, new forms of partnership, and devolution.

The panel consisted of:

- Euan Mills, Connected Places Catapult
- Sam Stacey, Innovate UK
- Zoe Metcalfe, ARUP
- Mark Tewdwr-Jones, Newcastle University
- Sarah Chilcott, Planning Portal

The panel discussion outlined the key problems in revolutionising the planning system to create better housing. These findings helped inform the Making Planning Work programme submitted as part of the Urban Team's Innovation Climate budget for the 2020-21 financial year.

Rushlight events

Rushlight events promote the development and deployment of clean technologies, innovation and sustainable solutions. These networking opportunities are suitable for small and large companies, advisers, investors, financiers, consultants, analysts, media and other sector followers.

On 20 June 2019, the Rushlight Summer Showcase exhibited over 60 clean technology solutions. The event included the Innovate UK Showcase of Materials & Advanced Manufacturing, Clean Growth, Innovation Loans, Faraday Batteries and Transport projects, the Department for Business, Energy & Industrial Strategy's Energy Entrepreneurs Fund entrants, and participants in the Department for Transport's Future Fuels for Flight and Freight Competition.

The Rushlight Show was held on 30 January 2020. It featured an exhibition of innovative clean technology solutions, including the Innovate UK Infrastructure Systems Showcase, while the Cleantech Conference included the Cleantech Innovation Showcase, featuring engineering research specialist OakTec and renewable energy innovator Deciwatt (both supported by Innovate UK). There was also a Sustainable Solutions Market Panel and the Resourceful Conference, in association with London Community Resource Network and Circular Economy Club.

Data and Community: Bristol and Bath Hackathon (Pilot)

As a hackathon for problem solvers, designers and programmers, Data and Community was an opportunity to develop innovative digital solutions to some of Bristol and Bath's biggest social challenges. The event explored how data can be used to understand the issue of sub-standard housing, support the homeless and hidden homeless, and address the digital divide.

Because of COVID-19, outputs from the 2019 event are yet to be realised. Four winners were due to present their projects (funded to continue after the event) to Bristol City Council in March. The council is interested in working with the innovators to implement some of their solutions. However, the social care and homelessness teams who would have implemented these are currently busy with COVID-19, and the work will therefore be picked up at a later date.



Rushlight testimonials

"Thank you very much again for the opportunity to take part yesterday. We all found it a very useful day and the presentations showed a fantastic breadth of innovation in the clean tech sphere – really inspiring and exciting."

Gemma Pearce, managing director, Jelly Products

"Thank you for a great event. It was interesting to meet such a range of companies. A most enjoyable and productive day."

Karen Boud, senior technical PR, Resonates

"It was a really good event. I think the concentration of themes around the Energy Catalyst and Faraday Challenge funds worked really well, as the event seemed fairly focused."

Vijay Bhopal, managing director, Connected Energy



Gravitricity's lead engineer Miles Franklin (left) and project development manager Chris Yendell

Gravitricity

Two Innovate UK grants have helped this Scottish clean technology company store electricity by lowering weights inside disused mine shafts.

“We’re responding to second-by-second or minute-by-minute imbalances on the grid, which is more valuable. Our system has a lot of versatility, focusing initially on power.”

Independent analysis by Imperial College London supported the company's claim that gravity energy storage was more cost-effective than current alternatives as well as being cleaner and having greater longevity.

Like many heavy engineering projects, Gravitricity has a timeline of five to six years before the concept comes to fruition. The initial grant of £175,000 from Innovate UK solidified the concept in 2017.

“We had put a patent in, but there wasn't really any push to do anything,” says Charlie. “The funding from Innovate UK enabled us to employ a couple of people and get moving.”

More mechanical engineers led to further innovation, including the development of a multi-weight concept that increases the flexibility and power of a single system.

Project development manager Chris Yendell started working for Gravitricity after the second Innovate UK grant of £650,000 was awarded in 2019. His work is currently focused on the company's scale 250kW concept demonstrator, which will be installed in Edinburgh; later he will begin developing a full-scale prototype.

Chris says: “Working at Gravitricity, we're really motivated by the cause. It's more than 'just a job'. The end goal is something we all believe in.”

The company has also built a strong working relationship with Dutch company Huisman Equipment BV to help Gravitricity develop its winches. Gravitricity is also building relationships in Eastern and Central Europe, and South Africa. Partnering with countries who still have working mines enables the company to work with mining specialists, which gives them an indication of where Gravitricity might go in the long term.

“The initial plan is to deploy in existing mine shafts,” says Chris, “but we've done feasibility on sinking new shafts and deploying where it's needed, which includes right in the middle of a city or near a wind farm. We'll carry on doing R&D work on that and hopefully work with Innovate UK to achieve it.”

Edinburgh company Gravitricity is developing a system that uses mine shafts to store and supply energy to the National Grid. The system is the brainchild of serial inventor and technical director Peter Fraenkel. Peter previously worked with Gravitricity's chairman Martin Wright when developing similarly innovative work for Marine Current Turbines. Managing director Charlie Blair joined Gravitricity in 2015 after leaving the Carbon Trust. He was looking for a low-carbon innovation to help lower emissions more directly.

Charlie says: “Using gravity to store energy is already commonplace in pumped hydro, but using a solid weight has many advantages. There are a few companies out there that are using weights, but Peter is really great at simplifying things.”

Peter Fraenkel's innovation was to hoist and suspend weights over disused mine shafts then use the power generated by lowering the weight inside the shaft to rebalance supply quickly.

Charlie added: “We're responding to second-by-second or minute-by-minute imbalances on the Grid, which is more valuable. Our system has a lot of versatility, focusing initially on power.”

Centres of excellence

Our relationships with these partner organisations are fundamental in driving the science and technology innovations that will help grow UK energy, cities and infrastructure sectors.

The connecting role of our world-leading partners is a vital one in helping UK SMEs find success. In the following pages we highlight the expertise and impact of the Catapult Network, Knowledge Transfer Network, Enterprise Europe Network and Innovation and Knowledge Centres in bringing the bright ideas of UK businesses to market and contributing to future economic growth.

Clean Catapults

By transforming the UK's capability for innovation, these independent centres are helping drive innovation and promote productivity and economic growth.



BladeBUG robotic crawler (and above); GE's Haliade-X (right)



Offshore Renewable Energy (ORE) Catapult

We've seen huge strides in the development of the UK's offshore wind and tidal sectors, driven largely by innovations in technology, and operations and maintenance practices. ORE Catapult has been a key part of this. In boosting UK innovation in offshore renewable energy, it's established strong global leadership, furthering investment, growth, productivity and job creation.

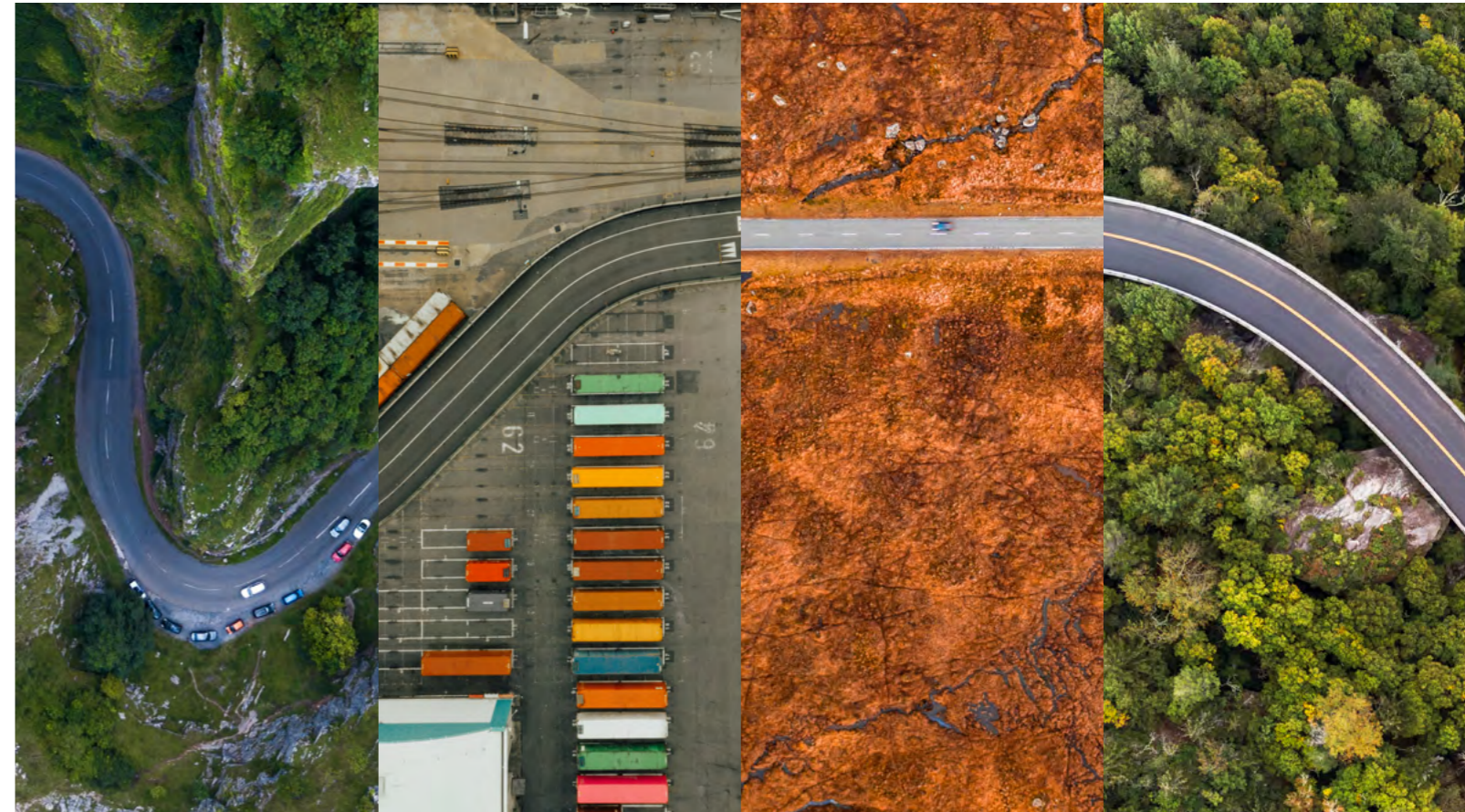
More than 800 SMEs have now received technical innovation and business growth support from ORE Catapult through collaborative R&D projects. The 2019-20 financial year saw 65 projects completed and 11 industry-led innovation challenges launched aimed at accelerating supply chain development.

ORE Catapult is already helping cement the UK's position as a global leader in offshore wind. 2019-20 saw testing commence on the world's largest turbine and longest blade at ORE Catapult's unique facilities in Blyth. Deployment of GE's Haliade-X turbine in Dogger Bank will create the world's biggest offshore wind farm, presenting

unparalleled opportunities for the UK's supply chain to develop new products and services, and creating jobs while generating economic benefits.

ORE Catapult's technology accelerator programme, Launch Academy, is now underway. Operating at national and regional levels, the programme channels high-value business and technical support to innovative UK companies, enabling new technologies and services in the offshore wind market.

In the first intake for the ORE Catapult Launch Academy, GreenSpur Wind Limited secured one of 10 places. GreenSpur, who had previously advanced its technology as part of an Innovate UK project, was one of several companies selected to pitch to a panel made up of industry representatives from ORE Catapult, Siemens Gamesa Renewable Energy (SGRE), Red Rock Power Limited (RRPL), ScottishPower Renewables (SPR) and Quaybridge. As well as unlocking private investment into offshore wind technology, the Launch Academy will now support GreenSpur and other applicants through its commercialisation journey.



Connected Places Catapult (CPC)

The Connected Places Catapult (CPC) was launched on 1 April 2019. It followed the coming together of the Future Cities and the Transport Systems Catapults, and embarked on a significant programme of transformation to integrate these two very different organisations, as well as implementing the commitments of both legacy delivery plans and targets.

Real-world trials were delivered through two projects funded by Innovate UK and the Centre for Connected and Autonomous Vehicles, FLOURISH and HumanDrive. HumanDrive demonstrated a fully autonomous 260-mile drive from Cranfield in Bedfordshire to Sunderland.

CPC's international reach has continued with numerous projects. These include the £2.1 million flagship scheme Urban Links Africa, set up to develop business innovation programmes across six African cities, and the Innovating for Clean Air programme, which aims to improve the local business ecosystem. It will also create a sustainable platform for ongoing governmental and industrial cooperation between the UK and India through air quality and electric vehicle innovation streams.

The CPC Intelligent Mobility Accelerator is a partnership between Connected Places Catapult and Wayra UK, the world-leading start-up accelerator part of Telefónica Open Future. Set up to attract disruptive start-ups with high-growth potential into the UK transport industry, progress is encouraging. It has created 24 commercial pilots and \$250 million in new private investment to date, including a €100 million investment for Arrival from Hyundai and Kia, a €400 million order for 10,000 vehicles from UPS, and £7.6 million of Series A funding for AppyParking. In March, to address air quality and mobility challenges, CPC also launched a new accelerator, SIMULATE, in partnership with Staffordshire County Council, Amey and Keele University.

The collaboration between CPC and the Department for Transport continues, with a portfolio of ongoing strategic projects throughout the year. As part of this, CPC delivered the Department's Transport-Technology Research Innovation Grants programme, which has provided grants to 30 SMEs looking to commercialise their respective products and services within the mobility sector.

CPC achieved many more outcomes throughout the year, including its regular programme of Connections Cafés and Third Thursdays, plus strategic events PlanTech Week, Cityx and Housing Innovation Week at the Urban Innovation Centre in London.

Energy Systems Catapult

Energy Systems Catapult has worked with over 100 innovative companies this year. Using unique capabilities, expertise and assets, ESC accelerated to market high-growth potential businesses that will drive the UK's low-carbon economy as we emerge from the current lockdown. 19 of these work in the most challenging and exciting areas of the energy transition and have accessed the Innovator Support Platform, where SMEs are guided towards commercialisation at home and abroad.

New and established companies alike have benefited from access to business model innovation, consumer insight and markets, policy and regulation expertise. They have also been able to test their products and services with real consumers in our Living Lab.

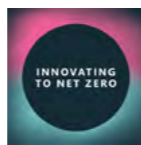
In an industry first, two British companies have successfully trialled selling 'heat-as-a-service'. It's something experts believe will now pave the way for the low-carbon retrofit revolution. Furthermore, ESC were invited on to the BBC's *Panorama* to showcase the innovation, and received positive feedback from wider consumers at the UK's first national Citizens' Assembly on Climate Change.

ESC's track record for helping innovators and delivering complex energy innovation programmes also won the Catapult the management contract for the £16.5 million Electrification of Heat Demonstration Project.

'Over 100 innovators supported – more than ever before.'



Guy Newey, Director of Strategy and Performance at Energy Systems Catapult



Innovating to Net Zero

ESC's Innovating to Net Zero programme has provided government and business with their most in-depth insights yet into how the UK could reach net-zero. The programme is underpinned by the Energy System Modelling Environment, the UK's leading techno-economic, whole-system model. The report was widely welcomed by government, academia, industry and innovators. Over 200 people attended the event, with extensive national news coverage (including 134 mentions across all BBC radio stations) and over 2,000 downloads of the report. This means Energy Systems Catapult is now one of the world's leading voices on net-zero, which has directly resulted in leading the Catapult Network in the Innovating to Net Zero challenge.

Two green and clean government taskforces

Energy Systems Catapult chaired and provided unrivalled insight into two of the most wide-ranging collaborations between the UK energy sector, the public sector and two sectors vital to the future growth of the UK economy, transport and mobility (EVET) and digital and data (EDTF).

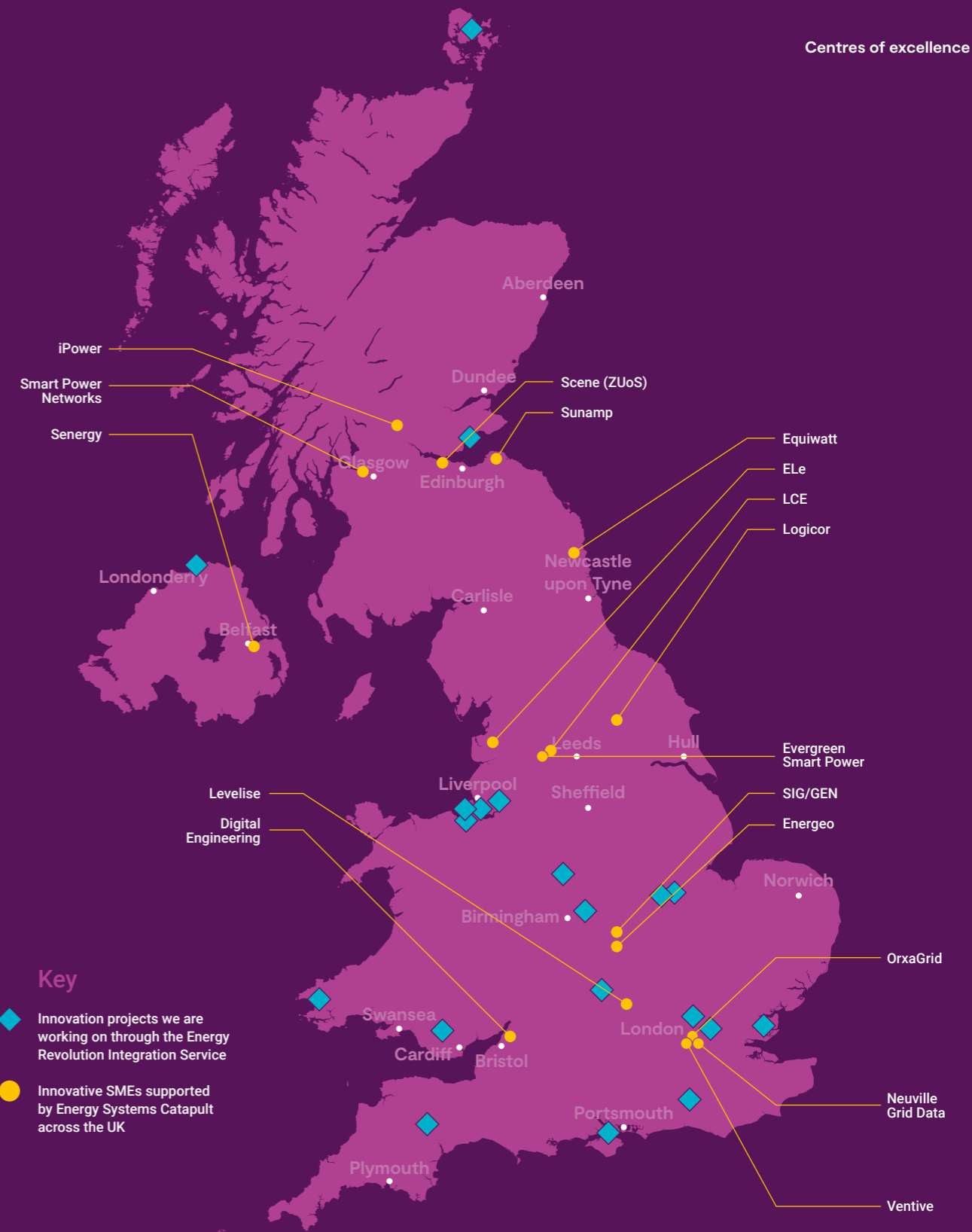


Electric Vehicle Energy Taskforce (EVET)

EVET will ensure the mass roll-out of electric vehicles (EVs). It delivers benefits for drivers and the energy system, including creating markets that can unlock EVs' economic potential. Several companies have already launched initiatives and offerings consistent with its recommendations.

Energy Data Taskforce (EDTF)

EDTF's recommendations are fully endorsed by the Department for Business, Energy & Industrial Strategy and Ofgem. Key elements are included in all energy network companies' draft digital business strategies, and Energy Systems Catapult works with many of these to embed the changes.



Driving localised Energy Systems and levelling-up across the UK

The Industrial Strategy Challenge Fund's Prospering from the Energy Revolution (PFER) programme has helped 25 consortiums, and over 100 businesses, reduce system costs and cut carbon. This involved creating local markets for innovative technologies, such as energy storage and electric vehicles using digital technology. Finding new ways to harvest system data to create local energy

maps has been a key part, where identifying system constraints can unleash opportunities for low-carbon investment and innovation.

This focus on local innovation extends to our work on Local Area Energy Planning (LAEP) with Ofgem this year. It includes LAEP in key guidance for energy networks, submitting new eight-year price control business plans.

ACT Blade

An Innovate UK-backed start-up has developed a lighter wind turbine blade that could generate more power, cost-effectively.

A Scottish start-up has developed a wind turbine blade that could boost energy production by nearly 9%. ACT Blade was set up in 2015 after a feasibility study funded by Innovate UK proved its 55m blade was technically viable and could offer significant savings. Early analysis suggests the blade could reduce the levelised cost of energy by nearly 7%, giving it the potential to make a significant impact in renewable energy.

Founder Dr Sabrina Malpede says Innovate UK funding has helped every step of the way, from resourcing the team and enabling staff retention to supporting the IP process and helping unlock further investment.

Currently wind energy provides up to 15% of Europe's electricity demand. To create more

power, turbines need longer blades. However, most blades are made of fibreglass, which is too heavy to be lengthened and expensive to produce. The blades also erode over time and have to be replaced.

Sabrina was working in the yachting industry when she began to wonder if the same textile used in modern sails could be used to make wind turbines. The idea was so powerful she entered it into an Innovation Challenge run by the Offshore Renewable Energy Catapult, one of Innovate UK's centres set up to support UK businesses.

The resulting collaboration led to the creation of the ACT Blade, the world's first textile blade that was 24% lighter than a traditional fibreglass blade. If a blade is lighter, it can be made longer. Not only that but when compared to a conventional blade the ACT Blade uses less material and so less waste is produced in production. As the textile covers the entire surface of the blade, the ACT Blade does not need to be painted. A further benefit is that ACT Blades are component-based and therefore relatively easy to dismantle and separate out for recycling.

ACT Blade founder
Dr Sabrina Malpede



“Innovate UK funding has helped the company massively and on several layers.”

Sabrina says: “Innovate UK funding has helped the company massively and on several layers. Deployment of new technologies in the wind industry is too expensive and risky for private investors alone.”

A prototype 13m-long blade was successfully tested at the Offshore Renewable Energy Facility in Blyth in March 2020. Three blades will be tested on a working wind turbine at the Energy Technology Centre in East Kilbride and will be producing energy by the end of 2020.

Now a team of eight, ACT Blade is developing a commercial strategy, beginning with 50m replacements for blades on 2MW turbines that will be tested in 2022 on a commercial turbine then commercialised by 2023. The company was also chosen to visit San Francisco at the beginning of 2020 on an Innovate UK-supported Clean+Cool mission.



KTN supports a diverse range of UK industries including agri-food

Knowledge Transfer Network

Our network partner offers expertise across a range of UK industries, providing support and connecting businesses with innovation partners and events.

The Knowledge Transfer Network (KTN) is a network partner of Innovate UK. KTN helps businesses maximise creativity, ideas and the latest discoveries, strengthening the UK economy and improving people's lives. The organisation links new ideas and opportunities with expertise, markets and finance through its network of businesses, universities, funders and investors. From agri-food and autonomous systems to energy and design, KTN combines in-depth knowledge in all sectors with the ability to cross boundaries.

Our collaboration with KTN has strengthened during 2019-20. KTN has supported us in developing and successfully delivering Global Business Innovation Programmes (GBIPs) and Global Engagement Meetings (GEMs) both domestically and internationally. KTN supported the Energy Catalyst programme with its brokerage events for Rounds 7 and 8 in Sub-Saharan Africa and South East Asia, as well as Domestic Missions with local authorities in Derry.



Centres of excellence

EEN provides bespoke support throughout the GBIP

Enterprise Europe Network

This network provides specialist support in innovation growth, funding opportunities and building partnerships, all with a global perspective.



The Enterprise Europe Network is the world's largest support network for internationally ambitious SMEs. It helps businesses innovate and grow on a global scale and is active in more than 60 countries worldwide. The network also brings together 3,000 experts from more than 600 member organisations, all renowned for their excellence in business support.

Examples of our collaboration with EEN include the Clean + Cool 2020 Mission, as well as the Future Cities 2020 Mission to India. Here, EEN advisers give participants bespoke one-to-one support to help them maximise opportunities before, during and after the mission, all as part of the full programme.

Innovation and Knowledge Centres

These university-based centres for excellence, led by expert entrepreneurial teams, bring together international research capabilities and access to disruptive technology.

Centre for Smart Infrastructure and Construction

Founded in 2011, the Cambridge Centre for Smart Infrastructure and Construction (CSIC) has catalysed transformation in infrastructure and construction. Working with partners to research, demonstrate and support the implementation of smart solutions for industry, the centre has provided a platform for strong academia-industry collaboration. It brings together clients, industry, policymakers and academics to develop the emerging market for smart infrastructure solutions. The following are the highlights of CSIC's achievements in 2019-20.

CSIC partnership: collaboration with industry on R&D, deployment, data analysis and dissemination

CSIC has welcomed three new organisations as formal partners this year – Royal HaskoningDHV UK, FDH Infrastructure Services and Sintela – making a total of 31 partners of which 10 are SMEs. CSIC continues to receive significant support from industry, as evidenced by letters of support from 22 companies, totalling £490,000 cash and £1.9 million as leverage funding for the Engineering and Physical Sciences Research Council's recent £500,000 investment.

Industry secondments: working with industry to co-develop industry-ready tools

CSIC's secondment programme, funded by Innovate UK, helps to develop emerging tools and technologies for industry use. Over the past four years, 23 secondees have gained a deep understanding of innovations, which they have used for the direct benefit of their own organisations. In 2019-20, CSIC hosted 11 secondees on eight secondment projects with industry, ranging from well-known British firms to SME partners. To enhance knowledge sharing, the outcomes of the projects were presented by the secondees to an audience of over 50 people, including delegates from CSIC's wider partnership and academics from other universities, as well as the secondees' own companies.

CSIC hosted the International Conference on Smart Infrastructure and Construction (ICSIC 2019) at Churchill College, Cambridge in July 2019. The conference attracted over 200 delegates from around the world representing industry, academia and policy organisations. CSIC researchers contributed 20 papers at the conference and demonstrated technologies developed through CSIC research activities.



Dr Jennifer Schooling, Director of the Centre for Smart Infrastructure

Growing Underground: smart monitoring at an urban farming facility

Growing Underground, a CSIC monitoring and modelling system that optimises energy-efficient growing conditions, has won the Innovation in Tunnel Fit-Out, Operations and Maintenance Award at the New Civil Engineer Tunnelling Festival Awards 2019. The project is located on what is described as 'the world's first underground farm'. Growing Underground's hydroponic facility is housed in World War 2 air raid shelters and supplies greens to Waitrose and Marks and Spencer.

Fibre optic sensing for safer real-time rockfall monitoring of rail cuttings

A project between CSIC, Network Rail and BAM Nuttall that solves the problem of landslide monitoring at Hooley Cutting won Best Use of Technology at the Rail Partnership Awards 2019. 25km south of London, Hooley Cutting carries the main railway line from the capital to Brighton.

Innovative Structural Health Monitoring of Ageing Railway Infrastructure and Smart Monitoring for Condition Assessment of Ageing Infrastructure

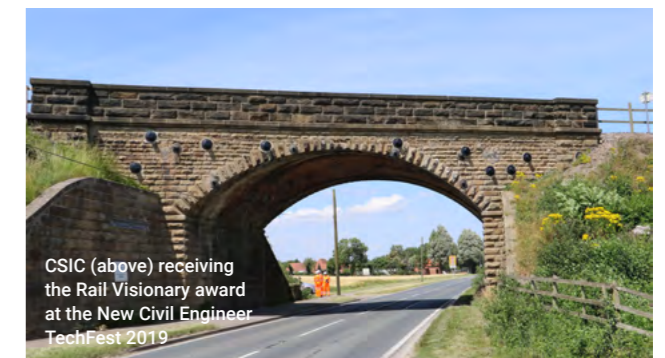
In a collaboration between CSIC, AECOM, Network Rail and the Alan Turing Institute, CSIC's innovative method to monitor the health of ageing railway infrastructure won the Rail Visionary category in New Civil Engineer TechFest 2019's awards.



ICSIC keynote speakers and organising committee at Churchill College, Cambridge



Delegates at the International Conference on Smart Infrastructure and Construction



CSIC (above) receiving the Rail Visionary award at the New Civil Engineer TechFest 2019



Growing Underground was an award winner at the NCE Tunnelling Festival 2019



Fibre optic sensing was used to monitor landslides at Hooley Cutting



Active Office, the UK's first energy-positive office, is designed to generate more energy than it uses

Sustainable Product Engineering Centre for Innovative Functional Industrial Coatings (SPECIFIC)

SPECIFIC was one of seven Innovation and Knowledge Centres (IKCs) set up to grow new industries. Closing the gap between scientific research and its commercial exploitation, SPECIFIC's Active Building concept integrates solar technology into one system that enables them to generate, store and release their own solar energy – both heat and electricity.

More than 26 full-scale demonstrator sites have now been set up. Each incorporates various aspects of the Active Buildings concept and showcases the emerging conceptual technologies. Proving the concept in real buildings is critical for this technology's adoption by industry, regulators and consumers, and so demonstrators are used to closely monitoring and developing systems under realistic conditions and in a range of building uses.

SPECIFIC: 2019-20 Annual Review

In the past financial year, the team at SPECIFIC have continued to develop technologies, seek collaborators for market pull, and develop relationships with organisations interested in commercialising these technologies. Further progression on its Solar Heat Energy Demonstrator (SHED) has continued, with its solar thermal generation system continuing to develop and five of its six solar systems are now live. The performance of the Active Classroom and Active Office continue to be monitored and are a credit to the objectives of the IKC to generate buildings as power stations, with both remaining energy positive.

In June 2019, the Active Office won the Innovation in Delivering a Sustainable Education Facility award at the Education Buildings Wales Awards. This accolade celebrates excellence and achievement in the design, build, management and maintenance of schools, colleges and universities across Wales. Active Office was also runner-up in the Buildings that Inspire category of the Guardian University Awards.

The success continues. The Active Building Concepts have led to £6 million of further funding secured from the European Regional Development Fund (ERDF), which confirmed the continuation of SPECIFIC until March 2023.

Throughout 2019-20, SPECIFIC has completed 58 papers that have been indexed by Scopus, including two four-star impact reviews and multiple publications through some highly respected periodicals. These papers include:

- examining the performance of substrates for photocatalytic water cleaning
- a review of sensors and communications technology for integration of building control
- the performance improvements or assessment techniques of solar cells.



References

- 1 GWEC – Global Wind Energy Council. *Global Wind Report 2019*; 2019. Brussels: GWEC – Global Wind Energy Council. Available from: <https://gwec.net/global-wind-report-2019/> [Accessed 16 July 2020].



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We connect businesses to the partners, customers and investors that can help them turn ideas into commercially successful products and services and business growth.

We fund business and research collaborations to accelerate innovation and drive business investment into R&D. Our support is available to businesses across all economic sectors, value chains and UK regions.

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