



Department for
Energy Security
& Net Zero

Net Zero Innovation Portfolio and the Advanced Nuclear Fund

Final report
2021-25





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Foreword

The global challenge of climate change demands bold action and innovative solutions, but within this challenge lies an extraordinary opportunity to build a low carbon economy where clean technologies cut emissions and drive economic growth.

Our mission is clear: to make the UK a Clean Energy Superpower. We have already reduced the UK's territorial greenhouse gas emissions by 54%, between 1990 and 2024.¹ Yet the International Energy Agency estimates that around 35% of global CO2 reductions needed for net zero by 2050 will come from technologies not yet commercially available.² This is why our support for innovation has been vital, backing areas too risky for the market alone and accelerating solutions that might otherwise take decades. This approach positions the UK at the forefront of the rapidly growing global cleantech market.

The Net Zero Innovation Portfolio (NZIP) and Advanced Nuclear Fund (ANF) together represent a £1.3 billion investment, over a quarter of the government's £4.2 billion commitment to net zero R&D between 2022 and 2025. Since 2021, NZIP has supported over 600 innovative projects, created over 7,500 jobs and attracted over £900 million in investment, figures set to grow.

Behind these figures are British success stories: entrepreneurs developing game-changing technologies, from decarbonising industry to transforming how we power and heat our homes. These British innovations are not just climate solutions; they are the foundation of tomorrow's industries and jobs.



I am immensely proud of what has been achieved. NZIP has done more than fund ideas; it has strengthened investor confidence and helped breakthrough projects scale. With this foundation, we can now deploy these technologies to deliver real economic benefits.

As we work towards our Clean Energy Superpower Mission, I invite innovators, investors and industry leaders to join us in shaping the next chapter, one where the UK leads the world in clean technology innovation and sets the pace for a global transition that is as ambitious as it is essential.

A handwritten signature in black ink, appearing to read 'Lord Vallance'.

Lord Vallance

Minister of State (Minister for Science, Innovation, Research and Nuclear)

Introduction

Innovation has been critical in the transition towards net zero. To meet the UK's net zero target, key technologies that reduce greenhouse gas emissions must be commercialised, scaled and deployed across the country.

The government is accelerating the technical and commercial readiness of these technologies and stimulating private sector investment through the NZIP and ANF, collectively referred to as 'NZIP' for this report. The UK government allocated a total of £1.3 billion to NZIP over 2021 to 2025, supporting 10 different priority themes which are critical for achieving the UK's net zero target.

The principal aims of NZIP are listed below.

1. Support the development and demonstration of new energy technologies, systems and processes.
2. Stimulate private sector investment in the most promising mid- to late-stage low-carbon innovations facilitating commercialisation.
3. Maximise international co-ordination and collaboration opportunities to achieve a timely and effective low-carbon transition.
4. Maintain the UK's international leadership in areas that will benefit the UK clean energy sector.
5. Ensure UK net zero policies are based on the most up-to-date and robust technical evidence.
6. Drive international action on climate change by promoting research and innovation efforts to drive down costs globally and build new markets.

This report provides an overview of the progress achieved as NZIP comes to an end, with 87% of projects having ended on or before 31 March 2025 and the remaining 13% due to end within the 2025 to 2026 financial year. It outlines the advancements made in developing and commercialising net zero technologies and the wider impact generated and builds on the achievements noted in the previous NZIP Progress Report.³ The quantitative data presented in this report is the result of analysing the key performance indicators (KPIs) collected from all projects. For this report, we have aggregated the KPIs to theme and portfolio levels of granularity.⁴ The KPIs reflect the performance of NZIP projects as of April 2025. The finance forecasts included in this report are taken from October 2025 and are subject to change as projects complete the remainder of the work over the course of this financial year.



NZIP progress

The thematic areas of NZIP are designed to accelerate the development and deployment of low-carbon technologies, systems and business models in their respective fields. There are 10 thematic areas, which correspond with the areas set out in the Net Zero Research and Innovation Framework.⁵

1. **Energy Storage and Flexibility** – Improving energy storage solutions and enhancing the flexibility of the energy grid to better integrate renewable energy sources.
2. **Future Offshore Wind** – Supporting the development of next-generation offshore wind technologies to increase efficiency and reduce costs.
3. **Advanced Nuclear** – Researching and developing advanced nuclear technologies to produce low-carbon energy.
4. **Bioenergy** – Advancing bioenergy technologies, including the production of biomethane, green hydrogen and biofuels, to enhance the UK's biomass supply chain.
5. **Industry** – Encouraging industries to decarbonise their systems and processes to reduce their carbon footprint.
6. **Hydrogen** – Promoting the development of hydrogen production, storage and distribution technologies as a key component of the future energy system.
7. **Advanced Carbon Capture, Usage, and Storage (CCUS)** – Reducing the costs and improving the efficiency of capturing and storing carbon dioxide (CO₂) emissions from industrial processes.
8. **Greenhouse Gas Removal (GGR)** – Developing technologies to remove CO₂ directly and indirectly from the atmosphere, contributing to negative emissions.
9. **Homes and Buildings** – Improving the energy efficiency of buildings and developing low-carbon heating solutions.
10. **Disruptive Technologies** – Investing in innovative and potentially game-changing technologies that can significantly reduce emissions across various sectors.

Key performance statistics

544

innovation projects completed and

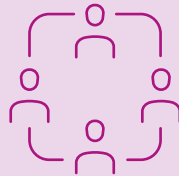


71

ongoing

Over **750**

organisations supported



Two thirds are small and medium-sized enterprises (SMEs)

Over **7,500**

jobs supported



86%

located outside London and the South East



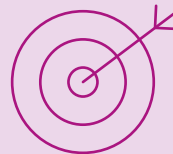
74% of projects that aimed to improve a technology increased their technology readiness level (TRL)

54% increased by two or more levels



2,657 formal⁴ and

2,943 informal business relationships⁵ established



63% of closed projects met all of their objectives

88% of closed projects met at least some of their objectives



£917 million

in investment generated from private, public and third sector investors



£690 million

in matched funding



£147 million

in follow-on funding



£80 million

in sales or licencing



252 patents applied for, of which **104** have been granted so far.

Progress in delivering NZIP programmes, projects and budget

	Completed / spent	Ongoing / committed	Forecast / yet to start	Total
Programmes	24	14	0	38
Projects	544	71	0	615

NZIP and ANF funding by region (%)

Country	Region	NZIP and ANF spend
England	East Midlands	36%
	East of England	2%
	London	8%
	North East	2%
	North West	7%
	South East	11%
	South West	7%
	West Midlands	3%
	Yorkshire and the Humber	4%
Northern Ireland		3%
Scotland		15%
Wales		2%



NZIP's support of SMEs

Alongside the development of novel technologies for our net zero ambitions, supporting SMEs has been central to NZIP. Through the **Acceleration Support Programme**, SMEs who received NZIP funding had access to tailored support to help commercialise their technology. More than 175 companies have benefited from support, which included advice on market opportunities, value proposition, sales strategy, business operations, funding and investment, and access to finance. Funding via NZIP has also been invested in the **Clean Growth Fund** – a commercially run, multi-award-winning venture capital fund launched in 2020. This government cornerstone investment was aimed at catalysing investment into the UK's clean technology venture capital market and accelerating sector growth. By 2022, the fund grew significantly, with the £20 million government-committed investment sitting alongside £81 million of private sector funding. To date, the fund has made 19 investments in UK SMEs across a range of net zero sectors. With its clear ambition to deliver quantitative greenhouse gas emission reductions and commercial returns, the Clean Growth Fund continues to demonstrate the strong investment opportunities available in the UK's clean technology ecosystem.



Kelp harvesting for sustainable bioenergy. Image credit: SeaGrown



Energy Storage and Flexibility

Delivering clean power by 2030 and net zero by 2050 will depend heavily on the UK's ability to deploy energy storage and flexibility solutions. As the grid accommodates increasing levels of intermittent renewable energy and as sectors electrify at pace, balancing supply and demand of electricity in a cost-effective way will become more challenging and even more essential. Addressing this challenge requires developing technologies that can store excess electricity for use during periods of high demand, as well as smart systems which can shift energy consumption to times of lower demand. According to estimates from the Department for Energy Security and Net Zero (DESNZ) and Ofgem (2021), enhancing the flexibility of the energy system could unlock savings of £6 billion to £10 billion each year by 2050.⁸

The Energy Storage and Flexibility theme aimed to address a wide variety of challenges. These programmes supported the development and real-world testing of the technologies, infrastructure and operational models needed to build a smarter, more adaptive and lower-carbon energy system.



Solar-powered depot supporting fleet decarbonisation and energy storage innovation.
Image credit: Keep Energy Systems

Programmes

1. Longer Duration Energy Storage (LoDES) Programme

- **Objective:** to accelerate the development and commercialisation of innovative energy storage technologies.
- **NZIP expected spend:** £77 million.

2. Flexibility Innovation Programme

- **Objective:** to enable large-scale, widespread electricity flexibility through smart, flexible, secure and accessible technologies and markets.
- **NZIP expected spend:** £48 million.

Results

As part of the LoDES Programme, projects which progressed to demonstration stage consisted of eight first-of-a-kind longer duration energy storage technologies, including:

- Electrical storage, such as flow batteries, designed for applications like grid balancing.
- Thermal storage, such as advanced heat batteries for residential heating.
- Power-to-X, including hydrogen-based systems for storing and reusing renewable energy.

In the Flexibility Innovation Programme, the demonstration stage has seen the creation of new proof-of-concept systems, and the testing of innovative technologies and solutions which enable flexibility. 10 sub-programmes were launched – the five below demonstrate the breadth of work undertaken.

1. **The Vehicle-to-Everything Programme**, aimed to enable energy flexibility by trialling bi-directional electric vehicle charging.
2. **The Interoperable Demand Side Response Programme**, which tested systems of energy-smart appliances (such as heat pumps and batteries) that can respond to signals to adjust energy consumption, regardless of manufacturer or platform.
3. **The Automatic Asset Registration Programme**, which built a proof-of-concept system to improve the visibility of low-carbon flexible assets.
4. **The Alternative Energy Markets Programme**, which trialled new tariffs, products and services for consumer-led flexibility.
5. **The Non-Domestic Smarter Tariff Comparisons Programme**, which developed tools to help smaller businesses compare tariffs and engage with time-of-use pricing.

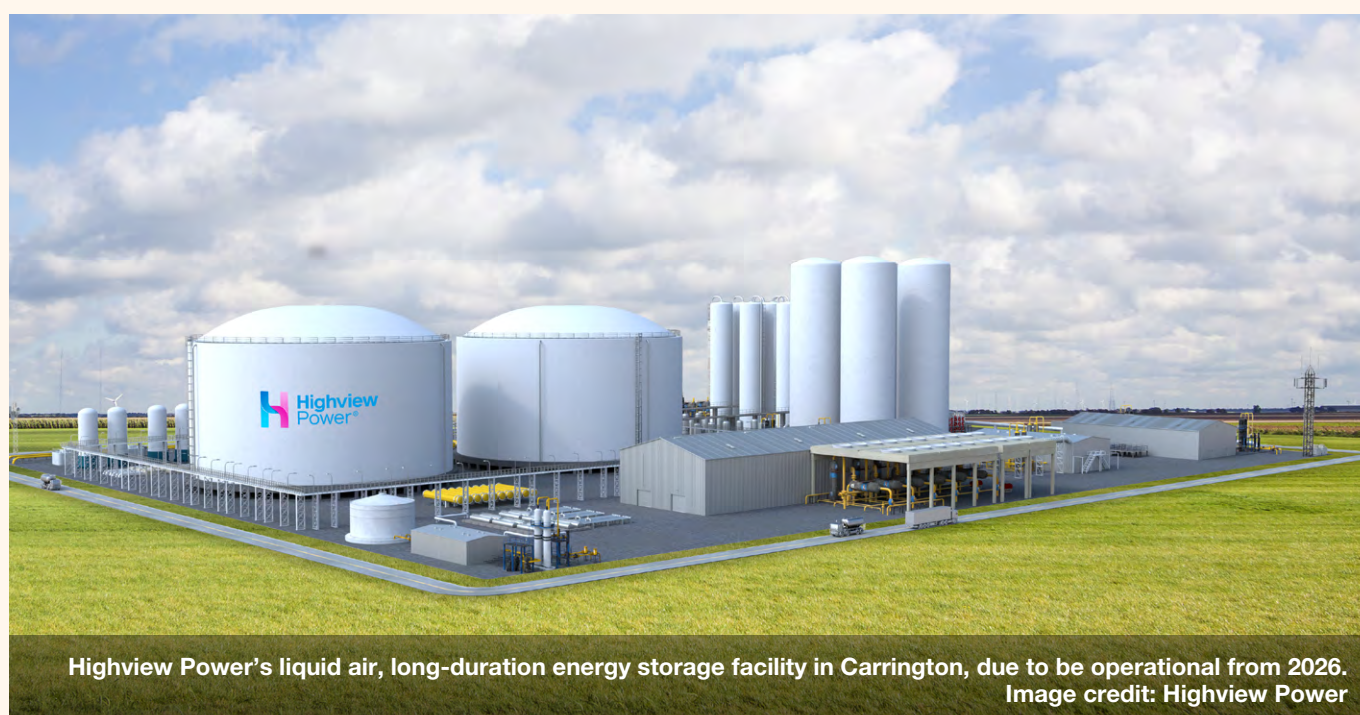
Theme	Energy storage and flexibility
NZIP expected spend	£125 million
Matched funding	£283 million
Programmes	12
Projects	106
Closed projects achieving all objectives in full	70%
Closed projects achieving at least some objectives in full	96%
Jobs supported	1,280
Jobs outside London and South East England	82%
Percent of relevant projects that increased TRL	67%
Percent of relevant projects that increased TRL by two or more	48%
Percent of relevant projects that increased their Commercial Readiness Level (CRL)	44%
Business relationships – formal	242
Business relationships – informal	334
Patents applied for	13
Patents granted	5
Follow-on funding projects	10
Follow-on funding value	£12 million
Projects reporting sales or licencing	5
Value of sales and licencing	£9 million

Progress summary

Along with the development of technologies, demonstration of digital solutions and exploration of market mechanisms, the energy storage and flexibility theme has offered valuable insights into the practical challenges of delivering low-carbon innovation. A key lesson has been the difficulty in securing matched funding for large-scale storage projects, highlighting the need for earlier engagement with potential funders and clearer support pathways. On the flexibility side, scaling solutions has proven highly dependent on a supportive policy and market environment, reinforcing the importance of structured knowledge sharing and cross-sector collaboration. Findings from both the **LoDES** and **Flexibility Innovation Programmes** have already begun to shape policy and regulatory approaches. One example is the feasibility study conducted under the **Flexibility Innovation Programme**, which explored the concept of a 'digital

spine' – a data-sharing infrastructure designed to allow the swift and secure sharing of energy data. The 'digital spine' concept has since been taken forward by DESNZ, Ofgem and the National Energy System Operator (NESO), with NESO currently developing the data sharing infrastructure through pilot and minimum viable product phases.

On the energy storage side, the **LoDES Programme** has made a significant contribution to the UK's evolving long duration electricity storage environment. Ofgem's new cap and floor scheme, an investment mechanism providing revenue stabilisation to unlock the first large-scale, new-build long duration electricity storage projects in 40 years, has already received applications from developers supported by NZIP. Insights from NZIP-funded projects, including technology reports, site visits and direct engagement with developers, supported elements of policy development for this scheme.



Case study: Energy Storage and Flexibility



Project name:
FlexiTanker – Keep Energy Systems
(formerly Cheesecake Energy Ltd.)

NZIP funding received:
£6.9 million

Total project cost:
£6.9 million

Programme:
LoDES Programme

Funded under NZIP's LoDES Programme, the FlexiTanker project is led by Keep Energy Systems, who have developed a first-of-a-kind thermo-mechanical compressed air energy storage system.

This technology is a stationary medium-to-long duration energy storage solution which stores energy in the form of heat and pressurised air. It repurposes ex-service truck engines, using electric motors to drive pistons and compress air without combustion or emissions.

Over the course of this two-and-a-half-year project, Keep Energy Systems have been developing, testing, validating and optimising their innovative energy storage technology. The project is culminating in a commercially viable demonstrator system, taking the technology an important step closer to deployment at customer sites.

In addition to the core technology development, the project is delivering several important outcomes.

Competitive performance

The system rivals conventional technologies, like lithium-ion batteries, delivering up to four times the lifetime energy at a lower cost.

UK supply chain growth

By building a strong and scalable domestic supply chain, the team is validating both the technology and cost roadmaps for future production.

Job creation

At least seven new high-value science and engineering roles have been created, with further employment opportunities emerging across manufacturing, assembly and installation.

Sustainability by design

The system embraces circular economy principles, using fully recyclable materials and repurposed industrial components such as truck engines and pressure vessels, offering a practical route to decarbonisation for suppliers in high-carbon sectors.

Commercial momentum

Support from the LoDES programme has accelerated Keep Energy Systems' development and significantly boosted commercial engagement. Interest from customers and investors, both in the UK and internationally, has grown, unlocking further investment. In 2024, a design study was completed with a major mining company and was selected for Amazon's pilot programme to help decarbonise their logistics sites.

This project is on track to meet the LoDES programme objectives to reduce storage costs and de-risk non-conventional energy storage technologies by its end date in December 2025.

Chief Commercial and Product Officer, Michael Simpson, said:

“ The funding received from the LoDES Programme as part of NZIP has been transformational for Keep Energy Systems (formerly Cheesecake Energy). It has allowed us to rapidly iterate our energy storage technology and demonstrate a step change in commercial maturity to prospective customers and investors. ”



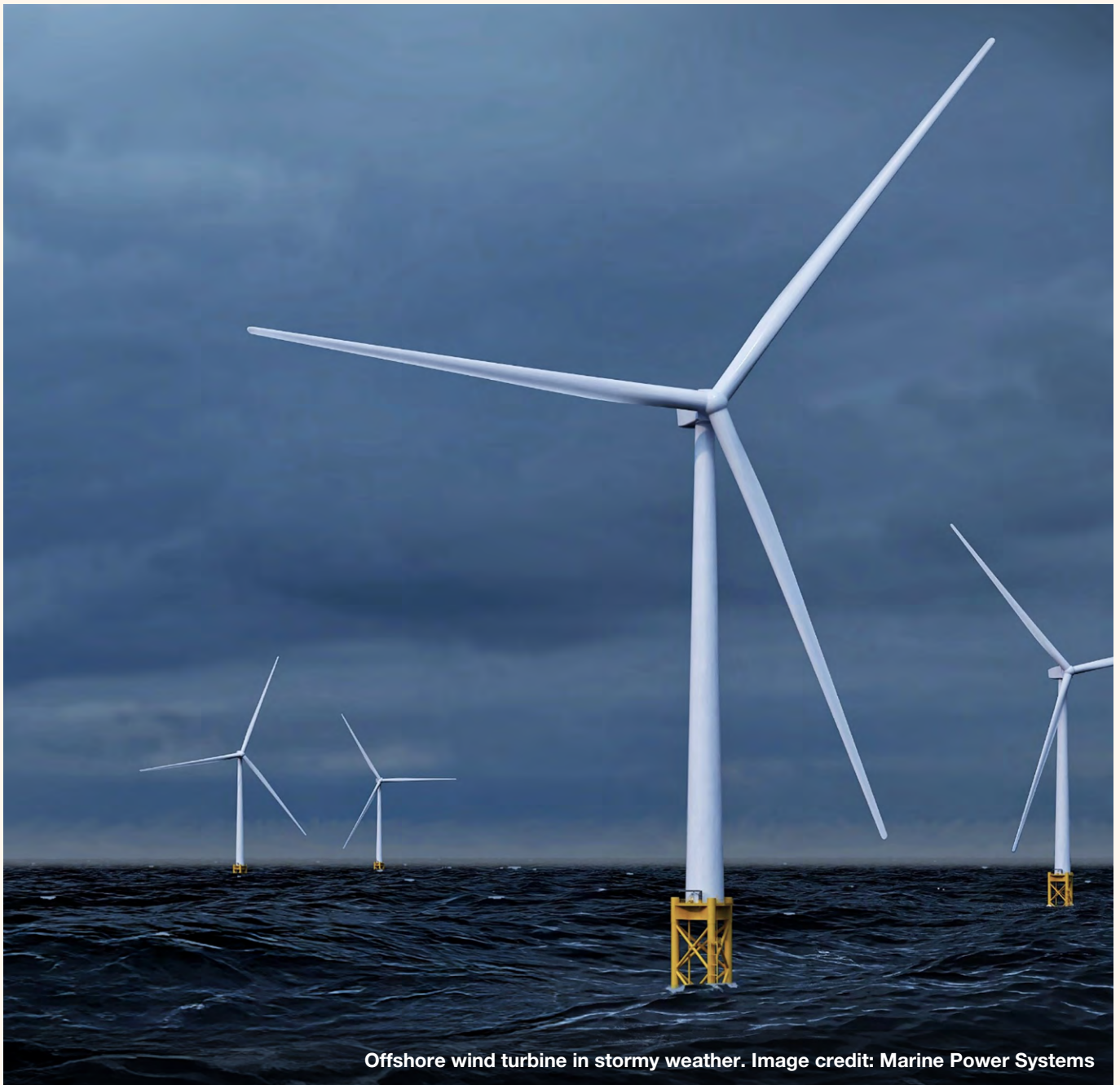
Renewable energy infrastructure enabling on-site storage and fleet decarbonisation.
Image credit: Keep Energy Systems



Future Offshore Wind

The UK government has committed to decarbonising the electricity system by 2030, with a major focus on expanding renewable energy. This includes an ambition to generate 43GW to 50GW of electricity from offshore wind.

Supporting a step change in offshore wind innovation is essential to achieving this goal. Acceleration will help scale deployment beyond current limits and position the UK as a global leader in the design and manufacture of offshore wind technologies.



Offshore wind turbine in stormy weather. Image credit: Marine Power Systems

Programmes

1. Floating Offshore Wind Demonstration Programme

- **Objective:** to demonstrate floating offshore wind technologies to encourage market confidence, investment and further development to bring down the levelised cost of energy.
- **NZIP final spend:** £23 million.

2. Windfarm Mitigation for UK Air Defence Programme

- **Objective:** to develop technologies ensuring the coexistence of future offshore windfarms alongside UK air defence radar, together with the Ministry of Defence collaboration.
- **NZIP final spend:** £8 million.

3. Joule Challenge Programme

- **Objective:** to showcase how lightweight composite materials can be integrated into the future generation of offshore wind turbines with the Offshore Renewable Energy Centre and National Composites Centre.
- **NZIP final spend:** £10 million.

Results

The Floating Offshore Wind Demonstration Programme has enabled the projects selected to bring technology closer to commercialisation to support cost reduction, reduce levelised cost of energy and enable floating offshore wind development at new sites.

The Windfarm Mitigation for UK Air Defence Programme made real progress in finding ways to reduce the impact of wind farms on radar systems.

The Joule Challenge Programme achieved weight reduction, lower environmental impact and cost savings compared to traditional steel design by redesigning key parts of a future 20MW floating turbine, especially the tower section.

Theme	Future Offshore Wind
NZIP final spend	£41 million
Matched funding	£13 million
Programmes	3
Projects	17
Closed projects achieving all objectives in full	55%
Closed projects achieving at least some objectives in full	95%
Jobs supported	200
Jobs outside London and South East England	85%
Percent of relevant projects that increased TRL	81%
Percent of relevant projects that increased TRL by two or more	52%
Percent of relevant projects that increased CRL	73%
Business relationships – formal	115
Business relationships – informal	52
Patents applied for	51
Patents granted	25
Follow-on funding projects	9
Follow-on funding value	£14 million
Projects reporting sales or licencing	1
Value of sales and licencing	£3 million

Progress summary

The Floating Offshore Wind

Demonstration Programme successfully advanced the UK's capabilities in key technical areas critical to commercial deployment. Across 11 funded projects, tangible progress was made in addressing challenges related to dynamic cables, mooring systems and integrated platform design. For example, JDR Cables validated a new dynamic cable configuration that demonstrated improved fatigue resistance under simulated offshore conditions. These outcomes not only strengthened the UK's supply chain, but also positioned domestic firms to export specialised technologies and expertise.

The Floating Offshore Wind

Demonstration Programme projects were impacted by wider operational challenges within the offshore wind industry, such as securing seabed leasing and grid connections. These challenges impacted the ability for the projects to test innovations on the sites but the continued developments in industry will mitigate these challenges in the future.

Within **the Windfarm Mitigation for UK Air Defence Programme**, both the radar-absorbing blade materials and the passive sensor systems demonstrated promising results. However, neither solution is ready yet for dynamic, real-world deployment. Continued development, testing and validation are needed to reach the operational maturity required for integration into UK air defence capabilities.



New modular, flexible deep-water wind technology. Image credit: Marine Power Systems

Case study: Future Offshore Wind



Project name:
Marine Power Systems (MPS)

NZIP funding received:
£3.5 million

Total project cost:
£5.0 million

Programme:
Floating Offshore Wind
Demonstration Programme

Over the course of three-and-a-half years, the MPS project developed a new modular, flexible deep-water wind technology that can be stably anchored offshore, allowing wind turbines to be cost-effectively installed at greater depths.

Innovative design

Its design offers exceptional stability and energy efficiency, while reducing system mass and lowering costs compared to similar solutions.

Modular and scalable

The platform's modular nature makes it easy to assemble, deploy and maintain, supporting local content delivery through a decentralised logistics model as it can be manufactured in local supply chains without the need for unique machinery.

Economic and environmental impact

The design helps utility-scale developers reduce costs, while boosting local economic benefits and accelerating large-scale deployment.

Cost-saving engineering

The project achieved more than 25% reduction in weight, significantly cutting manufacturing and deployment costs by reducing the need for steel and smaller cranes and vessels.

Simplified logistics

The platform design eliminates the logistical challenges with wet storage and mooring multiple platforms in congested marine areas, resulting in lower deployment costs compared to transporting platforms with pre-installed turbines over long distances.

Industry validation

The platform's performance was successfully tested at FloWave in Edinburgh, a leading ocean energy research facility that simulates real sea conditions, confirming its readiness for real-world deployment.

The project has been hugely successful, positioning the technology to launch into the next phase, which will consist of the deployment of the leading deep water wind technology.

Dr Gareth Stockman, Chief Executive Officer of Marine Power Systems Ltd, said:

“ **MPS' best-in-class technology has achieved significant cost reductions and provides an optimal solution for industrial-scale farms, positioning us to capitalise on this global opportunity.** ”

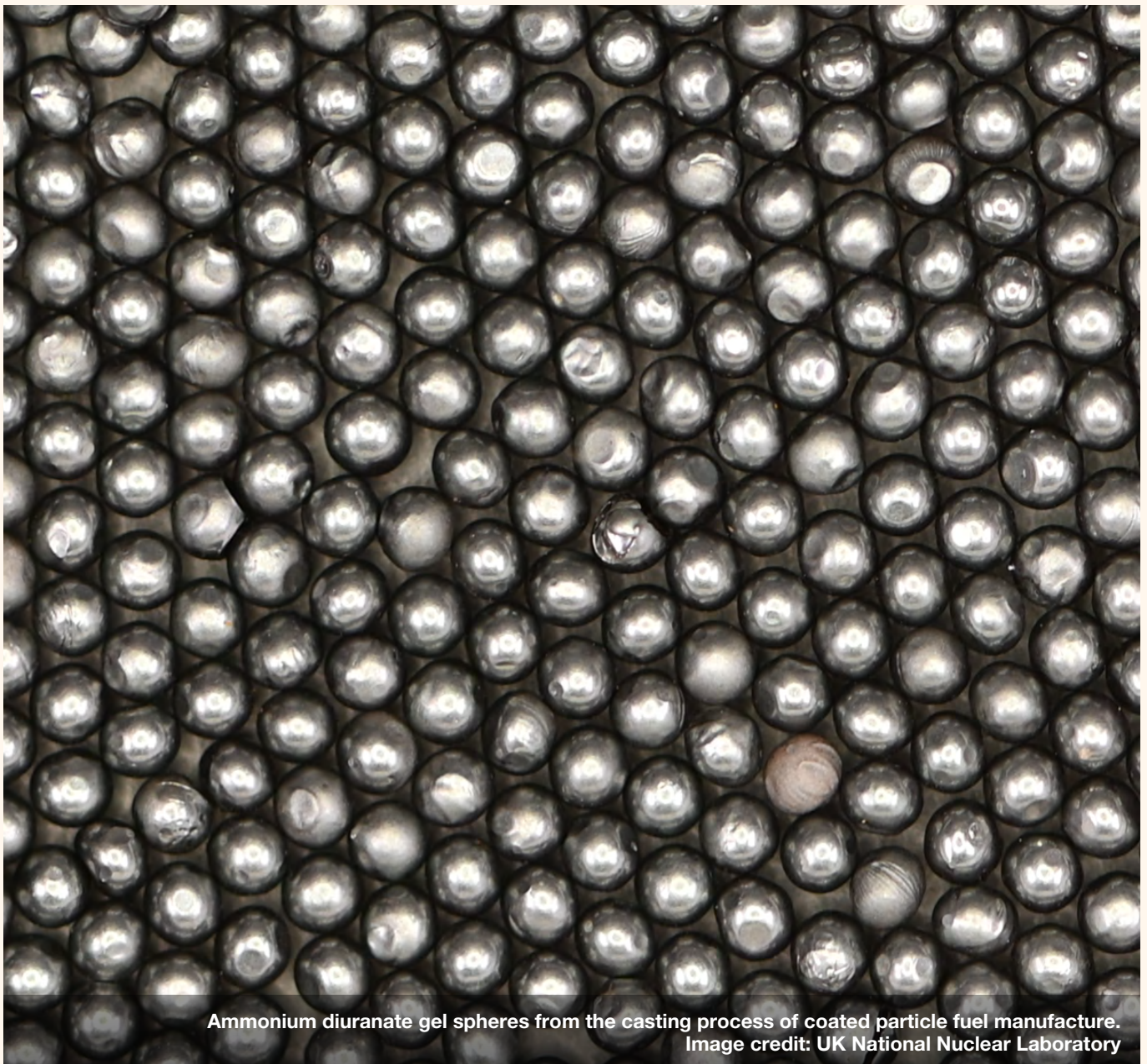


Advanced Nuclear

A key focus of the government's energy policy, nuclear power offers potential solutions for low-carbon, high-capacity, flexible heat and electricity production.

The NZIP programmes, funded through the ANF, aim to develop advanced nuclear technologies to provide substantial and

consistent power as part of a net zero energy system. They also seek to reduce the risks and timescales of building new nuclear power stations, while increasing investor confidence.



Ammonium diuranate gel spheres from the casting process of coated particle fuel manufacture.
Image credit: UK National Nuclear Laboratory

Programmes

1. Small Modular Reactor (SMR) Programme, also known as the Low-Cost Nuclear Challenge

- **Objective:** to support the development of the Rolls-Royce SMR, a compact, standardised and modular nuclear reactor based on existing light-water-cooled reactor technology.
- **NZIP expected spend:** £215 million.

2. Advanced Modular Reactor (AMR) Programme

- **Objective:** to carry out research and development and mature high-temperature gas reactor designs to a higher TRL, with a view to deployment in the 2030s and upskill the UK's nuclear regulators in AMR technologies.
- **NZIP expected spend:** £26.8 million.

3. Advanced Fuel Cycle Programme

- **Objective:** to establish a sovereign advanced fuel supply to meet the UK's energy security requirements, producing fuel to supply any potential UK AMR deployment, as well as offering significant export opportunities.
- **NZIP final spend:** £16.7 million.

4. Coated Particle Fuel Programme

- **Objective:** to support the UK's National Nuclear Laboratory to develop and scale up their coated particle fuel capability at their Preston facility with £16 million and around £1 million to upskill the regulators.
- **NZIP final spend:** £16.9 million.

5. Engage Programme

- **Objective:** to enhance the UK's strategic engagement on advanced nuclear by ensuring that participation in international research collaborations supports UK innovation programmes.
- **NZIP expected spend:** £8 million.



Generation IV International Forum, London, October 2024. Image credit: DESNZ

Results

Theme	Advanced Nuclear
NZIP expected spend	£283 million
Matched funding	£304 million
Programmes	5
Projects	17
Jobs supported	1,310
Jobs outside London and South East England	100%
Percent of relevant projects that increased TRL	60%
Percent of relevant projects that increased TRL by two or more	60%
Percent of relevant projects that increased CRL	33%
Business relationships – formal	120
Business relationships – informal	54
Follow-on funding projects	4
Follow-on funding value	£41 million

Progress summary

The Low Cost Nuclear Programme advanced a new SMR design through the UK's Generic Design Assessment Step 2, following a successful concept phase. Rolls-Royce SMR entered Step 3 in July 2024, continuing progress towards deployment. This work supports the UK's nuclear innovation and regulatory readiness.

The AMR and Advanced Fuel Cycle Programmes advanced high-temperature reactor designs and accident-tolerant fuels to support AMR deployment, industrial decarbonisation and hydrogen production.

Through **the Engage Programme**, the UK has strengthened its nuclear innovation capabilities by deepening international collaboration and aligning national efforts with global research agendas. Initiatives supported under Engage have laid the foundations for future innovation by establishing strategic partnerships and strengthening technical capabilities. A key example is the UK's active participation in the Generation IV International Forum, where ongoing collaboration has raised the UK's global profile in advanced nuclear technologies.



Small modular reactor concept design. Image credit: Rolls-Royce SMR

Case study: Advanced Nuclear



Project name:
Low-Cost Nuclear phase 2 (SMR) –
Rolls-Royce

NZIP funding received:
£215 million

Total project cost:
£468 million

Programme:
Low-Cost Nuclear Challenge

Rolls-Royce SMR Ltd developed a compact nuclear power station using a UK-designed SMR, aiming to make nuclear energy more affordable and scalable.

The project focused on completing key design milestones, building a strong supply chain, promoting diversity in the sector, and supporting public understanding and government policy around nuclear energy.

Rolls-Royce began work on their SMR design in 2015. They completed Step 1 (Initiation) in April 2023 and Step 2 (Fundamental Assessment) of the Generic Design Assessment in July 2024 and entered Step 3 (Detailed Assessment) in July 2024. The completion of Step 2 was one of the main aims of this NZIP-funded project.

In addition to the core technology development, the project has delivered several important outcomes.

Enhanced design

The SMR's power output has been increased from 440 MWe to 470 MWe, boosting its potential contribution to the UK's clean energy future.

Manufacturing innovation

The modular build system was successfully tested at the Manufacturing Test Centre in Coventry, with insights directly informing the final design and production process.

Regional job creation

Around 1,000 people are currently employed on the programme across Derby, Warrington and Manchester, supporting high-value jobs and strengthening the UK's regional engineering and manufacturing base.

Global collaboration

In October 2024, Rolls-Royce SMR and Czech energy company ČEZ announced a strategic partnership. This includes an equity investment by ČEZ and plans to deploy up to 3 GW of electricity using Rolls-Royce SMR technology at the Temelín site in South Bohemia.

Preferred bidder status

In June 2025, Rolls-Royce SMR was selected as the preferred bidder to build the UK's first small modular reactors, following a two-year competitive process led by Great British Energy – Nuclear.



Bioenergy

Bioenergy with carbon capture and storage (BECCS) is the process of extracting energy from biomass, such as wood, fast-growing grasses or biogenic waste, and then capturing and storing the CO₂ that is produced. By permanently removing recent biogenic CO₂ from the atmosphere, BECCS has become a new negative emissions technology. Biomass can also be used to produce low-carbon hydrogen.

Programmes

The Bioenergy theme has supported two programmes focused on sustainable supply of biomass and negative emission hydrogen production.

1. Biomass Feedstocks Innovation Programme

- **Objective:** to improve the supply of sustainable biomass in the UK, by funding commercially viable technologies that help farmers grow bioenergy crops.
- **NZIP final spend:** £34.5 million.

2. Hydrogen BECCS Programme

- **Objective:** to support technologies which can produce hydrogen from biomass and be combined with carbon capture technologies.
- **NZIP final spend:** £26 million.



Results

The Biomass Feedstocks Innovation Programme included 25 feasibility and design projects supported via phase 1, which resulted in 12 progressing to phase 2 demonstrators. The innovations were awarded funding to prove that their ideas can improve biomass yields, efficiencies and cost reductions, with a further allocation given to the Biomass Connect demonstrator to create eight hubs nationwide demonstrating technological advancements across various regional climates and soil conditions. Since then, over 1.5 million biomass plants have been grown and the programme has evidenced 50% to 100% increases in dry tonnes of biomass per hectare.

Highlights include:

- Demonstration of the best genotypes of willow and miscanthus for our climate and biomass production, assessing for climate resilience.
- Creation of the first North Sea farm for seaweed, expanding marine biodiversity through new habitats and cropping up to four times a year.
- Joining up the biomass value chain to support both renewable energy and GGR.

The Hydrogen BECCS Programme

supported 22 feasibility and design projects, with six projects being awarded funding to demonstrate their innovations. This programme sought to support the development of technologies that would enable the commercialisation and deployment of the hydrogen BECCS value chain (generating hydrogen from biogenic feedstocks, combined with carbon capture and storage) at scale.

The programme has achieved:

- Production of over 300kg of hydrogen.
- Sustained demonstration of wood chip gasification to hydrogen.
- Creation of enzymes to convert organic waste food and paper to hydrogen.
- Plans to deploy scaled-up technologies, accelerating decarbonisation across a variety of industries including cement and transport (both sea and land).

Theme	Bioenergy
NZIP expected spend	£60.5 million
Programmes	2
Projects	65
Closed projects achieving all objectives in full	77%
Closed projects achieving at least some objectives in full	94%
Jobs supported	400
Jobs outside London and South East England	84%
Percent of relevant projects that increased TRL	58%
Percent of relevant projects that increased TRL by two or more	38%
Percent of relevant projects that increased CRL	62%
Business relationships – formal	298
Business relationships – informal	379
Patents applied for	9
Patents granted	2
Follow-on funding projects	3
Follow-on funding value	£1 million
Projects reporting sales or licencing	3
Value of sales and licencing	£1 million

Progress summary

To effectively demonstrate increases in biomass yield, projects need sufficient harvest cycles, ideally over a five-year period, with three years considered the minimum. Several projects have benefited from strong links to end markets. For example, willow suppliers have provided biomass to GGR projects, while gasifier operators have preferred wood chip over waste materials to optimise performance.

These experiences highlight the value of early engagement with local planning authorities and the Environment Agency during the design and feasibility stages of future programmes. Internally, the biomass projects have provided valuable insight and evidence to various government departments, and the Hydrogen BECCS Programme influenced inclusion of bio-hydrogen in the second Hydrogen Allocation Round.



A containerised proprietary biohydrogen production unit, image courtesy of CATAGEN Ltd.

Case study: Bioenergy



Project name:
Waste Biomass to Biohydrogen
Production – CATAGEN Limited

NZIP funding received:
£5.1 million

Programme:
Hydrogen BECCS

CATAGEN is a Belfast-based SME that has applied its recirculating gas reactor technology to develop BIOHGEN. This electrically-driven technology produces low-carbon biohydrogen whilst capturing biogenic CO₂ which can be permanently stored or used.

The BIOHGEN technology has the potential to decarbonise heavy industry and produce sustainable fuels such as Bio-SAF (Sustainable Aviation Fuel) when paired with CATAGEN's E-FUEL GEN modular reactor, developed under the NZIP Red Diesel Replacement programme.

Phase 1: proof of concept

CATAGEN successfully adapted its e-reactor into a thermochemical system capable of producing hydrogen from waste biomass, demonstrating technical feasibility.

Phase 2: scaling up

A pilot demonstrator was designed and built at CATAGEN's Net Zero Campus to produce biohydrogen at scale, marking a key step toward commercial deployment.

Supports integration with carbon capture

The technology was integrated with a third-party system, which removes CO₂ from the reactor outputs by compressing, refrigerating, and flowing through a selective membrane. The biogenic CO₂ is stored in liquid form, making it easier to transport and manage

Industrial decarbonisation potential

The technology could play a major role in reducing emissions from sectors like cement manufacturing. Biohydrogen produced on-site can be fed directly into cement kilns, delivering the high temperatures required without relying on fossil fuels and capturing CO₂. Alternatively, together with E FUEL-GEN units, modular decentralised SAF reactors can be located near airports or intermittent renewable energy sources such as wind and solar to support decarbonisation of aviation.

Dr Andrew Woods, Chief Executive Officer, said:

“CATAGEN's electrically driven biohydrogen reactors provide an accessible route to market for low-carbon hydrogen adoption in hard-to-abate sectors. It can also be used to produce blended synthetic fuels such as bio-SAF. Our modular reactors are easily manufactured using existing supply chains and the funding from NZIP has allowed us to develop at speed and grow the team.”



Industry

In 2024, industry sector emissions represented approximately 14% of all UK territorial emissions.⁹ It will be essential that UK business continue to be competitive as they decarbonise. Half of our decarbonisation goal will be achieved by supporting industry to switch away from fossil fuel power sources such as gas, and onto homegrown low-carbon alternatives such as electricity, hydrogen and bioenergy. The remaining savings are expected to come from lower-carbon design choices, process improvements and material substitutions, as outlined in the 2021 Industrial Decarbonisation Strategy.¹⁰

As part of this journey towards decarbonising industrial systems and processes, the central aim of this theme was to support innovation in key new technologies to help minimise the associated costs and CO2 emissions. In doing so, this supports the acceleration to net zero set out in the government's mission to make Britain a clean energy superpower.



Road construction using recycled materials. Image credit: Colas

Programmes

1. The Industrial Fuel Switching Programme

- **Objective:** to support innovation in the development of pre-commercial fuel switching and fuel switching-enabling technologies for industry.
- **NZIP expected spend:** £50 million.

2. Green Distilleries Programme

- **Objective:** to support innovation targeted at helping the distilleries sector decarbonise with a focus on fuel switching enabling technologies – especially important for an industry which produces high-value products in remote locations.
- **NZIP final spend:** £8.8 million.

3. Red Diesel Replacement Programme

- **Objective:** to help develop technologies in low-carbon fuel and system alternatives to be deployed on non-road mobile machinery.
- **NZIP final spend:** £27.7 million.

4. Industrial Energy Efficiency Accelerator (IEEA) programme

- **Objective:** to demonstrate the energy savings from innovations across a range of industrial sectors, helping industry to adopt alternative low carbon innovations by addressing barriers to implementation.
- **NZIP final spend:** £9.3 million.

Results

Under the **Industrial Fuel Switching Programme**, technologies were grouped into three categories – hydrogen, electrification, and biomass/waste or other net zero fuels – to encourage innovation across diverse areas. Phase 1 delivered 21 feasibility studies to assess the potential impact of these technologies on the industrial energy system. Phase 2 has then supported 11 demonstration projects, showcasing applications in hydrogen, biofuels and electrification. Highlights included hydrogen in aluminium recycling at Novelis, the world's first hydrogen-fired cremation and electrification replacing gas in a commercial biscuit oven.

The Green Distilleries Programme

tackled the challenge of limited grid access in the distillery sector by exploring alternative energy sources including hydrogen, electrification, biomass and waste power. Delivered in two phases, phase 1 funded 17 feasibility studies to explore fuel switching and enabling technologies. In phase 2, funding supported three projects: two demonstrating fuel switching and one showcasing a full hydrogen system. This includes generating hydrogen via wind-powered electrolysis to fuel a custom boiler for whisky distillation.

The Red Diesel Replacement

Programme supported innovation in certain industrial sectors – such as mining, quarrying and construction – which were no longer able to use rebated red diesel fuel to conduct their operations after April 2022. Grants were awarded across two phases. Phase 1 included 16 feasibility projects exploring innovations in fuel, equipment, and energy systems. Phase 2 supported six demonstration projects testing technologies in real-world non-road mobile machinery environments.

The Industrial Energy Efficiency Accelerator Programme has driven major improvements in energy and resource efficiency across UK industry. Through 13 demonstration projects, the IEEA showcased innovations in sectors such as metalworking, food processing, brewing, road resurfacing, and recycling. Carbon Trust estimates that

these projects could save up to 4 million tonnes of CO2 over ten years, with some technologies delivering efficiency gains of up to 70%. Notable achievements include advanced sensors for water and energy savings, robotic automation in food production, and new materials for low-carbon road resurfacing.

Theme	Industry
NZIP expected spend	£95.8 million
Matched funding	£23 million
Programmes	4
Projects	77
Closed projects achieving all objectives in full	52%
Closed projects achieving at least some objectives in full	88%
Jobs supported	910
Jobs outside London and South East England	69%
Percent of relevant projects that increased TRL	59%
Percent of relevant projects that increased TRL by two or more	35%
Percent of relevant projects that increased CRL	71%
Business relationships – formal	397
Business relationships – informal	494
Patents applied for	14
Patents granted	36
Follow-on funding projects	8
Follow-on funding value	£9 million
Projects reporting sales or licencing	7
Value of sales and licencing	£6 million

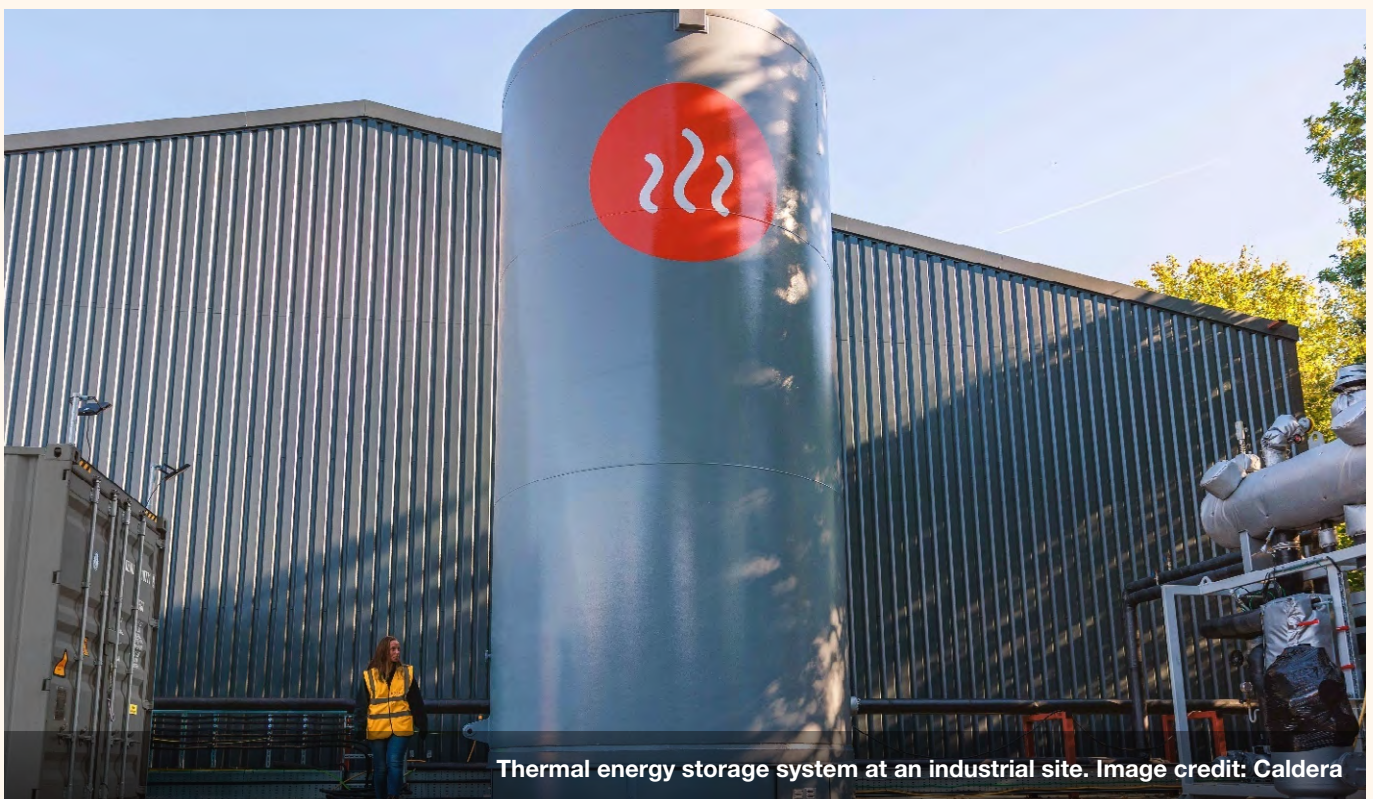
Progress summary

The industry theme has delivered high-quality feasibility studies and demonstration projects, including several notable achievements. These include the world's first 100% hydrogen-fired whisky distillation and the UK's first 100% hydrogen-fired recycling of aluminium.

As is the nature of innovation projects, some demonstration projects have encountered challenges in managing supply chains which deliver complex, high-value components. These issues have impacted project timelines and highlight the need for stronger supply chain resilience.

The Red Diesel Replacement Programme has aided an industry-led working group examining the potential of hydrogen internal combustion engines to decarbonise non-road mobile machinery. Learnings from the programme are also informing off-road machinery decarbonisation policy, with a relevant cross-government strategy expected to be published in due course.

Collaborative innovation and government support have unlocked substantial energy and carbon savings across UK industry. Programmes such as the Industrial Energy Efficiency Accelerator have delivered step-change improvements in efficiency and resource use, building confidence in the sector's ability to adopt low-carbon technologies. These successes provide a strong foundation for future growth, with lessons learned helping to shape the next generation of industrial decarbonisation initiatives.



Thermal energy storage system at an industrial site. Image credit: Caldera

Case study: Industry



Project name:

Demonstrating Fuel Switching
Industrial Heating from Gas with
Electric Storage Boilers – Caldera

NZIP funding received:

£4.3 million

Total project cost:

£4.3 million

Programme:

Industrial Fuel Switching phase 2

Caldera is a British manufacturer developing technology to replace fossil fuels in industry with heat from renewable electricity. Industrial heat is responsible for approximately a quarter of global energy-related emissions.

Caldera's solution enables decarbonisation by storing low-cost electricity, either from on-site solar or from the national grid during off-peak periods, as heat, which can then be used on demand.

Industrial application and design

Caldera's modular electric storage boiler is designed for industrial applications operating at 100°C to 200°C and up to 16 bar pressure, including food and drink processing, distillation, pasteurisation and paper manufacturing. The system features a patented thermal core, scrap aluminium cast around volcanic rock, with embedded resistive heating elements

and a stainless-steel heat exchanger. Vacuum insulation enables highly efficient heat storage over multiple days, with the flexibility to release it as steam.

Innovation and government support

Funding awarded through the Industrial Fuel Switching Programme supported the transition of Caldera's technology from prototype to industrial scale and enabled performance validation under realistic conditions.

Full-scale demonstrator

A full-scale storage boiler demonstrator was built at Caldera's Hampshire site. It included integrated electrical charging, thermal storage, and steam generation capabilities – with a 15,000-litre load tank and steam network to simulate industrial conditions, which allowed for rigorous testing.

Commercial impact

The project was instrumental in moving the technology from development to commercial readiness, helping establish a scalable, low-cost solution for industrial decarbonisation. The demonstrator is now regularly visited by prospective customers and specifiers, supporting a strong pipeline of commercial sites across the UK and Europe.

Investment and market confidence

The maturity and credibility achieved via government support were essential in securing a £10 million strategic investment from GEA Group, one of the world's largest suppliers of systems for the food, beverage and pharmaceutical sectors.

Caldera added:

“The investment from GEA is a game-changing opportunity for our company and a strong endorsement of our technology.”



Hydrogen

Low-carbon hydrogen is essential to achieve the government's clean energy superpower and growth missions. It will be a crucial enabler of a low-carbon and renewables-based energy system, by providing flexible, cleaner energy for our power system and helping to decarbonise vital UK industries. Hydrogen presents significant growth opportunities and will help to deliver new clean energy industries which can support good jobs in our industrial heartlands and coastal communities. Government and industry are already delivering projects to kickstart the UK hydrogen economy, as demonstrated by the contract signings from the first Hydrogen Allocation Round, with £2.3 billion of revenue support funding confirmed by the Chancellor in November 2024.

The hydrogen theme supported hydrogen production scale-up and use across the value chain through three programmes.

1. Low-Carbon Hydrogen Supply 2 Programme

- **Objective:** to make hydrogen production, transport and short-term storage more efficient and cost-effective.
- **NZIP expected spend:** £54.8 million.

2. Industrial Hydrogen Accelerator Programme

- **Objective:** to demonstrate the viability of end-to-end hydrogen fuel switching in industrial applications, as well as reducing its costs and risks.
- **NZIP expected spend:** £9.1 million.

3. Hydrogen Skills and Standards for Heat Programme

- **Objective:** to develop sets of technical standards, for domestic and non-domestic hydrogen gas installations.
- **NZIP final spend:** £2.7 million.



Quality checks on hydrogen electrolyser components. Image credit: ITM

Results

While hydrogen is a nascent fuel, it has important long-term potential, partly due to how it can be physically stored in high volumes and over a long period of time. Hydrogen can help to decarbonise hard-to-abate sectors like chemicals, ceramics, glass and heavy transport, complementing our wider electrification efforts, and is one of a limited set of technologies that can provide flexible low-carbon power generation.

Projects involving hydrogen technologies were also supported by solution-neutral NZIP programmes, such as Industrial Fuel Switching 2 and Red Diesel Replacement. Around £170 million of NZIP funding was allocated to projects using hydrogen technologies, from both this thematic area and others.

In addition, £81 million from the overall NZIP budget was ring-fenced for **the Hydrogen Heating Programme**. This initiative aimed to gather evidence to identify the necessary options for enabling the use of 100% hydrogen for heating across parts or all of the UK gas network. It also sought to assess the associated costs, impacts, benefits, and overall feasibility of implementing such changes.

The **Low-Carbon Hydrogen Supply 2 Programme** aimed to make hydrogen production, transport and short-term storage more efficient and cost-effective.

Stream 1 supported novel, less-advanced technologies and initially supported 23 feasibility studies. Five of the 23 projects then secured demonstration funding in phase 2.

1. Immaterial have enhanced the understanding of handling metal organic frameworks through scaling up production and operating test tanks.
2. The University of Manchester are building a demonstration of a gas-to-hydrogen conversion plant in which carbon is captured using chemical looping.
3. Tetronics have trialled using plasma to produce hydrogen from water.
4. Start-up Actuation Lab tested its leak-free valve at a new test loop at partner University of Wales' site.
5. The Science and Technologies Facility Council ASPIRE project developed a system for producing ammonia from simulated intermittent electricity supply.

Stream 2 targeted more mature solutions, enabling rapid progress through five projects. To better integrate wind generation with electrolysis, ERM tested offshore pipe connectors (risers) and recently ran a world-leading demonstration of electrolysis using seawater in Wales and Vattenfall also explored this opportunity. ITM made progress in electrolyser technology, while Gemserv's Birmingham plant generated insights into large-scale ammonia-to-hydrogen conversion. A storage project was also supported. All projects had planned to conduct demonstrations, but Vattenfall chose to conclude theirs after design work, feeling that new developments meant field tests were no longer justified.

The **Industrial Hydrogen Accelerator Programme** aimed to demonstrate the viability of end-to-end hydrogen fuel switching in industrial applications, as well as reducing its costs and risks. The

programme supported nine feasibility projects whose published findings illustrate the varied challenges and opportunities of switching to hydrogen. Follow-on funding enabled EON to develop a blueprint for hydrogen production at Blackburn Meadows, Sheffield, and its use at nearby steel processing sites. The EDF-led Bay Hydrogen Hub project is exploring the potential of nuclear-powered hydrogen and testing a novel hydrogen burner for use in asphalt production.

The **Hydrogen Skills and Standards for Heat Programme** developed two sets of technical standards, for domestic and non-domestic hydrogen gas installations, published in 2024. These codify safe ways to repurpose existing natural gas installations for hydrogen, and to design and install new hydrogen-suitable pipework and appliances.



Hydrogen electrolyser stacks in a production facility. Image credit: ITM

Theme	Hydrogen
NZIP expected spend	£66.6 million
Matched funding	£6 million
Programmes	3
Projects	54
Closed projects achieving all objectives in full	55%
Closed projects achieving at least some objectives in full	86%
Jobs supported	940
Jobs outside London and South East England	84%
Percent of relevant projects that increased TRL	56%
Percent of relevant projects that increased TRL by two or more	28%
Percent of relevant projects that increased CRL	64%
Business relationships – formal	343
Business relationships – informal	495
Patents applied for	22
Patents granted	7
Follow-on funding projects	14
Follow-on funding value	£21 million
Projects reporting sales or licencing	3
Value of sales and licencing	£21 million

Progress summary

Building on experience from the earlier Energy Innovation Portfolio, programme design enabled a greater diversity of entrants by providing the option of feasibility studies before down-selecting to high-value demonstration projects. This approach has enabled challenger technologies to be supported alongside more established electrolysis and gas reformation systems.

Almost all demonstration projects experienced some supply chain challenges with electrolyser and compressor timelines slipping significantly in several cases – likely reflecting the nascency of the hydrogen economy. Co-ordinating hydrogen production with hydrogen demand also proved challenging. Feasibility studies from the Industrial Hydrogen Accelerator Programme found that if pipelines were not an option, distribution and storage would need careful thought to optimise the use of costly equipment such as compressors and tube trailers.

Most projects overcame several innovation challenges to reach completion and have delivered on many of their objectives. ITM's technical improvements to its Trident electrolyser stack are already showing strong commercial potential, and several other projects have sought patents for the significant technological advancements that they have achieved. New insights have also been generated about the behaviour and handling of hydrogen. The ERM trial in the marine energy test area in Wales was a highlight event for the theme – marking the first time hydrogen was produced in a floating offshore environment in the UK. The Industrial Hydrogen Accelerator Programme is supporting another significant demonstration underway in

Criggion, using hydrogen to produce low-carbon asphalt. Trials at such scale bring important insights and have moved at accelerated pace thanks to NZIP support.

Developments from the Low-Carbon Hydrogen Supply 2 Programme have recently led to direct impacts on hydrogen policy and regulatory arrangements. Vattenfall's HT-1 and ERM's Dolphyn projects funded under the programme have both accelerated changes to secondary legislation, reducing the risk of offshore hydrogen energy projects being delayed or cancelled due to regulatory uncertainty. In 2023, a new statutory instrument was laid to extend existing oil and gas regulatory frameworks to cover hydrogen pipelines and storage facilities.

Similarly, EON, as part of their industrial hydrogen accelerator Hydrogen Decarbonisation of Sheffield Steel (HYDESS) project, undertook modelling of hydrogen distribution through road transport to local users. This has informed DESNZ's analysis of potential distribution models and cost assumptions, helping to identify critical insights for enabling the wider hydrogen economy. Over time, the demonstrations supported through NZIP will lead to considerable improvements to the technologies and accelerate their deployment.

Case study: Hydrogen



Project name:
Gigatest – ITM Power

NZIP funding received:
£7.7 million

Total project cost:
£7.7 million

Programme:
Low-Carbon Hydrogen Supply 2

As part of the Low-Carbon Hydrogen Supply 2 Programme, the ITM Power Gigatest project set out to accelerate the commercial development of their fourth-generation electrolyzers for hydrogen production. There was a dual focus on enabling in-house and real-world testing of the next generation of electrolyser cell stacks and supporting manufacturing upgrades. Stacks are the heart of electrolyzers, where water is split into hydrogen and oxygen. ITM have been able to make proton-exchange membrane electrolyzers that are more compatible with renewable electricity than alkaline electrolyzers – the other commercially mature form of these devices.

Electrolyser testing and manufacturing

The new generation electrolyser stacks have been tested in Sheffield and have been field-tested in Germany and Norway to validate performance under real-world conditions. At their new Gigafactory in Sheffield, ITM have also refined

electrolyser stack production processes, deploying and validating the use of new manufacturing equipment to help automate production processes and to improve quality standards.

Impact of NZIP funding and commercial partnerships

Support from NZIP has enabled the delivery of meaningful outcomes. Shell recently announced they have taken a positive investment decision on the 100MW REFHYNE II plant in Germany and have signed a contract with ITM to supply electrolyser stacks for the plant. This, alongside numerous recent large scale capacity reservations and Front-End Engineering Design projects in the UK and around the globe demonstrate the positive impact of NZIP funding.

Andy Allen, VP Strategy, said:

“Gigatest funding has allowed ITM to commercialise our Trident stack, which is at the heart of all our products, through research into improved components, supply chain development, and manufacturing automation development followed by stringent testing both in-house and in the field. Gigatest research has led to leading conversion efficiencies, reduced catalyst content per stack and semi-automated volume manufacture, leading to lower stack costs and the most advanced proton-exchange membrane electrolyser technology in the world.”



Advanced Carbon Capture Usage and Storage

There is a significant role for CCUS to play in achieving the UK's commitment to reach net zero by 2050. Some industrial processes emit CO₂ as a byproduct of the process (in cement production) and some power generation methods

(bioenergy) require CCUS to achieve negative emissions (BECCS). CCUS technologies are key enablers to mitigate CO₂ emissions from hard-to-abate industrial sectors including cement, chemicals, glass and lime.



Carbon capture equipment at TERC research facility. Image credit: Nuada

Programmes

1. CCUS Innovation 2.0 Programme

- **Objective:** to reduce the cost of capturing and storing CO₂ while supporting UK industry in the development, demonstration and deployment of next-generation CCUS technologies.
- **NZIP expected spend:** £15.7 million.

2. Accelerating Carbon Capture Storage Technologies 3 (ACT-3) Programme

- **Objective:** an international initiative run by the Research Council of Norway to accelerate and mature CCUS technologies through targeted innovation and research.
- **NZIP final spend:** £4.7 million.

Results

The CCUS Innovation 2.0 and ACT-3 Programmes have advanced CCUS technologies across the full supply chain to help scale deployment. CCUS Innovation 2.0 awarded funding to 19 UK projects, with £19 million in private co-funding. These span point-source capture (such as Nuada in Belfast and Carbon Clean in London), carbon usage (such as Remediate in Swansea and Ingenza in Edinburgh), and transport, supply chain and storage (such as John Crane in Slough and Net Zero Geosystems in London). The first projects completed in 2024, with the remainder scheduled to complete by March 2026. In May 2022, a technoeconomic analysis and supporting research paper¹¹ was also published under the programme reviewing the next-generation capture technology to be deployed on UK industrial, waste and power sites between 2030 and 2035.

ACT-3 was built on previous programmes created through international collaboration across 14 countries. It awarded grant funding to 11 UK consortia involved in international projects, contributing to a total funding pot of £40 million, including £25 million provided by international partners. The funding supported one carbon capture and storage network, three capture, four storage and three usage projects. All projects have now finished with final reports due to be published by December 2025.

Between 2004 and 2023, the UK government has invested over £371 million in CCUS research, development and demonstration activity. To build on this CCUS knowledge base in the UK, each project produced a series of key knowledge deliverables to share learnings with industry and academia. Almost 200 reports are set to be made publicly available through the CCUS Innovation 2.0 Programme webpage.

Theme	CCUS
NZIP expected spend	£20.4 million
Matched funding	£19 million
Programmes	2
Projects	30
Closed projects achieving all objectives in full	41%
Closed projects achieving at least some objectives in full	76%
Jobs supported	260
Jobs outside London and South East England	89%
Percent of relevant projects that increased CRL	56%
Percent of relevant projects that increased TRL by two or more	24%
Percent of relevant projects that increased CRL	48%
Business relationships – formal	116
Business relationships – informal	82
Patents applied for	13
Patents granted	2
Follow-on funding projects	3
Follow-on funding value	£11 million
Projects reporting sales or licencing	1
Value of sales and licencing	£30,000

Progress summary

The NZIP CCUS Innovation Programme was designed to advance CCUS technologies beyond the scope of current cluster-based policy approaches and business models. It focused on enabling scalable solutions suitable for deployment across the UK's industrial, waste and power sectors in the 2030s, including dispersed emitters not easily integrated into CCUS clusters.

By taking a technology-agnostic approach across point source carbon capture, CO₂ transport, usage and subsurface storage, the programmes supported a diverse portfolio of projects. These included a comprehensive technology review and techno-economic assessment of next-generation carbon capture technologies, development of advanced materials such as metal-organic frameworks for carbon capture, software tools for assessing well cement casing integrity, innovations like dry gas seals for high-temperature power generation and novel CO₂ usage applications, including protein production for aquaculture feed.

These efforts lay the groundwork for future deployment, particularly in sectors with hard-to-abate emissions such as cement, chemicals, glass and lime. The programmes also supported the long-term goal of decarbonising dispersed emitters with technologies that can operate independently of cluster-based systems.

Challenges encountered during delivery of the projects included limited access to specialist supply chain capabilities, which affected project timelines, as well as permitting and safety constraints at industrial sites.

Continued work is needed to mature the CCUS technologies for deployment in the 2030s, support the decarbonisation of dispersed emitters, strengthen the domestic supply chain and enable the UK to become a leading global exporter in these technologies.



Technician operating equipment in a carbon capture research facility. Image credit: TERC

Case study: Advanced Carbon Capture Usage and Storage



Case study:

Flexibly-operated capture using solvent storage (FOCUSS) – SSE Thermal

NZIP funding received:

£0.5 million

Total project cost:

£0.7 million

Programme:

CCUS Innovation 2.0

The project aimed to accelerate the market readiness for amine post-combustion carbon capture technology and achieved consistent 95% to 99% CO₂ capture rates across all operating conditions, including start-up, shut down and other transient periods.

This technology is particularly useful in power generation applications. These operational regimes are already common in the UK's Combined Cycle Gas Turbine (CCGT) fleet and are likely to become more widespread and acute in a renewables-led clean power system. Where amine-based post-combustion carbon capture plants have insufficient thermal energy available, such as during early start-up phases, they can require several hours to reach optimal operating temperatures.

Real-world demonstration at the Translational Energy Research Centre (TERC), Sheffield

FOCUSS leveraged an existing amine post-combustion carbon capture plant at TERC, Sheffield, with the addition of innovative solvent storage systems. These systems allowed the plant to continue capturing CO₂ during periods where the power output from the turbines changed during simulated start-up and shut-down phases.

By incorporating dedicated storage for both treated lean and CO₂ rich solvents, the system maintained stable capture performance under changing operating conditions. Designed with retrofit in mind, this flexible solution can be integrated into existing power generation infrastructure, supporting more reliable and responsive carbon capture in real-world environments.

Industry-focused design and testing

AECOM and SSE Thermal have defined the objectives for FOCUSS to ensure it matches industry needs and ease of adoption. Modifications to the TERC solvent capture plant enabled testing and reporting of novel storage-based approaches during start-up and transient operating modes.

Successful completion of UK test campaign

The 2024 test campaign at TERC marked a major milestone, validating the performance of the FOCUSS approach under dynamic conditions. These results provide a strong foundation for broader application across the sector.

International expansion

To build on the UK results, two additional testing phases are now underway at the Haifeng Power Plant in China. These trials will further demonstrate the technology's scalability and global relevance.

Knowledge sharing

FOCUSS is an open access project committed to supporting the CCUS sector at large. Initial study results were presented at the 17th IEAGHG Greenhouse Gas Control Technologies Conference in Calgary, Canada, in October 2024. Final results were presented at the PCCC-8 Post Combustion Carbon Capture Conference in Marseille, France, in September 2025. Final data interpretations from modelling and testing results are currently being used to create public guidance documents for industrial deployment.

Marc Rudd, Director of Engineering and Asset Management, SSE Thermal said

“Power CCS will have an important role to play in providing low-carbon flexible back up to a renewables-led power system, so maximising CO₂ capture rate at all stages of operation is crucial in supporting a Clean Power system. SSE is developing large-scale power CCS projects at Keadby, in the Humber, and Peterhead, in Aberdeenshire, and is already deploying the learnings from this work while seeking to bring investment to industrial regions.”



FOCUSS project test rig at TERC research facility. Image credit: SSE Thermal



Greenhouse Gas Removal

GGR technologies remove CO₂, methane and other gases associated with climate change from the atmosphere. They will be important for the UK to reach net zero, balancing residual emissions from hard to decarbonise sectors.

The government's priority is to reduce emissions of greenhouse gases from human activities and to adapt to those impacts that are unavoidable. The purpose of GGRs is to balance the residual emissions from sectors that are unlikely to achieve full decarbonisation by 2050. It is not a substitute for decisive action across the economy to reduce emissions.

Some engineered GGRs require access to a CO₂ transport network to permanently store the removed CO₂. This includes technologies such as BECCS and direct air carbon capture and storage. We expect the GGR sector to become a major user of the CO₂ transport network by the

mid-2030s. The UK is well positioned to be a global leader in these technologies with world-class engineering expertise and access to offshore geological storage sites.

One programme was created under NZIP to address this challenge.

1. NZIP's Direct Air Capture (DAC) and GGR Innovation Programme

- **Objective:** to deliver at least one first-of-a kind demonstration plant by 2025. The longer-term objectives of the programme include identifying one or more ways of reaching metric tons of carbon dioxide equivalent (MtCO₂e) per year scale and achieving costs below £200 per tonne CO₂e removed.
- **NZIP expected spend:** £53.5 million.



Results

Under NZIP, 24 projects were awarded funding for feasibility and design. Of these, 15 progressed to demonstration. These demonstration projects were awarded funding for TRL4-6 systems capturing 100 tonnes per year (tpa) CO₂ and for TRL 6+ systems capable of capturing at least 1,000 tpa CO₂.

Through **the DAC and GGR Programme**, CO₂ has been captured from the air and sea at pilot scale for the first time in the UK. The central objective to achieve at least one first-of-a-kind demonstrator has been exceeded, as well as five biochar projects having captured solid carbon instead of CO₂ and four DAC plants having captured CO₂ including modular solutions, plus a further project in commissioning. In addition to this, one project is demonstrating the capture of methane emissions from cattle, and a marine direct ocean capture project has stripped CO₂ from seawater where the concentration of CO₂ is higher than in the air to help increase absorption of CO₂ from the atmosphere.

Moving from concepts and lab scale demonstrations to pilot plant has provided evidence of commercial viability of the next generation of carbon removal technologies. Additionally, the programme has:

- Developed non-amine methods of capturing CO₂.
- Substantially reduced the energy demand for carbon removals.
- Carefully assessed the impact on marine life under controlled conditions with the return of seawater when CO₂ has been removed.

- Evidenced the significant opportunity from biochar in net zero, reducing carbon removal costs, demonstrating its stability under the specific production conditions and offering other benefits such as water retention, odour control and enhanced crop production.
- Demonstrated a complete circular economy of biomass and peatland restoration, using pyrolysis with heat and power generation, through to organic food production and permanent carbon capture.

This is a nascent sector with uncertainties associated with the new technologies and markets being in their infancy. Therefore, NZIP support has been crucial for developing first-of-a-kind demonstrators in the UK.

In spring 2024, to support commercialisation, the Track 1 Hynet expansion process allowed GGR projects over 50,000 tpa CO₂ to apply to the CCUS cluster. This provided new opportunities for commercial deployment of GGRs at scale in the UK. In August 2025, DESNZ announced the list of projects progressing to negotiations for the Track 1 HyNet expansion.¹² It also published the GGR Business Model contract¹³ and Grant Funding Agreement, which will form the basis of these negotiations. The UK Emission Trading Scheme Authority is considering how GGRs could be integrated into the UK Emission Trading Scheme, and the government has commissioned the British Standards Institution to develop technology-specific GGR methodologies addressing quantification, monitoring and reporting.

Theme	GGR
NZIP expected spend	£53.5 million
Programmes	1
Projects	38
Jobs supported	210
Jobs outside London and South East England	83%
Percent of relevant projects that increased TRL	62%
Percent of relevant projects that increased TRL by two or more	56%
Percent of relevant projects that increased CRL	69%
Business relationships – formal	346
Business relationships – informal	213
Patents applied for	19
Patents granted	1
Follow-on funding projects	2
Follow-on funding value	£2 million
Projects reporting sales or licencing	2
Value of sales and licencing	£4 million

Progress summary

Through the DAC and GGR Innovation Programme, projects report they have successfully captured 800 tonnes of CO₂ equivalent (tCO₂e) and commissioned the UK's first long-term storage-enabled DAC facility.

The two-phase approach, focusing on project design and planning in phase 1, was highly valued by participants, as it effectively de-risked the construction phase of the demonstrators. Regular site visits provided government officials and regulators with the opportunity to observe the technologies in operation and engage directly with innovators. This collaborative and integrated approach has generated valuable evidence to inform policy development and support decision-making.



Industrial plant where a greenhouse gas removal system is tested. Image credit: Ole Jørgen Bratland, Equinor

Case study: Greenhouse Gas Removal



Project name:
ENCORE – Equinor

NZIP funding received:
£2.8 million

Total project cost:
£2.8 million

Programme:
DAC and GGR Innovation
Programme

The ENCORE (Environmental CO₂ Remover) project set out to demonstrate the first low temperature, liquid-based DAC system operating at scale. The project was awarded funding by NZIP's DAC and GGR Innovation Programme to design, build and test the demonstrator system.

Demonstrator performance

The demonstrator, located in the East Midlands, has exceeded expectations, demonstrating a capture rate of over 150 tpa against a 100 tpa ambition.

The process works by moving air through a large liquid-air contactor, which selectively removes CO₂ from the air. The CO₂ is then removed from the liquid, using thermal energy, at which point the liquid can be recycled. The CO₂ comes out as a high purity gas stream, which can then be processed for permanent sequestration or used in products such as sustainable fuels.

Technology readiness and scalability

The project marks a significant milestone in proving that the technology is safe and cost competitive. The liquid-based approach is optimised for scaled deployments as future plants grow towards the million tpa industrial capacities.

Embedded net removal design

CO₂ emissions embedded in the process are accounted for in the design, to ensure clarity on the net CO₂ removals. This supports genuine progress on our journey to achieving net zero.

Commercial potential

This low-cost DAC technology presents new solutions for companies with a CO₂ value chain to explore the carbon removal industry as a commercially attractive business opportunity for companies.

Morten Halleraker, Senior Vice President of New Business and Investments at Equinor, said:

“ This project is a good example of how Equinor can work together with strategic partners and the UK government to advance the understanding of a new-generation technology with the potential to deliver a cost-effective solution to remove CO₂. We are very grateful for the support and engagement from the DESNZ team and look forward to working with them in the future on carbon removal and other areas vital to achieving net zero. ”



Homes and Buildings

As of 2024, buildings sector direct emissions are responsible for approximately 21% of UK territorial greenhouse gas emissions. They have reduced by nearly 30% compared to 1990 levels. Of these emissions, around 66% are produced from the use of fossil fuels for space heating and hot water in residential buildings.¹⁴ To reduce these emissions, the UK plans to enhance buildings' energy efficiency through measures like improved insulation and the adoption of low-carbon heating systems. However, the journey to net zero faces barriers such as high costs, technological hurdles, and limited adoption by commercial and private property owners and occupants.

Programmes

1. Heat Pump Ready Programme

- **Objective:** to explore ways to make domestic heat pumps more accessible and appealing to consumers.
- **NZIP expected spend:** £32.0 million.

2. Green Home Finance Accelerator Programme

- **Objective:** to create new financial models to ease the initial homeowner investment needed for building energy efficiency improvements.
- **NZIP expected spend:** £19.7 million.



Environmentally friendly homes with rooftop solar panels and a heat pump installed. Image credit: Wondrwall

Results

The Heat Pump Ready Programme

focused on two key barriers to heat pump deployment. Stream 1 aimed to identify and resolve issues related to the efficient, high-density rollout of heat pumps in local areas. 11 projects under stream 1 assessed the feasibility of their proposed high-density deployment methods, with four advancing to trial their approaches. A clear takeaway from these local deployment projects was that, despite being very resource intensive, local engagement and extensive peer-to-peer support were crucial to bringing customers along on the journey.

Stream 2 projects concentrated on developing tools, technologies and processes to address specific obstacles in domestic heat pump deployment, such as creating enhanced 'heat pump readiness' assessments for potential customers. A total of 34 projects received funding under this stream to deliver a range of outputs. These included innovation in heat pump design leading to smaller systems occupying less internal space, with up to 20% reduced operational costs compared to standard heat pump systems. They also included a breakthrough in heat pump financing with bundling heat pump installations into long-term securitised financial products that can attract large-scale investment at competitive interest rates.

Stream 3 facilitated knowledge sharing across the programme and with the wider heat pump sector. This enhanced information exchange between projects and provided guidance, tools and training to ensure learnings from the programme informed a range of stakeholders, including improving installer and customer experience.

The Green Home Finance Accelerator

supported lenders in developing and testing innovative green finance products and services, like home improvement loans, to encourage domestic energy performance enhancements. The programme developed a diverse range of green finance products, fostered partnerships between lenders and energy efficiency providers, and reduced consumer barriers towards investing in energy efficiency and low-carbon heating. This initiative aimed to unlock private financing to help as many UK homes as possible decarbonise and achieve improved energy efficiencies. During the discovery phase, 26 projects received grant funding, with 13 moving on to the pilot phase.

Theme	Homes and buildings
NZIP expected spend	£51.7 million
Matched funding	£21 million
Programmes	2
Projects	88
Closed projects achieving all objectives in full	63%
Closed projects achieving at least some objectives in full	81%
Jobs supported	750
Percent of relevant projects that increased TRL	92%
Percent of relevant projects that increased TRL by two or more	85%
Percent of relevant projects that increased CRL	91%
Business relationships – formal	181
Business relationships – informal	341
Patents applied for	19
Patents granted	0
Follow-on funding projects	3
Follow-on funding value	£13 million
Projects reporting sales or licencing	10
Value of sales and licencing	£7 million

Progress summary

Decarbonising the UK's homes requires a range of innovations – not just in the technologies being installed in homes, but also in how they are managed and making the transition easier and more appealing for consumers.

Through the Heat Pump Ready and Green Home Finance Accelerator Programmes, innovation has been brought forward across a number of areas, from reducing the size of heat pump systems so they can fit in smaller homes, to the testing of financial products to support consumers with the upfront cost of a heat pump. A vast amount of insight has been gained on the need for breadth and choice in availability of financial products to cater to varying different consumer needs. Through this, consumers can feel better supported in decarbonising their homes.

The department's recent 'Solar Roadmap: United Kingdom Powered by Solar'¹⁵ highlighted initiatives such as the Green Home Finance Accelerator, which supported Sunsaver's Electric Roof Project, as strong examples of government and industry working together to deliver financial solutions for householders. The Boiler Upgrade Scheme and certification requirements consultation also identified Heat Pump Ready as a key innovation initiative, helping to overcome barriers to heat pump deployment and driving forward product design innovation.

Insights and learnings from both the Green Home Finance Accelerator and Heat Pump Ready Programmes are actively informing the development of the government's forthcoming Warm Homes Plan.



Factory visit showcasing advanced heat pump technology. Image credit: Cube X

Case study: Homes and Buildings



Case study: Total Heat Pump Installation Solution (THIS) – Heatly

NZIP funding received:
£1.6 million

Total project cost:
£1.7 million

Programme: Heat Pump Ready

Heatly's objective was to streamline and expedite the heat pump installation process by developing an integrated software package that can complete a full typical house survey in under 10 minutes. The platform is aimed at both installers and consumers by using just a smartphone. The intention was to complete a full heat pump system design and procurement solution, and follow the process through to post-installation.

Key aims:

In particular, the project aimed to:

- Reduce the time and cost of standard heat loss surveys by enabling a full room-by-room heat loss survey of a property using a smartphone app, 3D modelling and augmented reality.
- Develop a fully integrated management tool including equipment procurement and documentation management.

User-centric design

Consumers can see exactly how a heat pump system, including radiators, will look in their property before installation. The Heatly platform has the potential to be a step change in shortening and simplifying the heat pump customer journey and accelerating the rollout of heat pumps into the mass market.

Regional Growth

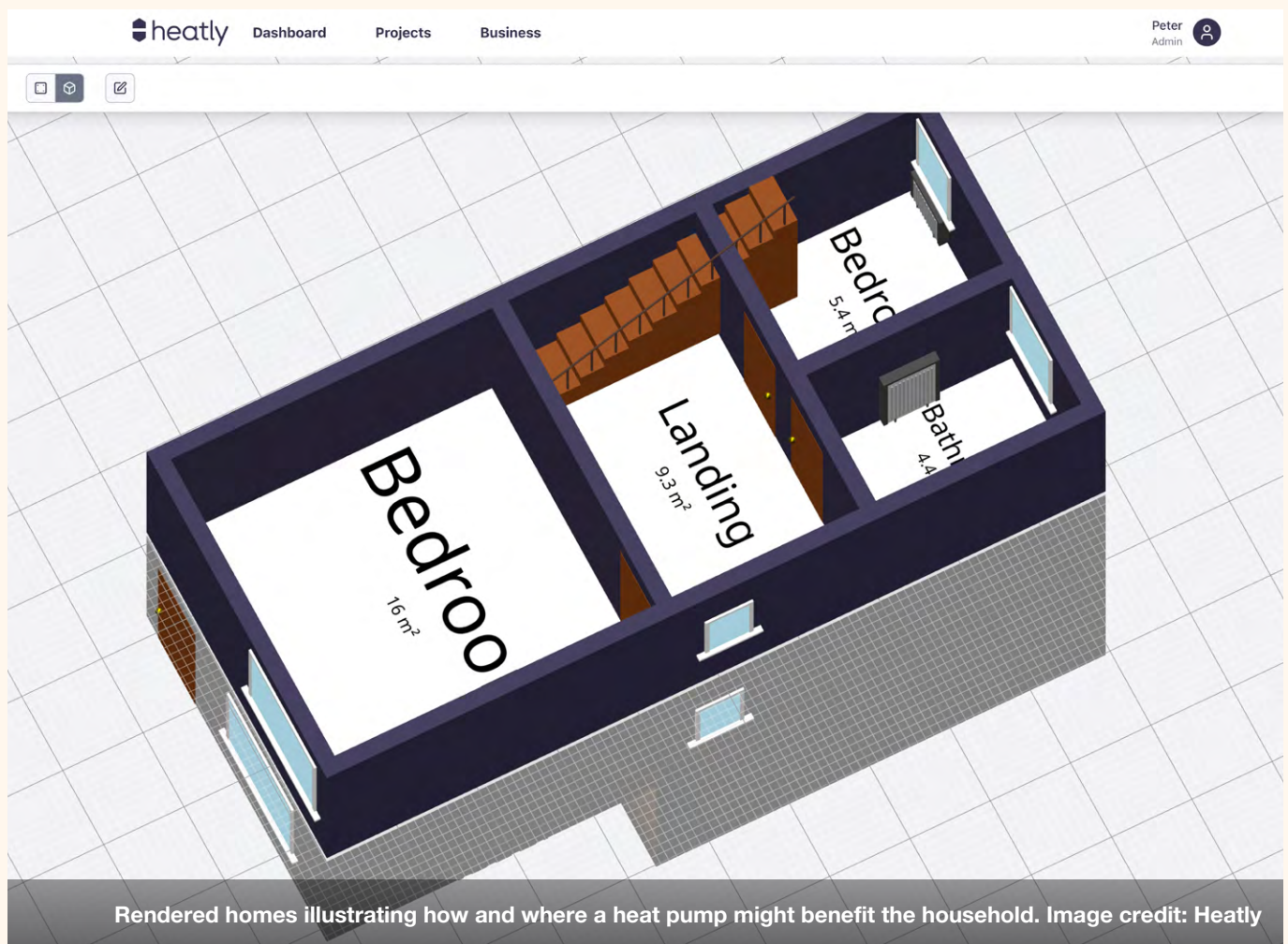
Over the funded project lifetime, Heatly has grown from a team of two to over 30 staff members in their West Yorkshire base.

Commercial Readiness and Future Plans

This success culminated in 2024 when United Living Group acquired a majority stake in the company (now United Infrastructure) with a multi-million pound investment. Following the conclusion of the funded work, Heatly now has a market-ready product that is currently in final user acceptance testing. The full launch of Heatly will take place by the end of 2025.

Griff Thomas, founder of Heatly, said:

“Heatly’s participation in the Heat Pump Ready Programme has fundamentally shaped our trajectory. The programme provided the foundation for us to build an integrated digital platform that solves the key challenges installers encounter throughout the entire process – from property surveys to final commissioning. This support has propelled our mission to streamline heat pump installations, making them more efficient and accessible for both trade professionals and property owners. With backing from United Infrastructure, we’ve transformed our development approach by establishing an internal team of skilled software engineers, system architects and data scientists. This strategic shift has resulted in a ten-fold expansion of our workforce.”



Rendered homes illustrating how and where a heat pump might benefit the household. Image credit: Heatly



Disruptive Technologies

The Disruptive Technologies theme emphasises new and emerging technologies that have the potential to aid in decarbonisation, with strong industry support for speeding up innovation. It provides crucial support to entrepreneurs and early-stage innovators, helping them develop and commercialise their innovations to bring them closer to market.

Programmes

1. Energy Entrepreneurs Fund (EEF)

- **Objective:** aimed at increasing the economic impact of UK industry in decarbonisation, EEF supports the development of technologies, products and processes in the areas of energy efficiency, power generation, heat generation, industrial decarbonisation, and energy storage to reduce greenhouse gas emissions and increase energy security.
- **NZIP final spend:** £45 million.

2. Space-Based Solar Power (SBSP) Innovation Programme

- **Objective:** this joint programme with the UK Space Agency was launched in 2022 to develop key technology areas to improve the feasibility of SBSP as well as explore its technological and commercial case.
- **NZIP final spend:** £5.4 million.

3. Artificial Intelligence for Decarbonisation Innovation Programme

- **Objective:** to support the development and adoption of artificial intelligence (AI) technologies for decarbonisation applications to support the UK's transition to net zero and ensure the UK remains at the forefront of action on both decarbonisation efforts and AI development.
- **NZIP final spend:** £3.2 million.



RFC Power's first 10kWh system demonstrator, delivering 10 hours of storage. Image credit: RFC Power

Results

The **EEF** supports UK industry in developing technologies that cut emissions and boost energy security across areas like energy efficiency, power and heat generation, industrial decarbonisation, and energy storage. Round 8 (launched in February 2021) awarded funding to 58 projects, while round 9 provided funding to 37 projects. Supported innovations span sectors and include improved wind turbine maintenance, advanced power cable coatings, novel battery chemistries, low-carbon building materials, efficient textile dyeing and refrigeration technologies.

The £5.5 million **SBSP Programme**, jointly funded by NZIP (£3.3 million) and the UK Space Agency (£2.2 million), launched in 2022 to explore the feasibility and commercial potential of SBSP. Funding was awarded to eight leading universities and technology firms across four themes: wireless power transmission, concentrated solar photovoltaics, systems energy engineering, and space mission architecture. Deliverables included indoor demonstrations of novel wireless power transmitters. The programme also supported innovations with terrestrial applications, such as in-flight power beaming for drones and more efficient, cost-effective solar power technologies.

The funding allocated to the **AI for Decarbonisation Innovation Programme** supported the development and adoption of AI technologies for decarbonisation across sectors such as energy, manufacturing, agriculture, transport and smart grids. It also established the Artificial Intelligence for Decarbonisation Virtual Centre of Excellence (ADViCE), an online hub connecting AI experts and industry to accelerate AI-driven climate solutions. ADViCE identified seven key focus areas for AI in enhancing energy security and achieving net zero and published papers offering strategic guidance on AI adoption, sustainable data centres, and positioning the UK as a global leader in climate-focused AI. Its work aligns with international efforts, including the Sustainable AI Charter signed at the Paris AI Summit.

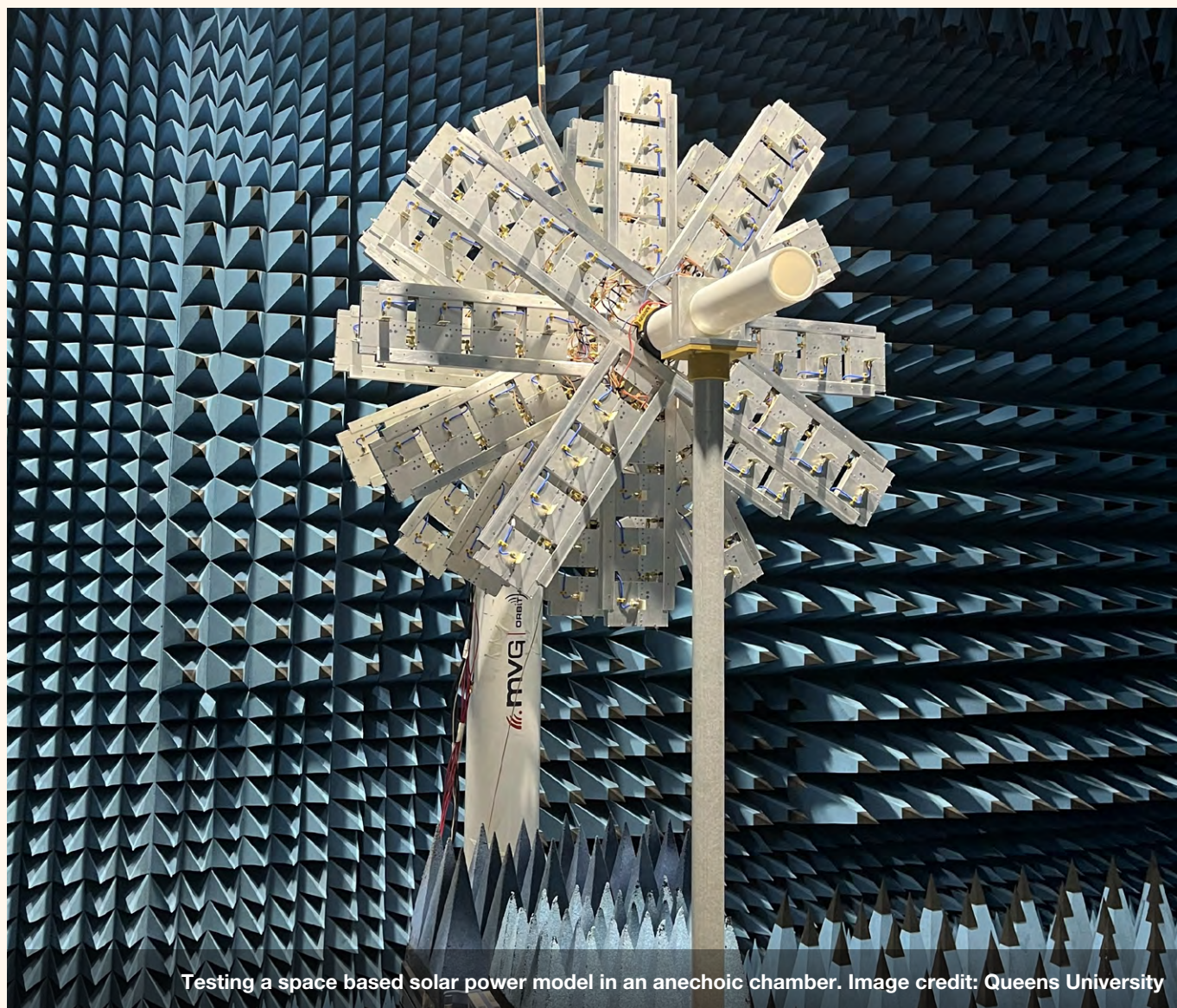
Theme	Disruptive technology
NZIP final spend	£53.6 million
Matched funding	£20 million
Programmes	4
Projects	123
Closed projects achieving all objectives in full	72%
Closed projects achieving at least some objectives in full	89%
Jobs supported	1,210
Jobs outside London and South East England	64%
Percent of relevant projects that increased TRL	91%
Percent of relevant projects that increased TRL by two or more	69%
Percent of relevant projects that increased CRL	89%
Business relationships – formal	499
Business relationships – informal	499
Patents applied for	92
Patents granted	26
Follow-on funding projects	21
Follow-on funding value	£24 million
Projects reporting sales or licencing	32
Value of sales and licencing	£29 million

Progress summary

There is a wide range of companies and organisations in the UK that have high-quality innovative ideas that will both make net zero cheaper and develop strong economic growth, while ensuring energy security. This support involves grants, matched by private capital, but also access to new developing international markets and help in commercialisation activities to ensure the UK remains in the lead in the global race to decarbonisation.

This programme has demonstrated that a targeted innovation programme, responsive to innovator needs, can deliver considerable overall benefit to the UK.

In many cases, the work started out in the Disruptive Technology Programme has now turned into mainstream policy. For example, AI is now recognised as an enabler for meeting net zero, and promoting the safe and secure adoption of AI within the energy system is one of the key objectives of the recently established AI Energy Council set up by government.¹⁶



Testing a space based solar power model in an anechoic chamber. Image credit: Queens University

Case study: Disruptive Technologies



Case study: Photovoltaic Forecasting Using Real-Time Weather and Satellite Data – Open Climate Fix

NZIP funding received:
£0.1 million

Total project cost:
£0.1 million

Programme: Artificial Intelligence for Decarbonisation Innovation Programme

Accelerating the rollout of solar photovoltaic (PV) panels is one of the crucial ways of the UK hitting our 2030 clean power ambition due to the relative ease of installation and scale-up. As of July 2024, there are approximately 1.4 million domestic solar installations currently operational in the UK. However, their intermittency presents challenges, as they cannot be scheduled with the same predictability as traditional fossil fuel generation. To compensate, the National Grid Electricity System Operator encourages power grids to overproduce energy which usually comes from fossil fuels.

Open Climate Fix's objective is to use AI to integrate satellite imagery, weather data and real-time solar PV generation data to create an open-source foundational model for forecasting near-term, hyper-local solar PV generation. This project aims to improve grid load forecasting, which will enable improved scheduling of generation assets and reduce network congestion and renewable energy curtailment.

Boosting solar forecast accuracy

The project achieved a 10% improvement in solar PV accuracy by accounting for the tilt and orientation of solar panels and expanding their weather data sources.

Commercial partnerships

As a result of this project, Open Climate Fix signed their first paid contract with a smart home optimisation start-up that will use their forecasts to help households with renewable assets to manage their energy usage better.

Ongoing research and development

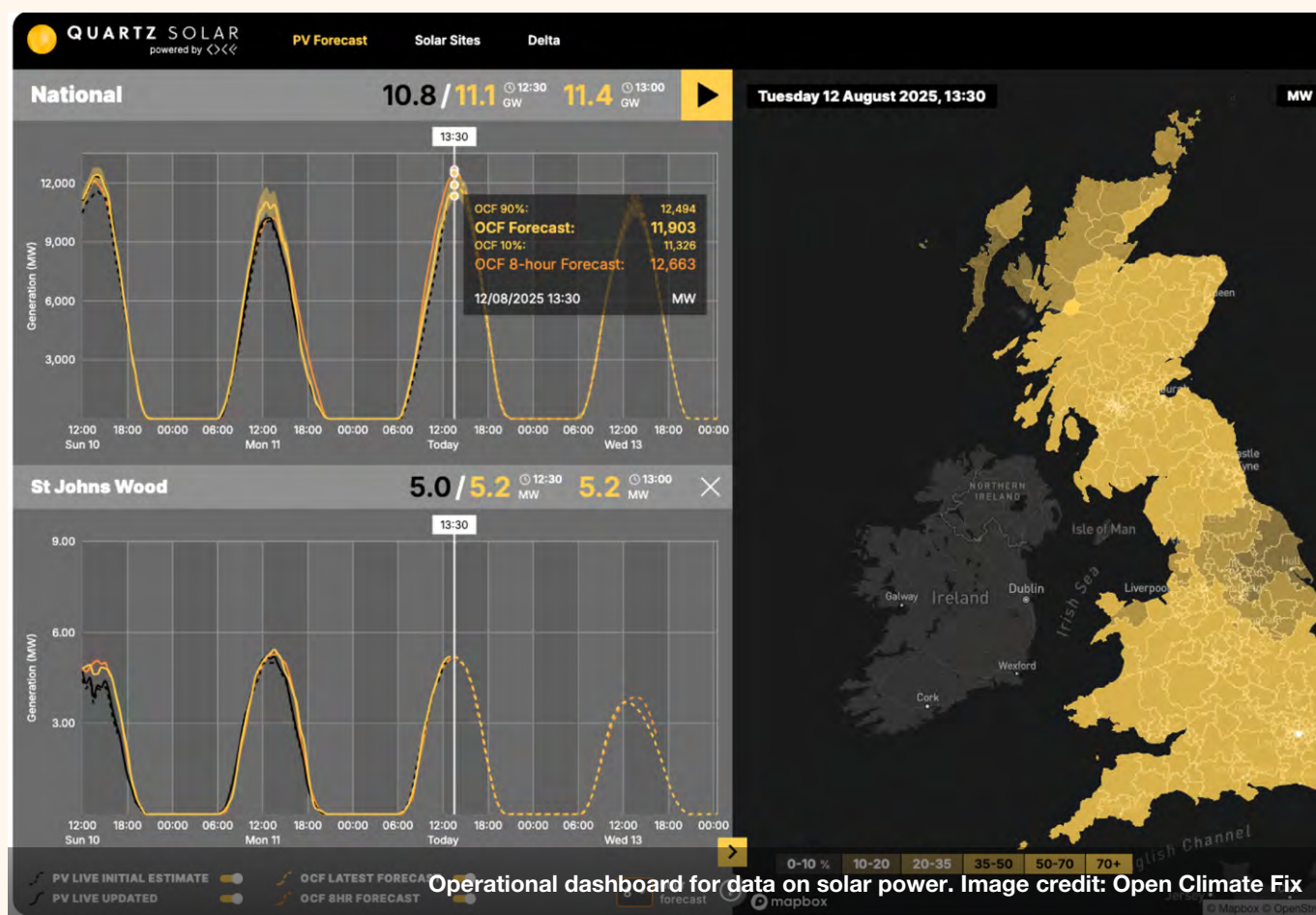
Open Climate Fix continues to develop its product and previously collaborated with the Alan Turing Institute to create Cloudcasting, an innovative forecasting tool that predicts future satellite imagery of cloud movements to improve solar accuracy.

Recognition

The project was selected as one of ten finalists in the inaugural Manchester Prize, which concluded in March 2025. It was also named among the Top 100 Startups of 2025 by startups.co.uk, recognising its contribution to climate innovation and its growing presence within the UK's startup ecosystem.

Dan Travers, Co-Founder of Open Climate Fix, said:

“ The support we received from DESNZ was invaluable. The innovation grant accelerated the development of our AI solar generation forecasts for UK-based solar farms and domestic solar panels. The forecast is now used across a variety of UK sites, saving costs for green energy users and encouraging faster uptake of renewable power sources. Aside from the financial support, we are grateful for the credibility given to us by the UK government’s endorsement of our project. ”



Concluding remarks

NZIP was established to accelerate the development of technologies essential to achieving net zero. Since the last progress report in 2023, many projects have progressed from early-stage concepts to demonstrators and market-ready solutions. This marks a pivotal shift from innovation to deployment – a transition essential for the UK to become a clean energy superpower. This will continue to require close co-ordination across government, industry and investors, with a renewed focus on adoption, rollout and long-term value creation.

From a technological perspective, NZIP has enabled high-profile successes like the Rolls-Royce SMR, which has been selected as the preferred bidder to partner with Great British Energy – Nuclear to develop small modular reactors, marking a new golden age of nuclear in the UK. This is one of the many examples demonstrating how UK-led innovation is delivering real-world solutions with global significance.

NZIP's impact goes beyond individual technologies. It has laid the foundation for a net zero economy by de-risking clean technology development, supporting commercialisation pathways, and shaping new business models and supply chains. These are essential not only for decarbonising power, buildings and industry, but for driving regional growth and long-term energy security.

The programme has helped generate more than 7,500 jobs, 86% of which were located outside London and the South East. The geographic spread reflects the portfolio's ambition to build on existing strengths in industrial heartlands, as well as develop new industries across the country. For example, the Floating Offshore Wind

Demonstration Programme catalysed regional supply chains in Scotland and East Anglia, enabling firms like Marine Power Systems to successfully develop modular floating platforms for deep-water wind turbines; and Highview Power are constructing one of the world's largest long duration energy storage facilities in Carrington in Manchester. With completion targeted for 2026, this project is expected to create over 700 jobs during the construction phase and across the energy supply chain.

Alongside job creation, nurturing future talent is critical to securing the long-term growth of these emerging industries. For example, through the Acceleration Support Programme more than 20 apprenticeships were created, as well as equipping project teams with a broad set of skills – from project management to sustainability expertise – to ensure that the workforce is prepared to lead the UK's clean technology transition. By building capability within companies at the forefront of clean technology innovation, the programme helped to embed lasting skills needed for the net zero economy.

So far, NZIP projects have secured £690 million in matched funding and a further £147 million in follow-on funding, demonstrating strong market confidence in the portfolio. In addition, 64 projects have already reported income from sales or licencing, generating a combined value of £80 million – showing that government-backed innovation is creating early commercial returns. In other areas, financial returns could not be realised within the lifetime of the project. These include projects in areas such as bioenergy, where earlier stages of development and the commercial terms

for awarding funding limited early financial returns. However, the technical advances achieved have increased the likelihood of commercial success in the longer term.

Another area of impact is the valuable lessons NZIP has provided on the role for government in supporting clean technology innovation.

These include:

- The need for long-term support through to deployment, not just early-stage innovation.
- Support for SMEs to navigate investment, scale and market access challenges.
- Programme and project-level evidence to inform real-time decision-making and policy.
- Cross-sector co-ordination to amplify outcomes and reduce duplication.
- Identification of common delivery barriers – like planning delays, consumer recruitment and matched funding – which should be addressed early to accelerate progress and enable innovation to move beyond demonstration.

Innovation is high risk but high reward. Government has a critical role to play in supporting early-stage, transformative projects that the private sector alone may be unwilling to back. While not every project achieved its full intended outcome, each has generated valuable insights that will strengthen future innovation and deployment. Where projects were closed early due to technical or commercial challenges, this reflected a pragmatic and adaptive approach in delivery of NZIP.

NZIP has delivered strong progress in accelerating the development and commercial readiness of key net zero technologies. The knowledge generated through NZIP has already influenced wider government strategy and accelerated our progress toward net zero. However, the need for innovation remains. We will continue to work closely with the clean technology sector to identify emerging gaps and ensure the right support is in place to drive continued progress. Building on NZIP's momentum, the UK is well positioned to lead the deployment of next-generation technologies – converting innovation into economic growth, enhanced energy security and lower costs for consumers.

References

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Department for Energy Security and Net Zero (2023), *Biomass Strategy*. Available at: www.gov.uk/government/publications/biomass-strategy

Department for Energy Security and Net Zero (2023), *Carbon capture, usage and storage: A vision to establish a competitive market*. Available at: www.gov.uk/government/publications/carbon-capture-usage-and-storage-a-vision-to-establish-a-competitive-market



Inspecting and filling a traditional oak barrel during a visit to a Scotch whisky distillery, applying net zero technologies in the production process. Image credit: Supercritical

Annex A: Methodology

The quantitative data presented in this report is the result of analysing the KPIs collected from all projects. KPIs measure project-level inputs (such as funding), outputs (such as objectives achieved), outcomes (impact on jobs or sales) and long-term impacts (such as on energy demand). All projects are required to provide KPI data at project start, annually during delivery, at close and for three years post-closure. The data helps evidence what NZIP-funded projects have delivered, how this compares with expectations and how this compares with previous funding initiatives.

For this report, we have aggregated the KPIs to theme and portfolio levels of granularity.

The data for reporting progress represents 74% of NZIP projects and is based on a subset of the 469 projects who have provided returns during delivery or at close. We also have start data for 534 projects from which we have drawn demographics.

We do not require projects to provide data for every KPI. The relevance of each KPI to the project is determined at project inception. Where percentages are reported, they represent the percentage of the projects for which the KPI is relevant. Where percentages are based on a small sample of projects (five or fewer), figures have not been reported.

The following limitations apply to the findings.

- Innovation and its commercialisation is a long process, and we report here the findings of projects that have closed recently. This limits the ability to assess longer-term impacts, and the findings presented here should be seen as early indicators. We are planning to continue to collect this data to enable an assessment of longer-term progress.
- The data here shows high-level, summarised, quantified measures of complex processes. It gives limited insight into why we are seeing the results we are seeing. For that purpose, most programmes are also subject to separate evaluation activity.

KPI	KPI description	Metrics
KPI 1	Number of NZIP projects supported	• Project start and completion.
KPI 2	Number of NZIP projects that have met objectives	• Extent to which project objectives have been met to date. • Change in objectives and reasons for change.
KPI 3	Number of organisations supported to deliver the project	• Lead partner delivering the project: name, organisation size and number of jobs supported within the organisation to deliver the project. • Other partner organisations involved in delivering the project as named on the contract or grant: name, organisation size and number of jobs supported within the organisation(s) to deliver the project.

KPI	KPI description	Metrics
KPI 4	Number of active contractual and non-contractual business relationships supported	- Number of contractual relationships: name and type of contractual relationship. - Number of formal non-contractual business relationships: name and type of non-contractual relationship. - Extent to which your organisation expanded its network of business relationships because of the project.
KPI 5	Technology advancement	- TRLs (current and anticipated). - Other technology improvement indicators: patents applied for or granted, academic, technical or non-technical publications generated, and knowledge exchange events attended (such as conferences).
KPI 6i	Initial financial leverage to deliver project	Project funding structure: amount in millions of pounds of Department for Business, Energy and Industrial Strategy, other public sector and private funding.
6ii	Follow-on funding secured	Amount of follow-on funding raised and the source (public or private)
KPI 7i	Reduction in energy costs	- Scope and scale of impact on reducing energy costs. - Route to reducing energy costs.
7ii	Increased energy efficiency or reduced energy demand	Scope and scale of impact on reducing energy demand or increasing energy efficiency.
7iii	Increase in energy system flexibility	- Scope and scale of impact on energy system flexibility. - Route to increasing energy system flexibility.
KPI 8	Commercialisation advancement	- Commercial readiness levels (current and anticipated). - Steps towards commercialisation including licencing agreements, commercial partnerships, product certifications, as well as national or international standards passed. - UK and international sales secured and their value (in millions of pounds).
KPI 9	CO2 emissions reductions	- Scope and scale of project impact on carbon emissions. - Route to achieving carbon emissions reductions.
KPI 10	Policy impact	- Whether, how and to what effect evidence from the project has informed policy development. - Whether projects have engaged in activities with industry or civil society.

Annex B: List of acronyms

Acronym	Definition
AMR	Advanced modular reactor
ANF	Advanced Nuclear Fund
BECCS	Bioenergy with carbon capture storage
CCUS	Carbon capture, usage and storage
CRL	Commercial readiness level
DAC	Direct air capture
EEF	Energy Entrepreneurs Fund
GGR	Greenhouse gas removal
MtCO ₂ e	Metric tons of carbon dioxide equivalent
NZIP	Net Zero Innovation Portfolio
PV	Photovoltaic
SAF	Sustainable Aviation Fuel
SBSP	Space-based solar power
SME	Small to medium-sized enterprise
SMR	Small modular reactor
tpa	Tonnes per year
TRL	Technology readiness level

Endnotes

- 1 [Provisional UK greenhouse gas emissions statistics 2024 – GOV.UK](#)
- 2 Share of emissions reductions to reach net zero by 2050 from technologies that are not commercially available, 2024 – Charts – Data & Statistics - IEA
- 3 Department for Energy Security and Net Zero (2023), Net Zero Innovation Portfolio and the Advanced Nuclear Fund progress report 2021 to 2022. Available at: <https://assets.publishing.service.gov.uk/media/646f13627dd6e70012a9b34c/nzip-anf-progress-report-2021-22.pdf>
- 4 See Annex A for the full list of KPIs and further details of the data and analysis, including caveats.
- 5 Department for Energy Security and Net Zero (2021), Net Zero Research and Innovation Framework. Available at: www.gov.uk/government/publications/net-zero-research-and-innovation-framework
- 6 Organisations brought on board in a contractual capacity such as subcontractors, supply partners or advisory group members.
- 7 Organisations brought on board without contract, in an advisory or joint delivery capacity, with a substantive contribution to the project – for example, academia, advisory board members, supply chain partners and trade bodies.
- 8 Department for Business, Energy and Industrial Strategy (2021), Appendix I: Electricity system flexibility modelling. Available at: <https://assets.publishing.service.gov.uk/media/60f57aade90e0764cd98a0a3/smart-systems-appendix-i-electricity-system-flexibility-modelling.pdf>
- 9 [Provisional UK greenhouse gas emissions statistics 2024 – GOV.UK](#)
- 10 [Industrial decarbonisation strategy – GOV.UK](#)
- 11 Next generation carbon capture technology: technoeconomic analysis work package 6
- 12 [HyNet expansion: project negotiation list – GOV.UK](#)
- 13 [Greenhouse Gas Removals \(GGR\): business model – GOV.UK](#)
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- 16 Department for Science, Innovation and Technology and Department for Energy Security and Net Zero (2025), AI Energy Council to ensure UK's energy infrastructure ready for AI revolution. Available at: www.gov.uk/government/news/ai-energy-council-to-ensure-uks-energy-infrastructure-ready-for-ai-revolution

