ENA Annual Innovation Summary Report 2025

The Voice of the Networks

energynetworks association

Introduction

Ofgem's Innovation Funding

Ofgem, the energy regulator, has introduced funding mechanisms for innovation as part of the network price controls. The current mechanisms include:

Network Innovation Allowance (NIA)

Ofgem created the Network Innovation Allowance to support projects that explore better ways of running energy networks. These projects can be technical, commercial, or operational, and must be directly related to the network itself. Each network gets a set amount of money through the NIA as part of its overall budget. The goals are to de-risk innovation, promote learning, and drive consumer value by helping networks trial new ideas that can make the energy system cleaner, smarter, and cheaper. This funding started during the RIIO-1 price control period, continued through RIIO-2, and will carry on into RIIO-3 for electricity and gas networks, as well as the National Energy System Operator (NESO). The periods covered by these price controls are presented below.

	Electricity Transmission	Electricity Distribution
RIIO-1	2013-2021	2013-2023
RIIO-2	2021-2026	2023-2028
RIIO-3	2026-2031	2028-2033

Network Innovation Competition (NIC)

The Electricity Network Innovation Competition (NIC) was used to fund new ideas through a yearly competition. Networks applied for funding to test and demonstrate new technologies or ways of working. This competition was replaced by the SIF (see right hand side) for RIIO-2.

Some of the projects included in this report were originally funded through the NIC. Some of these projects have continued in longer phases or have been built upon, meaning that the impact of this funding mechanism can still be seen in recent or ongoing innovation work.

Strategic Innovation Fund (SIF)

The Strategic Innovation Fund helps energy networks develop big ideas to support the UK's journey to Net Zero. Ofgem replaced the previous innovation scheme (NIC) with this fund during the RIIO-2 price control period. It supports large, transformational research and development projects that tackle specific challenges set by Ofgem. There are three fixed application windows each year. Over RIIO-2, the fund is expected to provide up to £450 million to support these types of projects.

SIF is competitive and typically allocated for larger-scale demonstration projects that may involve wide industry participation. Network companies must apply through Innovate UK – UKRI and funding is only given to projects that support the transition to Net Zero.

SIF projects follow a three-stage process:

Discovery - Exploring ideas and feasibility

Alpha - Developing and testing

Beta - Building and demonstrating

The three phases are designed to allow innovators and networks to explore truly novel ideas and build upon learnings at each round of funding, while the breakdown of projects into these phases reduces the capital risk at each stage.

Ofgem makes the decisions for SIF funding and Innovate UK - UKRI manages the process and supports innovators in line with the SIF Governance Document.

Introduction

About ENA

We represent the electricity networks that power homes and businesses across the UK and Ireland.

As the voice of the sector, Energy Networks Association (ENA) brings together the owners and operators of licensed transmission and distribution networks. Our members manage and maintain the critical infrastructure that keeps energy flowing safely and reliably.

We work to ensure our networks are among the safest, most efficient, and most sustainable in the world. We influence decision-makers on the issues that matter most to our members, including:

- Regulation and the wider representation in UK, Ireland and the rest of Europe
- Cost-efficient engineering services and related businesses for the benefit of members
- Safety, health and environment across the electricity industry
- The development and deployment of smart technology
- Innovation strategy, reporting and collaboration in GB.

We provide a strategic focus for the sector and act as a central channel of communication. We promote the interests and reputation of our industry and offer a forum for collaboration among our members.

We lead and support a wide range of innovation activities, including hosting events and conferences, such as our Annual Energy Innovation Summit.

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1.

Report highlights

1. Report highlights

1.1 Executive Summary / Key Takeaways

Our **Annual Innovation Summary Report 2025** showcases the impact of innovation across Great Britain (GB)'s electricity networks.

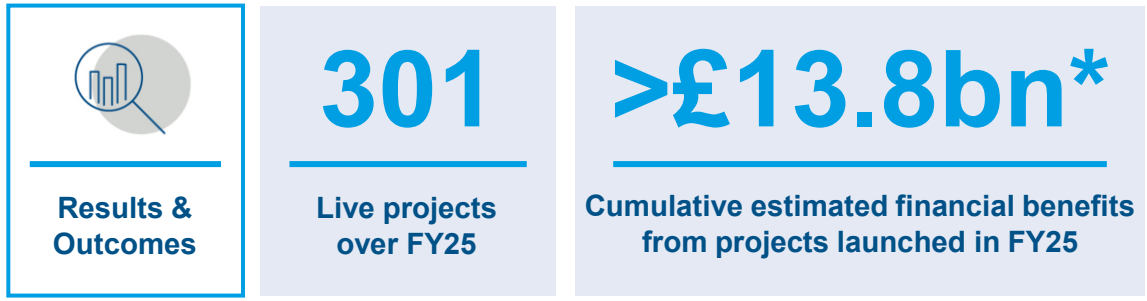
This year's report highlights how our members are investing in innovation to help build the energy system of the future and accelerate progress toward decarbonisation and Net Zero. Through key funding mechanisms like the Network Innovation Allowance (NIA) and the Strategic Innovation Fund (SIF), networks have committed millions of pounds to projects that deliver real-world benefits.

Guided by our shared innovation strategy and six core themes, we're driving a transition that is fast, fair, and efficient.

In FY25 alone, networks registered 120 innovation projects, with estimated financial benefits exceeding £13.8 billion from a total of around £150m of funding provided.

This report features a selection of standout projects, each demonstrating clear benefits for consumers and the wider electricity system.

Figure 1.1 – FY25 Innovation Overview



1.2 This Document

The Annual Innovation Summary Report builds on the individual Network Summary Reports to present an aggregated view of the progress made in Innovation over the past year. All electricity networks have contributed to this report, allowing it to give a cohesive overview of common Innovation themes and achievements through collaboration over the past year.

The report format has been updated this year to focus on guiding you through the innovation landscape and understanding the present picture across different networks, innovation themes, policy developments and key topics. Individual Network Summary Reports have further details on individual achievements and projects undertaken. These reports can be found here.

We intend this document, and the priorities, themes and principles it contains, to help enable collaboration and shape the sector's efforts over the years ahead through the sharing of challenges encountered and learnings taken over the innovation process. Further details on the networks' forward look to meet interim and 2050 targets can be found here.

* Note that financial benefits quoted here are projected future benefits of the impact of the innovation.

1. Report highlights

1.3 GB Electricity Networks

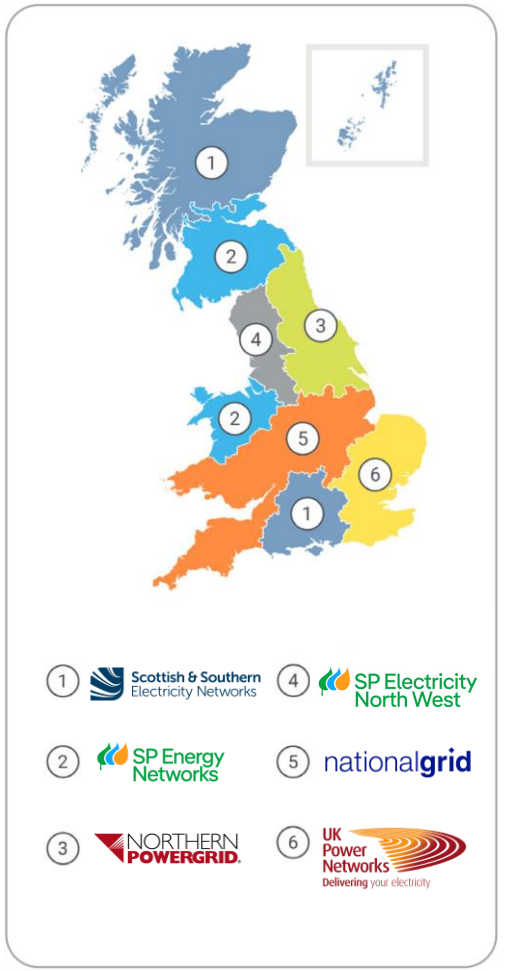
Electricity networks are critical to Great Britain's journey to Net Zero.

The nine network operators and the National Energy System Operator play a vital role in ensuring the electricity grid can meet the evolving needs of consumers in a changing energy landscape. There are two network types:

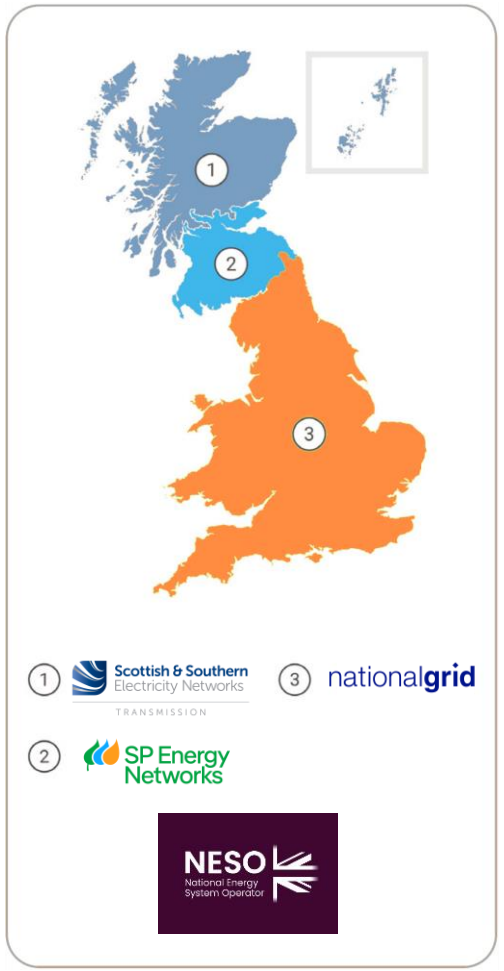
- **Transmission networks** – high-voltage systems that transport electricity over long distances from generation sources to regional distribution networks. They form the backbone of our national electricity system.
- **Distribution networks** – lower-voltage systems that deliver electricity from transmission networks directly to homes and businesses. These operate at a regional level and connect our infrastructure to everyday lives.

Together, these networks enable the transition to a smarter, cleaner, and more resilient energy future.

Figure 1.3 – All of the GB electricity networks, as well as NESO, the system operator for England, Scotland and Wales, have contributed to this report



Electricity Distribution Network Operators (DNOs)



Electricity Transmission System Operators (TSOs)

2.

FY25 Year in Review

2. FY25 Year in Review

2.1 Key Metrics

FY25 marks the second year of RIIO-ED2 for electricity distribution network operators (DNOs) and the fourth of RIIO-T2 for transmission system operators (TSOs). Data on all network projects and benefits have been tabulated and collated in the FY25 IMF[1] data (and the Balanced Scorecard – see Figure 2.1) referenced throughout this report.

The statistics presented in this report are not able to be directly compared to the FY24 report, as although this report represents another year of progress under RIIO-2, the FY24 report collated both electricity and gas networks' innovation data, whereas this year's report focuses solely on electricity networks.

The **Balanced Scorecard** highlights four performance indicator groups identified by the networks as key enablers of innovation: Strategy & Vision, Organisation & Culture, Capabilities & Technology, and Results & Outcomes. The three columns map these performance indicators to the three stages of the innovation process (1 - Initiation and Evaluation; 2 - Demonstration, Iteration, and Learning; and 3 - Deployment and Optimisation) to show how networks are performing against each indicator throughout the innovation process.

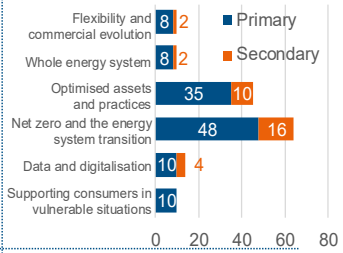
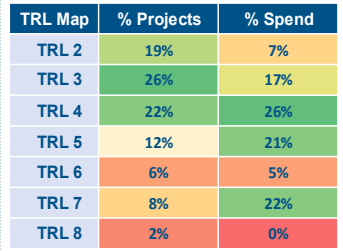
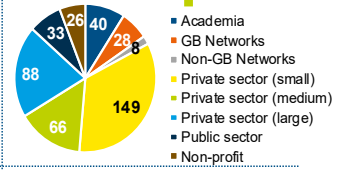
This year's scorecard shows continued strength in the number of ideas generated/received and in the number of projects registered from third party ideas. There have been several notable conferences held this year (discussed further on the next page) that have supported the development of new initiatives to facilitate even more ideas.

The 2025 Balanced Scorecard demonstrates significant progress in the number of projects registered and their distribution across innovation themes. FY25 has seen a robust total of 120 projects registered. Collaboration remains a key focus, as evidenced by the substantial number of projects developed from third party ideas. In FY25, 40 projects originated from external collaborations, while the number of project partners is 438.

[1] Innovation Measurement Framework – a mechanism by which networks submit data on innovation projects

2.2 Balanced Scorecard

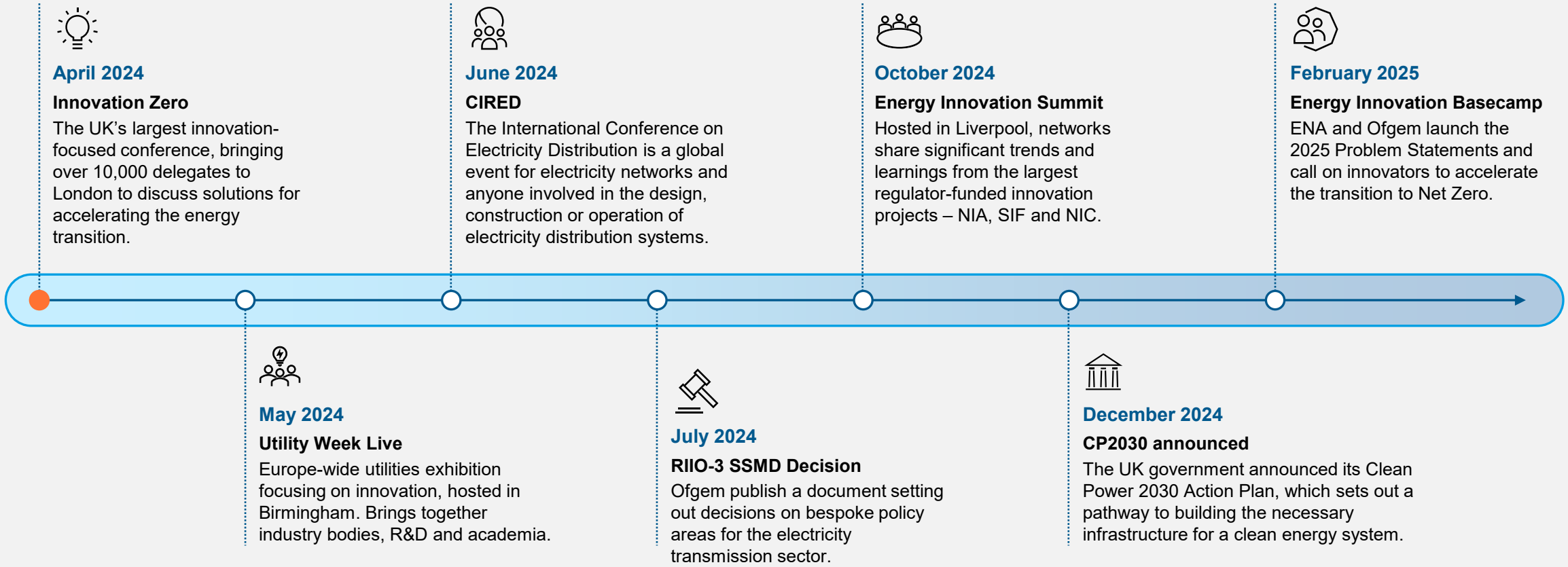
Figure 2.1 – FY25 Balanced Scorecard

	Initiation and Evaluation	Demonstration, Iteration, and Learning	Deployment and Optimisation
Strategy & Vision	Energy Networks Innovation Strategy 2025	244 Attendees at the Basecamp Launch event	
Organisation & Culture	721 Innovation ideas generated		120 Projects registered in the FY25 period
Capability & Technology	475 3rd party ideas received	40 Projects registered from 3rd party ideas	438 Project partners in RIIO-2 
Results & Outcomes	155 Projects being taken forward from ideas generated	301 Live projects over FY25	155 Projects closed in FY25

TRL Map	% Projects	% Spend
TRL 2	19%	7%
TRL 3	26%	17%
TRL 4	22%	26%
TRL 5	12%	21%
TRL 6	6%	5%
TRL 7	8%	22%
TRL 8	2%	0%

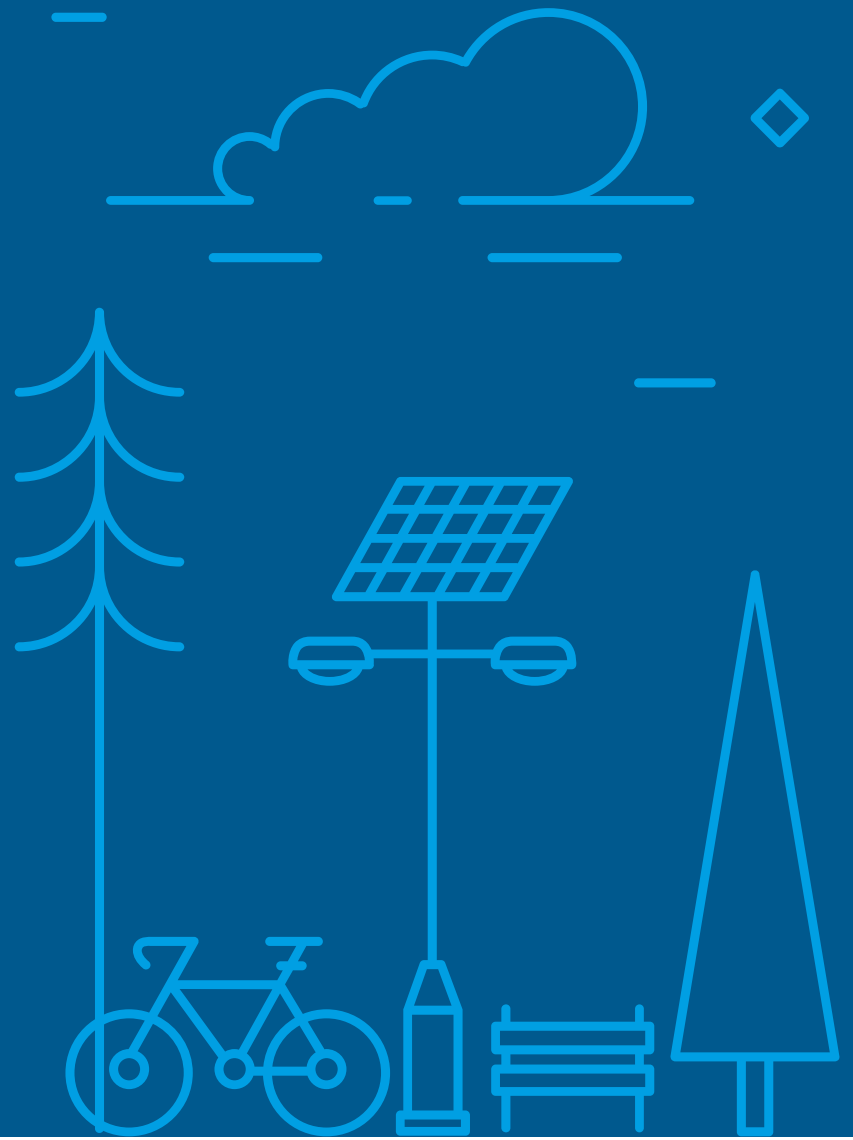
2. FY25 Year in Review

2.3 Innovation Key Event Timeline – FY25



3.

The Innovation Process



3. The Innovation Process

3.1 Energy Networks Innovation Strategy

Our updated Energy Networks Innovation Strategy sets a shared direction for innovation across gas and electricity networks[1].

Published in April 2024, the strategy brings together common principles and themes to guide how we work with innovators on solutions that deliver safe, resilient networks and support the transition to Net Zero.

At its core are three consumer-focused innovation objectives, shown in Figure 3.1 and set by Ofgem, which underpin all network innovation activity:

1. Maintain a safe and resilient network
2. Deliver an environmentally sustainable network
3. Meet the needs of consumers and network users

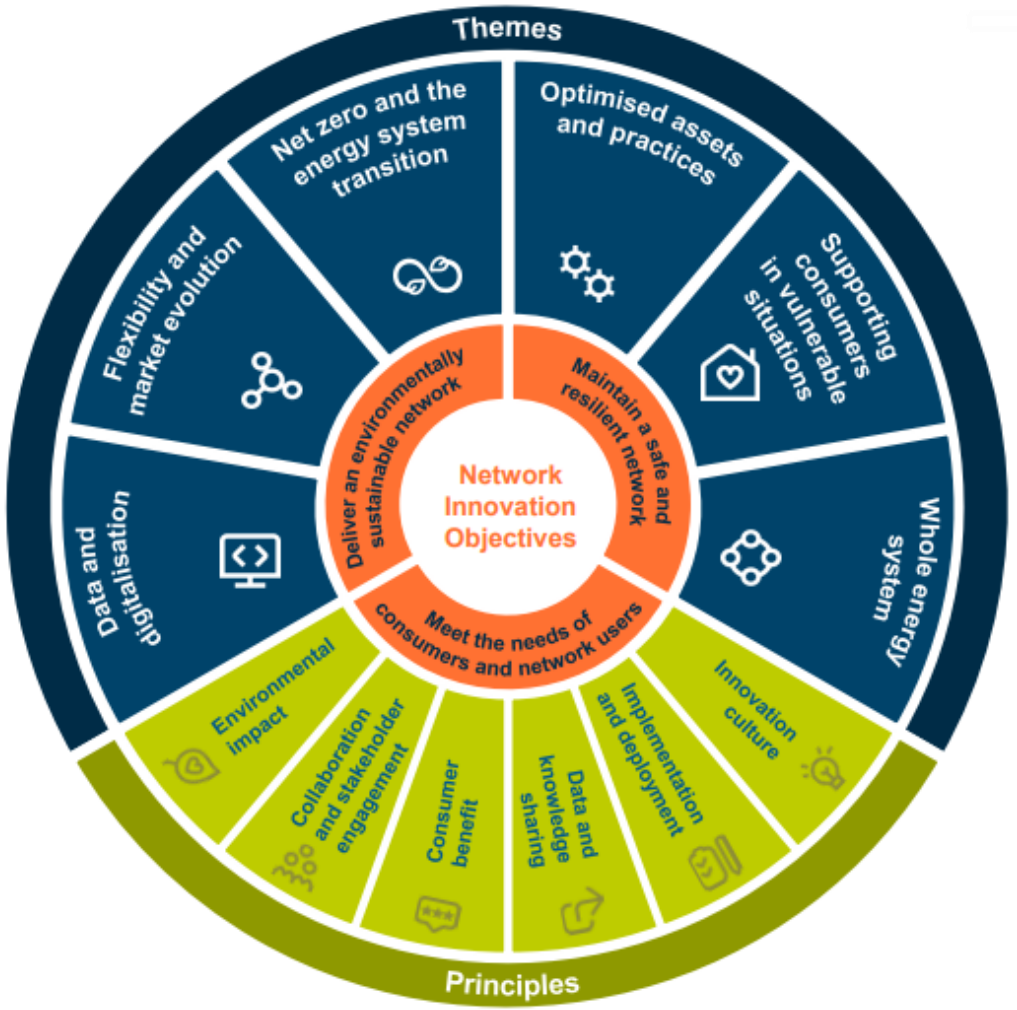
These are supported by a set of network innovation principles that apply throughout every stage of a project, as well as shared innovation themes, which are priority areas that reflect the biggest challenges facing our networks. All innovation projects must align with one of these themes to ensure we're focused on delivering meaningful impact.

Innovation Strategy Roadmap

The Innovation Strategy acts as a roadmap for how network operators can:

- Support the Net Zero transition
- Tackle emerging challenges to Great Britain's energy security
- Deliver better outcomes for customers

Figure 3.1 – The Energy Network Innovation Strategy: Objectives, themes and principles



[1] This will be replaced in future by a separate "Electricity Network Innovation Strategy" to provide clarity specific to electricity networks

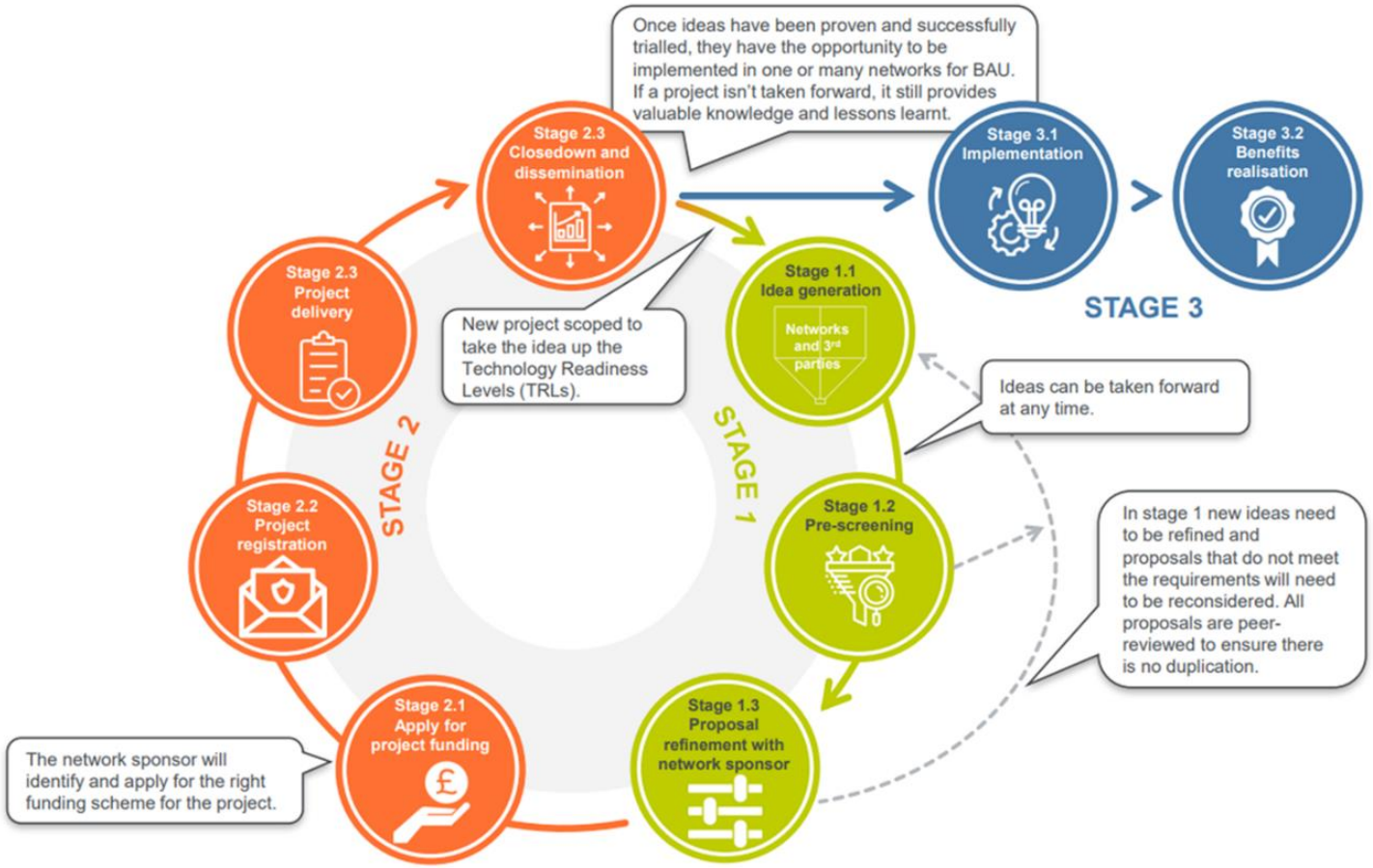
3. The Innovation Process

3.2 Innovation Project Process Overview

Network innovation projects follow a structured process from idea generation through to benefits realisation, regardless of theme or subject matter.

- The process, illustrated in Figure 3.2 begins with Stage 1 where ideas from networks and innovators are refined and aligned with the shared innovation themes described on the previous page.
- Once an idea progresses to Stage 2, the focus shifts to securing appropriate funding and successful delivery of the project. This stage includes critical steps of project registration, delivery, and dissemination of findings and lessons learnt. Dissemination of new knowledge created enables other projects to build on these insights.
- At this stage if a project demonstrates potential but requires further development, the project is cycled back to the first stage for additional trials or refinements, following a process of continuous improvement.
- In the final stage, Stage 3, project outcomes are realised. For some, this means that proven innovations are integrated into Business as Usual (BAU) operations and benefits are seen. Successful integration ensures that the benefits of innovation are delivered to consumers, smoothly and cost-effectively. Throughout this stage, networks collaborate with regulators, policymakers, and supply chain partners to ensure that innovations are implemented safely and effectively.
- Projects which do not progress to BAU operations can still deliver significant value by supporting policy decisions, contributing to evidence building, furthering learning and providing options to support a just Net Zero transition.

Figure 3.2 - The innovation process

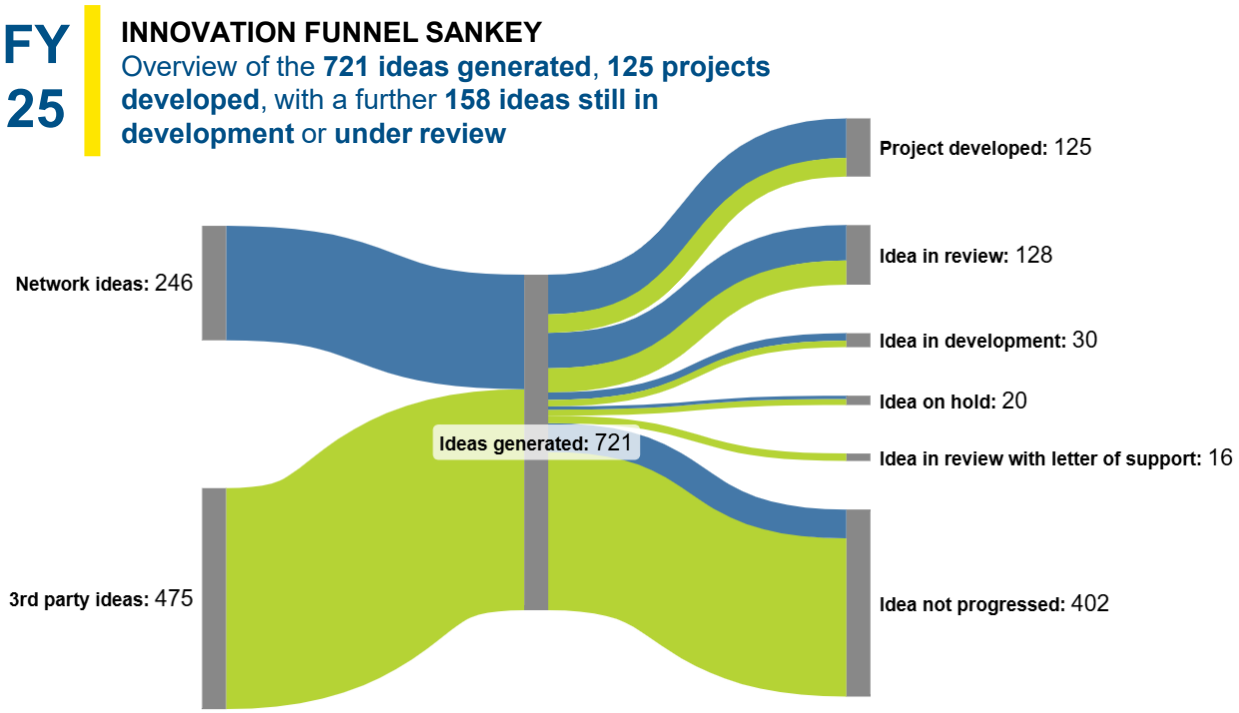


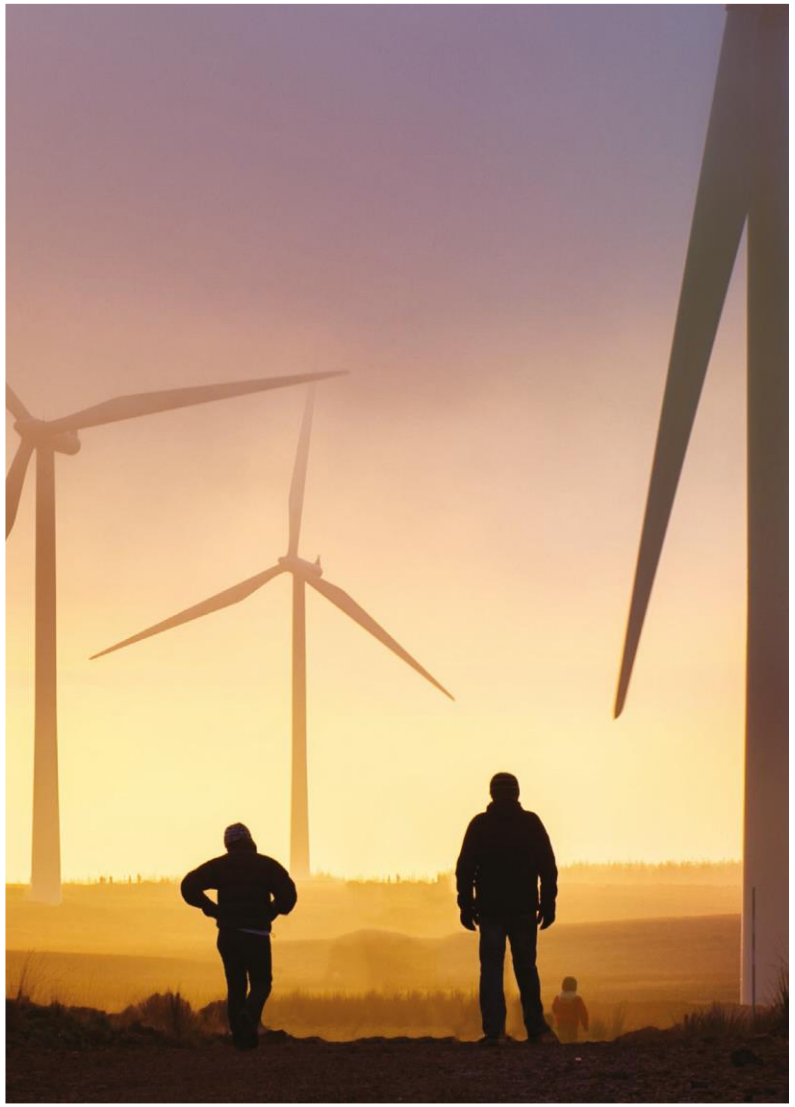
3. The Innovation Process

3.3 The Innovation Funnel

This section demonstrates how ideas are funnelled through the innovation process from ideas generated, to projects developed. The progress of the 721 ideas reviewed by the electricity networks and system operator, of which 475 came from external partners, is shown in Figure 3.3 below. The robust governance process used to evaluate these ideas ensures that those that progress into projects are good value for money and are aligned to the shared set of network goals.

Figure 3.3 The innovation funnel for ideas received in FY25



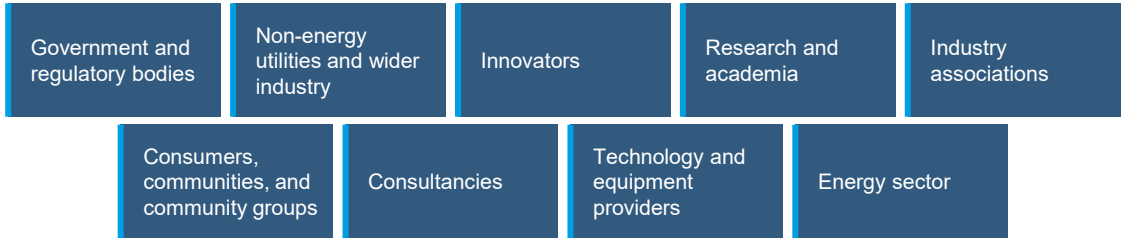


3. The Innovation Process

3.4 Our Stakeholders – who participates in innovation

An electricity network stakeholder is any individual, group or organisation that has an interest in the present or future state of our energy system. This includes:

Figure 3.4 - Electricity network stakeholders



ENA and our member networks work to strengthen engagement with a broad range of stakeholders, including non-governmental organisations (NGOs), public sector bodies and small and medium-sized enterprises (SMEs). We also collaborate with research-focused bodies and academia to foster innovation through shared expertise and experimentation.

Our stakeholder engagement goes beyond individual projects. For example:

- **NESO** welcomed international stakeholders from Japan and Singapore into their control room to exchange ideas on grid decarbonisation through innovation.
- At Utility Week Live in 2024, the **National Grid** Innovation team took part in various interactive sessions to boost stakeholder engagement. Highlights included:
    - Phillipa Slater, Director of Asset Management and Operations Support, led a session on Net Zero flexibility vision for flexible distribution networks.
    - Liza Troshka (Innovation and Deployment Engineer), Nina Klein (Ofgem Flexibility Project expert), and Jamie Bright (UKPN Data Science and Development Manager) to lead a collaborative exchange session: “How can energy companies create an accurate efficiency digital model to understand and forecast constraints?”

3.5 Our Approach to Stakeholder Engagement

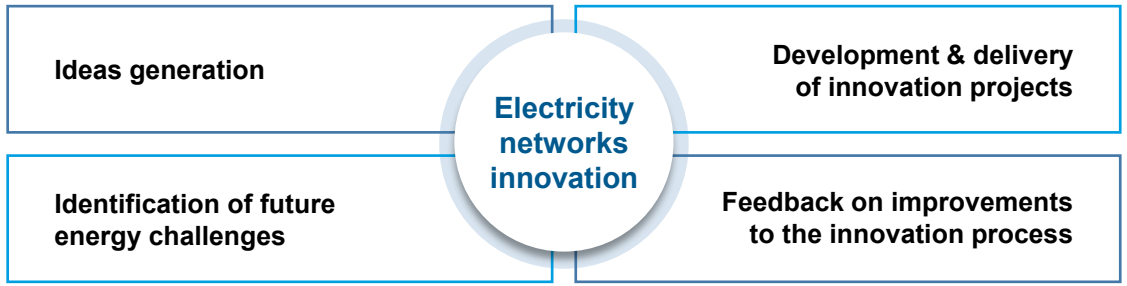
We take a collaborative approach to innovation, ensuring stakeholders have a strong voice and a clear role in shaping the future of our electricity networks.

Our networks work together to deliver meaningful engagement, focusing on:

- **Communicating the strategic challenges** facing our industry and highlighting opportunities for stakeholders to get involved in electricity network innovation.
- **Generating ideas**, fostering meaningful collaboration, and delivering innovation projects with electricity networks working closely and in partnership with stakeholders.
- **Embedding stakeholder feedback** through multiple channels into our governance structures (for example, the industry working groups). This drives continuous improvement and positive change to the electricity networks innovation process.
- **Providing transparent reporting** across our innovation portfolios.
- **Disseminating knowledge** and clearly communicating the outcomes and benefits of delivered innovation.

Stakeholders play a crucial role in the success of electricity networks innovation. Their insights, expertise and participation help us deliver solutions that benefit consumers and the wider energy system.

Figure 3.5 - Role of stakeholders in electricity networks innovation:



4.

POLICY OVERVIEW AND CONSUMER TOPICS

4. Policy Overview and Consumer Topics

4.1 Policy Overview

Policy plays a pivotal role in shaping the future of the UK energy system, setting ambitious decarbonisation timelines that electricity networks are instrumental in delivering. As outlined in Section 3, the strategic direction for network innovation is driven by six core innovation themes. The table below maps selected key policies influencing electricity network innovation to these themes, demonstrating clear alignment between policy intent and innovation focus.

Policy	Overview	Innovation Theme [1]
Clean Power 2030	UK government is committed to at least 95% of Britain's power being produced by clean sources by 2030. This will require whole system coordination and improved grid flexibility to account for increased amounts of low-carbon generation.	• All six innovation themes
Connections Reform	This reform addresses the overly congested grid connections system, changing it from "first come, first served" to "first ready, first connected". This will require improved digital load forecasting capabilities as well as maintaining safe and efficient operation of networks as more (often HV) generation and demand comes online.	• Data and digitalisation • Optimised assets and practices • Net Zero and the energy system transition
Clean Heat Market Mechanism	Establishes a requirement for boiler manufacturers to sell a certain number of heat pumps or other clean heat technologies. To adapt to this additional source and profile of demand, the grid will need to evolve, for example through demand-side flexibility schemes.	• Net Zero and the energy system transition • Flexibility and market evolution
Future Homes Standard	From 2035, new UK homes must cut carbon emissions by 75–80% through energy-efficient design and low-carbon heating. As the country transitions to low-carbon forms of heating, networks must ensure that the most vulnerable customers are not left behind.	• Net Zero and the energy system transition • Supporting customers in vulnerable situations
Zero Emission Vehicle (ZEV) Mandate	Car makers must ensure 80% of new cars sold are zero-emission by 2030, rising to 100% by 2035. To adapt to this additional source and profile of demand, the grid will need to evolve, for example through demand-side flexibility schemes.	• Flexibility and market evolution • Net Zero and the energy system transition

[1] Each policy mentioned can often be linked to more themes than are listed next to it– this column aims to highlight the most significant themes for each policy

4. Policy Overview and Consumer Topics

4.2 Consumer Topics

Innovation in electricity networks delivers benefits that reach far beyond the energy sector. The work our networks do touches on many areas of public interest—from environmental impact to community partnerships. That's why the innovation projects we highlight in this report are chosen not only for their technical value, but also for their wider relevance to consumers and society.

To help demonstrate this, we've grouped key topics into two broad categories: '**Network operation and evolution**' and '**Communities, partnerships and the environment**'.

While this list isn't exhaustive, it reflects the broad and meaningful impact of the innovation delivered by our networks.

Group 1: Network operation and evolution
Optimising and developing network functionality to support the Net Zero transition

Reliability and Resilience

Improving the grid's ability to anticipate, withstand, and recover from disruptions, either natural (e.g. weather patterns) or human-made (e.g. cyber attacks).

Minimising network outages as more renewable energy sources like wind and solar are added.

Integrating New Technologies

Enabling deployment of innovative hardware into the electricity system. Examples include Electrical Vehicle (EV) charging, heat pumps and distributed solar generation.

Artificial Intelligence

Using smart technology like AI to help run the electricity grid more efficiently and make quicker, better decisions. For example, it can help predict energy demand faster, which supports a more flexible and responsive system.

Group 2: Communities, partnerships and the environment
Guiding electricity network innovation to deliver broad societal and environmental benefits

Collaboration with Partners

Keeping strong partnerships between energy networks and outside groups – like businesses and universities – as well as between networks themselves, to help deliver projects faster and more effectively.

Supporting Community Stakeholders

Making sure energy systems work well for local communities, while also making sure everyone can access the network fairly—especially those who may struggle with energy costs.

Climate Impact and Risk

Using more renewable energy to cut carbon emissions.

Helping to enable decarbonisation of other sectors like transport and heating.

Protecting the energy system from problems caused by climate change, like extreme weather.

5.

Innovation Themes and Case Studies

5. Innovation Themes and Case Studies

The Focus of Innovation

Innovation projects from Networks can be broken down into the following shared innovation themes, which were introduced in Section 3:

1. Data and Digitalisation
2. Flexibility and market evolution
3. Net Zero and the energy system transition
4. Optimised assets and practices
5. Supporting consumers in vulnerable situations
6. Whole energy system

This section highlights progress across our shared innovation themes, supported by case studies that show how networks are delivering impact.

Each case study offers a high-level snapshot of a project that reflects network activity in a specific innovation area. To explore the full details, you can follow the project documentation hyperlink, which links to publicly available resources. Additional insights are also available in the individual Network Summary Reports, accessible here.

For more information on referenced policies and topic descriptions, see Section 4 of this report.

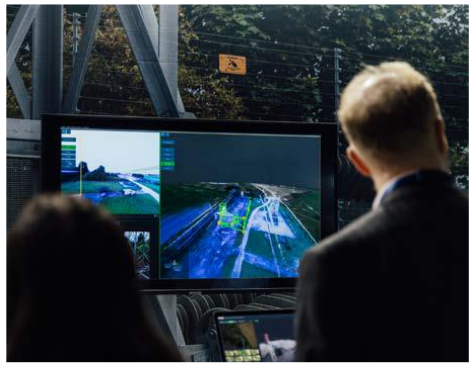
Network acronyms

The following acronyms are used throughout this section to refer to electricity networks and the system operator:

- **SSEN-T / SSEN-D:** Scottish and Southern Electricity Networks Transmission / Distribution
- **SPEN-T / SPEN-D:** SP Energy Networks Transmission / Distribution
- **NGET / NGED:** National Grid Electricity Transmission / Distribution
- **ENWL / SPENW:** SP Electricity North West
- **NPg:** Northern Powergrid
- **UKPN:** UK Power Networks
- **NESO:** National Energy System Operator

5. Innovation Themes and Case Studies

5.1. Data and Digitalisation



Developing new data services, applying data science methods and harnessing the power of digitalisation to solve both system operation and wider stakeholder challenges.

Data and Digitalisation work is often an enabling tool for all projects and evidence-based decision-making by increasing the information available for electricity networks to use in future projects as well as BAU operations and resilience planning. As such, projects which fall under this innovation theme often have objectives which overlap with other innovation themes (and projects under other innovation themes could also be classified under this one).

14

Projects registered to this theme in FY25

Electricity networks have made significant strides in embedding digital tools to improve planning, operational efficiency and increasingly importantly, resilience against cyber attacks.

In particular, efforts have been made to develop AI capabilities - **NPg**'s Artificial Forecasting tool aims to employ AI to improve load forecasting capability, while **SPEN-T**'s Cyber-RIAST and Cyber-SAFEN projects are developing AI-driven platforms to detect and respond to cyber threats and enhance the resilience of digital substations.

Another area of interest is enabling faster and more informed decision making while reducing manual workload. **UKPN**'s HV Auto Quote tool enables customers to self-serve formal connection offers, streamlining the application process.

Importantly, digitalisation is also improving the accessibility of network data for stakeholders, from local authorities to aggregators by supporting more collaborative and inclusive planning, exemplified by **SSEN-D**'s Near Real-time Data Access 2 (NeRDA2) project. This shift toward real-time monitoring, predictive analytics, and digital twin infrastructure will lay the foundation for a more agile and intelligent energy system.

"I've been using the NeRDA data for day ahead and half-hourly ahead grid load forecasting, and then calculating a dynamic grid tariff. This enables the control of flexibilities within the distribution network (such as EVs, heat storages, and heat pumps) to mitigate distribution grid congestion. The NeRDA API operates seamlessly, and the team's responsiveness and assistance have been exemplary."
Omid Mousavi, Lead Data Scientist, KrakenFlex (NeRDA partner)

5. Innovation Themes and Case Studies

Artificial Forecasting – Beta (NPg)

Developing innovative AI-based approaches to augment load forecasting capability, unlocking flexibility as a reinforcement option.

This project will test machine learning algorithms to produce load forecasts and develop AI techniques for modelling load connections.

As DNOs transition to DSOs, the load forecasting process must become increasingly granular to support flexibility dispatch – frequency needs to increase from annual to monthly, weekly and daily, and the scope needs to expand to capture HV / LV transformation points. Previously, networks have typically employed manual approaches to forecast load, so novel approaches are required to enable system flexibility and support network stability under these new conditions.

Available capacity in the network for new low-carbon loads will be freed up thanks to more effective network management, increasing the speed and lowering the cost of decarbonisation.

The project will benefit a wide range of users, including connectees of low-carbon load, flexibility providers and controllers, network customers and other electricity distribution companies.

- Funded: £3,664,540 (SIF)
- Project timeline: February 2025 - February 2027
- Project partners and collaborators: UKPN, Oak Tree Power Ltd, EV Dot Energy Ltd, Faculty Science Ltd
- Project lead: Neal Wade – System Forecasting Engineer

Smarter Networks Portal project page

Benefits

Cost savings for networks:

Reduction in HV / LV reinforcement cost by about 5 -10% (£3.5m-7m p.a. for NPg, increased by a factor of 7 for all DNOs)

Staff cost savings of ~£2m p.a. in NPg, increased by a factor of 7 for all DNOs

TRL change

4 to 8

Integrating New Technologies

Artificial Intelligence

5. Innovation Themes and Case Studies

TOTEM 2 (SSEN-T)

Developing innovative tools and resources for power system modelling and analysis, specifically advancing re-dispatch and simulation capabilities.

Scottish & Southern Electricity Networks TRANSMISSION

Manitoba HYDRO INTERNATIONAL

The UK's power system is rapidly evolving as greater levels of renewable energy are being connected, leading to a much lower level of system inertia and lower short circuit levels. The potential for adverse control interactions between these devices is rising and needs careful consideration within the context of a potentially weaker UK power system.

This project follows on from TOTEM and TOTEM Extension to continue developing innovative tools and resources for power system modelling. These projects provided a multi-party agreement that enables the Transmission Owners to work together to acquire and validate a new system model that will enhance, as well as de-risk the integration of new technologies.

The previous TOTEM projects developed a large-scale EMT model capable of accurately simulating power electronic systems, supporting the development of strategies to futureproof the UK's energy networks. TOTEM 2 successfully enhanced the re-dispatch tool for seamless integration with PowerFactory models, ensuring adaptability to evolving network configurations. In parallel, the project optimised the Scottish network model, significantly improving simulation performance - enabling faster, more efficient evaluation of complex operational scenarios.

SSEN Transmission's technical teams have adopted the outputs of the TOTEM 2 project into business-as-usual operations as part of the broader TOTEM toolset.

- Funded: £100,000 (NIA)
- Project timeline: May 2024 – March 2025
- Project partners and collaborators: Manitoba Hydro International (MHI)
- Project lead: Peter Taddei - Innovation Delivery Project Manager

Smarter Networks Portal project page

Benefits

Risk reduction:

Expected to mitigate the risk of network black out and localised disruption.

Net benefit / cost ratio of £14.93

TRL change

2 to 7

Integrating New Technologies

Reliability and Resilience

5. Innovation Themes and Case Studies

ERA (NGET)

Developing an automated severe weather alert tool to help protect vulnerable assets at risk from extreme weather events, as well as helping networks better react to threats when they emerge.

Electricity assets such as towers and the equipment in substations have been designed to withstand a variety of environmental conditions. The increasing number and ferocity of extreme weather events exposes assets to a greater risk. For example, uncontrolled surface water flooding events are expected to rise along with the cost of damages.

These risks need to be monitored to ensure the network continues to provide consumers with an uninterrupted electricity supply.

This tool will initially focus on flooding risk, pinpointing when and where network assets could be at risk from flooding and erosion. This will play an important role in maintaining uninterrupted electricity supplies.

The tool uses data from the Environmental Agency, the Flood Forecasting Centre, Natural Resources Wales and Previsico's surface water flood risk forecasts, coupled with Previsco's radar based sensors which allow remote monitoring of high flood-risk sites while providing a real-time flood risk assessment.

- Funded: £455,314 (NIA)
- Project timeline: January 2023 – March 2024
- Project partners and collaborators: University of Liverpool, Previsico Ltd, Frazer-Nash Consultancy
- Project lead: Tinashe Chikohora – Strategic Innovation Engineer

Smarter Networks Portal project page

TSO project page

Benefits

Cost saving / risk mitigation

Mitigation of the potential impact of uncontrolled flooding, which posed a £6m risk in damages at vulnerable sites assessed in this project.

Potential for further savings as remit expands.

TRL change

6 to 8

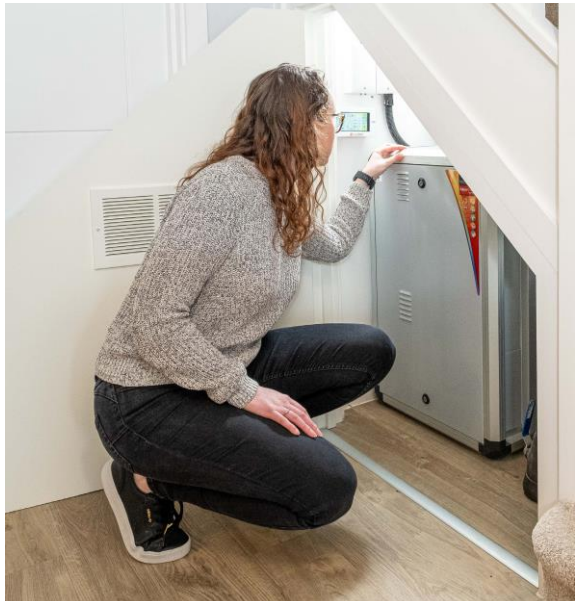
Climate Impact and Risk

Reliability and Resilience

5. Innovation Themes and Case Studies

5.2. Flexibility and Market Evolution

Developing market-based solutions to increase the flexibility and efficiency of electricity networks, accelerating the adoption of low carbon technologies. Particularly focused on exploring innovative solutions around demand-side flexibility, aiming to reduce curtailment of renewable generation.



10

Projects registered to this theme in FY25

The evolution of flexibility markets is reshaping how networks interact with consumers and distributed energy resources, and is becoming increasingly central to network strategy, particularly as larger quantities of renewable generation is being added across the country. Meanwhile, the shift of consumer demand profiles, due to adoption of technologies such as heat pumps and EVs, promoted through policies such as the Clean Heat Market Mechanism and ZEV mandate, present opportunities to explore demand-side flexibility.

Projects across multiple networks are exploring dynamic pricing, demand-side response, and new commercial models to better align consumer behaviour with network needs. This is particularly evident in trials that manage electric vehicle charging, such as **UKPN**'s Shift 2.0 project, and heat demand (for example **UKPN**'s Heatropolis and **NGED**'s EQUINOX projects) to avoid local peaks and reduce reinforcement costs.

These developments are critical to unlocking system-wide efficiency and enabling a more decentralised, responsive grid.

5. Innovation Themes and Case Studies

EQUINOX (NGED)

Developing new commercial arrangements that unlock flexibility from residential low carbon heating across Great Britain.

Ryan Huxtable
Innovation Programme Lead

EQUINOX is the first Network Innovation Competition (NIC) project dedicated to addressing the challenges that Distribution Network Operators (DNOs) may face with the electrification of domestic heat. As part of the energy transition, DNOs may witness a substantial increase in peak electricity demand, requiring significant network reinforcement.

There are currently limited viable solutions for DNOs to unlock the flexibility from residential low carbon heat at scale in a reliable, cost-effective, and equitable way.

The project has demonstrated the benefits available to the network through flexibility from domestic heat pumps. The first round of trials acted as proof of concept, while the second and third rounds informed BAU arrangements with a larger and more diverse pool of customers. The trials aimed to include households from all sectors of society, ensuring that commercial and technical arrangements were designed equitably.

Trial 2 results were released in summer 2024, and saw home energy use dropping by an average of 48%. These learnings informed the design of trial 3.

- Funded: £7,766,000, of which £6,980,000 is NIC
- Project timeline: March 2022 - December 2025
- Project partners and collaborators: SPEN, Octopus Energy, Passiv, Welsh Government, West Midlands Combined Authority, Guidehouse, Sero, Scottish Power, National Energy Action
- Project lead: Ryan Huxtable – Innovation Programme Lead

Smarter Networks Portal project page
DNO project page

Benefits

Customer Bills

Trial 2 participants were rewarded financially with an average of £43 per participant over the winter.

Carbon Savings

1,900 tCO2e of direct savings up to 2050 across GB

Demand Reduction

779 MVA capacity released up to 2050 across GB

Integrating New Technologies

5. Innovation Themes and Case Studies

CrowdFlex - Beta (NESO)

Increasing the integration of renewable energy into the grid, reducing balancing costs and decreasing the need for additional capacity or network reinforcement.

Sanna Atherton
CrowdFlex Project Lead

The requirement for domestic flexibility is increasingly apparent. Crowdflex is playing a pivotal role in establishing domestic flexibility as a reliable grid management resource. The project has been conducting large-scale consumer trials and gathering data to develop models to more accurately forecast consumer flexibility. It is an industry wide collaboration, bringing together expertise and innovation from across the sector, including OVO Energy, Ohme EV, distribution, energy industry partners and consultants.

CrowdFlex aims to enhance understanding of domestic flexibility's potential and technical capabilities, as well as consumer behaviours, to inform future market strategies. The first phase of summer trials took place in 2024, with OVO and Ohme EV's customers incentivised to use electricity flexibly, receiving utilisation payments for adjusting their energy usage (turn-up or turn-down) or availability payments for making assets like electric vehicles (EVs) available to the grid for automated control of when to charge.

CrowdFlex is an industry-wide collaboration. The project aims to integrate more renewable energy into the grid, reduce balancing costs, and minimise the need for additional capacity or network reinforcement works, potentially lowering operating costs and consumer bills.

- Funded: £22,530,137 (SIF)
- Project timeline: December 2023 - January 2026
- Project partners and collaborators: NGED, SSEN-D, OVO Energy, Ohme, Centre for Net Zero, AWS, ERM, Centre for Sustainable Energy, Smith Institute, CGI, Smart Grid Consultancy
- Project lead: Sanna Atherton – CrowdFlex Project Lead

Smarter Networks Portal project page
System Operator project page

Benefits

Network Savings

By year 10, it's calculated that CrowdFlex could help enable domestic flexibility to provide a total direct and indirect net benefit of £472m annually, by reducing balancing costs and the need for additional capacity and network reinforcements.

Carbon Savings

Reduce the need for thermal generation equating to a cumulative 10-year benefit of avoided CO2 emissions of 6.3MtCO_2e

TRL Change

3/4 to 7

Integrating New Technologies

"We're excited to be in the Beta phase of the CrowdFlex project and collaborating with key industry partners on this large-scale programme."
Sanna Atherton, CrowdFlex Project Lead

5. Innovation Themes and Case Studies

BiTraDER (ENWL / SPENW)

Investigating an innovative trading market for connected resources to trade curtailment obligations bilaterally within regionally aggregated stacks.

SP Electricity North West

LCP Delta ELECTRON AFRY

As part of the UK's Net Zero journey, DNOs are seeing more requests to connect low-carbon energy sources. To avoid costly and disruptive network reinforcement, they offer flexible (curtailable) connections. These allow access subject to conditions that let DNOs curtail import or export to manage the network. While faster and cheaper, flexible connections carry curtailment risks, making some customers hesitant.

BiTraDER aims to allow new and existing connected customers to mitigate the risks associated with curtailment obligations. The project will investigate, design, build and trial a new market for flexible resources to trade their curtailment obligations with other connected customers. It will develop the bilateral market trading rules, explore the market's ability to operate in near real-time, and determine the functionality required to return the output of the market to the DNO and ESO systems for execution in real time.

FY25 has seen the design of the trading platform and publication of a report which focuses on the methods to implement the designed solution and the lessons learned during the process. The simulation trials started in October 2024 and finished in May 2025.

- Funded: £8,367,858 (NIC)
- Project timeline: May 2022 - July 2026
- Project partners and collaborators: LCP Delta, AFRY, Electron
- Project lead: Christopher Greenfield – Innovation Project Manager

Smarter Networks Portal project page

DNO project page

Benefits

Cost Savings

NPV of £35.5m to ENWL

NPV of £581m to GB as a whole

Carbon Reduction

7,649 tCO2e for ENWL

92,114 tCO2e for GB as a whole

TRL Change

6 to 8

Integrating New Technologies

5. Innovation Themes and Case Studies

5.3. Net Zero and the energy system transition

Enabling and accelerating the UK's transition to a Net Zero energy system, supporting networks' own decarbonisation objectives while facilitating renewable penetration and supporting uptake of low carbon technologies (LCTs). Objectives of projects from other themes may overlap with those in this theme, for example projects looking to improve grid flexibility or whole system coordination.

Network innovation is increasingly aligned with the UK's Net Zero targets and the Clean Power 2030 Action Plan, focusing on electrification, renewable integration, and physical low-carbon infrastructure, exemplified by projects such as **SSEN-T**'s Low Profile Steel Poles and OHL Foundation Uplift projects.

Networks are working closely with local authorities, housing providers, and developers to support decarbonisation at scale. This includes enabling Local Area Energy Planning (for example in **UKPN**'s CLEO project) and trialling alternative heating technologies (e.g. **UKPN**'s Neat Heat Project, which demonstrates the viability of Zero Emission Boilers as heating sources in constrained housing). These efforts aim to ensure that the UK's energy transition occurs in a coordinated and cost-effective manner.

64

Projects registered to this theme in FY25

5. Innovation Themes and Case Studies

Low Profile 132kV Steel Poles (SSEN-T)

New steel pole design for future wind farm connections at altitudes over 300m, reducing steel usage and eliminating the need for permanent maintenance access tracks and concrete foundations.

Scottish & Southern Electricity Networks TRANSMISSION

PLPC LTD POWER LINE SPECIALISTS | energyline | NORPOWER Overhead Line Services

Steel lattice towers are proposed for future wind farm connections above 300m however, they come with high costs, long lead times, and environmental impacts. Currently, wooden poles are not a suitable alternative due to capacity limitations and are not robust enough to withstand climatic conditions above 300m. In addition, creosote preservation used on wooden poles is due to be removed from the market in 2029 at the latest.

This project developed a new innovative and resilient design for overhead powerlines at elevations above 300m and can support with the accelerated delivery of our future network. The design reduces steel usage and eliminates the need for permanent access tracks for maintenance and the need for concrete foundations, as they are directly buried in the soil.

The poles are visually aligned with existing wooden poles to reduce the visual impact of our network and aim to improve the consenting process. The project could support faster energy connections due to a reduction in construction lead times and could save up to 50% on construction costs compared to traditional steel lattice towers.

Following successful testing, the design has now been accepted in BAU deployment. The first deployment has already begun on a high-altitude customer windfarm connection with the structures to be built in early 2026.

- Funded: £1,100,000 (NIA)
- Project timeline: January 2022 - November 2024
- Project partners and collaborators: PLPC, Energyline, Norpower
- Project lead: Peter Taddei – Innovation Delivery Project Manager

Smarter Networks Portal project page

Benefits

Cost saving:

Expected £9.8m cost benefits at the end of RIIO-T3

TRL change:

4 to 8

Reliability and Resilience

5. Innovation Themes and Case Studies

OHL (overhead line) Foundation Uplift (SSEN-T)

Improving the methodology for calculating the uplift capacity of steel lattice tower foundations, identifying opportunities to use less material and space and optimising the shape and surface of the OHL design.

The method for designing overhead line (OHL) foundations has not changed considerably since the 1920's. Initial research work undertaken by the University of Dundee identified that the 'frustum method', which is adopted by most Transmission Operators in the UK and forms industry standards, is generally over-conservative and, in some cases, potentially underestimates foundation uplift capacity by up to 25%.

The project set out to improve the current methodology for calculating the uplift capacity of steel lattice tower foundations. This includes gaining a better understanding of the optimal shape and surface of OHL foundation designs, as well as identifying opportunities to use less material and space for foundations.

The removal or reduction of over-conservative design for OHL foundations would reduce the amount of construction materials required and require smaller scale excavations. This would provide a significant reduction in carbon emissions associated with the construction of OHLs, causing less disruption to the surrounding land and reducing associated costs for energy consumers.

Test results from the University of Dundee's centrifuge have shown that by including a chamfer on the top edge of concrete foundations, we can potentially increase the uplift capacity of the foundation and also reduce the volume of concrete by approximately 18%, resulting in significant carbon savings.

- Funded: £584,307 (NIA)
- Project timeline: December 2022 – May 2025
- Project partners and collaborators: NGET, University of Dundee
- Project lead: Peter Taddei – Innovation Delivery Project Manager

Smarter Networks Portal project page

Benefits

Cost saving:

Potential cost savings from Foundation Uplift of at least £4.7m during asset lifetime, lifetime cost saving on identified projects of at least £8m

Carbon Saving:

Use of new method in 5 SSEN-T OHL projects (approx. 1,500 towers) gives a carbon saving of ~ 1,600 tCO2e, equivalent to the annual electricity consumption of over 2,200 households

TRL Change:

2 to 4

Collaboration with Partners

Climate Impact and Risk

5. Innovation Themes and Case Studies

Powering Wales Renewably - Beta (NESO)

Establishing a strategic long-term approach to planning in Wales, identifying whole energy system needs, and ensuring that the system can be designed and constructed accordingly. The project is now in its R2 Beta phase.

Megan McNeill
Innovation Delivery Manager

To deliver the Welsh Government's decarbonisation plans, prepare for a Net Zero power system and deliver benefits to Wales' citizens and communities, strategic priorities for investment were identified.

Following on from this, the project will deliver a digital twin of the entire Welsh energy transmission and distribution systems. The project is designed to deliver a range of qualitative and quantitative benefits, including cost savings on energy bills for consumers and enhanced CO2 savings through increased renewable generation. It also aims to achieve future reductions in the cost of operating the network by reducing flexibility costs and avoiding curtailment, as well as annual cost savings for users of network services through improved network capacity utilisation.

- Funded: £12,195,722 (SIF)
- Project timeline: January 2025 – January 2029
- Project partners and collaborators: NGET, NGED, Welsh Government, SPEN, CGI, Wales & West Utilities, Cenin, National Gas Transmission
- Project lead: Megan McNeill – Innovation Delivery Manager

Smarter Networks Portal project page

System Operator project page

Benefits

Cost saving:

More generation from cheap renewables and enhanced capacity utilisation leading to lower customer bills

Reduced operating costs for networks due to flexibility and reduced curtailment

Carbon Saving:

Additional renewable generation leading to emissions reduction

TRL Change:

5 to 8

Integrating New Technologies

"We're excited to begin the Beta phase of this collaborative Innovation project with the Welsh Government and industry partners, which aims to advance data sharing between energy organisations to enable more renewable energy on the grid."
Megan McNeill, Innovation Delivery Manager

5. Innovation Themes and Case Studies

5.4. Optimised assets and practices

Developing and implementing techniques for optimising existing business practices and adopting new technologies to boost network performance. Projects under this theme have particularly focused on automation and prediction, especially about faults, outages and asset deterioration.

Innovation in asset monitoring and maintenance is improving reliability, safety and efficiency, helping to reduce costs.

SPEN-T's Innovative Monitoring of GIS Cable Terminations project uses sensors to predict faults before they cause outages, **NGED**'s LV Visibility project is installing thousands of monitors on the network to improve fault visibility and **SSEN-T**'s AIM High project deployed autonomous robots in HVDC converter halls for continuous condition monitoring. These projects all lead to tangible consumer benefits by avoiding unplanned outages and reducing maintenance costs which can then be passed on by way of lower energy bills.

The cumulative impact of these innovation projects is a more resilient and efficient network that can support growing demand without excessive reinforcement.

45

Projects registered to this theme in FY25

5. Innovation Themes and Case Studies

AIM High (SSEN-T)

Testing and deployment of an autonomous robotic system for monitoring High Voltage Direct Current (HVDC) valve halls to improve safety and security of the network, allowing maintenance without unplanned system downtime.

Scottish & Southern Electricity Networks TRANSMISSION

Ross Robotics

HVDC valve halls operate at an extremely high voltage level of electricity, meaning service personnel cannot access many of the electrical environments when energised and in operation.

Historically, HVDC converter stations were monitored using remote systems and static CCTV cameras to check for any issues, however, they do not provide full visibility of the electrical equipment and its condition. Planned outages are put in place to shut down systems to allow engineers to carry out close inspections of the electrical components. In the instance of a condition-based equipment failure the system would need to be shut down through an unplanned outage. By monitoring the condition of equipment using the robot it is expected that these condition-based unplanned outages can be avoided.

For the first time, thermal & UV images were obtained from within energised HVDC halls, helping to understand operational temperatures and assess live plant from within the hall. Having the ability to see inside the halls using the platform allows quicker fault identification and diagnostics to improve network safety. With the robot successfully deployed at Blackhillock HVDC converter station, SSEN Transmission are looking to deploy further robots across future HVDC convertor stations during the RIIO-T3 period.

- Funded: £454,556 (NIA)
- Project timeline: June 2023- October 2024
- Project partners and collaborators: Ross Robotics
- Project lead: Tania Shaw – Innovation Project Delivery Manager

Smarter Networks Portal project page

Benefits

Cost saving:

Annual £200k cost saving from maintenance per site, potential lifetime cost savings over 20 applicable sites of over £22m

TRL Change:

5 to 8

Reliability and Resilience

"We're very excited to have been a part of this important [AIM High] project with SSEN Transmission. The deployment of our robot at Blackhillock HVDC converter hall has delivered a new level of monitoring for this type of critical asset and the data captured will support the transition towards predictive maintenance, with all the operational, availability and commercial benefits it brings."
Dominic Cusk, Managing Director of Ross Robotics

5. Innovation Themes and Case Studies

Cyber-SAFEN (SPEN-T)

Development and demonstration of an AI-enabled cyber security platform to enable a resilient digital power network.

The electricity network links distributed generation, active demand, and local flexibility markets. Digital substations are key to safely and securely controlling power flow, accelerating the digital transformation of power systems. However, this makes them prime targets for cyber-attacks, which could result in widespread power outages. Existing tools are not proven to defend against advanced threats, so new systems are needed to protect networks.

Cyber-SAFEN aims to build and demonstrate an integrated cyber defence (ICD) platform to provide a foundation on which to build essential cyber safe and resilient functions for electricity networks against advanced cyber-attacks. Cyber-SAFEN uniquely focuses on a combined intrusion detection (IDS) and intrusion response system (IRS) powered by advanced AI and machine learning technologies to build a dual defence system against advanced cyber threats.

The IRS serves to verify the accuracy of the machine learning system, acting as a safeguard to the system. The project has shown that through this pairing, cyber attacks can be detected with very high confidence. This added security is an enabler to the digitalisation of substations, which will themselves provide cost and carbon savings (not included in benefits table).

Learnings have been taken regarding the importance of testing solutions in real-world environments, and how future projects can de-risk these trials by developing comprehensive simulation capabilities.

- Funded: £487,000 (NIA)
- Project timeline: May 2022 – April 2026
- Project partners and collaborators: University of Manchester, Energy Innovation Centre, NGE-T
- Project lead: Lara Cardoso – Senior Innovation Engineer

Smarter Networks Portal project page

Benefits

Risk Mitigation:

Reduced risks of outages and damages caused by cyber attacks (e.g. 2015 Ukraine energy system cyber-attacks which resulted in power outages for nearly 230,000 consumers

TRL Change:

2 to 4

Reliability and Resilience

5. Innovation Themes and Case Studies

LV Visibility and LV Pre-fault (NGED)

Supporting our Field Operations teams with a new digital dashboard and installation of over 10,000 LV monitors to prevent faults.

nationalgrid Electricity Distribution

Steven Pinkerton-Clark
Innovation and Deployment Engineer

Jacob Lynch
Innovation and Deployment Engineer

LV Visibility: Installation of over 10,000 LV monitors to provide greater visibility of load-related issues and potential fault activity, providing a more resilient network. The focus is on parts of the network that will provide the greatest benefit, including substations with high customer densities and older parts of the network that are historically more prone to reliability disruptions.

These installed monitors have enabled the running of a second project, LV Pre-Fault.

LV Pre-fault: Data collected from the LV monitors installed through LV Visibility has allowed NGED to gain insight into pre-fault activity. NGED have created a digital dashboard to visually portray alarms that are being flagged, show the potential benefits of responding to these alarms and the likelihood of failure within a given timeframe.

Data collected will inform whether underground cables are in need of immediate replacement or intermediate remedial action. This prevents power cuts by fixing issues before they occur. This supports NGED's core commitments to improve service levels to customers, enhance network reliability, invest in assets, and better utilise the existing network.

These projects are now in the roll-out stage – evaluation / trial stage projects were completed prior through the NIA and NIC.

- Funded: £500,000. LV Visibility is EJP funded, LV Pre-fault is internally funded by NGED
- Roll-out timeline: April 2023 – March 2028
- Project partners and supply chain: Kelvatek, EA Technology, Lucy Electric
- Project leads: Steven Pinkerton-Clark – Innovation and Deployment Engineer, Jacob Lynch – Innovation and Deployment Engineer

Benefits

Cost saving:

Potential to save UK energy consumers an estimated £10.3m by 2040. This could increase to £24.8m if effectiveness of prefault services increases further

Supply consistency

Reduced number of network interruptions

Reliability and Resilience

5. Innovation Themes and Case Studies

QUEST (ENWL)

Developing the technology in use at transforming interfaces, providing the ability to centrally control the voltage on the network at all voltage levels.

To cater for the subsequent increase in electricity demand and generation caused by decarbonisation targets, DNOs have investigated and deployed techniques such as Customer Load Active System Services (CLASS), Smart Street and Active Network Management (ANM) optimisation systems. Whilst these systems have proven successful in helping DNOs to manage the network, they do have limitations.

Using a novel application of proven technology combined with innovative software, QUEST will build an overarching system which operates a holistic voltage control methodology. This will co-ordinate existing and future voltage management techniques, establishing efficient network operation, promoting low-cost connection and use of LCTs, to deliver significant customer benefits.

QUEST develops the technology in use at the 33kV/HV and HV/LV transforming interfaces and adds similar functionality to the 132kV/33kV transformer interface, providing the ability to centrally control the voltage on the network at all voltage levels. This project builds upon ENWL's successful CLASS and Smart Street Innovation and will reduce the overall costs of accommodating increased load on networks. These savings will be passed on to consumers and facilitate the integration of low carbon technologies

- Funded: £9,674,000 (NIC)
- Project timeline: June 2021 – Dec 2025
- Project partners and collaborators: Schneider Electric, Smarter Grid Solutions, Impact Research, Fundamentals
- Project lead: Andrew Howard – QUEST Project Manager

Smarter Networks Portal project page

DNO project page

Benefits

Cost saving:

Saving of £266m by 2050 across DNOs

Capacity release

2,236.7 MVA of capacity released through deferral of reinforcement

TRL change

6 to 8

Reliability and Resilience

5. Innovation Themes and Case Studies

Interconnected HV Substation Battery Monitor (SPEN-D)

Developing and testing a low-cost solution to monitor 30V battery systems in secondary substations and alert operators when intervention is required.

Andrew Moon
Innovation Manager

Multiple times a year in interconnected HV distribution networks, the unit HV zone protection at the nearest upstream secondary substations is not tripping in the event of a network fault, due to faulty batteries. As a result, the upstream HV protection at the primary substation needs to clear the fault, and significantly more customers experience loss of supply than if the unit protection was operating correctly to isolate the fault to a smaller zone. The chance of this occurring can be significantly reduced by remote monitoring of the battery condition which is currently done by a yearly onsite inspection.

This project is developing and testing a basic automated monitoring system using the currently rolled-out LV Monitors to monitor 30V battery systems in secondary substations. The system will be able to alert operators when intervention is required, enabling earlier fault detection and increasing operational reliability.

This project is expected to result in faster restoration times during HV Faults on networks, reducing frequency and duration of power outages for consumers. This will also lead to reductions in charges paid by the network due to Ofgem penalties for Customer Minutes Lost and Customer Interruptions.

- Funded: £249,950 (NIA)
- Project timeline: March 2024 – June 2026
- Project partners and collaborators: EA Technology
- Project lead: Andrew Moon – Innovation Manager

Smarter Networks Portal project page

Benefits

Cost saving:

Expected cost saving for the DNO of up to £206,000 p.a.

Supply reliability

DNO customers are expected to have a more reliable supply thanks to the decrease in interruption frequency

TRL change

3 to 7

Integrating New Technologies

Reliability and Resilience

5. Innovation Themes and Case Studies

VICAP (NGET)

Fully automating capture and processing of corrosion-related condition data for pylon steelwork, using drones and AI to reduce helicopter use.

nationalgrid Electricity Transmission

KEEN AI sees.ai

National Grid Electricity Transmission (NGET) owns 21,900 steel lattice towers in England and Wales. Steelwork condition deteriorates through corrosion, so periodic assessments are made to understand the health of the network. NGET targets the inspection of 3,650 towers each year, capturing images of steelwork from a helicopter. These images are then processed manually. Whilst the exercise is carried out by a limited number of experienced inspectors, where classifications are marginal, there is a risk of inconsistent subjectivity in addition to substantial time and resource needs.

A RIIO-1 innovation project proved the feasibility of automating Overhead Lines (OHL) Steelwork corrosion assessment using multi-spectral and RGB (Red-Green-Blue) imaging combined with clustering algorithms to grade the extent of corrosion. To move towards an end-to-end solution that is suitable for BAU use, the automation needs to include the capability to classify collected imagery and assign the images to the right section of the tower. This project aims to test the feasibility of and build an end-to-end process for collecting, uploading, and processing visual data for an OHL tower steelwork by combining autonomous drone flights with automated data processing platform.

This innovation will lead to better data being collected at lower cost and with lower environmental impact. The project has now ben rolled out into BAU operation.

- Funded: £430,000 (NIA)
- Project timeline: April 2022 – September 2023
- Project partners and collaborators: Keen AI, Sees.ai
- Project lead: Matti Ward – Innovation Engineer

Smarter Networks Portal project page

TSO project page

Benefits

Cost saving:

Savings for consumers of £630k p.a. by reducing fuel and maintenance costs associated with helicopters and speeding up data processing

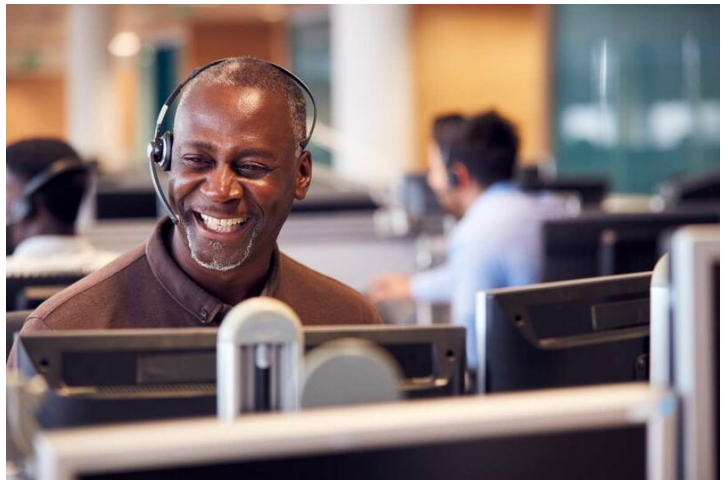
TRL change

6 to 8

Supporting Community Stakeholders

Artificial Intelligence

5. Innovation Themes and Case Studies



5.5. Supporting customers in vulnerable situations

These innovations are exploring how to best support consumers in vulnerable situations to ensure a fair and inclusive energy transition. Projects range from protecting hard-to-reach areas from outages to working with communities to make low-carbon heating affordable and accessible, as set out in the Clean Power 2030 Action Plan. Heating the homes of vulnerable customers should be fair and affordable, as the Future Homes Standard looks to transition to low-carbon heating.

As the UK transitions to a Net Zero energy system, inclusive innovation is crucial to ensure no one is left behind.

This includes a focus on empowering consumers, for example developing digital tools for personalised energy advice, such as **UKPN**'s Aimee, an AI-powered tool aimed at providing support for vulnerable consumers. Another key area of focus is maintaining connectivity and communication during network outages in remote areas, which is explored by **NGED**'s REACH project and **UKPN**'s Keeping Comms Open. Finally, social outcomes such as physical health and wellbeing are directly prioritised by projects such as **SPEN-D**'s WARMTH and **NPg**'s Supporting Warm Spaces.

Projects under this theme are particularly collaborative with local organisations and community groups, underlining the importance of stakeholder engagement. They reflect a growing emphasis on social equity, resilience, and proactive engagement with vulnerable communities.

10

Projects registered to this theme in FY25

5. Innovation Themes and Case Studies

MultiResilience - Beta (NPg)

Investigating how novel low-carbon technologies present opportunities for delivery of resilience services that maintain customer supply during unplanned grid outages.

Resilience is increasingly important as customers rely more on electricity for heat and transportation, with greatest value in rural locations that have a heightened risk of outage. Proliferation of Low Carbon Technologies across LV and HV systems present opportunities, if coordinated appropriately, for delivery of resilience services that maintain customer supply during unplanned grid outages.

Previous projects have demonstrated separate approaches via LV-connected and HV-connected resilient Distributed Energy Resources (DERs). These are small-scale power generation or storage technologies used to provide an alternative to the traditional electricity grid.

Coordination of such solutions can enhance the value case of resilience. The project will compare and contrast technologies and optimise hybrid applications of the two approaches to deliver cost-effective resilience to customers.

This project builds on learnings from both the MicroResilience and RaaS projects, taking the single-deployment cases from both projects and demonstrating the enhanced value of coordinated deployment of solutions in a network area.

This project has greatest value in rural locations that have a heightened risk of outage.

- Funded: £8,317,990 (SIF)
- Project timeline: December 2024 – September 2028
- Project partners and collaborators: SSEN, Smarter Grid Solutions, TNEI Services Ltd
- Project lead: Francis Shillitoe

Smarter Networks Portal project page

Benefits

Cost saving:

Potential savings of £235m-42.8m (conservative estimate) due to a reduction in the costs that DNOs will spend on 3rd party resilience services

TRL change

3 to 7/8

Supporting Community Stakeholders

Reliability and Resilience

5. Innovation Themes and Case Studies

VIVID – Vulnerability Identification Via Informative Data – Alpha R2 (SSEN-D)

Developing new techniques to identify which households would most benefit from offers of practical and financial support.

Simon O'Loughlin
Innovation Project Manager

The Priority Services Register (PSR) is a free UK wide service which provides extra advice and support, including when there's an interruption to your electricity, gas or water supply. VIVID will help find people who, until now, haven't registered for the PSR, are missing from Local Authority support databases or who would benefit from receiving the financial and energy efficiency help they are entitled to.

VIVID will use innovative techniques to unlock the potential of smart meter data by combining it with social and local information to drive inclusion and engagement in the energy market.

These new techniques will be used to identify which households would most benefit from offers of practical and financial support. The project will also investigate the creation and maintenance of a common regional vulnerability reference system.

VIVID successfully completed the R2 SIF Alpha phase. Learnings from VIVID are now being used as part of the VERIFY Beta project.

- Funded: £516,490, of which £448,525 is SIF
- Project timeline: October 2023 – April 2024
- Project partners and collaborators: CGI IT UK Ltd, Aberdeen City Council, E.ON, Quarriers, Smart DCC Ltd, UKPN
- Project lead: Simon O'Loughlin – Innovation Project Manager

Smarter Networks Portal project page

Innovation team email address: futurenetworks@sse.com

Benefits

Cost saving:

Initial CBA modelling shows a potential £50m benefit for consumers, society and networks, assuming that 100k households can be identified and helped with solutions implemented

Environmental impact

Promote energy efficiency and integration of LCTs amongst vulnerable households, leading to reduced carbon emissions

Supporting Community Stakeholders

Integrating New Technologies

"Building on our work to ensure a fair and equitable transition to net zero, our partnership working is also helping us progress LCT take-up amongst the vulnerable community. This is not an easy area to tackle, however our VFES and VIVID projects are helping us to understand barriers and work on solutions."
Andrew Scott, Director of Customer Services, SSEN-D

5. Innovation Themes and Case Studies

Rural Energy and Community Heat (REACH) – Alpha R3 (NGED)

Working with rural community groups to assess decarbonisation priorities and investigate whether a modular energy centre could accelerate their decarbonisation.

nationalgrid Electricity Distribution

Laurence Hunter
Innovation and Deployment Engineer

Government policy to reduce carbon emissions directs domestic properties to shift towards electrification of heating, transportation and installation of local and small-scale renewable energy and storage. This has a significant impact on the usage of electrical networks, necessitating infrastructure upgrades to lift capacity. This will be most challenging in rural areas that make up just over 21% of UK population. To promote best value for consumers, we need transitional solutions to ensure many rural customers can choose to adopt low carbon technologies when it suits them, even if it is ahead of network upgrades.

REACH will work closely with rural community energy groups to understand their decarbonisation priorities and develop a modular rural energy centre that can accelerate their decarbonisation. This can offer communities shared low carbon heating, rapid EV charging, and renewable generation in an areas where commercial markets may not serve customers and where the electricity network has limited capacity.

Working closely with community energy groups, NGED connections, and innovative suppliers, the project will evaluate the feasibility of a novel way to help customers make cost effective decarbonisation plans coordinated with wider development plans.

- Funded: £627,857, of which £487,770 was from SIF
- Project timeline: December 2024 – May 2025
- Project partners and collaborators: Smarter Grid Consultancy, Regen, Passiv, VEPod Ltd, Frontier Economics, Cranfield University
- Project lead: Laurence Hunter – Innovation and Deployment Engineer

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Learnings

Key learning 1:

A modular approach is required as one-size fits all is inappropriate given communities' diverse aspirations

Key learning 2:

Modular energy centres would only be feasible in areas of intact network constraints

Key learning 3:

A repeatable standardised connection agreement would expedite low carbon connections

Supporting Community Stakeholders

5. Innovation Themes and Case Studies

HOMEflex (Household or Microbusiness Energy Flexibility) COMPLIANCE (SSEN-D)

Developing the HOMEflex Code of Conduct, promoting an inclusive, fair and transparent domestic flexibility marketplace.

Scottish & Southern Electricity Networks

Flex Assure

Centre for Sustainable Energy

Simon O'Loughlin
Innovation Project Manager

HOMEflex started before the cost-of-living crisis and the energy price crisis, which was driven by wholesale gas price increases. During this time, the team delivering HOMEflex have engaged with consumers and stakeholders to develop the HOMEflex Code of Conduct (the Code) with the aims of creating standards for an inclusive, fair, and transparent domestic flexibility marketplace from the start.

The Code has proven to be a valuable resource for the sector, but without the Compliance Scheme based on the Code, there will be no mechanism to carry out advance due diligence of providers, ensure Flexibility Service Providers are maintaining standards or any mechanism to ensure standards for complaints and dispute resolution.

This phase of the project will deliver a Compliance scheme to establish standards, help new entrants meet the service levels consumers expect, and deserve, and enable electricity networks to confidently procure flexibility ethically, encouraging the domestic flexibility market to grow in a fairer, more sustainable manner.

HOMEflex Compliance has taken large steps to embed fairness and transparency into the Domestic and Microbusiness flexibility markets. This will result in improved customer experience and confidence, a better understanding of flexibility offers via a clearer framework of accountability, and a greater uptake of flexibility services, benefiting consumers and the energy industry alike.

- Funded: £193,000 (NIA)
- Project timeline: March 2024 – March 2025
- Project partners and collaborators: Flex Assure Ltd, Centre for Sustainable Energy
- Project lead: Simon O'Loughlin – Innovation Project Manager

Smarter Networks Portal project page

Innovation team email address: futurenetworks@sse.com

Benefits

Demand balancing (domestic flexibility in general):

Potential to reduce the GB system peak demand by up to 10% (6.8GW) and to provide up to 37GW of demand turn up flexibility (53% of the GB system peak)

TRL change:

3 to 7

Supporting Community Stakeholders

Integrating New Technologies

"We're delighted to publish HOMEflex's final recommendations report marking a pivotal step toward a fair, transparent, and consumer-focused domestic flexibility market. This work lays the foundation for a voluntary compliance scheme that will help prepare the sector for upcoming government licensing."
Charlotte Roniger, Scheme Manager, Flex Assure

5. Innovation Themes and Case Studies

5.6. Whole Energy System

Optimising the integration and coordination of the operation of electricity networks with heat and other energy networks as well as other utilities and sectors, aiming to accelerate decarbonisation and deliver benefits across the energy ecosystem

10

Projects registered to this theme in FY25

This innovation theme recognises the importance of coordination across the nation's energy system, as networks better understand the interdependencies between electricity, heat, transport, and data.

Projects are exploring innovation strategies with holistic system benefits. For example **SSEN-T**'s INCENTIVE project, which investigates how inertia can still be provided to a Net Zero grid through offshore wind farms. Meanwhile, **NGED**'s Headroom - Whole System Thinking project analyses the impact of increased grid capacity on consumer bills and the country's carbon intensity as the generation mix tilts further towards renewables.

This whole-system perspective enables more efficient investment, better coordination across infrastructure providers, and improved outcomes for consumers. It also reflects a growing understanding that collaboration across sectors is essential in delivering the energy transition.

5. Innovation Themes and Case Studies

Headroom – Whole System Thinking (NGED)

Investigating the impact added distribution capacity will have on electricity costs and the carbon intensity of the grid as more generation connects to the network.

nationalgrid Electricity Distribution

ea technology

Baringa

Laurence Hunter
Innovation and Deployment Engineer

The move towards increased use of the electricity vector will mean that whole electricity system costs will have a higher dependency on distribution connected assets that can provide flexibility. As the rate of electrification increases, distribution network constraints are expected to have a higher impact on the optimisation of the costs, and carbon intensity of the whole electricity system.

This project aims to evaluate the whole energy system to determine the benefit per unit of added headroom. This benefit will be quantified in terms of both the reduced cost of energy (£/MWh) and reduced grid carbon intensity (CO2/MWh) that can attributed to increased distribution network headroom, for each voltage level, at critical times of year, and different constraint scenarios.

The project consists of two phases. It begins by quantifying the magnitude of benefit available from increasing headroom, then delves deeper into how different asset classes and archetypical variances will vary the benefit.

Voltage level analysis indicated that the strongest areas of potential benefit would be on the Low Voltage (LV) and 132 kV networks. Volume-based sensitivity derived a figure of £100 per MWh which is the total system curtailment vs total system benefit.

- Funded: £658,257, of which £560,463 was NIA funded
- Project timeline: September 2023 – May 2025
- Project partners and collaborators: EA Technology, Baringa
- Project lead: Laurence Hunter– Innovation and Deployment Engineer

Smarter Networks Portal project page

Benefits

Cost saving:

£2.5 bn potential savings in the best view (£1.93 bn wholesale, £0.21m carbon cost reduction, £0.35 bn in ancillary costs)

Majority of saving concentrated on 132 kV and LV network capacity upgrades

TRL change:

3 to 7

Integrating New Technologies

Climate impact

5. Innovation Themes and Case Studies

AFLM (SPEN-D)

Developing and trialling an Active Network Fault Level Management (ANFLM) system which improves fault level headroom utilisation.

The management of fault levels has always been challenging and problematic for DNOs, particularly given the safety implications as they can result in equipment failure and a serious personnel and public safety risk. Due to unprecedented growth in distributed renewable generation, fault level headroom constraints are becoming increasingly challenging, often requiring major reinforcement schemes. Fault levels can act as a barrier to the connection of renewable generation and have become a decisive factor in determining the financial viability of distributed generation connections.

This project aims to develop an active network management solution. The results of this will be to avoid or defer network reinforcement works and accelerate the integration of renewable generation.

The project has been re-registered under RIIO-2, and has been progressing satisfactorily. Interface between the AFLM system and the existing control system has been fully developed, while tests have been carried out within the offline development environment.

- Funded: £1,050,000 (NIA)
- Project timeline: March 2024 – March 2026
- Project partners and collaborators: Smarter Grid Solutions
- Project lead: Ralph Eyre-Walker – Environmental and Innovation Manager

Smarter Networks Portal project page

Benefits

Cost saving:

Potential savings of £600,000 per GSP (grid supply point, of which there are over 100 within the SP Energy Network)

TRL change:

2 to 7

Supporting Community Stakeholders

Reliability and Resilience

5. Innovation Themes and Case Studies

Regional Energy System Optimisation Planning (RESOP) (SSEN-D)

Developing the Local Energy Net Zero Accelerator tool, working with DESNZ and Scottish Local Authorities to improve functionality.

Rhys Williams
Project Manager

Regional bodies including Local Authorities (LAs) are increasing their focus on developing Net Zero Plans, including Local Area Energy Plans (LAEPs), through collaboration with utilities, private industry and other energy stakeholders. In order to create LAEPs, LAs require in house energy modelling expertise and energy modelling tools, which most do not have. Many LAs are therefore hiring external contractors to fill this gap, which is an expensive use of resources.

This project aims to develop the Local Energy Net Zero Accelerator (LENZA) tool so that it can be used to create digital LAEPs, as well as working with Scottish LAs and DESNZ to geographically display locations of potential Heat Networks and make LENZA available to all LAs within SSEN's network area to increase testing and functionality.

The project is a continuation in a series of associated projects including Whole System Growth Scenario Modelling Phases 1 and 2.

- Funded: £2,894,576 (NIA)
- Project timeline: October 2023 – October 2025
- Project partners and collaborators: Advanced Infrastructure Technology Ltd, DNV, Field Dynamics (Dotted Eyes Solutions Ltd), Landmark Information Group Ltd, Regen, Centre for Sustainable Energy, UrbanTide Ltd, Faculty Science Ltd, WSP UK Ltd
- Project lead: Rhys Williams – Project Manager

Smarter Networks Portal project page

Innovation team email address: futurenetworks@sse.com

Benefits

Cost saving:

Potential savings of £3.17m p.a. for LAs across the UK as no need to hire contractors to create LAEPs

TRL change:

4 to 6

Collaboration with Partners

Integrating New Technologies

"Oxfordshire sees the power and benefits of the LENZA platform, and it will form a central plank of our LAEP work and the development of our internal LAEP capabilities going forward. LENZA is already used by many people in councils across the county to understand network topography, visualising network scenarios and modelling the impact of local projects.." **Mark Saunders, Oxfordshire City Council**

5. Innovation Themes and Case Studies

INCENTIVE (SSEN-T)

Investigating and demonstrating how offshore wind farms can provide inertia to onshore networks.

Scottish & Southern Electricity Networks TRANSMISSION

NESO National Energy System Operator

CARBON TRUST

Inertia in the GB electricity network is falling, and without novel solutions, adding renewable generation capacity will become increasingly challenging, leading to instability events and increasing operating costs. Historically, renewable generators have not treated system inertia as their problem, as inertia has been high due to (mostly fossil-fuelled) synchronous generation. However, renewable generation is already being curtailed due to low system inertia.

The INCENTIVE project investigated how offshore wind farms can provide inertia to onshore networks. It found that offshore wind, with an INCENTIVE STATCOM supercapacitor or INCENTIVE BESS, can deliver necessary and cost-effective stability services.

Technical testing confirmed the devices could stabilise the grid, but current Grid Code requirements and testing practices do not reflect all system strength benefits – with other technologies rated more highly.

The project proved the economic benefits of INCENTIVE solutions. However, current market incentives were found to be unclear. By undervaluing grid-forming devices and imposing onerous requirements on inertia contribution, the current stability market framework places novel inverter-based assets at a disadvantage.

- Funded: £1,122,973 (SIF)
- Project timeline: June 2023 – October 2024
- Project partners and collaborators: NESO, University of Strathclyde, Carbon Trust
- Project lead: Adnan Mahmood – Innovation Delivery Project Manager

Smarter Networks Portal project page

Benefits

Cost saving - supercapacitor:

Adding supercapacitor energy storage and grid forming converter at would add stability services at a 75% cost reduction relative to standard Stability Pathfinder (SP) procurement. Assuming 50% of GB's offshore wind can be connected, savings of around £1bn could be delivered over 30 years.

Key learning:

Additional barrier to BAU deployment of the grid forming STATCOM with supercapacitors - the '5 second rule', which is based on the capability to deliver inertia

Reliability and Resilience

6.

Continuing the Cycle

6. Continuing the Cycle

6.1 Opportunities Ahead

Innovation continues to deliver progress across all strategic themes, with strong momentum in Net Zero and system optimisation.

During FY25, our networks launched 120 innovation projects, with 83 (69%) focused on the themes of 'Net Zero and the energy system transition' and 'Optimised assets and practices'. These projects accounted for 61% of total funding registered during the year, demonstrating a clear strategic focus.

At the same time, networks are aligning their innovation efforts with broader system goals, such as those outlined in National Grid's Operational Objectives, which take a whole-system view of progress. The most recent publication of the Electricity Networks Innovation Strategy reinforces this approach. It provides a unified framework to innovate in ways that support the UK's low-carbon transition and deliver value to customers.

As we progress through RIIO-2, projects are becoming increasingly iterative, building on learning from previous projects over extended periods of time and across funding streams. For example, SSEN-T's AIM High project, funded through NIA, has paved the way for the ambitious SIF project ODIN (Optimisation and Diagnostics for Innovative Networks). Future projects will also continue this trajectory to ensure that learnings from the past year are taken forward, moving up the Technology Readiness Level (TRL) scale and closer to business as usual implementation.

The next electricity transmission price control period, **RIIO-3**, begins in April 2026, with draft determinations announced by Ofgem in July. Ofgem expects total innovation for electricity transmission spending over the RIIO-3 period (2026-2031) to be far in advance of anything seen previously – total expenditure could exceed £80bn. The next electricity distribution price control period, ED3, is due to start in 2028, with draft determinations yet to be announced.

Looking ahead, networks will be expected to meet a range of requirements to secure project funding. Proposal documents will need to clearly outline how projects will engage stakeholders, assess environmental impacts, and align with the Distribution Network Operator's (DNO's) business plan.

Projects that demonstrate clear decarbonisation benefits, community value, scalability, and responsiveness to public concerns will be well-placed to secure funding and deliver lasting impact.

6. Continuing the Cycle

6.2 Key Learnings

Innovation is delivering results and shaping the future of our networks.

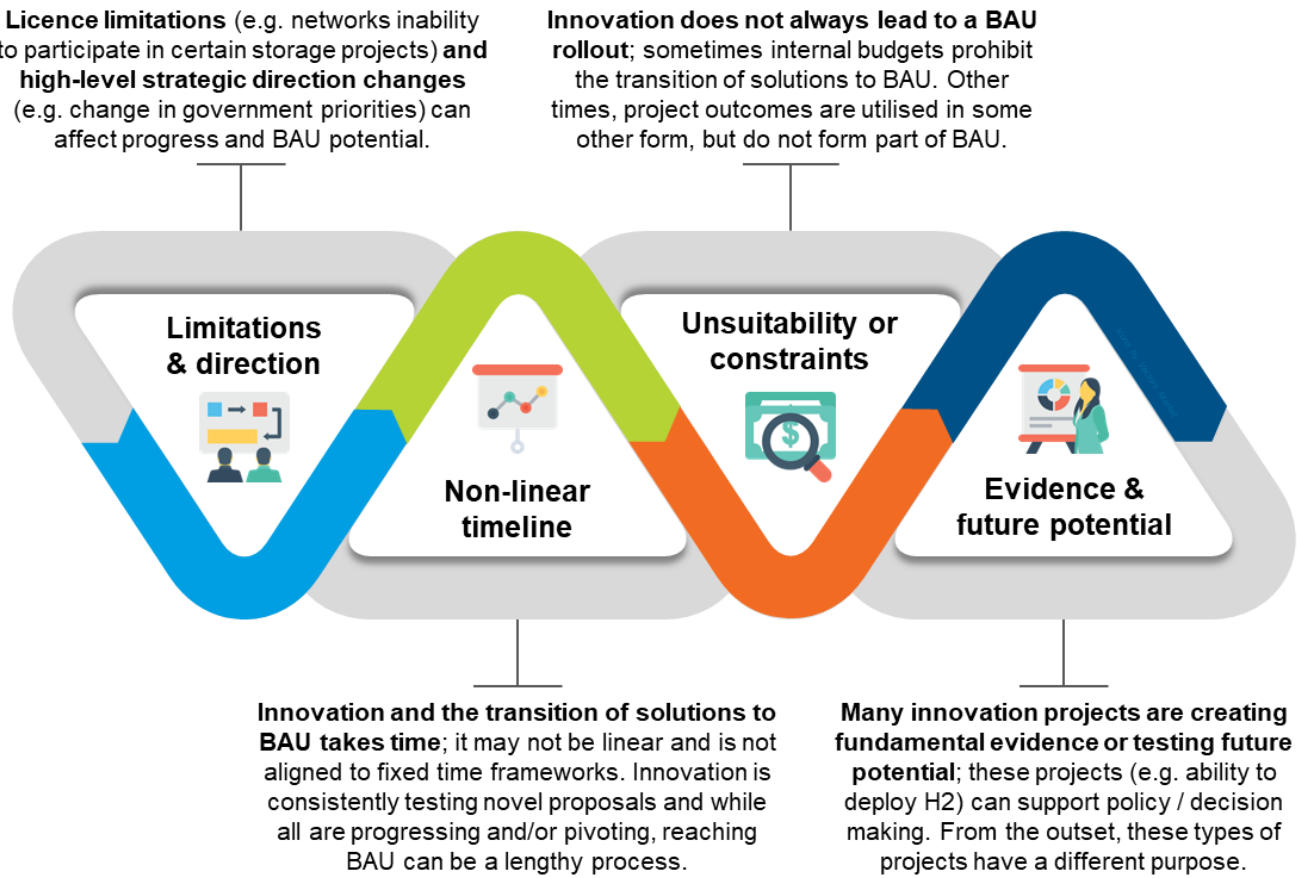
During the FY25 period, networks registered 120 new projects, completed 155 and successfully integrated 23 solutions into business-as-usual (BAU) operations[1]. As projects progress, networks continue to seek opportunities to embed innovative solutions into day-to-day operations.

However, this process is not always straightforward. Innovation takes time, and the path to BAU can be complex.

Networks may face strategic, policy, or operational challenges that require flexibility and persistence. Not every project is ready or designed for immediate rollout. Some focus on building evidence, testing feasibility, or exploring future possibilities. These projects play a vital role in expanding our collective knowledge and preparing the system for long-term transformation.

We've summarised the key challenges and lessons learned in Figure 7.2, offering insights that will help shape future innovation across the sector.

Figure 6.1 BAU challenges and lessons



[1]This imbalance between the number of projects launched / registered and the number completed is to be expected for a period nearing the end of a price control period, as project registration tends to be front loaded for a particular period of this type.

6. Continuing the Cycle

6.3 Recommended Actions

Embedding innovation into BAU requires clear communication, strategic planning, and industry-wide support. This section outlines the key enablers that help networks integrate innovation outcomes into day-to-day operations. A strong focus on communication throughout a project is essential, ensuring that teams across the business understand the value of proposed changes and are invested in successful deployment. To support this, networks are encouraged to develop a clear plan for deployment early in the project lifecycle. This helps align innovation activity with wider business strategy and provides a reference point for demonstrating benefits throughout development.

Support from industry stakeholders is also vital. A consistent methodology for capturing non-financial benefits, such as environmental impact and knowledge generation, would help networks better articulate the value of innovation, particularly to senior leadership and the wider energy sector. This is especially important for low Technology Readiness Level (TRL) projects, which play a critical role in testing feasibility but can be harder to quantify due to their experimental nature. ENA will continue working to ensure future updates to the Innovation Measurement Framework (IMF) reflect these priorities and support the sector's long-term innovation goals.

Unlocking innovation for business-as-usual requires targeted funding and flexible regulation.

Additional funding dedicated to deploying innovative solutions into BAU operations would help networks to overcome barriers such as resource constraints, policy limitations and organisational practice. To support this, Ofgem has introduced a beta version of the Energy Regulation Sandbox, which helps innovators trial new propositions without some of the usual rules applying, and are also planning to launch the Future Regulation Sandbox, an innovative policy instrument to test and trial changes to the energy rulebook in a controlled environment before implementing them. This initiative could help mitigate some of the regulatory barriers to innovation.

However, the specifics of deployment are often outside of the scope of innovation projects, and networks still struggle to quickly assemble the necessary resources. Additional policy support through relaxed licence obligations or the ability to use a more simplified/agile policy process has also been highlighted as an important avenue to boost BAU deployment.