UKRI Innovate UK

# Scaling Climate Technology

## Net Zero Review 2023

## Net zero is an investment opportunity that can only be realised through a step change in the mobilisation of climate tech capital.

## To do this Innovate UK is:

De-risking net zero technology across all sectors of the economy

Supporting businesses and projects across the UK

Making climate tech opportunities visible and compelling to the finance community

**Mike Biddle**
Executive Director, Net Zero

# Foreword

At Innovate UK our vision is for the UK to prosper from being the fastest transitioning economy to net zero. Prospering means creating net zero products and services, green jobs, sustainable growth and exports to help other countries reach net zero too.

We're helping build our future economy across the UK - in towns, cities and regions - by inspiring, involving and investing in UK business innovation.

Through the Building a Green Future programme, we work together across UKRI to support research and innovation that will unlock the solutions we need to achieve net zero in the UK by 2050.

Innovate UK is here to build on the UK's scientific strengths and accelerate business-led innovation, to grow a bigger, more productive data-driven economy that is net zero, with higher levels of health and wellbeing, and access to opportunities for all.

As well as the climate tech that will change our future and help us achieve net zero, we are also supporting the transition through systems thinking and finance.

From a systems perspective, it's about how all the elements fit together and stimulating demand – it can't just be about the supply side, or technology push. For example, our Net Zero Living programme inspires towns, cities and communities to remove the barriers to adoption, creating demand for new net zero technologies.

Furthermore, we need a step change in the mobilisation of capital towards the delivery of climate tech. We are making the opportunity visible and compelling to the finance community, showcasing how investors can prosper from the transition to net zero. Innovation may get us the prototype and the first of a kind, but we need to roll out solutions at scale, in the tens, hundreds, thousands and beyond.

Significant investment will be required. This year's annual review showcases companies we work with and the levels of investment they have achieved. Here we celebrate the successes so far, but most importantly we want to inspire further and bigger investment in achieving our net zero future.

Mike Biddle
*Executive Director*
Net Zero

**"Investors can prosper from the transition to net zero"**

# Contents

The aim of this year's annual review is to showcase the private investment opportunity in climate tech. Innovate UK currently delivers one of the largest climate tech funds with opportunities for investors to provide follow on scale-up funding. The following pages provide a window into our activities across our five core climate tech verticals: Agriculture and Food, Heat, Make and Use, Mobility and Power. It covers:

- **Market data and key stats**: building on the work we do to target our own investments
- **Dealflow**: demonstrating how companies we support successfully secure onward investment, highlighting selected examples
- **Pipeline**: highlighting selected companies receiving Innovate UK grants this year
- **Focus areas**: summarising where we are currently focusing our investments.

We've also included a section on how we're catalysing investment in place-based projects.

# The year in numbers

In 2022/23 Innovate UK awarded **1,043** net zero-related grants and supported **1,746** companies, committing over **£720 million** to net zero research and innovation projects across the United Kingdom[1].

**£28m**
**Agriculture and Food**

**£117m**
**Heat and Power**

**£144m**
**Make and Use**

**£400m**
**Mobility**

**£32m**
**Systems Approach**

# Innovate UK's five-year impact

In 2023, we are focusing on scaling climate technology, which places an emphasis on small and medium-sized businesses (SMEs). SMEs awarded a Net Zero Research and Innovation grant from Innovate UK since 2018 have:

Created **13,000** jobs

Raised **£4.7bn** of private investment

Exported **£4.5bn** worth of goods and services[2]

# Working across the UK

We are a UK-wide organisation. From funding and support services to facility and technology access. This selection of projects highlights innovations we have supported in every UK region.

### SCOTLAND

- Hydrogen/electric powertrain development at HV Systems
- Upscaling tidal energy production at Nova Innovation
- Developing sustainable insecticides at Solasta Bio

### NORTHERN IRELAND

- UK Smart Factory Innovation Hub at the University of Ulster
- Scale-up of technology for low-emission concrete at Material Evolution
- Hydrogen combustion engines at Causeway Aero

### NORTH EAST

- Network of PEMD Centres of Excellence at Newcastle University
- Magnet recycling plant at Seren Technologies
- Offshore charging system at MJR Controls

### NORTH WEST

- Automated solutions for circular construction at the University of Manchester
- Production of carbon-neutral lithium in the UK at Watercycle Technologies
- Converting industrial waste gases into sustainable materials for consumer products at BASF

### YORKSHIRE AND THE HUMBER

- Material Innovation for Sustainable and Efficient Use of Resources at Glass Futures
- Scale-up of power controller production at Magtec
- Modelling circular economy construction value chains at the University of Sheffield

### WALES

- Improving recycled steel purification at Swansea University
- Battery enclosure materials automation at Cytec Engineering
- Developing biodegradable packaging at Transcend Packaging

### WEST MIDLANDS

- UK Battery Industrialisation Centre
- Sustainable critical raw material supply chains at the University of Birmingham
- Increased efficiency, reliability and sustainability of automotive batteries at Jaguar Land Rover

### EAST MIDLANDS

- Tillage enhancements for sustainable potato farming at Grimme UK
- Recyclable wind turbine blades at Hive Composites
- Enhanced electric motorcycle performance and range at Norton Motorcycle

### EAST OF ENGLAND

- Ultra-fast battery charging technology at Nyobolt
- Air Mobility Ecosytem Consortium at Skyports Infrastructure
- Plant-based biodegradable pellets to replace plastic at Xampla

### LONDON

- Hydrogen engine architecture at Rolls-Royce
- Low carbon cement from waste glass at Carbon Upcycling
- Development of Ultra High Power Cells at AMTE Power

### SOUTH EAST

- Solid-state batteries at Ilika Technologies
- Silicon technology advanced reactor scale-up at Nexeon
- Supply chain innovation engineering at McClaren Applied

### SOUTH WEST

- Enhanced batteries for aviation at Vertical Aerospace
- Electric motor manufacturing at Electrified Automation
- UK lithium extraction at British Lithium



# Accelerating climate tech investment

## Climate tech ecosystem

Innovate UK is working to build the investment pathways needed to scale new climate tech businesses and technologies. Connect with our Investor Communities team to find out more about what we do and engage in the following activities.

Innovate UK is using its convening power to build capacity and connections across the climate tech finance ecosystem. We are doing this through:

- **Investment analysis:** curating in-depth, sector-focused analysis in all net zero verticals. Building a detailed picture of the investment gaps, specific barriers and opportunities while making visible our funding pipeline.
- **Capital to climate events:** disseminating insights from our investment analysis and convening the investor community to build knowledge of climate technologies and business models, bringing in new investors and building connections across the capital stack.
- **Showcasing series:** highlighting curated opportunities to targeted investors to build deal flow.

We work with market leading partners, including Cleantech Group, Sightline Climate, Carbon Limiting Technologies, Dealroom and Climate Connection.

## Greening Global Finance

We are working across UKRI to establish climate and environmental risk analytics capabilities in the UK, develop responsible data approaches for ESG reporting in the financial sector and integration of nature positive solutions in financial decision making.

## Investor Partnership Programme

Investor Partnerships are a unique opportunity for high-growth, innovative UK companies to access the funding they need to thrive and succeed. Innovate UK has and continues to partner with a diverse group of credible investor partners, including venture capital funds, corporate investors, business angel groups, and social impact investors from the UK, Europe and the US. These investors are committed to supporting innovative companies and providing the financing they need to grow and scale.

## Stimulating market demand

Market demand is a systemic challenge in net zero. Innovate UK is piloting new ways of supporting companies we fund through Demand Led Innovation. We are working with the First Movers Coalition and leading corporates to get advanced market commitments in place, pulling through investment and accelerating scale out.

### Diversity and inclusion investment readiness package of support

Innovate UK is establishing a tailored investment readiness package to unlock the potential of diverse talent. The purpose of the package of support is to level the playing field for all innovators, equipping participants with the knowledge and understanding to navigate the private investment journey.

Beginning this year, Innovate UK will deliver bespoke investment readiness support for up to 300 innovators from across backgrounds. Until March 2025, Innovate UK will help support these innovators' understanding of attracting private investment and helping them grow their businesses through other routes.

# Agriculture and Food

**Making the agri-food sector more productive and sustainable while reducing emissions and food waste can help the UK achieve its climate goals.**

The agri-food sector is vital to the health and wellbeing of society, providing us with a resilient and safe supply of food. Agriculture covers 71% of UK land[3], significantly shaping the environments we live in and with 4.3 million workers employed across the farm-to-fork food chain, it represents the biggest employment sector in the UK.

Including imports, the entire food system is responsible for 35% of the UK's total greenhouse gas emissions[4]. Between 2015 and 2021 there was a 12% reduction in emissions associated with food and drink consumption[5] with most of these reductions seen beyond the farmgate, while emissions from agriculture remained largely static. Controlling the release of emissions across the food system will be critical to realising our net zero commitments.

**$155 bn** The projected value of the global alternative protein market in 2027

**£128 bn** The UK food and drink sector's annual turnover, with an industry output of £33 billion

Data science will help farmers to use water, fertilisers, chemicals and fuel more efficiently[6]

Vertical farms will help the UK boost agricultural productivity, sustainability and crop resilience



# Innovate UK funded companies go on to raise significant private investment*

| | Private investment raised | |
|---|---|---|
| IGS | £66 million | Intelligent Growth Solutions (IGS) develops technology where products are grown in vertical towers in which the environment can be automatically controlled and data is fed to a platform for analysis. Innovate UK awarded IGS grants to develop environment monitoring and control systems for vertical farms. |
| HECTARE | £38 million | Hectare provides an online marketplace for farmers to trade livestock and grain through two websites, Sell My Livestock and Graindex. In 2019 Innovate UK awarded Hectare a grant to increase efficiency in the UK beef farming sector, aiming to reduce the environmental impact. |
| uncommon | £28 million | Uncommon produces cell-based meat. In 2021 Innovate UK funded a project led by Uncommon to develop the UK's first pilot plant for cultivated meat. |
| vertical future | £26 million | Vertical Future develops technologies designed to facilitate vertical farming, as well as offering consultancy services and operational support. Since 2020 Innovate UK has awarded the company five grants to develop technology for monitoring, environmental control and yield increases in vertical farming. |
| ROSLIN Technologies | £24 million | Roslin Technologies utilises biotechnology to develop sustainable food products, to combat the issues of food security, animal health and environmental change. Innovate UK awarded the company grants to develop cultivated meat and sustainable protein technologies. |

**Total private investment in companies receiving Innovate UK grants since 2018, selected examples.*



# Innovate UK is funding companies across the value chain*

## ANIMAL HEALTH AND WELFARE

ag PRODUCTS
Biotangents
FLOX
LA SYSTEMS
MUDDYMACHINES

## DIGITAL SOLUTIONS FOR SUSTAINABILITY

harvestlondon
HSAT Heimdal Satellite Technologies
INNOVENT TECHNOLOGY
zoetis

## SUSTAINABLE PEST MANAGEMENT

AVALON PRODUCE LIMITED
Charltons
NIAB
Russell IPM INTEGRATED PEST MANAGEMENT
SOLASTA Bio Nature Inspired

## PRODUCTIVE EFFICIENCY AND SUSTAINABLE PROTEINS

AGRIEPICENTRE Engineering • Precision • Innovation
CONCERT BIO
GRIMME
LettUs GROW
PEPSICO
upp

## RESILIENT SUPPLY CHAINS AND COLLABORATIVE NETWORKS

ABACUS AGRICULTURE
advice that counts
ADAS
B-hive
BRANSTON
crop systems

** Selected organisations receiving Innovate UK grants in FY 2022/23.*



# Current Innovate UK programmes building investment opportunities

To reach net zero by 2050 there needs to be a 64% reduction in emissions from agriculture and land use. For many sectors there is a significant gap between this target and what is possible with existing technologies; for example, in livestock it is estimated that existing technologies can only deliver a 24% reduction.

Innovate UK will support innovations that:

- enable existing agricultural systems to be more productive while contributing to net zero targets, increasing sustainability and supporting biodiversity;
- enable novel, low-emission, sustainable and resilient food production systems that are more efficient such as vertical farming, which offers radical new solutions that complement more traditional farming systems and hold significant potential to provide growth for UK companies;
- ensure better food for all, including plant-based and alternative proteins for healthier and more sustainable diets and preservation, packaging and storage technologies to reduce food waste.

Developing new solutions to reduce emissions is only the first step. If they are to help us reach net zero then they must be widely adopted. Innovate UK will work with stakeholders, including Defra, to accelerate the adoption of new solutions in agriculture and horticulture.

### Farming Innovation Programme

Since 2019, UKRI has invested almost £68 million through the Transforming Food Production (TFP) programme to help UK agriculture achieve net zero. Momentum generated through TFP has continued through the Farming Innovation Programme (FIP), a £210 million partnership between Defra and UKRI. FIP's goal is to make farming more efficient and productive through investment in research and development. The programme will support projects to transform productivity and enhance environmental sustainability in England. Its aims are to:

- help farmers, growers and foresters increase productivity, sustainability and resilience;
- reduce the environmental impact of agriculture and horticulture;
- apply agricultural research to provide real benefits to farmers, growers and foresters;
- use science to develop solutions for the practical challenges of agriculture and horticulture.

### Agri-Tech Africa Catalyst

Official development assistance was delivered through an Agri-Tech Africa Catalyst, supporting projects like Innovative Solar Energy Technology for Kenyan Tea Industry, which is reducing the use of firewood in the drying stage of tea processing by using alternative energy sources.

### Novel Low Emission Food Production Systems

The Novel Low Emission Food Production Systems competition has supported a range of innovative technologies from subsectors such as vertical farming and alternative proteins. The programme is co-funded by the Biotechnology and Biological Sciences Research Council.

### Better Food For All

Innovate UK's Better Food for All programme supports the food sector to innovate in the areas of nutrition and food processing to create affordable, convenient foods with improved nutritional quality.

### Agri-Tech Catapult

We are continuing to fund the world class facilities and expertise in the UK Agri-Tech Centres. We are working with three of the Centres – Agri-EPI, CEIL and CHAP – to develop a proposal for a new Agri-Tech Catapult. This new merged capability will play a crucial role in accelerating the development and adoption of agri-tech for net zero. Bringing the Centres' expertise and capabilities into a single entity will provide a centre of excellence for agri-tech businesses and provide leadership and coordination for the sector around innovation opportunities.

# Heat

**Meeting the Sixth Carbon Budget's targets will require the UK's sector for the retrofit of buildings to grow tenfold, presenting opportunities for SMEs and investors.**

Innovate UK's net zero heat programme supports innovation to develop alternatives to using gas to heat space and water in buildings. In the UK 23% of emissions are related to heat in buildings[7].
The sector for large-scale retrofit of buildings needs to grow by a factor of 10 to meet the pathways in the Sixth Carbon Budget.

Government targets mean a ramp up in activity over the next five years, installing 600,000 heat pumps and upgrading one million homes a year by 2028. The barriers to this scale-up include the current installed cost of retrofit measures, lack of trained/skilled installers, slow accreditation of innovation and inconsistent or confusing information for building owners.

**£7.5 bn** A cost-effective approach to UK retrofit could deliver a net present value of £7.5 billion[8]

This approach could realise additional economic value of up to £47 billion from system benefits and economic activity in the supply chain[8]

66,000-86,000 new jobs could be sustained annually across all UK regions if this approach were adopted[8]

The global energy retrofit systems market size was valued at $150 billion in 2022 and is anticipated to grow at a CAGR of 6.3% from 2022 to 2030[9]



# Innovate UK funded companies go on to raise significant private investment*

| | Private investment raised | |
|---|---|---|
| Kensa Group | £100 million | Kensa Group is responsible for the manufacture and installation of ground-source heat pumps and the ownership of associated underground infrastructure.The company deployed its heat pump solutions alongside grid-scale energy storage and the largest hybrid battery for EV charging points as part of the Energy Superhub Oxford demonstrator project. |
| SUNAMP | £22 million | Sunamp develops thermal energy storage devices. Innovate UK have awarded grants to Sunamp to improve the efficiency of its thermal energy storage devices and explore broader zero emission applications for their use. |
| mixergy | £16 million | Mixergy designs and manufactures hot water tanks. Innovate UK has awarded 4 grants to Mixergy since 2015 for projects aiming to integrate renewable energy into household supply. |
| tepeo | £15 million | Tepeo develops a zero-carbon emissions boiler aimed at providing a more efficient alternative to traditional electrical heating systems. Innovate UK supported the company's project in 2021 to develop a scalable manufacturing blueprint for the Zero Emissions Boiler. |
| arbnco | £15 million | Arbnco develops web-based software that enables real estate managers to analyse and reduce energy consumption across their property portfolio. Since 2017, Innovate UK have funded 5 Arbnco projects, focusing on improving energy monitoring and management for large estates and developing envelope systems for future buildings. |

**Total private investment in companies receiving Innovate UK grants since 2018, selected examples.*



# Innovate UK is funding companies across the value chain*

## BUILDING FABRIC

ISCLEANAIR® BREATHE YOUR LIFE
Micropore Technologies
STOLI chem
TechInspire Inspire for innovation
THERMULON
VENTAIRGE

## DEMAND AGGREGATION

Boxergy
FREDS BUILDING ENERGY ADVISOR
krellian
LOCO HOME RETROFIT
novoville

## HEATING SYSTEMS AND INTEGRATED RENEWABLES

biaco
centre for sustainable energy
HEATWEB
LUNYX
Tank Cube
X-HEAT Space Heating Technology
Mitravitae Integrated Renewable Energy Systems
SMD

## MAINTENANCE AND DATA

AUGMENTED REALITY CREATIONS
Eyesea Green
PragmaticEnergy transform natural resources
Carbon Co-op
ThermaFY ECO SOLUTIONS
q·energy

** Selected organisations receiving Innovate UK grants in FY 2022/23.*



# Current Innovate UK programmes building investment opportunities

Innovate UK's net zero heat programme focuses on interventions that address the following areas.

### Market demand

The programme takes a data-led approach to providing standardised information on what building upgrade to do where and when for maximum impact. This includes compiling a unified national stock model for the UK, developing pathways for large-scale retrofit that take the power network into account and faster, lower-cost solutions to do real-time measurements of building fabric efficiency.

### System barriers

We seek to understand and provide support to overcome the systemic barriers to scaling out of existing innovative solutions, building capacity and growing supply chains. This includes growing the Net Zero Heat Cohort (see below) and providing investor partnerships.

### Design engineering

We are reducing capital and installation costs across the system of net zero renovation (including fabric improvements, decarbonised heating technologies and installation methods) through cross-sector innovation involving construction, high-value manufacturing, digital, robotics, design and energy. During 2023 this will be achieved by running an Innovation Lab bringing together such experts to develop novel projects that rethink net zero heat upgrades to be lower cost and ready to industrialise.

### Net Zero Heat Cohort

The technology to deliver net zero heat largely exists, and Innovate UK has supported many of the solutions now on the market. However, these companies and supply chains haven't scaled due to system barriers. The Net Zero Heat Cohort is tackling these barriers collectively with our cohort delivery partners, Sustainable Ventures and Carbon Limiting Technologies.

Over the last year the cohort has connected with emerging demand aggregators, explored issues in insurance and worked on the largest current barrier, accreditation onto government retrofit schemes. On behalf of the cohort, Innovate UK, alongside the Energy Systems Catapult and the Sustainable Energy Association, is working with key accrediting bodies accrediting bodies and UK government to provide a smoother and faster process for innovative solutions to be accredited.

# Make and Use

**Resource and energy efficiency, rare earth materials and circular economy solutions are providing opportunities for growth in the UK's manufacturing sector.**

UK manufacturing is responsible for over 40% of the total emissions associated with the UK's consumption of goods. Innovate UK is focused on reducing this by helping companies address how products are sourced, made, used and disposed of.

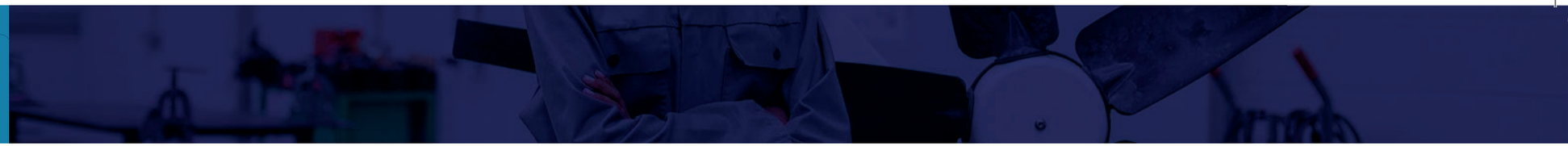
We believe that the UK can become a world-class destination of choice for advanced low-carbon manufacturing. Manufacturing sectors are key drivers for prosperous and sustainable future for the UK.

The Climate Change Committee estimates that, at 314 MtCO2, resource and energy efficiency in manufacturing is the single largest opportunity to abate carbon up to 2050[10]

12 MtCO2 of abatement could be in place by 2030 through the development and adoption of digitally-enabled efficiency

Resource efficiency measures can improve national resilience by increasing the domestic supply of resources and protecting industry from price shocks and supply disruptions

The global market for rare earth elements is projected to grow from $2.5bn to $5.5bn by 2028, with a compound annual growth rate of 10.0%[11]

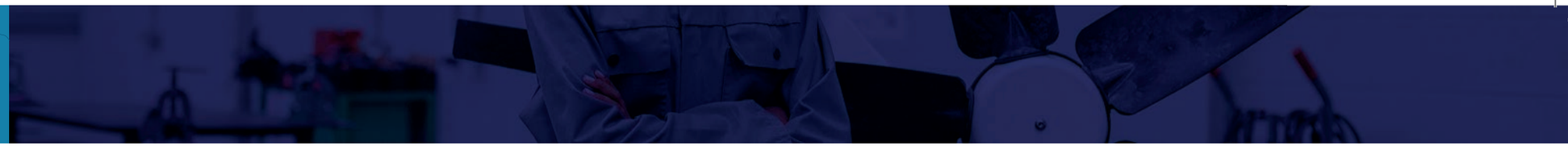




# Innovate UK funded companies go on to raise significant private investment*

| | Private investment raised | |
|---|---|---|
| Pragmatic | £143 million | Pragmatic manufactures ultra-thin integrated microcircuits for applications in mass-market objects and smart packaging. Since 2010, Innovate UK has awarded the company grants for projects that aim to decarbonise consumer electronics and increase plastic recycling through smart packaging techniques. |
| PARAGRAF LEADING THE WAY IN GRAPHENE ELECTRONICS | £67 million | Paragraf uses graphene to replace rare earth materials in electronic products. Since 2018, Innovate UK has awarded grants to help scale up the use of 'next generation graphene' to replace rare conductive materials used in electronic devices. |
| Poly materia | £58 million | PolyMateria has developed technology that enables it to manufacture recyclable and biodegradable plastic products. Innovate UK has funded projects that aim to develop advanced drop-in additive formulations for the manufacture of compostable, biodegradable and cost-effective plastics. |
| ACS | £34 million | ACS Clothing provides formal wear rental services. ACS received Innovate UK grants to make the fashion industry sustainable through new clothing development processes and sustainable supply chains. |
| Cornish Lithium | £34 million | Cornish Lithium explores the potential for lithium mining in Cornwall. The company received grants from Innovate UK to scope the production of enriched lithium at a pilot plant in Cornwall. |

**Total private investment in companies receiving Innovate UK grants since 2018, selected examples.*





# Innovate UK is funding companies across the value chain*

## FOUNDATION INDUSTRIES

CAMBOND · carbon upcycling · emr METAL RECYCLING REIMAGINED · Glass Futures · MATERIAL EVOLUTION · Materials Processing Institute · Q-FLO CNT Innovation · TATA STEEL

## SMART SUSTAINABLE PACKAGING

ACET SOLUTIONS · ALGREEN Treat Nature With Nature · BIOME TECHNOLOGIES · BMT · impact recycling · Xampla

## DIGITAL SOLUTIONS

Agile · BMT · GKN AEROSPACE · haydale · Matta · NISSAN · SortFlow · whering · winnow

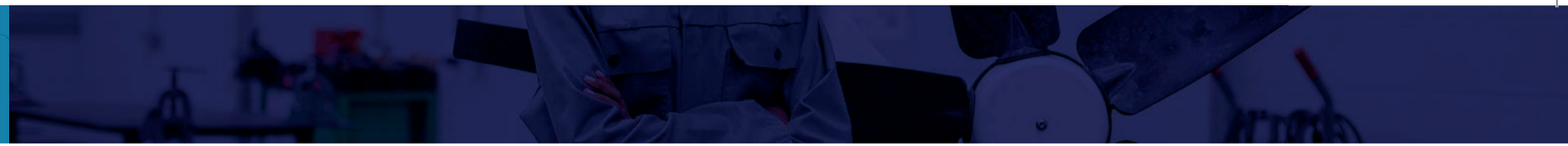
## CIRCULAR ECONOMY

amphico · BIMBOX · LONGWORTH · epoch BIODESIGN · ALTILIUM METALS · Pragmatic · PROZOMIX Recombinant Enzymes and Proteins · SHELLWORKS · VIGILANT SCANNING

## DECARBONISED MANUFACTURING AND PRODUCTION

Alcohols Limited · BAE SYSTEMS · BATCH WORKS · coomtech clean technologies · DeepMeta · DYCOTEC MATERIALS · SOMETRIC OUTCOMES · Photocentric · PragmatIC · Raynors · Samworth Brothers QUALITY FOODS · TOPOLYTICS · victrex

** Selected organisations receiving Innovate UK grants in FY 2022/23.*





# Current Innovate UK programmes building investment opportunities

Our vision is for UK materials and manufacturing in 2050 to be sustainable, safe, advanced, agile and resilient. We believe the UK will be an increasingly attractive place to manufacture goods with organisations in materials and manufacturing embracing innovation to be:

- net zero and resource efficient, understanding the environmental impact of every stage in the supply chain and manufacturing process, and widely adopting sustainable practices;
- resilient and responsive with the agility to mitigate risks arising from the changing global economy, interruptions to supply of critical minerals and materials, national and global disruptions, and climate change;
- technologically advanced and digital to improve efficiency across supply chains, enable novel business models, support whole-system design and deliver highly customised products.

The following programmes are designed to help UK businesses achieve their goals.

### CLIMATES

The Circular Critical Materials Supply chains (CLIMATES) programme is aligned to the UK's Critical Mineral Strategy and will create a more resilient and sustainable UK through the opportunity to build a stronger supply chain of materials for high-performance magnets. The aim is to position the UK as a world leader in rare earth materials recycling and to help meet the UK government's net zero targets.

### Made Smarter Innovation

The UKRI funded Made Smarter Innovation (MSI) challenge supports businesses and researchers to deliver a resilient, flexible, more productive and environmentally sustainable UK manufacturing sector. It aids the transformation of UK manufacturing by pioneering the development and integration of new and existing digital technologies, including artificial intelligence and virtual reality.

### NICER

National Interdisciplinary Circular Economy Research (NICER) aims to grow the circular economy community through a significant programme of outreach and collaboration. The programme consists of five resource-flow specific centres, a Circular Economy Hub and collaborative research and development (CR&D) competitions.

### REforMM

Resource Efficiency for Materials and Manufacturing (REforMM) aims to put in place the key building blocks to help businesses transform to a resource efficient future. This programme aims for UK organisations to understand the impact of the full product lifecycle and to thrive from the development and adoption of resource efficient solutions.

### Smart Sustainable Plastic Packaging

The Smart Sustainable Plastic Packaging (SSPP) challenge supports groundbreaking research and innovation to make plastic packaging fit for a sustainable future. The SSPP challenge is the largest and most ambitious UK government investment to date in sustainable plastics research and innovation, driving cleaner growth across the UK's plastics, packaging and retail supply chains.

### SusBioMM

Sustainable Bio-Based Materials and Manufacturing (SusBioMM) addresses the challenge of developing innovations in sustainable and scalable biomanufacturing processes. It aims to enable the UK to be more globally competitive by supporting development across different industries and sectors.

### Transforming Foundation Industries

The Transforming Foundation Industries challenge aims to transform the UK's foundation industries (including cement, metals, glass, paper, ceramics and chemicals) by making them internationally competitive, securing more jobs throughout the UK and growing the sector by 2024 in an environmentally sustainable way.

### HVM Catapult

Innovate UK invests £150 million a year in the High Value Manufacturing (HVM) Catapult. The catapult provides access to leading expertise, and world-class research and development facilities. It is a key partner both for government and industry for advanced manufacturing technologies in the UK.

# Mobility

**The transport sector is targeting significant reductions in greenhouse gas emissions across air, road, rail and maritime modes of transport.**

With Innovate UK's support, 85% of the UK's road transport will be zero emission by 2040 along with significant reductions in greenhouse gases in other modes of transport, such as maritime, which has made clear strides towards its pathway for decarbonisation over the last year.

Innovate UK's UK Transport Vision 2050 identifies pathways for the energy vectors powering transport, backed up by published reference material and peer review. Using this data, we forecast that 155TWh of electricity, 74TWh of hydrogen and other energy sources will replace nearly 55 million tonnes of petroleum products a year in the UK by 2050.


**90%** Percentage of zero emission rail travel by 2040

**£75 bn** It is estimated that £75 billion of investment will be needed to decarbonise the domestic maritime sector over the next three decades[12]

**113MtCO2e** Surface transport GHG emissions were 113MtCO2e in 2019, comprising 22% of total UK GHG emissions[10]

Over 85% of road transport will be zero emission by 2040. Greater connectivity and automation will ensure the right mobility method is chosen, used efficiently and lasts longer in service

# Innovate UK funded companies go on to raise significant private investment*

| | Private investment raised | |
|---|---|---|
| octopus electric vehicles | £650 million | Octopus Electric Vehicles, part of the Octopus Energy Group, offers electric vehicle leasing. In 2018, Innovate UK funded the Powerloop - Domestic V2G Demonstrator, a Vehicle to Grid (V2G) project led by Octopus that gives EV users more flexibility over the power in their batteries and helps to introduce additional renewable energy into the electricity grid to smartly fulfil local demand. |
| nexeon | £224 million | Nexeon develops silicon anodes for lithium-ion batteries, which enable the creation of lighter batteries with more power and longer lifetime between charges. Since 2010, Innovate UK has awarded Nexeon 5 grants support the scale up of battery development for Electric Vehicles. |
| GRIDSERVE SUSTAINABLE ENERGY | £210 million | GRIDSERVE delivered EV infrastructure powered by renewable energy solutions including its Electric Highway and Electric Forecourts across the UK. The company developed local transport decarbonisation plans for Warrington as part of the ReWIRE-NW project. |
| oxa | £185 million | Oxa develops software designed to power driverless vehicles, with technology that uses features such as cameras and lasers in order to sense and navigate the surrounding environment. Since 2015 Innovate UK has awarded 13 grants to Oxa to support autonomous vehicle development. |
| Reaction Engines | £159 million | Reaction Engines has developed a lightweight heat exchanger, which cools hot air, for the aerospace industry. The company is also developing a hybrid rocket and jet engine, together with a spaceplane that can fly through space and the Earth's atmosphere. Since 2011, Reaction Engines has received 10 grants from Innovate UK to develop and scale up power solutions for aerospace mobility. |
| VERTICAL | £158 million | Vertical Aerospace develops aerospace technology, specialising in electric aviation for urban air travel. Since 2020, Innovate UK has awarded 6 grants to support the development of electric aviation technologies. |

**Total private investment in companies receiving Innovate UK grants since 2018, selected examples.*

# Innovate UK is funding companies across the value chain*

## AEROSPACE

AIRBUS, ALTITUDE ANGEL, BLUEBEAR, NATIONAL COMPOSITES CENTRE, GKN AEROSPACE, ROLLS ROYCE, Skyports INFRASTRUCTURE, SPIRIT AEROSYSTEMS, WINDRACERS, VERTICAL, ZEROAVIA

## BATTERY DEVELOPMENT

ADDIONICS, British Lithium, Cornish Lithium, ilika, INTEGRALS POWER, JAGUAR LAND ROVER, LIVISTA, nyobolt, WEARDALE LITHIUM

## MARITIME

ACUA OCEAN, Artemis TECHNOLOGIES, CHARTWELL MARINE, PORT OF DOVER, MAHLE Driven by performance, PORT OF TYNE, RAD PROPULSION

## RAIL TRANSPORT

3SQUARED, ASSETCOOL THERMAL METAPHOTONICS, CrossTech, G-VOLUTION, MoniRail, PEAK TO PEAK Measurement Solutions, Transmission Dynamics, SIEMENS, Varamis Rail, TDI TRANSPORT DESIGN INTERNATIONAL, Wabtec CORPORATION

## ELECTRIC VEHICLE CHARGING

AQUA superPower, BLACKFISH, enTrust microgrid, ev.energy, EVMobiliti, Future Motion a Sustainable Ventures company, INDRA, tps, petalite, taskiES, mjr Power & Automation

## NEW AUTOMOTIVE TECHNOLOGIES

BRAMBLE ENERGY, Constellium, electrified automation, HiSpeed Ltd. e-Drive Technology, MAGTEC ELECTRIC VEHICLE DRIVE SYSTEMS, Norton, nyobolt, TOYOTA MANUFACTURING UK, OX DELIVERS

** Selected organisations receiving Innovate UK grants in FY 2022/23.*

# Current Innovate UK programmes building investment opportunities

Transport is fundamental to the daily movement, trade and communication of people, organisations and goods across the globe. But transport systems need to rapidly change to deliver against three challenges: achieving net zero, increasing resilience and embracing new technologies.

Our vision is for a 2050 transport system that enables the movement of people and goods from one location to another through seamless, safe, net zero, connected, cost effective, accessible and reliable means.

### ATI Programme

Innovate UK coordinates the aerospace ATI Programme in partnership with the Department for Business and Trade (DBT) and the Aerospace Technology Institute. All three organisations work together to build a portfolio of projects to support the UK's competitive position in civil aerospace. The programme has invested over £1.6 billion of funding across priority areas including zero-carbon emission aircraft technologies, ultra-efficient aircraft technologies and cross-cutting enabling technologies.

### Driving the Electric Revolution

UKRI's £80 million challenge is investing in electrification technologies, including power electronics, machines and drives (PEMD). The investment will support the UK's push towards a net zero carbon economy and contribute to the development of clean technology supply chains.

### Faraday Battery Challenge

The Faraday Battery Challenge continues to invest £541 million to deliver a mission-led research and innovation programme that covers 'lab to factory' development, cutting-edge research and national scale-up infrastructure to drive the growth of a strong battery sector in the UK. The new battery technologies we are supporting are cost-effective, high performing, faster charging, long-lasting, safe and recyclable, and have greater range.

### Future Flight Challenge

The UKRI Future Flight Challenge is investing £125 million in new classes of electric, hydrogen and autonomous air vehicles that will transform how we connect people, deliver goods and provide services. The challenge will speed up the acceptance of these vehicles into service by encouraging businesses to share knowledge and resources.

### Heavy Goods Vehicles

Innovate UK is investing up to £117 million alongside up to £100 million from the Department for Transport (DfT) in zero emission road freight demonstrations, enabling multi-year demonstration of 40-44 tonne electric and hydrogen fuel cell trucks.

### Maritime

Innovate UK is delivering multiple investments on behalf of the DfT's £206 million UK Shipping Office for Reducing Emissions (UK SHORE) programme. This includes £80 million invested in Zero Emission Vessels and Infrastructure (ZEVI) and £102 million invested in Clean Maritime Demonstration Competitions.

### Rail

Innovate UK will deliver the DfT's £7.5 million first-of-a kind demonstrator competition to accelerate innovation in the UK's rail sector and work with other partners such as Network Rail and HS2.

### Zero Emission Vehicles

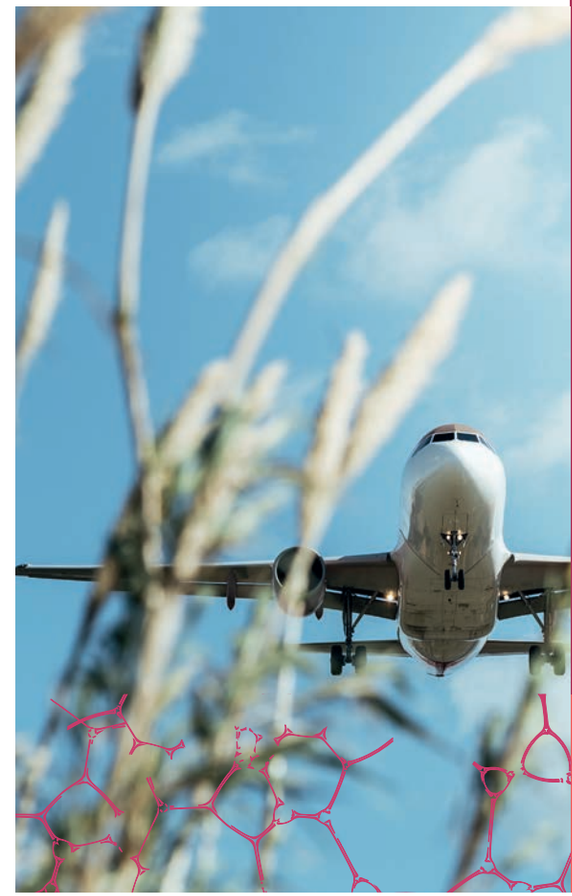
We support DBT and the Advanced Propulsion Centre to focus and deliver their £75 million a year budget, and support the Automotive Transformation Fund's £25 million a year in transformative R&D. These programmes enable the creation of a world-class eco system and supply chain for zero emission vehicles.

### Connected Places Catapult

Innovate UK invests £20 million a year in the Connected Places Catapult, the UK's innovation accelerator for cities, transport and place leadership.

### Innovate UK KTN

In partnership with Innovate UK KTN, we will continue to build communities around key technologies and markets; for example, the Sustainable Aviation Fuel Innovation Programme, which will support the UK's emerging sustainable aviation fuel supply chain.



# Power

**Increased demand and a transformation of how energy is produced, stored and supplied are opening up opportunities to invest in power.**

The energy system is becoming the backbone of growth as the economy transforms. Increased demand for electrification is creating fast growing markets with users looking for affordable and sustainable means to power, heat and cool.

The global transformation of energy systems towards a decarbonised and net zero future presents real technical and infrastructure challenges with the introduction and expansion of green generation and fuels. But there is also an economic opportunity for those who dare to innovate and invest in building a green, secure and resilient system that works for everyone.

The UK has set a target of 10GW of low carbon hydrogen production capacity by 2030, at least half of which will come from electrolytic hydrogen

Battery storage will represent a compound annual growth rate (CAGR) of 16% to 2029, reaching more than $30 billion

Offshore wind will offer a CAGR of 18% to 2030, representing a cumulative market of $600 billion

Civil nuclear power will represent a £1.3 trillion market by 2035

# Innovate UK funded companies go on to raise significant private investment*

| | Private investment raised | |
|---|---|---|
| OXFORD PV™ The Perovskite Company | £119 million | Oxford Photovoltaics develops solid-state dye sensitized solar cells (perovskite cells) that can be printed on glass, such as building windows. Since 2010, Innovate UK has awarded the company six grants to advance their solar cell technology. |
| Highview Power® | £77 million | Highview Power designs and develops large-scale energy storage solutions for utility and distributed power systems. The company has received seven grants from Innovate UK since 2012 to support the integration of renewable energy into the energy system. |
| azuri LIFE CHANGING TECHNOLOGY | £61 million | Azuri Technologies supplies solar panel units to individuals in rural Africa, where the costs are recovered using a "pay as you go" system which lasts for 18 months, at the end of which the panel can be upgraded or is free to use. In 2021 they received an Innovate UK grant to support power grid reliability with solar power in Nigeria. |
| PROTIUM | £55 million | Protium develops and implements hydrogen and other renewable energy technologies. Since 2020 Protium Green Solutions has received three grants from Innovate UK to support the development of a hydrogen based sub-regional air transportation network. In 2022 Protium secured over £40 million investment in its latest round, from SWEN Capital Partners and Sustainable Impact Capital. |
| GeoPura | £40 million | GeoPura was founded to help source enough clean energy to electrify our global economy and navigate the logistical issues of getting this energy to where it is needed. In 2022, GeoPura took part in an Innovate UK funded project to demonstrate a system capable of producing hydrogen from cracked ammonia, which would reduce the storage and distribution costs of the hydrogen supply chain. In 2023, GeoPura secured £36 million in investment to scale its green hydrogen business from GM Ventures, Barclays Sustainable Impact Capital and SWEN Capital Partners. |

**Total private investment in companies receiving Innovate UK grants since 2018, selected examples.*

# Innovate UK is funding companies across the value chain*

## ENERGY ACCESS

mobile power

PyroGenesys

Seawater Solutions

Straw Innovations Ltd

## ENERGY SYSTEMS INTEGRATION

Cadent Your Gas Network

nationalgrid Electricity Transmission

Northern Gas Networks

SGN Your gas. Our network

SP Energy Networks

## HYDROGEN

HYDRO EUROPE

Immaterial

ila International Lead Association

JM Johnson Matthey Inspiring science, enhancing life

LATENT DRIVE

the first element

## RENEWABLE ENERGY SOURCES (WIND, SOLAR, OCEAN)

BLADEBUG

CEE Centre for Energy Equality

GREEN MARINE

enturi net zero diversity

RENEWABLE DYNAMICS

HIVE

OPEN CLIMATE FIX

NOVA INNOVATION

** Selected organisations receiving Innovate UK grants in FY 2022/23.*

# Current Innovate UK programmes building investment opportunities

### Whole system integration

Innovate UK is Ofgem's delivery partner for the Strategic Innovation Fund. The fund will accelerate innovation to transition electricity and gas networks to net zero at the lowest cost to consumers. It connects innovators and energy network companies and supports the best ideas towards commercialisation.

Innovate UK funds the energy systems catapult to help transform the UK's energy system and ensure businesses and consumers benefit from the transformation.

### Hydrogen and CCS

UKRI's £210 million Industrial Decarbonisation Challenge drives the decarbonisation of the UK's industrial clusters through the development of low-carbon power, carbon capture and storage and low-carbon hydrogen production. It has funded large-scale engineering design for projects which are now able to access the £20 billion of support announced in the Spring 2023 budget, while also developing next-generation technologies through the Industrial Decarbonisation and Innovation Centre.

Innovate UK also delivers part of the £240 million Net Zero Hydrogen Fund, which supports the commercial deployment of low-carbon hydrogen production.

In addition, Innovate UK funds the Hydrogen Innovation Initiative to work across industry, government, and academia to create an investible, globally competitive, hydrogen sector in the UK. We have invested in innovative storage and distribution projects to develop the hydrogen supply chain.

### Offshore Renewable Energy Catapult

The UK's leading technology innovation and research centre for offshore renewable energy continues to support the industry to tackle key challenges to meet the UK's 2050 targets.

It operates key programmes to address supply chain development, skills needs, consenting bottlenecks, and component testing and design for next-generation turbines.

### Nuclear

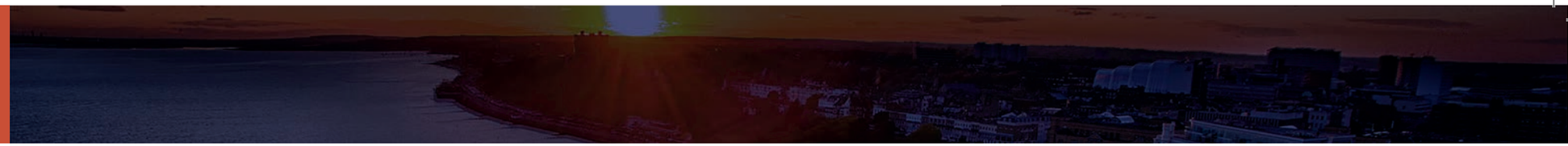
The Low Cost Nuclear Programme is supporting Rolls-Royce SMR Ltd in developing the UK's first small modular reactor design to enter the regulatory assessment process.

### Energy access

Innovate UK runs the Energy Catalyst and ZeGen programmes, which help provide access to clean energy for all across Africa, Asia and Indo-Pacific Communities.

### Energy Systems Catapult

We invest £12m per year in the Catapult to accelerate the UK to Net Zero by supporting innovators to commercialise, and helping design and deliver the future energy system.



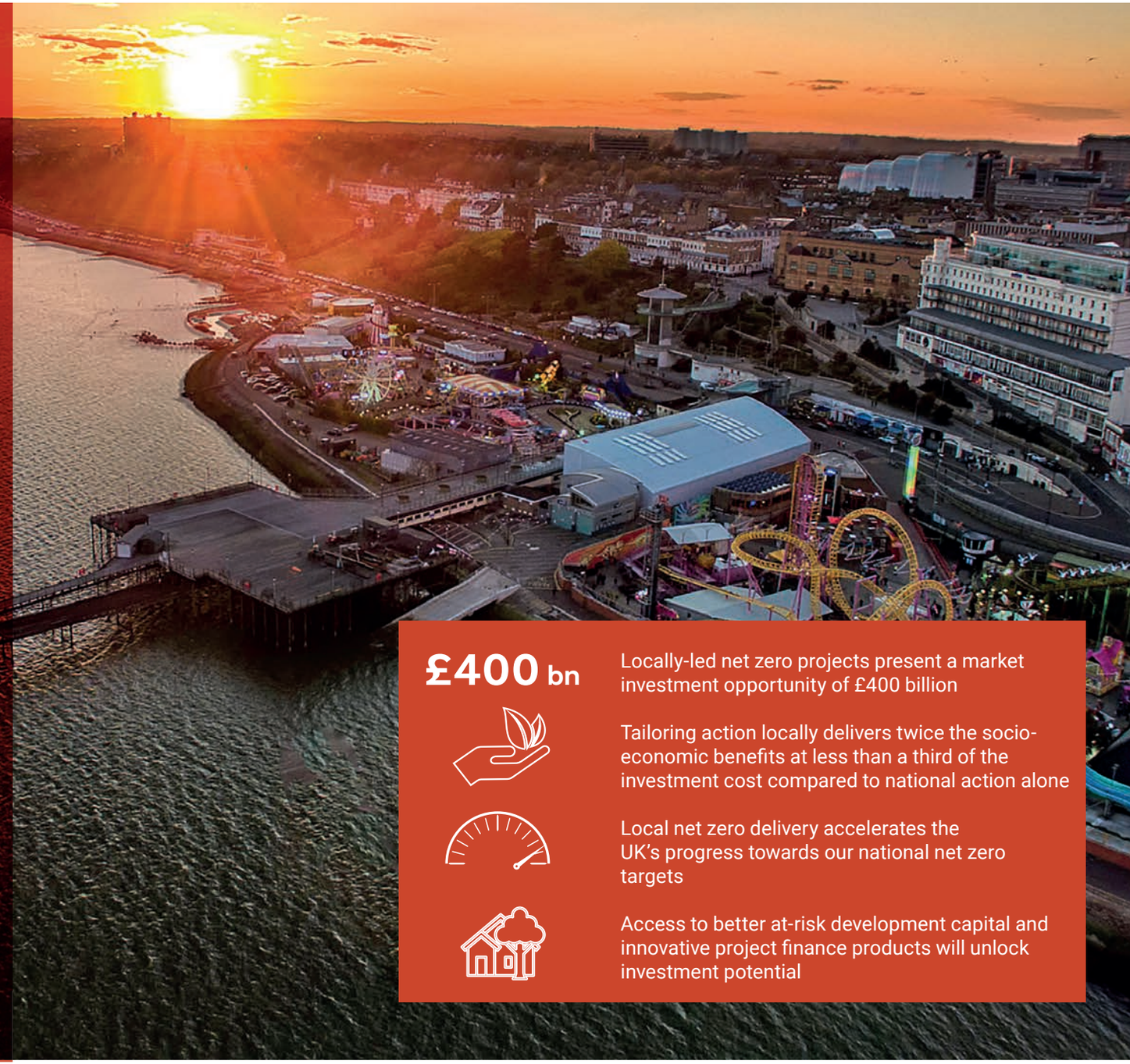
# Decarbonising Places

**Transforming the places where we live, ready for a net zero future, requires more than technology. That's why Innovate UK is investing directly in net zero ecosystems at the local level to unlock significant socio-economic growth and value.**

To maximise the net zero opportunity we need to drive demand and adoption of proven net zero solutions in our communities.

Towns and cities rapidly need to develop cross-sector investment pipelines to meet their ambitious net zero targets, many of them well ahead of our national 2050 target.

To accelerate the development of a strong pipeline of investable, local net zero projects Innovate UK is building capacity at the local level to catalyse financial innovation that can deliver development capital and project finance at scale.



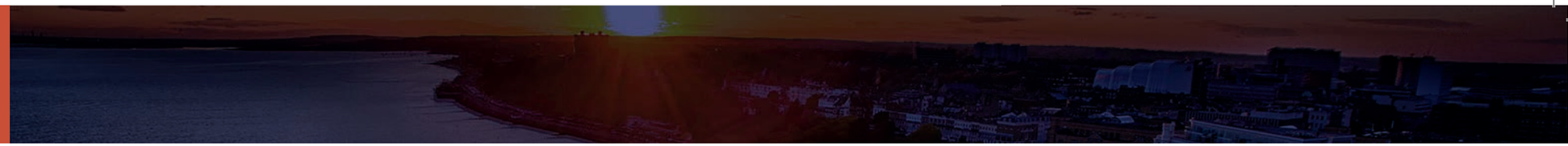
**£400 bn**

Locally-led net zero projects present a market investment opportunity of £400 billion

Tailoring action locally delivers twice the socio-economic benefits at less than a third of the investment cost compared to national action alone

Local net zero delivery accelerates the UK's progress towards our national net zero targets

Access to better at-risk development capital and innovative project finance products will unlock investment potential





# Current Innovate UK programmes building investment opportunities

Over the last five years, **UKRI's flagship place-based net zero programme Prospering from the Energy Revolution** has accelerated development of local net zero approaches.

**Participants successfully leveraged 7.5 times the original grant funding** awarded by Innovate UK in 2019.

However, challenges remain in mobilising private sector capital into high-risk, city-scale projects:

1. Lack of a mature, investable local project pipeline held back by local capacity, development capital constraints and uncertain demand
2. A policy and regulatory environment that limits access to revenue streams
3. A disconnect between local developers and the investment community.

Innovate UK's place-based programmes will start to address some of these challenges to unlock investment at scale.

## Net Zero Living

The Net Zero Living programme will equip local actors with the skills and capabilities needed to accelerate local pipeline development and unlock the £400 billion investment opportunity that local net zero delivery offers.

The programme will drive demand for net zero solutions across 51 places in the UK, funding local authorities all at different stages of their net zero journey. It will provide targeted technical assistance across the areas of visioning and citizen engagement, planning, policy and regulation, finance, and digital, and help investors navigate the complexity of local net zero delivery while connecting them with local project developers.

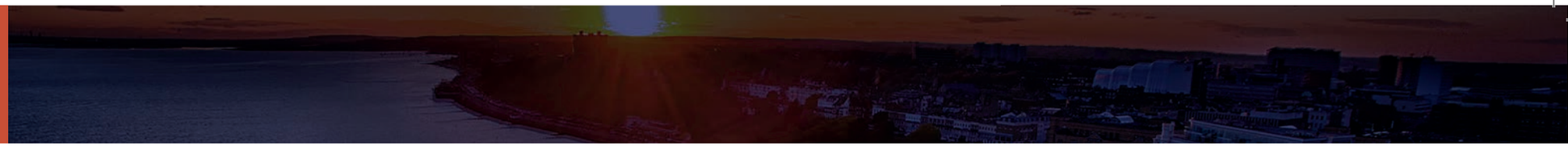
## Innovate UK Launchpads

This innovation cluster development programme aims to ensure more places in the UK host world-leading and globally-connected innovation clusters, creating more jobs, growth and productivity in those areas to develop a more robust pipeline of investible projects and businesses.

Net Zero Launchpad in Tees Valley was the first of two pilots launched in 2022. The launchpad will provide innovation funding and wrap around support to local businesses working in areas such as hydrogen, carbon capture, utilisation and storage (CCUS), offshore engineering, materials and processing, and the circular economy.

## Decarbonising Industrial Clusters

UKRI's Industrial Decarbonisation Challenge have funded major industrial clusters to develop decarbonisation plans. These cover a range of new technologies (e.g. hydrogen production, CCS and electrification). This puts these clusters in a strong position to scale solutions in their areas.



# Net Zero Living Places

Places funded to accelerate local net zero project pipelines, unlocking barriers to investment and delivery

1. Combairie Nan Eilean siar: Outer Hebrides Net Zero Foundations
2. Aquatera Limited (Orkney Islands Council): Orkney Pioneer Project
3. Belfast City Council: Net Zero Belfast
4. Mid and east antrim borough council: Mid and East Antrim Net Zero Business (MEANZ Business)
5. Armagh City Banbridge & Craigavon Borough Council: Driving Net Zero transformation of Mid South West region in Northern Ireland
6. Derry city & strabane district council: Net Zero - Derry & Strabane - From Ambition to Action
7. South Lakeland District Council: Net Zero and Rurality: Feasibility Study into a Cross-Sectoral, Place-Based Approach to Overcoming Non-Technical Barriers to Net-Zero Living in South Lakeland, Cumbria
8. Blackpool Council: Co-operative Heat Network
9. New Resource Partners Limited (Liverpool City Council) - Liverpool Net Zero Delivery Plan for Liverpool: Breaking Down Systemic Barriers
10. Rossendale Borough Council: Rossendale Net Zero Terraced Street
11. Warrington Borough Council: Warrington Carbon Culture
12. Gwynedd Council - Bethesda/Blaenau: Breaking Barriers to Bethesda & Blaenau Being Net Zero
13. Birmingham City Council: Net Zero Transition for Businesses in East Birmingham
14. West Midlands COmbined Authority - Dudley West Midlands Combined Authority: Creating a Market for Place-based Outcomes (CAMPOS)
15. Oxford City Council - Oxford City: FutureFit One Stop Shop (FOSS)
16. Forest of Dean District Council: Forest of Dean Fast Followers (F3)
17. Caerphilly County Borough Council - Caerphilly: Net Zero Caephilly Whole System Decision Support Toolkil (NetZeroCaer)
18. Cardiff Council Behavior Change - Lets Go Net Zero
19. Bristol City Council: Bristol Mission Net Zero
20. Southampton City Council: Pioneering Net Zero Delivery for The City of Southampton
21. Devon County Council: Financing Net Zero
22. Plymouth City Council: Plymouth Owning Net-Zero
23. Future Isle of Wight CIC (Isle of Wight Council): PIOW-NZ Pioneers Isle of Wight Net Zero
24. Runnymede Borough Council: Runnymede's Runway to Net Zero
25. Portsmouth City Council: Decarbonising Portsmouth City Island
26. South Downs National Park Authority - Lewes: South Downs National Park: Pioneer Parks Modelling a Common Framework to Track and Accelate Progress Towards Net Zero in National Parks Using the One Planet Platform
27. Energypro Limited (Surrey County Council, the Kent County Council, Essex Country Council, Brighton & Hove Ciry Council: Shift to Net Zero
28. London Borough of Lambeth: Net Zero Transition Lambeth
29. St Albans City and District Council: St Albans Greener Together
30. London Borough Of Haringey: Upskilling Domestric Retrofit - Harringey
31. Westminster City Council: Westminster Retrofit Taskforce
32. Essex County Council - Chelmsford: Essex Net Zero Delivery Taskforce (EssNet)
33. London Borough of Newham: green Economy Transition
34. Three Rivers District Council: Advancing Retrofit to Drive Net Zero in Three Rivers
35. Cambridgeshire County Council - Huntingdon: Cambridgeshire Net Zero Financing Framework for Whole System Change (CANFFUND)
36. Great Yarmouth Borough Council: Norfolk Climate CHange Partnershp (NCCO) Project: Clean Growth & Citizen Preparedness
37. Peterborough City Council: Peterborough Accelerate Net Zero (PANZ)
38. Nottingham City Council: CO-Country Carbon Coordination; a coordinated approach to achieving Net Zero at scale
39. Manchester City Council - Wythenshawe: Net Zero Pinoneer - Manchester
40. Leicestershire County Council: Leicestershire CAN (Collaboration to Accelerate Net zero): A Framework for Cross-Sector Decision Making, Governance and Delivery to Enable and Accelerate Net Zero Action
41. The Council of the City of Wakefield: Embedding Net Zero in Wakefield
42. Oldham Metropolitan Borough Council: Oldham Green New Deal Delivery Partnership
43. City of York Council: Accelerating York's Net Zero Transition
44. Gateshead Council: Engaging Gateshead with Zero Carbon Heat
45. Calderdale Borough Council: Power Calderdale
46. Greater Manchester Combined Authority, City Wide: LAEP to Net Zero - GMCA
47. Advanced Infrastructure Technology Ltd (Dundee City Council)
48. Perth & Kinross Council: Perth Dialogue to Speed Transition to Net Zero
49. Fife Council: Edinburgh and South East Scotland City Region Deal Net Zero Innovation and Delivery Programme
50. Shetland Islands Council: Shetland Rural Energy Hub

# Invest for impact

Measuring the impact of Innovate UK funding and its place in the net zero innovation ecosystem.

Innovate UK is committed to understanding and improving the effectiveness of its net zero programmes.

## Evaluation

A robust, independent and open evidence base helps us to ensure we are getting value for money from our public funding. At Innovate UK we measure the outcomes of innovation that align with our strategic goals, yielding economic benefit for the businesses and innovators we support, as well as for the UK as a whole.

Evaluation is a key part of this evidence base, complementing ongoing performance and impact monitoring activities; for example, through our Impact Management Framework. Evaluation and impact management enable us to consider the effects of our activities and incorporate what we learn into the design and delivery of our future programmes.

Our approach to evaluation closely follows the principles of the HM Treasury Magenta Book, and is described further in the Innovate UK evaluation framework.

## Measuring the effects of net zero

Measuring the impact of innovation programmes is notoriously difficult. Innovation can lead to improvements in business performance, but this generally happens over long timeframes. There is often a high level of uncertainty about when and where the benefits of innovation will manifest.

While net zero innovation is expected to lead to greater economic benefits, its evaluation has the added complexity of understanding the effect of new solutions on environmental metrics that demonstrate our progress in achieving net zero emissions by 2050.

To ensure that we can measure the impact of our net zero programmes, we are implementing a multi-phase evaluation project within Innovate UK. The key milestones of the evaluation include assessing net zero projects on reducing greenhouse gas emissions in the UK, increasing economic performance, influencing business level innovation and enabling commercialisation.

# References


1. Grant values, number of companies and grants are taken from Innovate UK data of Net Zero projects with a start date between 1 April 2022 and 31 March 2023. Data on Innovate UK funded projects can be found here: https://www.ukri.org/publications/innovate-uk-funded-projects-since-2004/
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