



Innovate  
UK

# Our clean future economy



Net Zero Review 2022







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**“Our vision is for the UK to prosper from being the economy that transitions fastest to net zero.”**

# Foreword



There is no doubt that the UK needs to build a secure, affordable and sustainable future. Recent events across our economy and the world make this clearer than ever.

Our vision is for the UK to prosper from being the economy that transitions fastest to net zero. We are hungry for UK-based business growth and inward investment to put the UK at the forefront of energy-secure, low-carbon growth.

Our mission is to drive this growth across the UK in a just transition. We will accelerate this transition by encouraging UK business to take innovation risks. We will work with government to remove barriers and complexity, and with the private sector to unlock the significant investment needed to realise this vision. This will stimulate business growth, create jobs and secure our energy future by stabilising energy costs.

The UK companies at the forefront of solutions will lead us into a brighter future we all want to see. It will put us at the leading edge of the global transition to a new energy future with a unique opportunity to foster global partnerships, encourage the adoption of UK standards, support the development of trade agreements worldwide and drive exports.

This document sets out the details of our approach, through existing activities and future plans. It is organised around a systems approach and five themes: Power, Heat, Mobility, Make and Use, and Agriculture and Food.

Nobody can achieve this alone – and Innovate UK is fully committed to our role to inspire, involve and invest to make this happen.

**Mike Biddle**

*Executive Director, Net Zero*



# Our role

**Innovate UK's role in net zero is to inspire businesses to create value through innovation, involve relevant organisations and people and invest in innovation to make a positive impact on the UK's economy and society.**

Net zero markets are developing. The UK's leading banks and investors have committed to aligning their portfolios with net zero, with the potential to create a significant pipeline of finance. Innovate UK is aiming to unlock this investment potential and the commercial and regulatory barriers to investment in clean technology.

We will do this by developing inspiring visions of a future net zero economy. Turning visions to reality will require us to identify challenges through cross-sector collaboration and convene resources to address barriers to innovation. We will focus on areas of UK strength with high carbon reduction and international market potential, simultaneously boosting growth, improving energy security and helping to address the cost-of-living crisis.

We will bring together and involve the partners required to build new net zero innovation ecosystems. Building on our collaborations developed through the [Industrial Strategy Challenge Fund](#), we are partnering across UKRI to

deliver the Building a Green Future Programme. The programme will unlock near-term private investment in solutions ready for deployment, work with government to tackle the medium-term research and innovation challenges required for the 2030s and partner with other nations on the most difficult 'last 20%' challenges to achieve net zero by 2050.

Our [Catapults](#) support businesses to transform great ideas into valuable products and services. Catapults are where the application of research is accelerated, where new technologies are developed, scaled and realised. Together we are developing the UK's hydrogen capabilities, building trusted tools to support industry to measure embodied carbon and tackling the carbon emissions of the growing data economy.

We will also continue to deliver a number of significant programmes on behalf of government. For example, the [Advanced Propulsion Centre](#) and [Aerospace Technology Institute](#) with the Department for Business, Energy and Industrial Strategy, [Strategic Innovation Fund](#) with Ofgem, and [Zero Emission Road Freight Demonstration programme](#) with the Department for Transport. We will use these links with government to develop and deliver on the net zero strategy and tackle policy and regulatory barriers to innovation.

We work across the Innovate UK family, with [Innovate UK KTN](#) (Knowledge Transfer Network) to connect innovators with new partners and new opportunities, and [Innovate UK EDGE](#) to support businesses growing and scaling.



# 2021–22 in summary

**2021–22 was a big year for net zero and Innovate UK is renewing its focus to help build a climate-neutral future.**

COP26 was the year's biggest event in net zero and by hosting the UK was able to demonstrate leadership in steering the world towards a climate-neutral future. The Glasgow Climate Pact included significant commitments to accelerate progress in reducing emissions in line with previous COP agreements<sup>1</sup>. UK Research and Innovation's activities at COP offered positive visions of a net zero future and highlighted the critical role research and innovation will play. Innovate UK played an active part, showcasing innovators and innovations such as [ACT Blade](#), [Entocycle](#) and [ZeroAvia](#), helping to communicate how these will contribute towards future growth.

This year saw the publication of the government's Net Zero Strategy and Net Zero Research and Innovation Framework. These highlight the critical role research and innovation will play in delivering net zero and provide clarity on the main areas of focus for accelerating emissions reductions<sup>2,3</sup>. Our analysis, looking at our economy in 15 years' time, points to significant economic opportunities from the development and commercialisation of new net zero solutions globally.

Against this strategic backdrop, and our 2021 spending review outcomes, Innovate UK has used this year to renew our focus on net zero. The [Innovate UK Action Plan for Business Innovation 2021 to 2025](#) clarifies the role we will play in achieving net zero, sets the framework for action and defines net zero as one of the main areas of the future economy in which to focus our work<sup>4</sup>. Our review has identified innovation needs across the main net zero sectors of Agriculture and Food, Heat, Make and Use, Mobility and Power as well



as what is needed to address the cross-cutting areas of financing net zero, thriving places and critical materials.

Significant ongoing financial commitments are also progressing with our partners. Highlights include a commitment to invest £210 million in the development of new small modular nuclear reactors through the ISCF's [Low Cost Nuclear Challenge](#) (funded by the Department for Business, Energy and Industrial Strategy), a £190 million commitment to deployment projects as part of the ISCF's [Industrial Decarbonisation Challenge](#) and a £20 million commitment to Zero Emission Road Freight Trials in partnership with the Department for Transport. A summary of all commitments made in the financial year 2021–22 and the impact from previous investments is provided in this report, together with a forward-looking view of Innovate UK's focus on net zero.



# 2015–2020 in numbers

The figures below show the impact of Innovate UK's net zero grant programmes between 2015 and 2020. In this period, Innovate UK supported 5,940 companies with net zero-related grants.

**£1.9bn**

of net zero grants awarded

**£4.8bn**

of private investment raised since 2015,  
by companies receiving a net zero grant  
between 2015 and 2020

**67,000**

new UK jobs created by businesses  
that received net zero grants

**£190bn**

of exports by net zero grant recipients  
in 2020

**£10bn**

invested by net zero grant recipients  
in research and development in 2020





# 2021–2022

Innovate UK and our partners committed £1,022 million to net zero projects in 2021–2022.\*



**£319m**  
Mobility



**£202m**  
Make and Use



**£463m**  
Power



**£28m**  
Agriculture  
and Food



**£10m**  
Heat

## Measuring impact in 2022–2037

For the UK to prosper from being the fastest transitioning economy to net zero, we will focus on the key outcomes that will lead to achieving carbon neutrality by 2050 and monitor our progress towards meeting them.

Our approach to impact management in net zero is based on eight outcomes that each project will contribute to:

1. accelerating leverage of private investment;
2. increasing exports of net zero goods and services to all markets;
3. greater cross-sector collaboration;
4. stimulating market demand and certainty;
5. contributing to the levelling-up agenda;
6. developing a UK competitive advantage in net zero;
7. reducing the carbon impact of UK businesses;
8. increasing the capacity and scale of UK supply chains.

\* This includes the Industrial Strategy Challenge Fund (ISCF) and other co-funding invested on behalf of government partners, including the Department for Business, Energy and Industrial Strategy, the Department for Transport, the Department for Environment, Food and Rural Affairs, and the Foreign, Commonwealth and Development Office.

Innovate UK has developed a new framework for measuring and reporting these eight outcomes and other key milestones on the path to climate neutrality. Our approach is based on the Climate Change Committee's (CCC's) Sixth Carbon Budget and its guidance on the changes required within primary industry sectors, such as power generation, buildings, construction and transport, that will result in the required reductions in emissions<sup>6</sup>.

# £1.2bn

Innovate UK will invest £1.2 billion in net zero from 2022–2025<sup>5</sup>, plus co-funding on behalf of government partners



# Make and Use

Reimagining materials and manufacturing can help achieve net zero while securing supply chains and unlocking significant economic benefits for the UK.



**The Make and Use programme will make the UK a leader in resource efficiency and adopting a circular economy. Organisations we work with are exploring the environmental, social and economic impact of the full product lifecycle.**

This will allow them to thrive by adopting solutions that use resources efficiently and which are fundamental to achieving net zero.

Our vision is for UK businesses to be:

- net zero and resource efficient, adopting the circular economy and understanding the environmental impact of every stage in the supply chain and manufacturing process;
- resilient and responsive and able to mitigate risks arising from interruptions to the supply of critical materials, other national and global disruptions, and climate change;
- technologically advanced so the UK will be an increasingly attractive place to manufacture goods and a leader in the development and export of industrial technologies.





**\$4.5**  
trillion

The value of economic benefits that switching to a circular global economy<sup>7</sup> could yield

**30%**

Innovate UK's Made Smarter Innovation<sup>8</sup> will boost productivity by up to 30%



Raw materials for manufacturing and construction<sup>9</sup> will be traced from the moment they are extracted through to first use, re-manufacture and eventual deconstruction and reuse



Robots used in material recovery facilities and demolition sites<sup>7</sup> will make waste sorting more accurate, increasing the availability of materials for reuse and recycling

## How we will get there

Innovate UK's strategy for achieving net zero in Make and Use is based on three core principles: inspire, involve and invest.

We will inspire, support and enable businesses to implement resource efficiency measures. This will include developing a common vision, providing quality advice, offering access to analysis (e.g. lifecycle), developing standards and helping raise consumer awareness. Innovate UK will publish a strategy document, Manufacturing and Materials Vision 2050, convene debate about the future of the sector and help develop alignment across industry and government.

We will involve diverse communities by working across manufacturing sectors and disciplines to improve engagement, collaboration and alignment. This will include national and

international network development across industry and with government departments, industry bodies, investor networks, academia, Catapults and RTOs. Innovate UK will build international collaborations to learn from cases of good practice and to open new markets, leading to increased UK exports of resource-efficient solutions.

Innovate UK will support innovation, drive demand and facilitate investment. We will co-invest with businesses to unlock emerging net zero markets in the UK and overseas, sharing the risk of development and adoption of resource-efficient solutions. This will include business model development, incentives to adopt resource efficiency through specification and procurement, and skills development to facilitate private investment.

# Progress to date

Between 2016 and 2018 Innovate UK launched a series of manufacturing and materials funding competitions. To de-risk new innovations, each round offered £15 million in funding which leveraged typically a further £10 million of private investment from business. The competitions represented a combined R&D investment of around £100 million in manufacturing and materials innovation projects.

Made Smarter Innovation (MSI) is a £147 million government investment. Its aim is to transform UK manufacturing by delivering world-leading products at pace and on price, thanks to digital innovation. MSI gives UK manufacturers access to digital innovation ecosystems that will help prove ideas and concepts, develop them quickly with the support of industry experts and support scale-up. The programme is predicted to generate thousands of new jobs and boost productivity by up to 30% by 2030.

With sustainability and international competitiveness both vital to the UK economy, the Transforming Foundation Industries (TFI) Challenge is supporting innovation and jobs. As the UK moves ever more rapidly towards a more sustainable future, it is imperative that materials such as glass, cement, metals, paper, ceramics and bulk chemicals are produced in a more environmentally sound but commercially viable way. The TFI Challenge aims to help businesses across the foundation industries share expertise and develop innovative solutions to increase their sustainability and remain internationally competitive.

Innovate UK invests £150 million a year in the High Value Manufacturing (HVM) Catapult. The catapult is government and industry's go-to place for advanced manufacturing technologies in the UK. It provides access to world-class research and development facilities and expertise that would otherwise be out of reach for many businesses in the UK.



The Smart Sustainable Plastic Packaging Challenge is working to make plastic packaging fit for a sustainable future. As a £60 million five-year programme, it is the largest and most ambitious UK government investment to date in sustainable plastics research and innovation. Funded companies like Notpla, which uses seaweed as an alternative to plastic food packaging, are helping to reduce the environmental footprint of plastics.

The National Interdisciplinary Circular Economy Research (NICER) programme is a four-year £30 million investment to move the UK towards a circular economy. The programme focuses on growing the circular economy community through outreach and collaboration. At the heart of the programme are five Circular Economy Research Centres, each focused on a speciality material flow, with collaborative research and development activities enabling SMEs to engage with and benefit from access to expertise.



## IMPACT STORY

Make and Use

# Flexi-Hex

A Cornish company set up by a pair of surfing brothers has already removed over 800 kilometres of bubble wrap from the packaging industry – equivalent to Land's End to San Sebastian as the crow flies.

Flexi-Hex has designed a protective packaging sleeve made from an expandable honeycomb material, creating an alternative to plastic bubble wrap, air pillows and void fill. The packaging is 100% plastic-free, curbside recyclable, biodegradable and compostable.

With Innovate UK funding, Sam and Will Boex developed the product for the boardsports, bottles, electronics, homeware and commercial industries.

Will Boex said: "Innovate UK funding has helped us to develop our products to market, achieving a growth of 277% year-to-date, creating jobs and growing from a company of three people to nine.

"In 2022, we plan to expand into the USA, European and Australian markets. Several conversations are currently taking place with renowned companies in the cosmetic and electronics markets to grow the business further."



# Power

Meeting our net zero targets requires a transformation of our electricity systems and offers an opportunity to grow the economy while securing our energy future and addressing the cost-of-living crisis.

The electricity system is becoming the backbone of growth as the economy transforms, in the supply of electricity through increased wind resource and through the take up of electric vehicles and increasing demand for electric heating. Transforming our electricity system to meet our net zero targets presents an opportunity to safeguard the UK's energy security and address the cost-of-living crisis. This transformation will result in growth in the economy and will benefit from Innovate UK's ability to unlock private investment to fund a revolution in power.



**20–30**  
million

The number of tonnes of CO<sub>2</sub> that will be captured and stored every year

**50%**

The increase in electricity demand, with significant commercial opportunities for low carbon sources



The UK will have increased its solar energy production to 70GW (a 352% increase)



The UK will have increased its electrical storage capacity by 20 times, up to 25GW

(All based on projections for 15 years' time.)

## How we will get there

- Innovate UK will support innovation in five sectors where the UK has strength and market opportunity: whole system integration, electricity production, hydrogen, nuclear and carbon capture. We will drive adoption by supporting innovation that supports growth, builds system resilience and responds to consumer demand, convening the sector around skills requirements and fostering the development of standards, certification and regulation in nascent markets.
- Innovate UK will open international market opportunities by partnering with innovation organisations in priority countries to support bilateral innovation and help UK businesses to develop international collaborations and market opportunities.
- There is great promise for UK businesses to take a lead in place-based energy systems – where assets are integrated in response to the local situation and needs. Creating 'energy-smart places' takes innovation, vision, collaboration, investment and a shift in thinking. (See Prospering from the Energy Revolution on page 16.)
- Innovate UK is Ofgem's delivery partner for the Strategic Innovation Fund (SIF). This £450 million, five-year programme supports the energy transmission and distribution networks as well as the National Grid, the system operator. Funded by energy users through the RII0-2 network price control, SIF will accelerate innovation to transition the electricity and gas networks to net zero at lowest cost to consumers. The programme connects innovators with energy network companies and supports the best ideas towards commercialisation within the energy network. Every energy network company is involved with the 40 funded projects. £12.6 million has been invested in the 205 project partners involved, with the most promising projects moving towards rollout. The next round of funding starts in autumn 2022, with more to follow.

# Progress to date



- Since 2011, Innovate UK has invested £1.1 billion in energy projects and programmes. This includes a £190 million investment in the Offshore Renewable Energy Catapult and the Energy Systems Catapult. They support businesses in transforming ideas into valuable products and services.
- Innovate UK runs the Energy Catalyst programme which uses the UK aid budget to accelerate the innovation needed to meet the UN's sustainable development goal 7: 'ensure access to affordable, reliable, sustainable and modern energy for all'. Through financial and

advisory support, and by building strategic partnerships and uncovering new insights, Energy Catalyst helps bring to market technologies and business models that can improve lives in Africa and Asia. This is making a difference in developing countries by connecting people with modern electricity, cooking facilities and critical services.

- Innovate UK has supported flagship programmes in the development of small modular nuclear reactors (Low Cost Nuclear Challenge), and the decarbonisation of industrial clusters (Industrial Decarbonisation Challenge).
- The Prospering from the Energy Revolution projects are showing clear benefits from integrated local approaches to energy. Projects range from large-scale demonstrators like Energy Superhub Oxford, with Europe's most powerful electric vehicle charging hub and a large-scale battery facility, to Zero Carbon Rugeley, a town-wide local energy system design including a former power station site. The programme has enabled partnerships between local authorities, innovators and energy companies to set a precedent for future local energy projects. It also funds EnergyRev, a consortium of 22 universities which has published extensive research on local energy systems, and the ERIS service run by the Energy Systems Catapult, which has created the Net Zero Go tool to support local authorities with decarbonisation.



# Project Girona

A project granted £2.43 million by the Prospering from the Energy Revolution Challenge is saving residents 40–60% on their energy bills. Project Girona, Northern Ireland's first smart grid, is bringing cheaper, greener electricity to homes and communities. It has installed solar panels along with smart storage batteries to properties and commercial premises, and developed software that decides whether the solar power should be used, stored or exported to help stabilise the grid.

Collectively, the cluster of properties and commercial premises saved 10.2 tonnes of CO<sub>2</sub> over 12 months compared with using energy generated by power stations. "That's the equivalent of taking 19 family cars off the road for a year in terms of CO<sub>2</sub> production," said Project Manager Jamie Rea.

During the same period, a total of 31,340kWh of electricity was exported back to the network, enabling more people to benefit from renewable energy and also helping stabilise the grid – an important consideration for network companies as they increasingly rely on fluctuating renewable sources of energy.



The Electric Storage Company's  
Jamie Rea, Project Manager  
on Project Girona



An aerial photograph showing a road surface covered with large solar panels. A blue car is driving on the road, and a white car is parked on the side. The solar panels are arranged in a grid pattern, and the road has white directional arrows.

# Mobility

With our support, 85% of the UK's road transport will be zero emission in 15 years' time, along with significant reductions in greenhouse gases in other modes of transport.

Innovate UK published its [UK Transport Vision 2050](#)<sup>10</sup> in August 2021 and identified clear pathways for the energy vectors powering transport, backed up by published reference material and peer review. Using this data we forecast that in the UK by 2037 30% of air transport, 40% of maritime, more than 90% of rail and over 85% of road transport will be zero emission. This means 133TWh of electricity, 37TWh of hydrogen and other energy sources will replace nearly 41 million tonnes of petroleum products a year by 2037.



90%

The percentage of rail travel that will be zero emission

41  
million

The petroleum products (in tonnes) that will be replaced by clean energy



Over 85% of road transport will be zero emission



Greater connectivity and automation will ensure the right mobility method is chosen, used efficiently and lasts longer in service

(All based on projections for 15 years' time.)

## How we will get there

We will manage and deliver innovation programmes on behalf of government in the following areas of mobility:

- The Industrial Strategy Challenge Fund (ISCF) includes three challenges relevant to transport: Driving the Electric Revolution, Future Flight and the Faraday Battery Challenge.
- Innovate UK coordinates the aerospace ATI Programme in partnership with the Department for Business, Energy and Industrial Strategy (BEIS) and the Aerospace Technology Institute. All three organisations work together to build a portfolio of projects to meet the aims of the UK Aerospace Technology Strategy.
- Supporting BEIS and the Advanced Propulsion Centre to focus and deliver their £75 million a year budget, and supporting the Automotive Transformation Fund's £25 million a year in transformative R&D.
- Working in partnership with the Department for Transport (DfT) to deliver up to £299 million over three years for R&D programmes to decarbonise transport, with a further £117 million contribution from Innovate UK. We will also deliver the DfT's £7.5 million first-of-a-kind demonstrator competition to accelerate innovation in the UK's rail sector.
- Innovate UK will continue to provide thought leadership on mobility, including updating our UK Transport Vision 2050, which highlights future market opportunities and our Global Competitiveness study, which assesses the strength of the UK's supply base compared to other countries.
- 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.

## Progress to date

Along with our partners we have invested over £450 million in zero emission vehicles and charging infrastructure. The investment covers a portfolio of over 350 projects involving 450 organisations. These include on-vehicle enabling technologies and vehicle charging infrastructure, including the world's first electric forecourt in Braintree that is powered exclusively by renewable energy, and Tevva, a maker of electric-hydrogen trucks, which has raised additional funding of £114 million.

The Faraday Battery Challenge is investing in research and innovation projects and facilities to drive the growth of a strong battery business in the UK. The new battery technologies we are supporting are cost-effective, high performing, longer range, faster charging, long-lasting, safe and recyclable. For example, the SUNRISE project has developed a battery material that could increase the range of an electric vehicle to more than 400 miles on a single charge.

The Driving the Electric Revolution Challenge is investing £80 million in electrification technologies including power electronics, electric 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, worth £80 billion in gross domestic product by 2050. (See STREAMLINED impact story on page 21.)

The Future Flight Challenge is investing £125 million in new classes of electric, hydrogen and autonomous air vehicles which 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. Heathrow Airport and TEKTown's Fly2Plan project is investigating how the airport's data can be used more effectively and enable net zero regional flight.



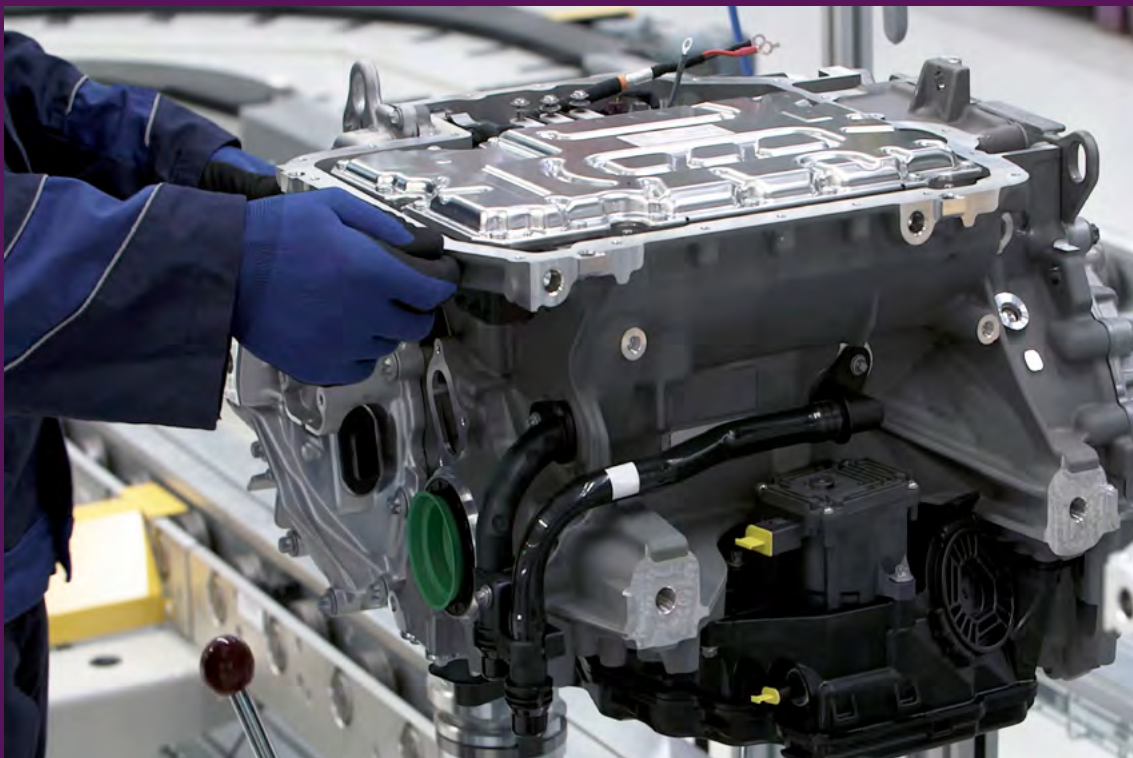


# STREAMLINED

Through the STREAMLINED project Lentus Composites has taken the UK closer to its goal of becoming a global leader in high power density (HPD) motor design and development. HPD motors reduce system weight, leading to more compact, more efficient designs. They will be key to electrification of the UK's roads and achieving net zero.

£355,277 of funding from the Driving the Electric Revolution Challenge enabled Lentus to invest in new, more advanced facilities and equipment. It has built a 100,000 sq foot manufacturing facility in Oxfordshire, allowing it to scale up production and meet the growing demand. Eight new jobs have been created as a result.

Lentus Composites was able to scale up production of its HPD motor from prototypes to 3,000 parts a year (predicted to increase to 6,000 by the end of 2022). During the project, a British luxury car manufacturer came on board as a customer and the company is also in talks with an Italian sports car brand.







# Heat

How we heat our buildings and how much we pay to do so are critical as the UK seeks to secure its energy future and address the cost-of-living crisis.

The UK has to move away from gas as a source of heating space and water in buildings to provide energy security, address the cost-of-living crisis and meet its net zero commitments. To meet the Sixth Carbon Budget the country needs to decarbonise heat for its 30 million buildings, which accounts for 23% of UK emissions<sup>11</sup>. This will be achieved by a combination of reducing demand and a faster, scaled roll-out of renewable heating technology. There will be a net benefit to the economy from scaling these solutions faster than other countries alongside greater energy security, lower energy bills, healthier indoor environments and reduced fuel poverty.



**23%**

The percentage of UK emissions the country's buildings produce through heating<sup>11</sup>

**+200,000**

The number of new jobs that could be created by decarbonising heat in buildings<sup>11</sup>



Net zero heat will mean lower energy bills for consumers



Decarbonising how we heat the UK's buildings will lower the cost of healthcare

## How we will get there

The technology to deliver net zero heat mostly exists already but has not yet been scaled and industrialised fully. This is because of system barriers such as inconsistent regional deployment, a lack of information for end users, a need for engineering expertise to industrialise and a shortage of project finance.

Innovate UK will work with key partners to overcome these barriers to enable a faster roll-out of decarbonised heat for buildings. The programme will focus on:

- market demand: coordinating standardised information on what net zero heat renovation to do where, when to do it for maximum impact, and low-cost methods to rapidly validate performance;
- financing net zero: to bridge the scaling gap leading to growth in supply chains and localised deployment alongside support for fast scaling companies to increase capacity and achieve accreditation;
- design engineering: to reduce 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.

# Progress to date

Innovate UK has supported a wide number of net zero heat solutions over the last 15 years and ran a specific programme on reducing carbon in existing properties, [Retrofit for the Future](#). This programme identified ways to improve energy efficiency in buildings (reducing demand for energy) while installing decarbonised heating solutions. This early programme was pioneering and showed that low or no carbon retrofit was possible and explored the barriers to scaling up retrofit to all buildings. The programme also looked at how buildings should be designed for a future climate.

More recently the [Prospering from the Energy Revolution Challenge](#) has seen demonstrator projects of local energy systems that are decarbonised. These include trialling solutions with residents such as heat storage, load shifting, heat pumps and heat networks that make use of waste industrial heat.

The Active Building Centre (ABC) was funded under the Transforming Construction Challenge. This had two components: a commercial focused RTO (research technology organisation) and a research programme led from Swansea University. The latter has been key to delivering the Optimised Retrofit Programme for the Welsh Government. The ABC RTO addresses the market need for unbiased information on the optimum combination of renewable energy and fabric technology integrated within a building to make it net zero for the lowest cost. This means understanding how technologies such as photovoltaics, heat pumps, heat batteries, etc. work in combination and incentivises



manufacturers of those products to improve integration. The ABC RTO has been able to develop design blueprints for clients to deliver [net zero homes](#) at a cost equivalent to current build.

The Transforming Construction Challenge focused on new buildings and supported modern methods of construction that deliver [net zero schools](#), [office buildings](#) and [homes](#).

Innovate UK's joint venture with Ofgem, the Strategic Innovation Fund (see page 15), is addressing net zero heat by focusing on the energy transmission and distribution networks.



# The Forge

A new build office building funded by the Transforming Construction Challenge has demonstrated energy savings of 73%. The Forge was the result of Landsec, Easi-Space and Bryden Wood Technology working together to develop and test automated construction on a real site and compare the efficiencies against a traditional office build.

Using Platform-Design for Manufactured Assembly (P-DfMA), 'kit of parts' frames and building information management (BIM) technology, the partners created a structural frame suitable for a commercial office that could be manufactured offsite and assembled onsite using an automated assembly process. In doing so, they demonstrated that office construction could be faster, more reliable, more productive and cost less – leading the way to an increase in quality, sustainable working environments and a new creation of skills and jobs in the construction workforce.

The efficiencies gained from using a P-DfMA and 'kit of parts' approach has already demonstrated a reduction in embodied carbon of 19.4%. Internal utility equipment is also designed to work with the all-electric central plant, making use of LED lights and procuring 100% renewably sourced energy. The 73% reduction in energy use was achieved using high-efficiency heat pumps.





# Agriculture and Food

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



The agri-food sector is vital to the health and wellbeing of society, and with agriculture covering 71% of UK land it significantly shapes the environments we live in<sup>12</sup>. However, the entire food system, covering primary production, food processing and manufacture, distribution, imports and retail, is responsible for 35% of the UK's total greenhouse gas emissions<sup>13</sup>. Therefore, controlling the release of emissions across the food system, particularly methane, nitrous oxide and carbon dioxide, will be critical.



# 30%

The decrease in methane levels needed to help meet our net zero targets<sup>14</sup>

# \$33.75

billion

The projected value of the global alternative protein market in 2030



Data science<sup>15</sup> will help farmers to use water, fertilisers, chemicals and fuel more efficiently



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

## How we will get there

The Farming Innovation Programme is a £210 million partnership between Defra and UKRI that will 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's agricultural and horticultural sectors. 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.

In 2023 we will launch the Novel Low Emission Production Systems (NLEPS) initiative to support novel methods of food production in non-traditional farming environments, which are already establishing new industry segments. NLEPS will support innovations such as vertical farming and alternative proteins which offer radical new solutions that complement more traditional farming systems and hold significant potential to provide growth for UK companies and tackle the net zero challenge. The programme is co-funded by the Biotechnology and Biological Sciences Research Council.

Also in 2023, The Better Food for All programme will support the food sector to innovate in the areas of nutrition and food processing to create affordable, convenient foods with improved nutritional quality. The NHS produces around 4%<sup>16</sup> of the UK's carbon emissions, so bringing down the number of cases of diet-related chronic disease in the system could reduce the burden on healthcare and contribute towards net zero.

## Progress to date

The agri-food sector's supply chain is complex and there are many challenges related to the environmental sustainability of the entire system. Globally, agriculture and food account for about 26% of greenhouse gas emissions<sup>17</sup>, with primary agriculture making up around 80% of this and supply chains making up the rest. The embedded carbon in food waste is another important consideration. We have supported businesses through thematic calls in many of these areas, while investing in both infrastructure and developing economies.

Innovate UK invested £90 million in the Sustainable Agriculture and Food Innovation Platform from 2010 to 2016. The programme stimulated the development and adoption of new technologies to help improve the productivity of UK food and farming industries, while decreasing their impact on the environment through

satellite-enabled precision farming and more sustainable livestock production technologies.

The UK Strategy for Agricultural Technologies<sup>18</sup> called for £160 million to be invested in agricultural technology, innovation and sustainability. The programme increased investment across a range of areas, including environmental sciences, clean technology and energy generation from waste. Within this strategy Innovate UK delivered the £70 million responsive mode catalyst programme which enabled businesses across the sector to access support and to develop solutions that are more resource efficient like individualised livestock nutrition and care, and alternative proteins.

Innovate UK in partnership with BEIS set up four [AgriTech Centres](#) with a further £90 million to support translational research in the UK and overseas. The centres are addressing the key challenges in the access and utilisation of multiple, complex data sets across the sector, innovation in crop and livestock systems, and engineering solutions.

Official development assistance was delivered through an AgriTech Africa Catalyst, supporting projects like [Innovative Solar Energy Technology for Kenyan Tea Industry](#), which promises to reduce the use of firewood in the drying stage of tea processing by using alternative energy sources.

[Transforming Food Production](#) supports innovations that reduce emissions and pollution and contribute to feeding a growing world population. For example, [CCm Technologies](#) has developed a patented fertiliser from organic waste. The company is working with Pepsico to use potato waste from Walkers crisps as fertiliser feed stock, which is expected to reduce carbon emissions of potato production by 70%.





# Better Origin

A Cambridgeshire company has used £1.3 million of Transforming Food Production funding to replace traditional animal feeds with a cheaper alternative that's better for the environment. Better Origin's X1 system turns food waste into a nutritious source of food for farm animals: insect larvae.

The X1 is a self-contained insect feed factory that's housed inside a shipping container and managed by AI so all the farmer has to do is harvest the larvae when they're ready to be fed to livestock.

The company aims to upcycle upwards of 50,000 tonnes of organic waste and mitigate as much as 100,000 tonnes of greenhouse gas emissions per year by 2023.

Better Origin raised \$3 million in a seed round led by Fly Ventures and solar entrepreneur Nick Boyle. It now has five commercial contracts and aims to expand further across the UK.



# A systems approach to net zero

To drive growth, attract private finance and secure our energy future Innovate UK is developing cross-cutting programmes in the areas of financing net zero, net zero living and critical materials.



Tackling the net zero challenge requires a 'systems approach', taking a broad view to address what is a complex problem<sup>19</sup>. This means developing programmes of activities that cut across large parts of the economy. We will invest up to £90 million on cross-cutting net zero programmes focused on the following areas:

- financing net zero;
- net zero living;
- critical materials.





# Financing net zero

Fulfilling the UK's ambition to be the country that transitions quickest to net zero, and the growth benefits that this will bring, will require a step change in the mobilisation of capital towards the delivery of net zero solutions. This will include much larger investments from private investors and businesses of all sizes.

Accelerating investment is one of the key net zero challenges, given the critical role finance will play in deploying new net zero infrastructure.

Our financing net zero programme goals are to:

- develop the investment landscape;
- better understand the barriers and opportunities in investing in net zero solutions;
- help net zero projects and companies to develop their investment readiness;
- provide funding to de-risk solutions and promote and showcase investment opportunities.

The programme will also focus on developing thought leadership on commercial opportunities, policy advocacy to remove barriers and strategic partnerships with investors, corporates and other stakeholders.

To help inform the development and delivery of this programme, Innovate UK has convened an advisory group of industry experts in financing net zero. This will provide strategic direction and expert insight into the financing challenges faced by the sector as well as approaches on how to overcome them. The financing net zero programme will utilise our existing Investor Partnerships and Innovate UK EDGE activities that prepare businesses for investment.

# Net zero living

To remain prosperous, we will need to transform our towns, cities, and communities, by adopting new net zero technologies. Progress is currently behind target. Many solutions already exist, and many of these through Innovate UK support. However, the adoption and scale-up of these solutions has been hampered by systemic challenges such as a lack of local capacity and

capability, procurement barriers, a need for clear local vision and engagement, and difficulties in accessing private finance.

The Net Zero Living programme addresses these barriers by focusing on unlocking demand and enhancing supply. The programme is based on what we learned from our Domestic Missions programme, Future Cities demonstrators and the Prospering from the Energy Revolution Challenge. These have shown the impact of collaboration between the public and private sectors, the strength of innovative approaches to ways of working, and the delivery and deployment of solutions.



## A systems approach to net zero

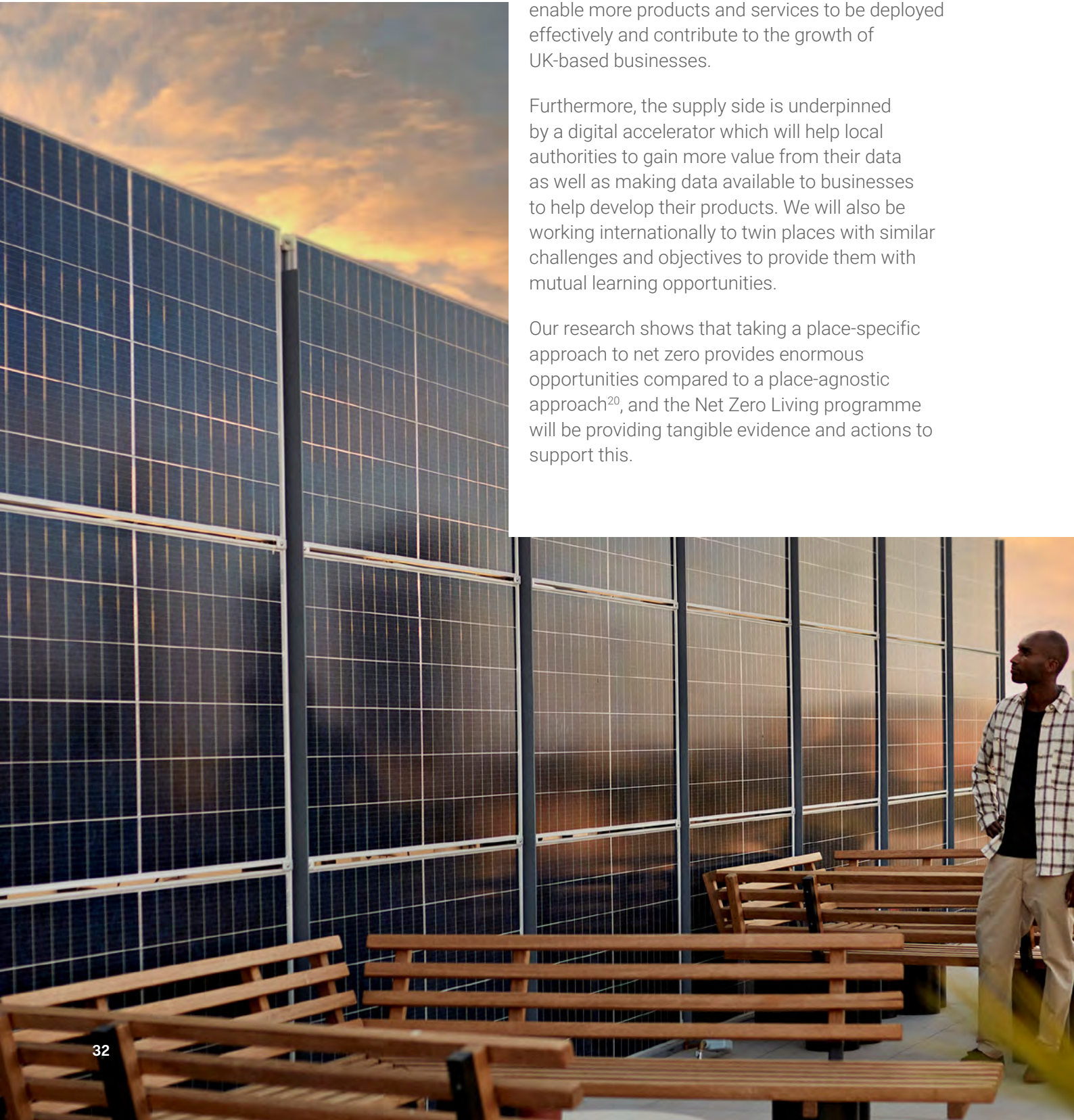
In terms of demand, the programme will support partnerships with local authorities that address barriers to delivery and will support the financing net zero initiatives to overcome barriers to investment. Trials will be delivered in three to six Pioneer Places to find the optimal mix of activities to accelerate net zero delivery. This will be shared

and implemented across 20 Fast Follower Places who will also benefit from expert insight into net zero best practice.

The supply side of the programme will work with previously funded businesses to help them overcome barriers to adoption. We will help them by providing access to design experts skilled in tailoring solutions for the market through business models and commercial approaches. This will enable more products and services to be deployed effectively and contribute to the growth of UK-based businesses.

Furthermore, the supply side is underpinned by a digital accelerator which will help local authorities to gain more value from their data as well as making data available to businesses to help develop their products. We will also be working internationally to twin places with similar challenges and objectives to provide them with mutual learning opportunities.

Our research shows that taking a place-specific approach to net zero provides enormous opportunities compared to a place-agnostic approach<sup>20</sup>, and the Net Zero Living programme will be providing tangible evidence and actions to support this.





# Critical materials

It is expected that the global demand for critical minerals will quadruple by 2040<sup>21</sup>. That demand should reach such a level in just a couple of decades is hardly surprising if you consider that most electric motors used in low-emission vehicles use rare earth magnets<sup>22</sup> and the amount of permanent magnetic material used in a wind turbine can be up to 650kg per megawatt<sup>23</sup>.

The UK government recently published its critical minerals strategy. Its three main aims are to:

- accelerate the UK's domestic capabilities by developing a circular economy of critical minerals and maximising what we can produce ourselves;
- collaborate with international partners to make global supply chains more resilient;
- enhance global markets with a focus on environmental, social and governance performance and improving data and traceability of critical minerals.

Innovate UK's critical materials strategy aligns with this. We will work with internal and external

partners, with the aim of not only securing a supply chain for the UK's critical materials but also collaborating with international partners to develop zero emission technologies that are truly zero emission. In turn this will increase global trade for the UK.

We will begin by focusing on rare earth materials, working with the Driving the Electric Revolution Challenge to develop whole-life solutions including recycling and reuse, while also working with the Faraday Battery Challenge. For example, NdFeB magnets used in electric vehicle motors use the rare earth element neodymium. We will be asking questions like: Could we use a substitute material to avoid using neodymium? What is the embedded carbon in these magnets? How can we improve traceability and tracking of rare earth materials for batteries? Do we even have to use this type of magnet; is there a cleaner alternative?

The UK's research, much of it funded by UKRI, is recognised as world-leading<sup>24</sup>, and we will work with councils such as the Natural Environment Research Council to provide answers to these questions and make the UK a leader in recycling, reusing and reducing our use of critical materials.



# How we can help

**Innovate UK is here to inspire, involve and invest in net zero solutions and help the UK prosper from being the fastest transitioning economy to net zero.**

Innovate UK is here to help businesses innovate to create commercially successful products, processes, services and business models based on new ideas and technologies. Our [Action Plan for Business Innovation](#) outlines our mission to support innovation through creating an outstanding ecosystem that is agile, inclusive, and easy to navigate. Our approach is to inspire, involve and invest in innovation, and this applies to how we can support the acceleration of net zero solutions.

## Inspire

Inspire means to make opportunities visible and compelling so that businesses are encouraged to create new value through innovation. A highlight of 2021–2022 was the publication of Innovate UK's [UK Transport Vision 2050](#), which aims to gather UK government and industry around a vision of what the transport system will look like in 2050. This will inform investments in the future of transport as an interconnected system that delivers for people and places.

## Involve

Innovate UK helps convene and support businesses through our networking partners [Innovate UK KTN](#) and [Innovate UK EDGE](#).

Innovate UK KTN enables collaboration across academia, industry, government agencies, the third sector and research bodies. It facilitates the transfer of knowledge by connecting ideas, people and communities, helping innovators convert

their ideas into solutions for real-world problems, accelerating the time to market. [Innovation Networks](#), including the Circular Economy Innovation Network and Hydrogen Economy, are an important tool in enabling this collaboration, and more of these will be announced.

Innovate UK EDGE is a key part of Innovate UK's investment in businesses to drive economic growth. It complements Innovate UK's project funding with intensive specialist-led support for ambitious SMEs, including beneficiaries of Innovate UK funding. Thousands of businesses have received support from Innovate UK EDGE, many with intensive support from its approximately 250 innovation and growth specialists located around the country.

## Invest

Through the [Innovation Funding Service](#) Innovate UK continues to offer a suite of financial support tools, including smart grants, innovation loans and investor partnerships. As the impact stories in this review show, this leads to significant direct investments in high potential future net zero solutions, and this support will continue to develop.



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**Together, we will work to  
inspire, involve, and invest to  
support UK business innovation.**

**inspire | involve | invest**