Electricity Transmission

nationalgrid

Innovation

Annual Summary 2022/23

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Welcome to your interactive Annual Summary

Look out for this symbol for the interactive content throughout the document. If you experience any difficulty viewing the interactivity click here for the online version.

Who we are and what we do

National Grid Electricity Transmission (NGET) owns and maintains the high-voltage electricity transmission network in England and Wales. Every time a phone is plugged in, or a switch is turned on, we've played a part, connecting you to the electricity you need.

We take electricity generated across England and Wales, including from windfarms and nuclear power stations, and transport it through our network, consisting of more than 7,000 kilometres of overhead line, 2,800 kilometres of underground cable and 350 substations, on to the distribution system, so it reaches homes and businesses.

We're investing in the network, connecting more and more low-carbon electricity – it's a crucial role and pivotal in turning the UK's net zero ambitions into reality.

Welcome to our Innovation Annual Summary 2022/23

One of the biggest drivers of change for society over the coming decades is reaching net zero carbon emissions by 2050. The UK Government has also set ambitious interim targets where energy networks will play a critical role, in particular an ambition to decarbonise the power system by 2035. This puts the energy system and energy networks front and centre in the transition now and into the future.

Enabling the transition does not just require us to increase the scale of the transmission network, it also requires us to deliver a network with distinct new capabilities and that is enabled by digitisation. The size and scale of this challenge means we can't meet net zero without fresh ideas and innovative solutions.

This year we published our new innovation strategy, which includes resetting our vision and ambition for innovation across NGET to make it more stretching than ever before. But we know this is required if we are to deliver the step-change needed both in the innovation projects we develop and how we implement them in our organisation.

In response to your feedback, in our updated innovation strategy we have also shared clear outcomes we need to deliver through innovation and have also included our near-term technical priorities. We want you to help us ensure we can deliver what is required to deliver net zero, and we welcome your feedback on our strategy.

This year has been a year of growth for our innovation activities. We've expanded our innovation team to manage the growing number of live projects we're progressing. This year we added a further 19 projects to our Network Innovation Allowance (NIA) portfolio, taking our total portfolio to 32. We're also working on two significant Network Innovation Competition (NIC) projects and multiple Strategic Innovation Fund (SIF) projects.

Collaboration is at the heart of our innovation strategy and throughout this year's report you'll find examples of how we're working with others across the energy sector and beyond. Across our NIA portfolio, for example, we're working with 35 project partners on important innovations – such as investigating how we can use drones and artificial intelligence (AI) to monitor the thermal condition of our substations; and finding new ways to mitigate risks arising from extreme weather events.

It is an incredibly exciting time and we are at the heart of the energy transition. Innovation will be a critical enabler of our collective success and we're looking forward to working with you on this exciting journey.

Mark Lissimore
Director of Infrastructure Development and Delivery

Meet the team

We're always on the look out for new ideas and opportunities to partner on innovation projects. If you'd like to find out more about the way our innovation process works, the NGET Innovation team would be happy to speak to you and share details of our innovation portfolio.

Net Zero Innovation team

Nicola Todd
Head of Strategy and Innovation

Gary Stockdale
Net Zero Innovation Manager

Xiaolin Ding
Senior Innovation Engineer

Siyu Gao
Senior Innovation Engineer

Kerri Hayes
Innovation Support

Gemma Pead
Innovation Stakeholder Lead

Amrit Sehmbi
Regulatory Innovation Lead

Gordon Wilson
Senior Innovation Engineer

Ibukunolu Oladunjoye
Innovation Engineer

Tinashe Chikohora
Innovation Engineer

Wangwei Kong
Innovation Engineer

Muhammad Shaban
Innovation Engineer

Deeside team

Sean Coleman
Deeside Centre for Innovation Manager

James (Jimmy) Deas
Senior Innovation Engineer

Ibrahim Iddrissu
Lead Test Engineer

Prem Ranjan
Test Engineer

Hadassah Clough
Innovation Contract Lead

Building on solid foundations

Our highlights from the year include…

Click each icon for more information

"Innovation in our industry is simply not a matter of choice. If we're to meet the government's decarbonisation targets and the outcomes people expect of us, innovation is going to play a central role. We need to find new ways of doing things and encourage fresh thinking, actively pursuing new technology and ideas."

Nicola Todd
Head of Strategy and Innovation

A year of growth

The past 12 months – the second year of RIIO-2 – has seen us building on the foundations and strategic direction we established at the start of the price control period.

For us, 2022-23 has been about growing our portfolio of innovation projects, increasing engagement with our stakeholders, adding to our team, and further developing our people's capabilities.

We've also seen some of our projects conclude and move into implementation, providing tangible benefits for our business and the industry. These include new ways for sealing SF_6 leaks from equipment that are currently difficult to address with available solutions. We're aiming for them to be flexible in terms of the leaks they can stop or significantly reduce, easy to apply, and readily removable whenever needed. You can read about this on page 28.

Our Visual Inspection and Condition Assessment Platform (VICAP) project (see page 30), has been implemented for some of our condition monitoring activities, while we have identified further scope for innovation and implementation to broaden deployment and associated benefits.

VICAP fully automates the capture and processing of corrosion-related condition assessment data. Formed through a collaboration with deep tech start-ups Keen AI and sees.ai, the system uses highly automated drones flown 'beyond visual line of sight' to gather detailed data. This is then processed using artificial intelligence.

Read more about Visual Inspection and Condition Assessment Platform (VICAP).

Read more about Novel methods for sealing SF_6 leaks.

Our refreshed innovation strategy

During 2022/23 we published our refreshed innovation strategy, following our previous publication in 2020 as part of our RIIO-2 engagement activities.

In recent years we've seen a significant increase in the UK Government's ambitions to drive forward decarbonisation of the electricity sector, so we felt it was the right time to evolve our strategy. This makes sure it's aligned to the sector-wide transformation we're making to deliver on our decarbonisation ambitions, while ensuring we achieve a fair and affordable transition that works for all.

Our refreshed strategy also reflects your feedback. You've told us we need to be even clearer about the specific engineering challenges that we need your help to address, so we can work more effectively with you to bring forward innovative solutions. You also asked us to share our specific technical priorities over the next couple of years and how these relate to our strategy. That's what we've sought to do in our refreshed strategy document.

Innovation has a crucial role in delivering the net zero transition. In NGET we cannot deliver the network required without it, and this is reflected in the strategic priorities of our organisation.

But we also know we cannot deliver it on our own, and we hope our revised strategy will enable us to work more effectively with you to deliver the transition that's so critical to all of us.

View or download our interactive National Grid Electricity Transmission Innovation Strategy 2023. We welcome your feedback on our strategy – you can find out how to get in touch with us on the final page of this report.

Working with others

Our strategy is about how we deliver the engineering outcomes required to enable the transition to net zero. It focuses to a large degree on the challenges we face and what we need to do to achieve our objectives. A big part of how we'll get there lies in our ways of working – and collaboration is central to our approach.

University partnerships

We've been building on and strengthening our links with the six UK universities who we're partnering with for the RIIO-2 period. Our university partnership framework, which we established last year, will help us decarbonise the electricity system in Great Britain and accelerate progress towards net zero.

We've been spending time with researchers, analysts and academics from Cardiff, Edinburgh, Exeter, Manchester, Southampton and Strathclyde Universities, so we can better understand their areas of expertise and specific research specialisms. This will help us match them to specific engineering challenges we're looking to solve.

Exploring new ways to promote our engineering challenges

We publish 'calls for innovation', where we promote our engineering challenges – seeking ideas and innovative solutions from prospective partners. An example of this during the past year was our call seeking state-of-the-art solutions for long-term partial discharge monitoring at our substations.

Another route for our calls for innovation is through the Energy Innovation Centre (EIC), whose wide-ranging stakeholder base provides opportunities to engage with forward-thinking suppliers and innovators.

Through the EIC we led an innovation call to improve the way we model and assess the impact of fires from substations on adjacent equipment and buildings. We were also a collaborator with a SSEN Transmission led innovation call, looking at sealing SF_6 leaks.

It also provides us with another forum to work with other networks on common challenges. Through our partnership with EIC, we have a transmission collaboration group comprising three transmission operators that are working closely on:

- net zero substations
- SF_6 alternatives
- consumer vulnerability.

We forged a new partnership with Leading Edge Only, whose global innovation marketplace platform is helping us connect with partners. For example, working with Leading Edge Only, we launched an innovation challenge looking for solutions for a vehicle capable of working in a 3m diameter high voltage cable tunnel.

This year the ENA ran its first basecamp, which gave networks the opportunity to share and address challenges and innovators a single platform to engage with networks. We received 21 responses to the three challenges we shared with innovators and suppliers:

- how does extreme heat affect network assets?
- how can we optimise future asset reliability?
- can we be more resilient to multi-hazard weather events?

Working with others
continued

Climate READi initiative

We're supporting the Electric Power Research Institute's (EPRI) Climate READi framework, which will enable global energy companies, climate scientists, regulators, and other stakeholders to address risks to energy networks from climate change disruption.

The framework produced from this effort will enable energy companies, regulators, and other stakeholders to use science-informed insights in a more consistent way to better understand, plan for, and disclose future global power system challenges. Its three workstreams are scheduled to be concluded in 2025.

Dissemination and engagement events

During 2022-23, we were involved in shaping and delivering a wide range of events. This included both hybrid and virtual events, which provide us with the flexibility to reach ever-wider audiences, meeting them in ways that best suit their needs.

Events we helped shape and deliver included Utility Week Live and the Energy Innovation Summit (EIS), which showcased Ofgem-funded innovation projects from the UK's gas and electricity networks.

At some of these events we've been joined by the partners we're working with on specific innovation projects, so they can provide their perspective and expert knowledge when talking to stakeholders about the work we're doing together.

For example, at EIS, we were joined by Rawwater. Together we showcased our collaborative project to develop a solution for rapidly sealing SF_6 leaks from pipework while systems remain in service on the transmission network. We were also joined by Keen AI and sees.ai to showcase our collaboration on the VICAP project.

We also delivered our own industry dissemination event, which was to share the results of our collaborative project with GeoPura and Siemens Energy – the carbon-free GeoPura 250kW hydrogen power unit (HPU), which was installed at our Deeside Centre for Innovation testing facility. The HPU is producing the energy to power low-voltage equipment needed for our innovation testing projects and site operations.

Members of our Deeside Centre for Innovation team attended the CIGRE Technical Exhibition in Paris to showcase the centre, which offers opportunities to develop and trial innovation ideas and solutions in a real-life environment.

We also sponsored the UHVnet conference in collaboration with Cardiff University. Attended by some 70 delegates from universities and most electricity network companies, the event explored advances in insulation technologies and high voltage phenomena.

Industry working groups and panels

Some of the people in our team are members of industry working groups and panels that are focused on innovation, such as the Electric Power Research Institute (EPRI), the International Council on Large Electric Systems (CIGRE), the Infrastructure Industry Innovation Partnership (i3P), the Institute of Electrical and Electronics Engineers (IEEE) and the Energy Networks Association (ENA). You can find out more about their roles in 'Meet the Team' on page 4.

We welcome ideas, feedback and your views on how we engage with you. If you'd like to get in touch, you can find our contact details on the final page of this report. You can also use our ideas form.

Awards and recognition

We're delighted to have received external recognition for some of the work we've been doing.

We won the Gold Award for Best Innovation in Net Zero and Sustainability at the annual IET E&T Innovation Awards, which celebrate the very best new innovations across the breadth of science, engineering, and technology. The award recognised our work with the University of Manchester to explore SF_6 alternatives.

Our joint paper with The University of Manchester was selected as best paper in Study Committee A3 at the CIGRE Paris Session in 2022. Published in CIGRE Science & Engineering, the paper explores the application of SF_6 alternatives for retro-filling existing equipment.

Looking to the future

Innovation culture

We're developing our organisational culture in NGET, and innovation is an integral part of this work.

As our innovation portfolio matures and projects conclude, new ways of working and fresh technology will be introduced to our business. We believe it's important that innovation is a core part of our culture so our people both develop and are receptive to new ways of working and technology. A more innovative culture will also ensure the successful implementation of valuable innovations across our business.

In our innovation strategy, we describe our ambition for NGET to be the most innovative and pioneering energy network company in the world, with innovative mindsets and capabilities part of our DNA. Having the right culture will be critical in enabling this.

Therefore, NGET and other networks are collaborating with UK Research and Innovation (UKRI) , Ofgem and other networks and external parties to determine what a good innovation culture looks like, as well as the practical steps we can all take to get there. As one of the lead networks involved, this will enable us to develop a NGET-specific plan for improving our culture.

Click here to read our innovation ambition.

Click here to find out how we are simplifying our procurement process.

Click here to find out about our next price control.

Portfolio overview

Our NIA projects

NIA funding provides us with the means to build a diverse and balanced innovation portfolio, with differences across maturity levels, risk, value, and technology areas. Collectively, our NIA projects are delivering ambitious innovations that will help us achieve our net zero targets, with a clear alignment to the specific engineering outcomes we've set out in our Innovation Strategy.

During 2022-23, we increased our portfolio, spending £6.582m on NIA projects during the year. We registered 19 projects, which brings our total of live NIA projects during the RIIO-2 period to 32 and we are collaborating on 6 NIA projects that are being led by other networks.

Our NIC projects

Our Deeside and RICA projects are two significant areas of work that have continued from RIIO-T1.

For our RICA project, we've now awarded a contract to an innovation partnership, to deliver the next phase.

In regards to DCI, we are on track to complete the substation this year, at which point power to the site can be restored. In the meantime, the site is already delivering value by offering its facilities as a test ground for important innovation projects that don't require high voltage.

Strategic Innovation Funding

Through SIF, we applied to Ofgem for £396,000 this year for three projects, which have been given the green light to progress to the first 'discovery' phase. They include: investigating technology to increase power flow capability on existing overhead lines; development of a long-term strategy to remove electrical insulating gas sulphur hexafluoride (SF_6) from the network; and a project to assess whole energy system resilience.

Two of our projects advanced to the Alpha phase of funding. One of these was looking at the potential benefits of replacing conventional cables with HTS cable technology. The other was investigating new satellite data analytics solutions.

The SIF funding we have been given will be spent in FY24.

You can read more about our NIA projects.

You can read more about our NIC projects.

You can read more about our SIF projects.

Our innovation in numbers

NIA Projects

£6.582m

spend on NIA projects in 22/23

£15m

forecast spend on NIA projects in 23/24

19

NIA projects registered in 22/23

10

number of Innovation Engineers working on NIA innovation projects

32

RIIO-2 NIA live projects

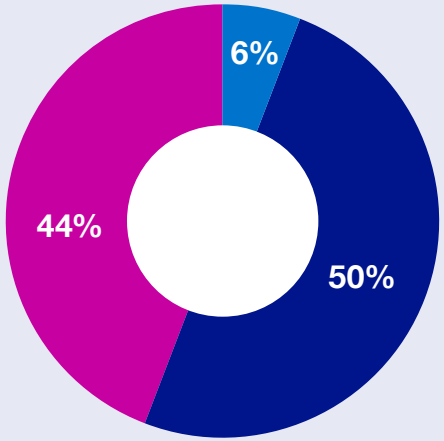
Number of collaborators involved in our RIIO-2 NIA live projects

35

project partners

8

project supports



Distribution of Technology Readiness Level by volume of NIA projects in RIIO-2

- Demonstration (TRL 7-8)
- Research (TRL 2-3)
- Development (TRL 4-6)

NIC Projects

2

ongoing NIC Projects

SIF Projects

2

SIF led Alpha projects registered 22/23

3

SIF led discovery projects worked on

Deeside Centre for Innovation

In 2015, we secured £12m in funding through Ofgem's annual Electricity Network Innovation Competition (NIC), to create the Off-grid Substation Environment for the Acceleration of Innovative Technologies (OSEAIT) project.

We combined this with an additional £14m of National Grid investment to convert a decommissioned substation into a unique research and innovation facility – the Deeside Centre for Innovation (DCI).

The first of its kind in Europe, DCI will help us optimise investments in a controlled, off-grid environment, 24 hours, seven days a week. It aims to deliver benefits to consumers by accelerating the deployment of innovative technologies that may be able to reduce both the carbon footprint and cost of present and future energy networks.

At its core are substation, cables and overhead line test areas designed to facilitate live trials at existing distribution and transmission voltages. This will enable us and all GB network licensees to test assets associated with electricity networks, and trial new technologies and methods to address climate change and maintain security of supply.

While operational, the centre will also collect valuable data by monitoring performance of assets on site.

Progress during 2022-23

Over the past 12 months we've completed the construction of DCI's overhead line test facility and expect to complete the substation this year. In the meantime, the site is already delivering value by offering its facilities as a test ground for important innovation projects that don't require high voltage.

Read more about the hydrogen powered generator trial.

Work we've completed at DCI includes:

- investigating the capabilities of Cemfree – a special cement-free binder mix with a CO_2 footprint that's five times lower than conventional concrete
- hosting investigation work into rapidly sealing SF_6 leaks on pipework (see page 28)
- work to install and test textured composite insulators at DCI. These have an innovatively designed texture that can improve the performance of the insulators. The project will finish once DCI goes live.

Hydrogen powered generator

This year we completed a trial to test a hydrogen generation at DCI. This comprised a GeoPura 250kW hydrogen power unit (HPU) contained within a transportable shipping container, which is producing the energy to power low-voltage equipment needed for our innovation testing projects and site operations.

The trial tested the capabilities and feasibility of HPUs as direct replacements for backup diesel generators across our substation sites – providing valuable insight into where it would be viable to deploy the technology across our network.

Ongoing projects at DCI include hosting trials for our Autonomous Aerial Thermal Inspection of Substations (AATIS) project (see page 24).

Deeside Centre for Innovation continued

Capturing waste heat

We've been putting in the groundwork at DCI to launch an NIA project to decarbonise heat networks, capturing waste heat from electricity transformers to generate hot water and space heating for homes and businesses. It's estimated that our heat recovery project will initially reduce heat network carbon emissions by more than 40% versus traditional gas-led systems.

Critically, the technology offers a route to net zero heat when applied to transformers served by 100% renewable electricity from wind or solar farms. The project has the potential to save millions of tonnes of CO_2 every year if rolled out across our network of transformers across England and Wales.

Events and training

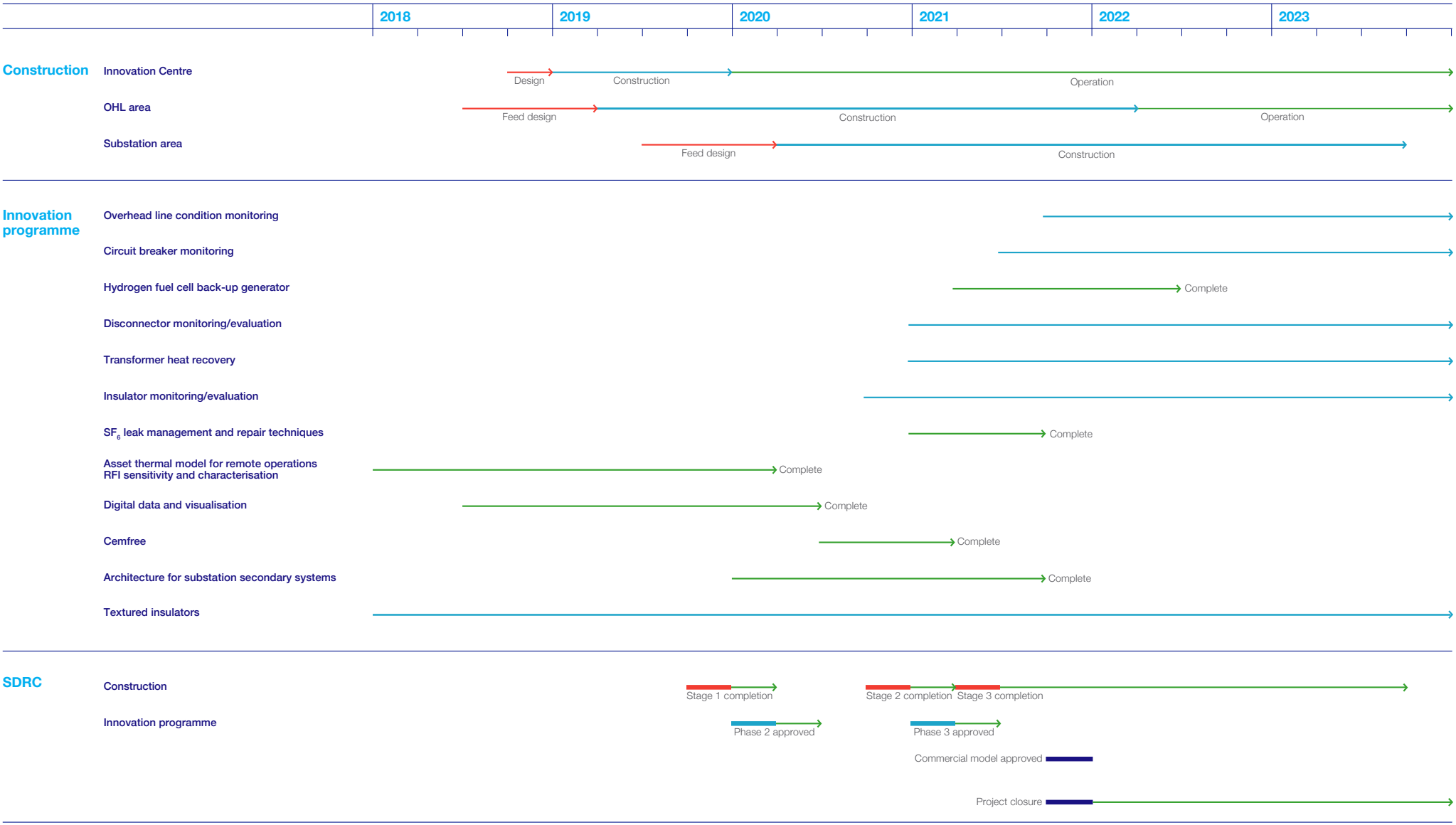
During the year, we presented DCI at key industry events, so we can promote its benefits to customers and stakeholders. These included CIGRE 2022 in Paris – an event that brought together some 9,000 power industry participants from over 90 countries, including 3,500 international experts and other decision-makers.

We also presented DCI at the 2022 Energy Innovation Summit in Glasgow – the only event of its kind, designed to bring together the UK's energy networks, industry and energy system innovators.

Other activities at DCI this year included looking at ways to accelerate the registration of new technologies for use on the transmission system; and also assessing how the site can provide training to boost skills across networks.

Deeside Centre for Innovation continued

Delivery Programme



Deeside Centre for Innovation continued

Successful delivery reward criteria reference table

Ref	Criteria	Description	Status
9.1	Formal agreement on Terms of Reference with Technical Advisory Board members	In order to achieve the efficiency required to meet the project's objectives it is essential that the other Transmission Licensees fully engage in the Technical Advisory Board. An early indication that this project will succeed will be the Board agreeing the Terms of Reference.	Complete
9.2	Detailed design of the facility completed and approved	The completion of both the infrastructure and technical layout designs are an important milestone on the way to delivery of the overall project as they will determine the level of testing and evaluation that can be carried out and at which stage.	Complete
9.3	Design, develop and publish internet site	One of the fundamental knowledge and dissemination channels for the project is the utilisation of the facility website, which will provide a secure area to share the outputs with the other Transmission Licensees.	Complete
9.4	Scope of work for the Phase 1 innovation programme approved	With there being a phased handover of assets it is essential to the project's success that a detailed plan be put in place, based on the assets available and trials proposed during this phase. This plan will include costs of the proposed trial projects, the estimated benefits and justification for how the trials satisfy the Electricity NIC criteria. The plan will also include any (NIA) projects that are able to be undertaken at this time.	Complete
9.5	Completion of Stage 1 construction works	The completion of the Innovation Centre building renovation and the transfer of the protection and control panels to the telecoms and control room are a key milestone to the effective functioning and monitoring of the facility.	Complete
9.6	Scope of work for the Phase 2 innovation programmes approved	The continuation of the phased handover of assets is essential to the project's success and a detailed plan is to be put in place, based on the assets available and trials proposed during this phase. This plan will include costs of the proposed trial projects, the estimated benefits and justification for how the trials satisfy the Electricity NIC criteria. The plan will also include any NIA projects that are able to be undertaken at this time.	Complete
9.7	Completion of Stage 2 construction works	The completion of the construction of the internal access road is a key milestone to the effective functioning of the facility, as this will enable the necessary vehicles to access all areas of the facility. Completion of OHL test area is a key milestone to deliver innovation programme for OHL technologies.	Complete
9.8	Scope of work for the Phase 3 innovation programme approved	The continuation of the phased handover of assets is essential to the project's success, and that a detailed plan is put in place, based on the assets available and trials proposed during this phase. This plan will include costs of the proposed trial projects, the estimated benefits and justification for how the trials satisfy the Electricity NIC criteria. The plan will also include any NIA projects which can be undertaken at this time.	Complete
9.9	Commencement of Phase 3 innovation programme	The delivery of the innovation programme testing and evaluation is a key milestone within the project and the ability to commence operations at the facility is fundamental to the measurement of its success.	Complete
9.10	Completion of Stage 3 construction works	The completion of the construction of the substation area is a key milestone to the effective functioning of the facility, as this will enable the delivery of HV equipment testing and evaluation projects.	Sep-23
9.11	Approval of model for enduring facility	The Technical Advisory Board will determine, based on the flow of projects, the future of the facility.	Complete
9.12	Project close down	All project learning will be consolidated and disseminated appropriately.	Oct-23

Retrofit Insulated Cross Arms (RICA)

Our Retrofit Insulated Cross Arms (RICA) project is a NIC project. It aims to find innovative ways to deliver network capacity – providing better value for money to consumers and accelerating the drive towards a low carbon future.

Insulated cross arms replace the standard metallic cross arms from which insulators and conductors are attached and/or suspended. Retrofit insulated cross arms enable licensees to upgrade the voltage rating on their existing towers from 275kV to 400kV, which has the potential to increase transmission capacity by more than 40%.

The project provides a pathway for Britain's first full-scale implementation of RICA technology, by mitigating technology risks and accelerating its adoption onto the network. It will help us progress with BAU deployment by making sure we better understand relevant processes and technology.

Using RICA will decrease emissions through avoiding use of steel and concrete required for new OHL builds. RICAs can deliver a 39kt reduction of net carbon emissions by 2050. Based on our forecast of where this technology could be deployed, there could potentially be benefits of more than £286m of efficiencies to consumers with future development.

Partnership established

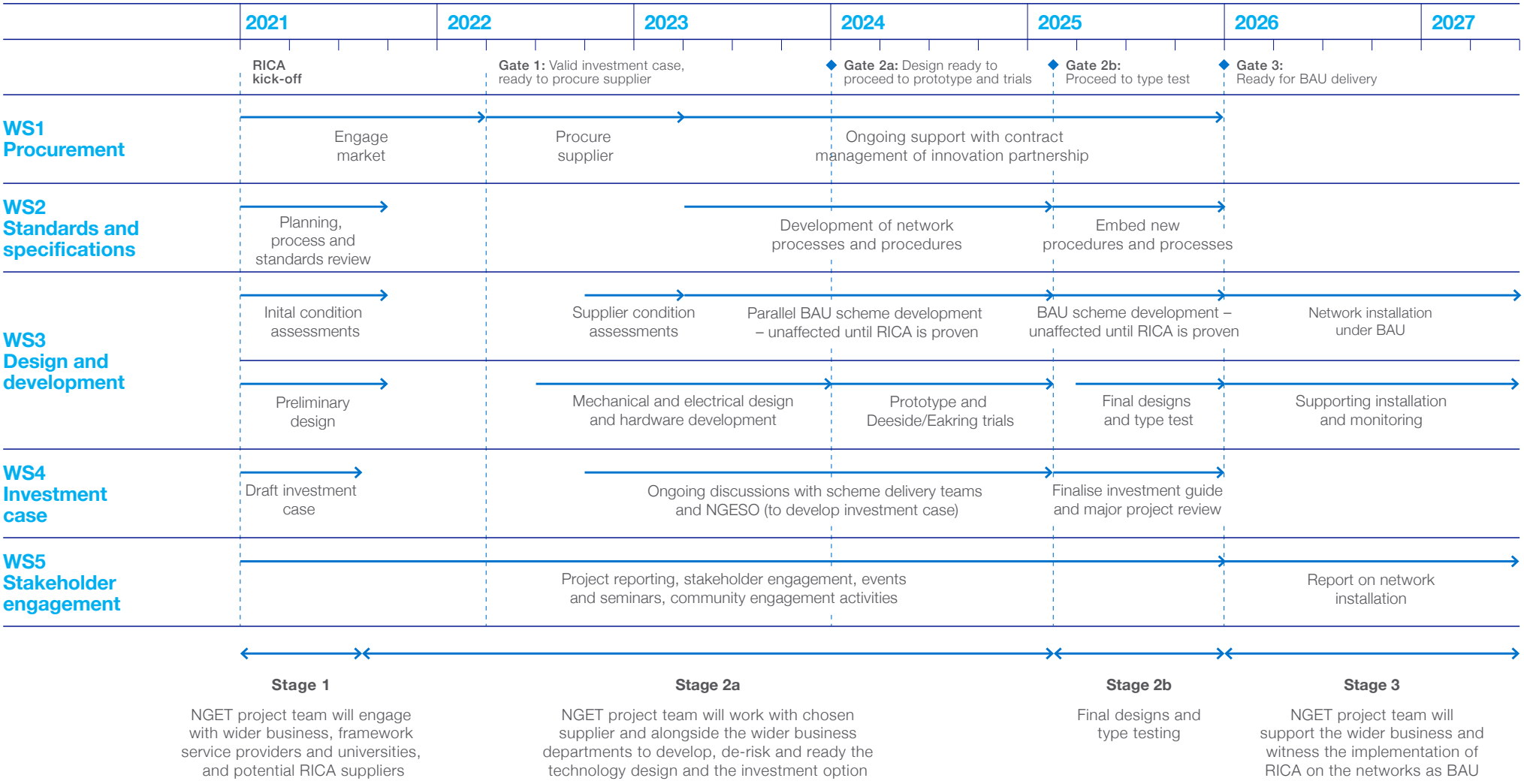
We've now awarded a contract to an innovation partnership, to deliver the next phase of the project, which will upgrade the voltage capacity on some existing overhead lines.

"This project promises to deliver a wealth of benefits in terms of increased capacity where it can be deployed. It also illustrates that National Grid continues to be well placed to deliver on net zero."

Jimmy Deas
Senior Innovation Engineer

Retrofit Insulated Cross Arms (RICA) continued

Delivery Programme



Retrofit Insulated Cross Arms (RICA) continued

Successful delivery reward criteria reference table

Ref	Criteria	Description	Status
D.S1.1	Detailed requirement definition	• Report consisting of all the information required for potential suppliers to accurately gauge the level of work that will be involved in Stage 2 • Shared with licensees through TAB.	Delivered 01 Jul-21
D.S1.2	Preliminary investment case	• Report on the preliminary investment case • Shared with licensees through TA • Workshop with TAB members to review benefits from technology on their networks.	Delivered 01 Jul-21
D.S2a.1	Draft functional specification	• Draft functional specification • Workshop with stakeholders to incorporate feedback into specifications • Disseminated through TAB.	Aug-23
D.S2a.2	First generation product design portfolio	• RICA designs for first generation • Workshop with stakeholders to review impact of different design choices on investments and applications • Disseminated through TAB.	Aug-24
D.S2a.3	Report detailing trial outcomes and lessons learned	• Report on hardware trials of RICAs • Evidence of workshops and lessons learned from trials • Non-confidential information disseminated through industrial conference or journal • Report disseminated to licensees through TAB.	Jul-24
D.S2b.1	NGET processes and procedures for RICA	• Updated technical specifications • Guidance note on rationale behind specification • Guidance on investment case development • Installation practices recorded in report • Disseminated to licensees through TAB, and non-confidential information through industrial conference or journal.	Aug-24
D.S2b.3	Full suite of documentation issued	• Final technical specifications, published • Final guidance note on rationale behind specification • Final installation practices recorded in report • Materials disseminated through TAB.	Feb-25
D.S2b.2	Detailed uprate methodology (final investment case)	• Report on scheme delivery plan and methodology • Disseminated through TAB to licensees • Final guidance on investment case development • Non-confidential learnings disseminated through industrial conference or journal paper.	Jun-25
D.S3.1	Enhanced stakeholder engagement	• Record of RICA engagement with stakeholders • Materials for stakeholder engagement posted publicly.	Dec-25
Common	Comply with knowledge transfer requirements of the Governance Document	• Annual Project Progress Reports which comply with the requirements of the Governance Document • Completed Close Down Report which complies with the requirements of the Governance Document • Evidence of attendance and participation in the Annual Conference as described in the Governance Document.	Dec-25 End of development

Our Strategic Innovation Funding projects

About SIF

SIF, which has replaced the NIC, is delivered in partnership with Innovate UK, part of UK Research and Innovation (UKRI). It funds ambitious, innovative projects that have the potential to accelerate the transition to net zero.

The Discovery is the first of a three-phase funding application. This stage comprises a solution feasibility study to identify challenges and benefits to end consumers. Successful delivery of this phase opens up the opportunity to receive further funding in Alpha and Beta phases to develop and demonstrate the solutions.

We progressed three projects that were granted SIF funding for discovery in 2021-22. Two of these projects advanced to the Alpha phase for 2022/23.

Super Conductor Applications for Dense Energy Transmission (SCADENT)

Through this project, we looked at the benefits that can be provided by replacing conventional cables with HTS cable technology. The aim was to increase network capacity in urban environments.

We carried out a study on the GB network, which demonstrated the technology is both viable and cost-effective as an alternative to traditional cables.

Eye in the Sky

Collaborating with partners, our Eye in the Sky project team investigated new satellite data analytics solutions. These have the potential to help networks improve the visibility of infrastructure and assets and emergency response, while assessing the effects of climate change effects, such as flooding, strong winds, snowstorms or wildfires.

The team assessed how novel uses of data and digital platforms can significantly improve network planning, modelling and forecasting capabilities.

The Alpha phase of funding involved carrying out three use cases based on overhead line asset monitoring, checking for any changes in our assets and the surrounding landscape (such as land subsidence, for example).

The solution should significantly reduce the requirements for manual ground and aerial based monitoring. This can better inform GB networks about network conditions, while lowering emissions and costs associated with operation and maintenance activities.

Neither project will be part of Beta in 2023/24 and therefore will not be reported next year.

Our Strategic Innovation Funding projects continued

During 2022/23 we applied to Ofgem for Strategic Innovation Funding (SIF) to deliver the Discovery phase of three new projects.

Super Conducting Overhead Lines (SCOHL)

This project will investigate the potential use of high-temperature superconductor (HTS) technologies as an alternative to our current overhead line technology to increase power flow capability. We'll test theory against potential use cases.

Whole Energy System Resilience Vulnerability Assessment (WELLNESS)

This project will establish the foundations to develop the first resilience vulnerability assessment for the whole electricity system in Great Britain. This will allow a standardised approach to large 'Black Swan' events (low probability events that have serious consequences).

SF_6 Whole Life

This project will develop an economic, efficient, holistic replacement and management strategy for the greenhouse gas sulphur hexafluoride (SF6) that will realise Great Britain's ambition to deliver a clean energy system.

Our NIA innovations

- Using drones and AI to monitor the thermal condition of substations
- Boosting our ability to control power flow
- Mitigating the risk from extreme weather events
- A longer life for fibre optics
- Seal of approval for remedying SF_6 leaks
- Understanding the impact of V2G on electricity peak demand
- Harnessing the potential of drones and AI

Using drones and AI to monitor the thermal condition of substations

Title: Autonomous Aerial, Thermal Inspections of Substations (AATIS)

Project number: NIA2_NGET0018

Engineering outcome: Maintain the health of an ageing asset base efficiently and economically.

Tactical priority: Improve understanding of the condition of our assets and failure modes.

Project overview

The AATIS project is investigating how we can use drones and artificial intelligence (AI) to automatically monitor the thermal condition of our substation assets.

Traditional asset management relies on time-based monitoring or a 'replace on fail' approach that can be inefficient and costly. As an alternative, we are studying the application of a 'drone-in-a-box' system, installed at our Deeside Centre for Innovation (DCI), that can fly beyond visual line of sight (BVLOS) missions and replace current manual inspection techniques.

The project involves close collaboration with the Civil Aviation Authority (CAA) to gain a BVLOS licence and regulatory approvals for BVLOS drone operations at DCI. The work will also produce a cloud-based AI model to process data and images gathered by the drone, as well as to generate near real-time asset condition reports.

What stage is the project at now?

A visual line of sight (VLOS) trial is under way at DCI to test the system and gather evidence for the BVLOS Operating Safety Case (OSC). The drone, which measures about the size of an A4 sheet of paper, will fly a pre-planned route designed to acquire images of the assets from a precise angle and position. Work has also been completed to prove the drone's ability to avoid obstacles intelligently in the substation environment. Simultaneously, we are working with the CAA to obtain an authorised BVLOS OSC.

What are key benefits and next steps?

If successful, the project will enable manual condition monitoring surveys to be replaced by autonomous drone inspections. We estimate the net present value benefit to be about £800,000 over the next 15 years. Next steps include BVLOS OSC revision and submission, and continuing to train the AI model with data from flight testing.

Siyu Gao
Senior Innovation Engineer

Boosting our ability to control power flow

Title: Enhance Power Flow Control Capability of GB Network

Project number: NIA2_NGET027

Engineering outcome: Coordinated control strategy for power flow control devices and conceptual design of compact mobile QBs.

Tactical priority: Ensure full utilisation of existing network and maximise boundary transfer capabilities.

Project overview

As demand for electrical energy grows and more renewables are connected to the grid, we need to find innovative ways of maximising the power transfer capabilities of our existing network.

The Enhance Power Flow Control Capability (EPFCC) project is investigating how we can improve the operating performance of quadrature boosters (QBs) – a specialised form of transformer used to control power flows.

QBs are highly effective in shifting power flows through the network, but have some limitations:

- Lack of mobility restricts their use across the network.
- Slow tap moving speed and therefore limited phase angle shift.
- Existing control means they're operated individually.
- Lack of coordination across multiple QBs limits overall power flow control capabilities.

Working with Exeter University, we're exploring how innovative approaches in phase shift transformer designs can provide more easily transportable QBs with greater system control capabilities. These future designs are expected to be flexible enough to cope with future demand and changes in network power flows, as anticipated during the energy transition.

We're also investigating how multiple strategically located power flow devices can be coordinated effectively and used to maximise power flow across restricted network boundaries.

What stage is the project at now?

So far, in this project, we have conducted an in-depth analysis of factors influencing the power flow control capabilities of our QBs.

We'll now start developing advanced control algorithms that enable QBs to tap into their full capability during post-fault actions. In addition, we will explore power electronic switching devices that enhance functionality and provide faster response times.

Once we've developed a recommended coordinated control strategy, we'll start working on the conceptual design for modular QBs that are smaller in size, cost-effective, and easy to transport for installation in UK substations.

Xiaolin Ding
Senior Innovation Engineer

Mitigating the risk from extreme weather events

Title: Environmental Risk and Assurance (ERA)

Project number: NIA2_NGET0005

Engineering outcome: Ensuring we can maintain resilience against a more challenging external threat landscape, both from natural climate events and cyber events.

Tactical priority: Understand and develop mitigation measures for network and asset resilience in the face of climate change.

What is the ERA project aiming to achieve?

Vulnerable assets on our network such as substations and towers face an increasing threat from extreme weather-related events, including flooding, severe storms and erosion. To ensure uninterrupted supplies to millions of consumers, we need to find a more effective way to understand and assess environmental risk.

Currently, we receive weather notifications in the form of 'heatmaps' that need to be interpreted by our own specialists. This is a time-consuming process because each notification has to be graded and categorised by human experts before action can be taken.

Through this project, we're developing a bespoke modelling tool that will use multiple sources of data to provide a quantitative risk rating for individual assets. This will effectively give us an early warning system for the threat of damage to vulnerable assets from upcoming weather events.

Strategically placed sensors on assets around the network will feed into the model to improve hazard resilience. The tool will generate real-time alerts alongside a dashboard that provides an instant snapshot of the risk picture.

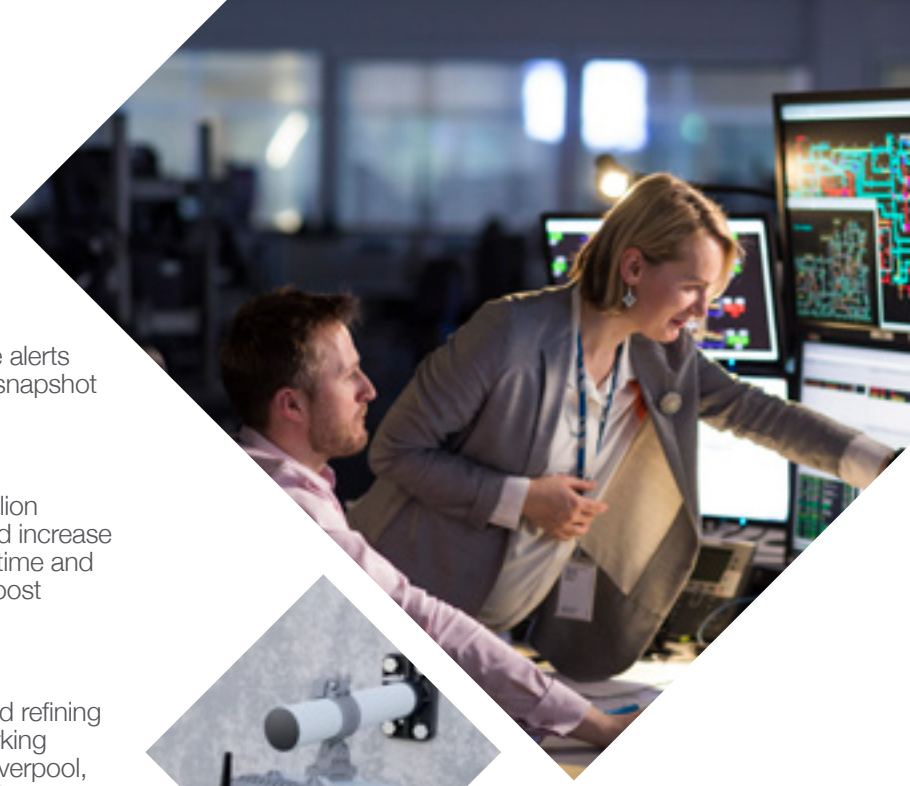
What benefits will the project bring?

We believe the tool will help prevent up to £6 million damage to vulnerable assets – a figure that could increase during the next price control. It also means less time and money spent on labour costs for repair, and a boost to network resilience.

What stage is the project at now?

We're currently developing the modelling tool and refining the dashboard. Supported by the EIC we're working with three external partners – the University of Liverpool, consultants Frazer-Nash and forecasting specialists Previsico, who together bring expertise in areas such as analysis of long-term erosion, flood forecasting and risk modelling.

By the end of 2023, we'll see sensors installed on vulnerable assets at around 50 sites on the network. This will give us valuable real-world data, so there's a big logistical effort ahead to complete these installations. We'll also be finalising the dashboard, adopting all user requirements to give us the most effective tool possible.



Tinashe Chikohora
Innovation Engineer

A longer life for fibre optics

Title: Fibre Health Monitoring

Project number: NIA2_NGET0015

Engineering outcome: Maintain the health of an ageing asset base efficiently and economically.

Tactical priority: Improve understanding of the condition of our assets and failure modes.

Project overview

The energy network transition will need more agile, flexible and interconnected networks – and these will depend on reliable communications networks, especially for protection and control activities.

Operational fibre optic networks are at a point where some of the assets are near end of life, while other parts of the network are still able to provide significant further service life. Unplanned loss of communications requires expensive repairs and electricity network outages. In many cases, it can lead to network constraints.

This project is examining improved optical sensing methods that can detect and track the ageing process of fibre optic cables and associated fittings. Our aim is to secure accurate health information and the capability to forecast failures.

We believe the technology could be available on the market within the next two to three years and that it could save some £2.9m in reduced constraint costs and extend the average service life of fibre optic cables.

What stage is the project at now?

We've been evaluating two slightly different technologies, both of which use sensors and software to analyse collected data. These have been deployed on the network for several months to monitor fibre optic routes.

The project involves comparing reflectometry data from optical time-domain reflectometers (OTDR) with other sources such as weather data – this will help us create a model for predictive asset health monitoring and management.

What are the next steps?

The trials are set to continue throughout 2023, so we can determine how the data from the sensors correlates to the changing weather. There are clear correlations between temperature and fibre loss events, and the focus now is on modelling the relationship and the overall trend after subtracting seasonal signals from the data. Early indications are that it will be possible to triage joints (splices and connectors) inside the network according to how affected by external factors they are, and how much fluctuation in optical signal loss is seen in any one-time window.

This wobble in power could be key to uncovering positions on the monitored network that are susceptible to failure. We're working with our suppliers to closely look at the data that has been collected so we can assess the performance of the technology. We'll then review and compare their suitability, performance, costs, and the benefits they can provide.

Ibukunolu Oladunjoye
Innovation Engineer

Seal of approval for remedying SF_6 leaks

Title: Novel Methods for Sealing SF_6 Leaks

Project number: NIA2_NGET0016

Engineering outcome: Reduce the emissions associated with our SF_6 inventory to achieve net zero by 2050, as well as interim reduction targets.

Tactical priority: Leak detection and repair.

Project overview

Sulphur hexafluoride (SF_6), which is widely used to insulate high voltage assets, has a greenhouse gas impact that's more than 20,000 times higher than CO_2. Emissions associated with leakage of SF_6 gas from our assets are the second-highest contributor to our carbon footprint, Scope 1 and 2 emissions for NGET.

This project involves developing two methods for sealing SF_6 leaks from equipment that are currently difficult to address with available solutions. We're aiming for them to be flexible in terms of the leaks they can stop or significantly reduce, easy to apply, and readily removable whenever needed. The two solutions are:

- A low melting point metal alloy cast with a modular design of mould for small bore pipe work – this follows our previous study of the use of metal alloys for sealing leaks as part of our NIC OSEAIT project. Results had demonstrated the solution's potential.
- A graphene-impregnated elastomer that can be applied as a tape and in a spray to address flange leaks from gas insulated busbars.

What stage is the project at now?

For the metal alloy cast solution, we've worked with Cardiff University to test whether there's any metal particle ingress inside equipment as a result of applying the seal under pressure. We were satisfied with the results and are now looking into the potential for a modular design. Currently a different mould is needed for each application, which adds time and cost to addressing any SF_6 leaks. We're aiming to find a solution that will be suitable for all eventualities of SF_6 leaks from small bore pipe work.

For the graphene-impregnated elastomer, we're working with The University of Manchester to impregnate graphene into an elastomer that can be applied both as a tape and a spray. A rig has been developed to performance test the selected formulation in both forms.

What are the next steps?

We're continuing research on the graphene-impregnated elastomer ahead of performance testing. The metal alloy spray is much further along. Once we've completed testing the mould, we'll trial it at National Grid, SSE and Scottish Power substations – we anticipate completing those trials this year.

Gordon Wilson
Senior Innovation Engineer

Understanding the impact of V2G on electricity peak demand

Title: System Value from V2G Peak Reduction in Future Scenarios Based on Strategic Transport and Energy Demand Modelling

Project number: NIA2_NGET0017

Engineering outcome: Understand the role of whole energy system solutions and their impact on the transmission system.

Tactical priority: Develop and understand capabilities of whole energy system modelling.

Project overview

The transition to electric vehicles (EVs) will require greater network capacity to power a significant new source of electricity demand.

As the EV roll-out gathers pace, Vehicle to Grid (V2G) offers the potential to reduce peak demand beyond 2035 by feeding power back into the grid. But V2G's success depends on many factors including consumer behaviour, availability of charging points and the range of tariffs on offer.

Through this project we aim to develop a strategic transport and energy demand (STED) model that investigates the impact of V2G on peak demand across the whole GB system under different credible decarbonisation scenarios. It will model demand profiles from domestic vehicles in 2035 and 2050 to help identify when and where EV uptake is likely to arise and support effective network investment.

What stage is the project at now?

The project started in October 2022 and we have analysed the scenarios for EV uptake and use in 2035 and 2050, studying potential travel patterns, regional variations and customer characteristics, and identified potential risks related to V2G. Development of the initial model is now complete and it considers factors such as National Grid Electricity System Operator's Future Energy Scenarios, customer profiles and energy market pricing signals.

What are the next steps?

An important next step is to conduct a customer behaviour survey that will provide detailed understanding of how people prefer to charge and discharge their EVs and their willingness to engage with a V2G scheme. We will model EV battery degradation based on different charging behaviours and carry out a risk impact assessment to analyse and rank the potential risks. Finally, we will refine the STED model based on behavioural research to produce a series of V2G profiles. This will provide revised results of V2G impacts and the implications for long-term network planning.

Wangwei Kong
Innovation Engineer

Harnessing the potential of drones and AI

Title: Visual Inspection and Condition Assessment Platform for OHL Steelwork (VICAP)

Project number: NIA2_NGET0009

Engineering outcome: Facilitate system access for all work as demand grows.

Tactical priority: Develop enhanced asset management practices, such as non-intrusive condition monitoring.

Project overview

Through this project we've been aiming to fully automate the capture and processing of corrosion-related condition assessment data for the steelwork on our lattice pylons.

Collaborating with deep tech start-ups Keen AI and sees.ai, we've been developing a process that uses automated drones flown 'beyond visual line of sight' (BVLOS). These gather high-definition close-up images of pylons, which are then processed using artificial intelligence (AI).

The project is enabling the capture of data that's optimal for automated processing, linking the images to exact positions on the tower and geographic locations on the network.

By implementing this innovation, we anticipate savings of around £655,000 for UK consumers by 2031. This includes benefits realised from reducing the use of helicopters, avoiding fuel costs, and faster processing times for assessments.

What stage is the project at now?

Through three iterations of semi-autonomous drone flights on a stretch of 10 pylons in Charlton, Hampshire, our team succeeded in developing the automated process, refining the data capture and AI algorithms.

We also secured a UK-first permission from the Civil Aviation Authority (CAA), making sees.ai one of the very few companies worldwide with routine permission to inspect the electricity grid from BVLOS – and perhaps the only company in the world capable of enabling close quarter inspection of pylons.

The project concluded in March 2023.

What are the next steps?

We want to further develop the software for the AI platform, as it's not yet ready to operate at scale. Our aim will be to introduce the technology to our existing fleet of drones and our helicopters – and operate it over a larger proportion of the network.

We also hope to work with the CAA to expand the BVLOS site permission, so we can use the technology at any location on our network that meets the right criteria.

Mark Simmons
Condition Monitoring Manager

Live project portfolio

Project Ref	Name	Partners
RIIO-2 Project Portfolio List		
NIA2_NGET0001	Impedance Scan Methods	
NIA2_NGET0002	Role and Value of Electrolysers in Low-Carbon GB Energy System	I C Consultants Ltd
NIA2_NGET0003	Retrofitting Oil Source Heat Recovery to Transformers	Therma-Mech Ltd
NIA2_NGET0004	Centralised PAC	UK Grid Solutions Ltd
NIA2_NGET0005	Environmental Risk and Assurance (ERA)	Frazer-Nash Consultancy Ltd, University of Liverpool, Previsico Ltd, Energy Innovation Centre Ltd (EIC)
NIA2_NGET0006	Non-invasive In-situ Monitoring and Interpretation of SF_6 Alternatives in GIS Equipment	The University of Manchester
NIA2_NGET0007	EPRI Research Collaboration on Electric & Magnetic Fields Health & Safety (P60) 2021-25	EPRI
NIA2_NGET0008	EPRI Substations (P37) and Analytics (P34) 2021-2025	EPRI
NIA2_NGET0009	Visual Inspection and Condition Assessment Platform for OHL Steelwork (VICAP)	Keen AI, sees.ai
NIA2_NGET0010	Non-Intrusive Tower Foundation Inspections Using UGW (NITFI)	The Welding Institute Ltd (TWI)
NIA2_NGET0011	Alternative Approaches to Tower Painting Preparation	Hive Composites Ltd
NIA2_NGET0012	EPRI Research Collaboration on Underground Transmission (P36) 2021-2025	EPRI
NIA2_NGET0013	Overhead Line Sagging Monitoring Using 5G Signals	Warwick University
NIA2_NGET0014	Secure Edge Platform	Capula Ltd
NIA2_NGET0015	Fibre Health Monitoring	EXFO Europe Ltd and ADVA Optical Networking Ltd
NIA2_NGET0016	Novel Methods for Sealing Sf_6 Leaks	Rawwater Applied Technology Ltd, The University of Manchester, Cardiff University, SPEN, SSEN Transmission, EIC
NIA2_NGET0017	System Value from V2G Peak Reduction in Future Scenarios Based on Strategic Transport and Energy Demand Modelling	Frontier Economics, Imperial College, Warwick University
NIA2_NGET0018	Autonomous Aerial, Thermal Inspections of Substations	Frazer-Nash Consultancy, HEROTech8

Live project portfolio continued

Project Ref	Name	Partners
RIIO-2 Project Portfolio List		
NIA2_NGET0019	Aerial E-field Inspection System for Live Overhead Transmission Assets	The University of Manchester
NIA2_NGET0020	Co-Simulation	Manitoba Hydro International
NIA2_NGET0021	New Online Tools for Assessment of Bushing Condition	Doble PowerTest
NIA2_NGET0022	Switch Oil Markers	The University of Manchester, Nynas Ltd
NIA2_NGET0023	Cable Alternative Cooling Technologies for Underground Systems (CACTUS)	The University of Southampton
NIA2_NGET0024	Insulating Dielectrics: Esters & Alternative Liquids	University of Southampton
NIA2_NGET0025	Wide Area Control Framework	Siemens Public Ltd Company
NIA2_NGET0026	Energy Water Nexus	Energy Systems Catapult
NIA2_NGET027	Enhance Power Flow Control Capability of GB Network	University of Exeter
NIA2_NGET0028	Identification and Quantification of C4F7N Gas Arcing By-Products and Their Implication for GIS Operation	Cardiff University
NIA2_NGET0030	Voltage Interaction and Thermal Dynamics of Tertiary Connection	The University of Manchester
NIA2_NGET0032	Swarfless Cut Isolation System for SF_6 Outages and Repairs (SCISSORs)	
NIA2_NGET0033	Digital Twin Enabled Innovation for Network Restoration	Arup
NIA2_NGET0035	Green Heat for Local Communities	Arup & SGN

Live project portfolio continued

Project Ref	Name	Partners
RIIO-T2 Collaborative Projects		
NIA_CAD0088	Digital Exclusion	Frazer-Nash Consultancy, Energy Innovation Centre
NIA_NGGT0175	5G – The Art of the Possible	Digital Catapult
NIA_SPEN_0064	Cyber Security for Active and Flexible Energy Networks (Cyber-SAFEN)	The University of Manchester
NIA_SHET_0039	OHL Foundation Uplift	SPEN
NIA_NGGT0184	Gas and Electricity Transmission Infrastructure Outlook	Guidehouse
NIA_SHET_0035	TOTEM (Transmission Owner Tools for EMT Modelling) Extension	SPEN

How our projects are funded during RIIO-2

We receive funding for our innovation portfolio from two main sources – the Network Innovation Allowance (NIA) and Strategic Innovation Funding (SIF).

NIA

The NIA provides an allowance to network licensees to fund research, development and demonstration trials that meet six specific eligibility requirements.

Each must:

1. Facilitate energy system transition and/or benefit consumers in vulnerable situations
2. Have the potential to deliver a net benefit to consumers
3. Involve research, development or demonstration
4. Develop new learning
5. Be innovative
6. Not lead to unnecessary duplication.

There's no maximum or minimum spend criteria for projects, and each should carry a risk profile.

Network licensees need to demonstrate why they cannot fund such a project as part of their business-as-usual activities.

During RIIO-2, there is £49.3m of NIA funding available to NGET – a 35% increase compared to the RIIO-1 regulatory period. This funding covers 90% of the cost of our projects; the remaining 10% comes from NGET. During the five-year RIIO-2 period, we will have £54.2m to spend on our NIA projects.

SIF

For RIIO-2, Ofgem replaced its Network Innovation Competition (NIC) framework with the Strategic Innovation Funding (SIF), with £450m available for GB networks over the five-year regulatory period out to 2026.

Network companies must comply with the SIF Governance Document, and their applications for funding should respond to the innovation challenges published by Ofgem. Each of these challenge descriptions defines the problem, success criteria, funding available and any other requirements.

Projects are funded progressively in three phases: Discovery, Alpha and Beta, to ensure focus on the right areas and minimise risk. The aim is to help the projects to develop rapidly, react to change and maximise their potential to transform the energy system.

Contact us

We'd really like to hear from you – our communities, consumers, customers, employees, investors and stakeholders. We want to make sure we're focusing on the right areas and delivering the right results.

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