Electricity
Transmission

Innovation
Annual Summary 2020/21

nationalgrid

Contents

About us

Click here to read...

1 Welcome to our innovation annual summary 2020/2021

"A carbon-free transmission system will be an integral part of an energy landscape that looks very different to the one we've been used to for so long."

In this year's report, we reflect not just on the work we've done in the final year of RIIO-1, but also on how our innovation work has evolved over the eight-year regulatory period. It's been a time of remarkable change, characterised by rapid technological growth and an increasing emphasis on the transition to a low-carbon economy.

Our Zero 2050 project is a good example of how our work is increasingly linked to the decarbonisation of transport, heat and industry – in this case, partnering with network providers to speed up progress towards making South Wales carbon-free by 2050. You can read more about this on page 31.

In our Innovation Annual Summaries, we always highlight how important collaboration is to the way we work. And like most other businesses, we've had to find new ways to talk to our stakeholders and customers during an extraordinary and challenging year.

As you can read on page 10, the impact of Covid-19 led us to re-think how we used digital technology to provide people with a host of different ways to engage with us. Ultimately, we want to reach as many stakeholders and customers as possible, so we can broaden debate, seek opinion and gather ideas.

Putting innovation at the heart of the way we work has gained significant momentum over the past year. Our new innovation forum (see page 4) brings together people throughout our business to discuss how innovation can help them achieve great outcomes for our customers. And, as you can read on page 19, our NGET Board Innovation Charter both demonstrates our leadership commitment and helps set the tone for an innovative culture.

All this is helping build the momentum we need to meet the challenges of the energy transition. A carbon-free transmission system will be an integral part of an energy landscape that looks very different to the one we've been used to for so long. To get there, we need fresh thinking, new ideas and a culture that challenges convention to be a natural part of the way we work.

Alice Delahunty
President of National Grid Electricity Transmission

2 A year of broadening our horizons

"An increasingly mature innovation culture will be crucial for us as we look to develop long-term benefits for consumers and decarbonise the industry and society."

Paul Gallagher
Head of Innovation,
National Grid Electricity Transmission

Over the past year we've been developing the breadth of our innovation ambition and portfolio, gearing both to meet the challenge of the Government's target of achieving net zero carbon emissions by 2050.

We've also been further developing a culture of innovation within our business, finding new ways for people to explore creative potential. Our new innovation forum brings together key stakeholders from throughout National Grid Electricity Transmission. The forum is providing the means for them to share their challenges and priorities, while showing them how innovation can help meet business needs.

The forum is also helping stimulate a culture where our people talk more naturally about innovation, promoting it as a topic that's an integral part of our way of working.

2 A year of broadening our horizons continued

Our highlights for the year include…

Continuing to deliver innovative projects
Throughout the year we have progressed 45 Network Innovation Allowance (NIA) funded projects, discovering innovative solutions across diverse areas to deliver better outcomes for consumers.

Zero 2050
This pioneering innovation project, which aims to speed up the progress of decarbonisation in South Wales, demonstrates our commitment to multi-stakeholder engagement. A partnership between network providers in South Wales, it's co-funded by Wales and West Utilities, Western Power Distribution and National Grid, and is backed by the Welsh Government and the South Wales Industrial Cluster.

Zero 2050 is a great example of how the nature of innovation is evolving, encompassing crucial work to explore whole system pathway options and ideas rather than specifying technical solutions. Although Zero 2050 relates to South Wales, it also demonstrates an approach we can apply to the wider decarbonisation agenda.

Click here to read more about this project

Deeside Centre for Innovation
We're now into the completion phase of constructing the Innovation Centre facilities that should start 24/7 commercial operation this year. We're also moving forward with a number of innovation projects that will use this new facility, including plans to examine how an alternative gas to SF_6 performs.

The Deeside Centre for Innovation will enable a lot of the work we want to do during RIIO-2, including our efforts to meet the net zero ambition. It will also provide an opportunity for the rest of the industry to develop and test important innovations.

Click here to read more about the Innovation Centre's progress

2 A year of broadening our horizons continued

SF_6

Replacing SF_6 in our equipment with low carbon alternatives, and reducing its leakage on our network, is the biggest direct environmental intervention that we can make.

We're at a transition phase with this work – moving from alternative gas technologies being on the horizon, to now preparing for replacing SF_6 equipment on our network. We expect to see alternative gases appearing on our network for the first time over the next couple of years, and we've been looking at the risks and issues we'll need to tackle in managing the transmission system safely and efficiently with this equipment.

We've also been continuing to find ways to reduce SF_6 leakage during the transition and minimising its impact when leakages occur.

Click here to read more about this work

RICA project funding

In November 2020 we were successful in securing £8.12m of funding from Ofgem's Network Innovation Competition (NIC) to develop innovation for the uprating of overhead lines.

The Retrofit Insulated Cross Arms (RICA) solution will allow over 40 per cent more power to be transported over existing lines with minimal construction interventions.

Click here to find out more about this project

We also made an NIC submission for our Proteus project, which proposed developing a new solution to support grid stability. Although the proposal progressed to the final stage of competition, it was not successful in securing funding.

Sharing our priorities

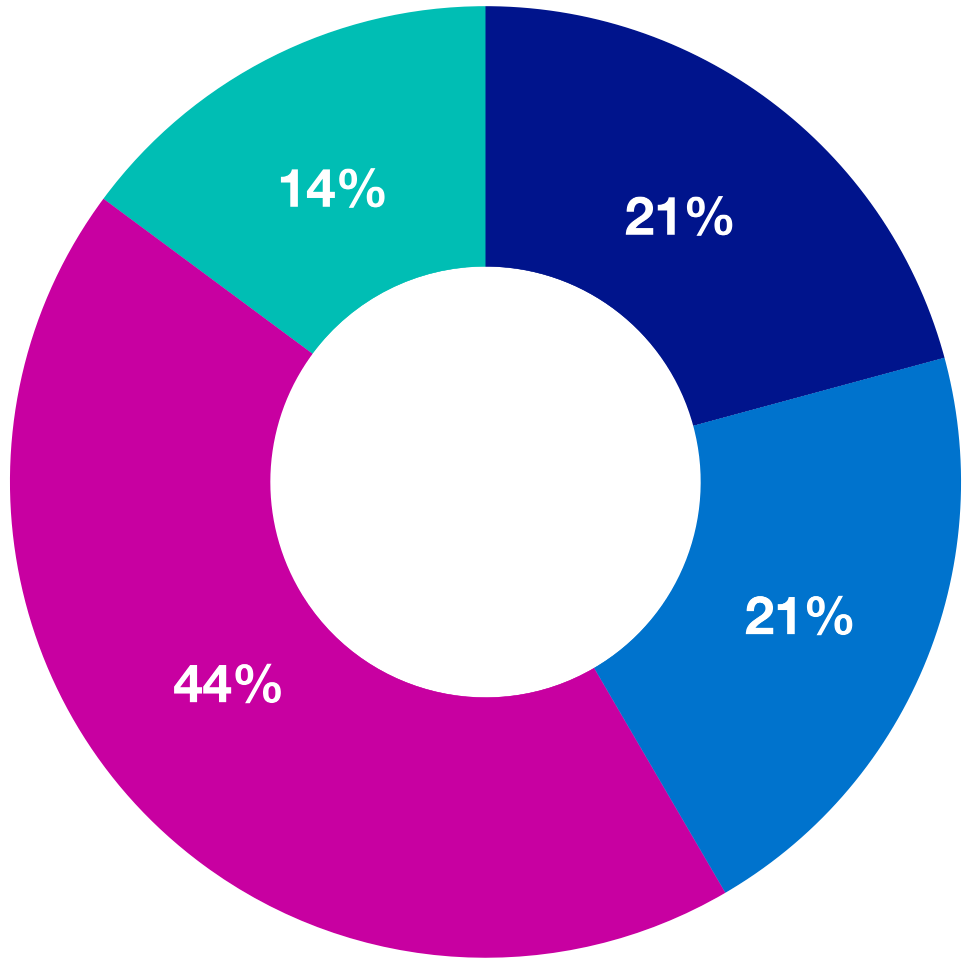
We have a clear vision to be at the heart of a clean, fair and affordable energy future and have been promoting our strategy for how innovation will play a crucial role in this.

Click here to read more about sharing our priorities

In February, *E&T Magazine* published an article about our strategy.

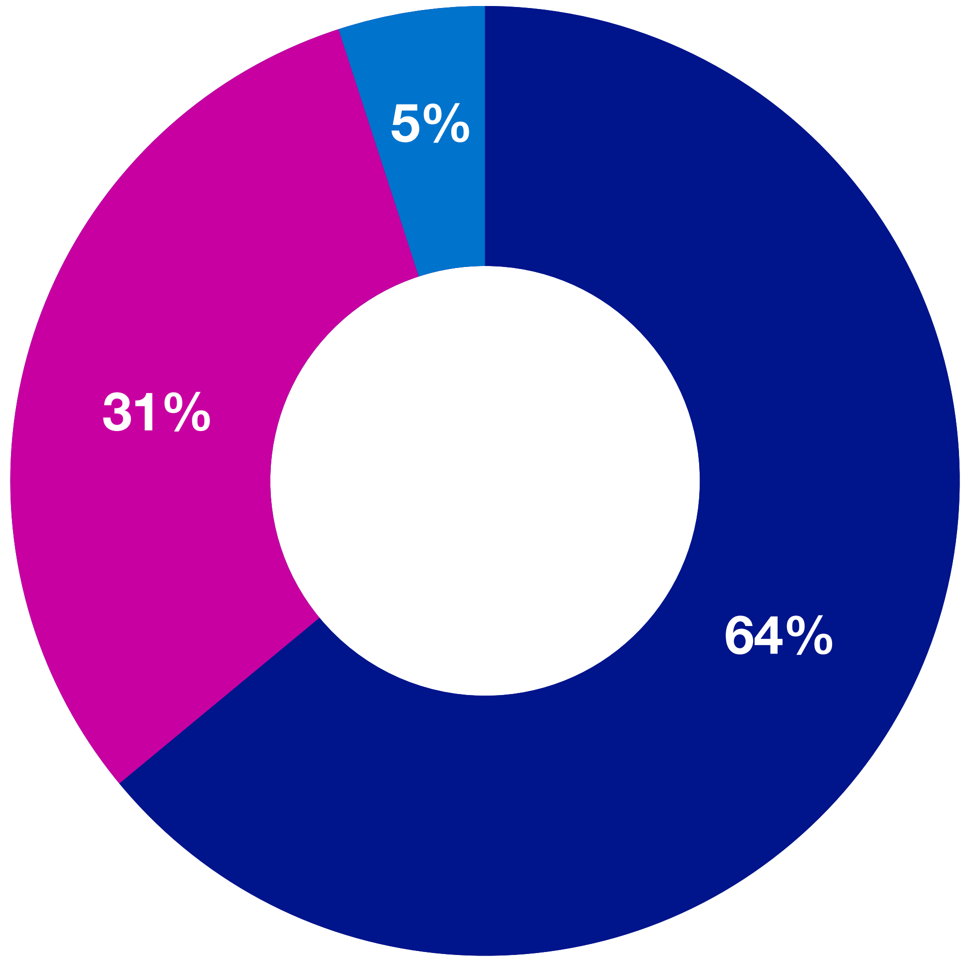
Click here to read about our strategy in the *E&T Magazine* article

3 Our innovation in numbers



Percentage of projects aligned to strategy in RIIO-1

Key:
- Corporate Responsibility
- Efficient Build
- Managing Assets
- Service Delivery



Distribution of Technology Readiness Level by volume of NIA projects in RIIO-1

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

Electricity Innovation Strategy

184
Network Innovation Allowance (NIA) projects in RIIO-1 period

£7.21m
spent on NIA projects in 2020/21

7
new NIA innovation projects started in 2020/21

12
RIIO-1 projects in delivery and will complete during 2021/22

£5.5m
forecast spend on NIA projects in 2021/22, including £1m of CNIA from RIIO-1

88%
of NIA allowance spent in 2020/2021 with an additional 12% being spent in 2021/22

14
FTEs dedicated to leading our innovation projects and engaging with NGET teams and external stakeholders to deliver the desired outcomes

4 Reflecting on RIIO-1

"Our ambition remains to promote innovation across the breadth of everything we do at National Grid Electricity Transmission – challenging ourselves to find new solutions and be more aspirational in the ways we achieve outcomes for customers."

Robin Gupta
Regulatory Innovation Manager,
National Grid Electricity Transmission

The eight-year RIIO-1 regulatory period came to an end on 31 March 2021. It's been a period where we've seen our whole approach to innovation evolve, while developing an innovation programme that provides asset, network and service delivery solutions in a responsible way.

Innovation in RIIO-1 came through three different funding streams: Network Innovation Allowance (NIA), Network Innovation Competition (NIC) and our innovation partnerships.

Through NIA funding, we delivered a total of 184 projects. Additionally, in 2015 we secured £12m in Ofgem funding, through its annual Electricity Network Innovation Competition (NIC), and invested a further £14m to convert a decommissioned substation into a unique research and innovation facility – the Deeside Centre for Innovation.

Click here to read more about the Deeside Centre for Innovation

We're proud of our achievements in progressing innovative ideas into roll-out across the network. For example, we introduced Smart Wires (SW) technology that will help decarbonise the UK by providing more control and flexibility over the power flow across our transmission boundaries, while enabling us to transmit more renewable energy to consumers at a lower cost.

And we've come a long way in the work we've done on preparing our network to replace SF_6, which you can read about by clicking on the link below.

Find out about how we introduced Smart Wires (SW) technology

Click here to read more about our SF_6 journey

Recognition

We've been nominated for a range of awards, making the shortlists on two external awards for our innovative textured insulators (these are designed to extend the lifetime of composite insulators by using a textured surface). And our application of the Novel Transformer Dehydration Using Membranes won an Electric Power Research Institute (EPRI) Technology Transfer Award, recognising the work we've done to move EPRI research into practice.

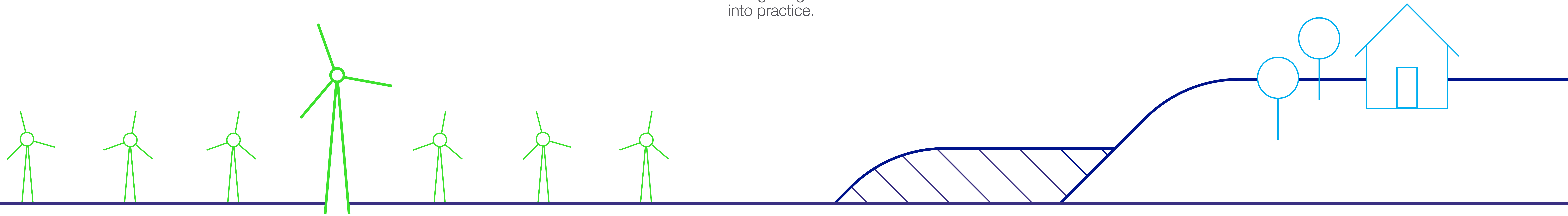
How our focus has evolved

When the RIIO-1 regulatory period began, many of our innovation projects centred on improvements to conventional transmission technology. But our focus has evolved over time to encompass areas such as the environment; enabling the energy transition; and digitising our operations to help us make better decisions, improve how we manage our equipment, and deliver cleaner and cheaper energy for consumers.

In addition to the changing nature of technical solutions, we've also been extending the way we innovate. For example, by developing policies that allow us to operate our equipment differently, or to extend its lifespan, we're maximising the benefits the equipment offers.

Similarly, our Forward Resilience project is less about technical innovation and more about how we approach a challenge – in this case, a topic that's strongly linked to the energy transition due to the technical and process issues it encompasses.

Click here to find out about our Forward Resilience project



5 Collaboration

Collaboration is a crucial part of the way we innovate in National Grid Electricity Transmission. Sharing and being open to new ideas from across industries and academia allows us to develop projects to transform energy systems and bring the greatest possible benefits to our customers, stakeholders and end consumers.

We make better decisions by being flexible, innovative and working together. For us, that involves finding the right specialist partners to work with us on the right challenges, while giving stakeholders plenty of time and opportunity to contribute and influence our decision-making.

Supply chain

Through our corporate level membership of, and collaboration with, the Electric Power Research Institute (EPRI), we leveraged research funding from more than 100 international electricity utilities so that each £1 we invested in 2020 generated nearly £18 worth of research.

We've also collaborated with academic institutions in the UK to leverage wider funding available through the Engineering and Physical Sciences Research Council (EPSRC).

We joined the Energy Innovation Centre (EIC) in 2020, and its wide-ranging stakeholder base gives us new opportunities to engage with forward-thinking suppliers and innovators. It also provides us with a forum to work together with other networks on common challenges that centre on SF_6, vulnerable customers and digital substations.

Additionally, we have continued engaging with innovative organisations through our membership of the Infrastructure Industry Innovation Partnership (i3P). Its large network of experts and innovators is helping drive transformation within the infrastructure and construction industry to deliver infrastructure for the future.

5 Collaboration continued

“Collaborating with our stakeholders is part of the way we work and will be crucial if we are to be successful during RIIO-2. The energy transition needs innovative solutions, and we can’t meet the challenges alone.”

Gemma Pead
Innovation Stakeholder
and Communications Officer,
National Grid Electricity Transmission

Stakeholders

Like many other organisations, the Covid-19 pandemic and resulting lockdown posed challenges for our stakeholder engagement activities.

Although we particularly value the benefits of face-to-face engagement with our stakeholders, we adapted and found ways to replicate our activities using digital technology. This included our involvement with the Energy Networks Innovation Conference (ENIC), which showcased the most significant Ofgem-funded innovation projects from the UK’s gas and electricity networks.

Our attendance at Utility Week Live – the first of its kind as a virtual event – was another great opportunity for us to collaborate and network with stakeholders using digital platforms.

We saw high attendances at some of our project-related online events for stakeholders – showing us that in the future we need to consider balancing more traditional face-to-face events with digital ones, allowing us to engage with a potentially wider audience.

We also made enhancements to our website, making it easier for stakeholders to get in touch.

Stakeholder webinar

On Tuesday 30 March we held a webinar for our stakeholders. In addition to presenting our innovation strategy themes and updates on some of our work, including the Retrofit Insulated Cross Arms (RICA) project and progress on the Deeside Centre for Innovation, we ran a series of polls that highlighted areas in which our stakeholders wanted to be engaged during RIIO-2.

At the virtual Energy Networks Innovation Conference (ENIC), we showcased a number of our innovation projects and RIIO-2 innovation strategy.

5 Collaboration continued

Academia

We currently have three strategic academic partners: The University of Manchester, Cardiff University and the University of Southampton. We're working with them on a wide range of innovation areas including exploring alternatives to SF_6, network resilience and whole system modelling. We have also worked with other universities on specific one-off projects such as Imperial College London on impedance modelling.

Click here to read more about Imperial College London and impedance modelling

For RIIO-2, we're setting up a new framework for a wider range of UK universities to work with us on delivering the energy transition and addressing consumer vulnerabilities. In addition, while we continue to work with framework UK universities we will have connections with a wider range of research institutions in the UK and overseas.

6 Deeside Centre for Innovation

Project update

In 2015, we secured £12m in Ofgem funding, through its annual Electricity Network Innovation Competition (NIC), to create the Offgrid 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 aims to deliver benefits to consumers by accelerating the deployment of technologies able to reduce both the carbon footprint and cost of present and future energy networks.

At its core are substation and overhead line test areas designed to facilitate live trials at existing distribution and transmission voltages, and beyond. It will enable us and all GB Network Licensees to:

- Test assets associated with electricity networks
- Trial new technologies and methods to address climate change and maintain security of supply while optimising investments in a controlled, off-grid environment, 24 hours, seven days a week

Collect valuable data by monitoring performance of assets on site.

The facility will underpin the effort we, along with energy industry stakeholders, are investing in innovation and will play an essential role in delivering innovations in RIIO-2 and beyond.

Over the past 12 months the project has made significant progress. We finished construction of the overhead line test area, which is ready to launch testing of insulator and conductor technologies at voltages up to 400kV. Availability of the test area provides opportunities for us and other stakeholders to verify new solutions. It also enables the updating of lifecycle models that predict end-of-life for overhead line assets – improving investment decisions, maintenance costs and reliability of the power system.

In the substation test area, the groundworks have been progressed so we can get the site ready for installing test equipment. The site will have five areas for testing high voltage assets with capabilities up to 400kV/4,000A and even up to 600kV single phase. One of the test areas is designed to test DNO assets.

In addition to the site work, we presented DCI at the Utility Week Live and Energy Networks Innovation Conference (ENIC) conferences in November–December 2020, engaging with a wider innovation stakeholder audience. And in October 2020 we chaired the Technical Advisory Board meeting to share the results of the work with stakeholders, including representatives from universities, utility companies and National Grid experts, and to approve the third phase of innovation trials for the year ahead.

6 Deeside Centre for Innovation continued

"While engaging with innovation stakeholder groups, we noted high level of interest to use Deeside Centre for Innovation for R&D activities. This gives us confidence that the centre will be successful in providing real benefits for the energy industry, customers and consumers while supporting the transition to Net zero."

Alexander Yanushkevich
Deeside Innovation Manager,
National Grid Electricity Transmission

Hydrogen power cell generator

We have engaged with a start-up company called GeoPura that developed a hydrogen power cell solution to replace our diesel generators – this has been successfully applied at our construction site for the Viking Link. We now want to investigate if a hydrogen-based solution can replace diesel generators providing emergency power that we have installed in all our substations. If the trial demonstrates technology compatibility with our existing systems, we can roll it out across the network, replacing retiring diesel generators, or use it as a standard solution in future substations. While reducing our dependence on fossil fuel, we are also creating more opportunities for hydrogen fuel applications.

Transformer heat recovery project

We've teamed up with a heat supplier company to investigate using our transformer electrical losses as a heat source for local consumers. Our normal operation transformer oil is maintained at 40-50 degrees and during peak load times can get above 70 degrees, when the oil has to be cooled by fans. While oil heat helps to raise water temperature, a heat pump warms up it further to the temperature required. Applying this solution supports decarbonisation of heat since each 400kV transformer can provide enough heat to supply an apartment building for a whole year.

Sensors for asset monitoring

To improve understanding of our assets' condition, we need to conduct more frequent measurements or monitor the stresses that are placed on them. We have partnered with the Electric Power Research Institute

(EPRI) to investigate the effectiveness of sensor technology to asses an asset's condition and stresses. Currently, we're preparing to trial sensors for three applications:

- Leakage current measurement, which will help determine the condition of insulators
- Load cell sensors to measure stresses on conductors
- SF_6 leak detection, and to accelerate repair and reduce our greenhouse gas emissions.

SF_6 leak management and repair techniques

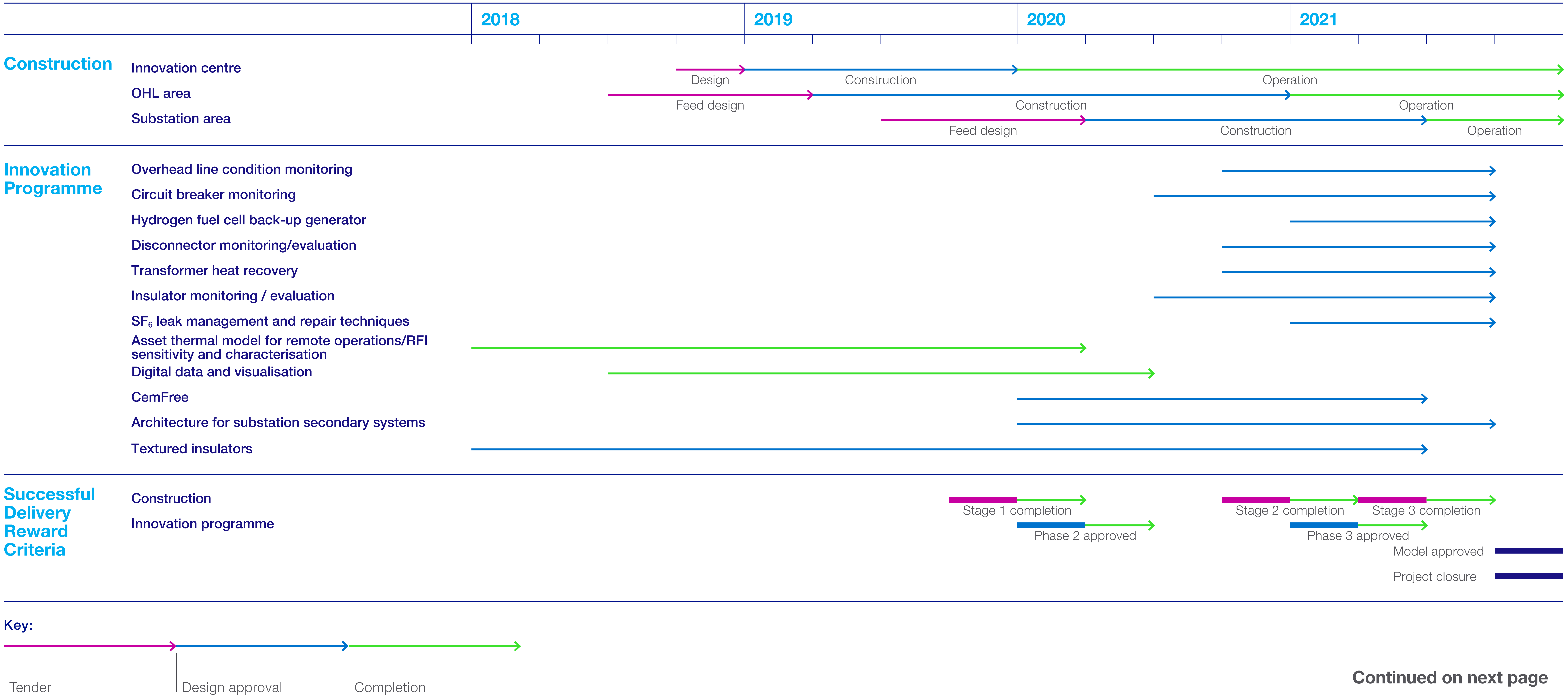
We have engaged with a start-up company called Rawwater, which has developed a solution for rapid repair of pipe leaks, mainly used in gas systems. We want to determine if this solution can be used to repair SF_6 leaks on our circuit breakers. If the trial is successful, this solution, together with fast leak detection technologies, can help significantly reduce emissions stemming from SF_6 loss.

Next steps

Construction work at the site has seen delays due to a range of factors, including the effects of the Covid-19 pandemic. Managing safety due to interactions with other transmission assets installed around the centre have reduced access to part of the site. We are, however, now pressing forward with all construction work across the site and innovation trials with the aim of completion of the project by October 2021. Over the coming months, we'll continue to lay the foundations for future benefits for the industry, customers and consumers, implementing a commercial model to operate the centre after October 2021.

6 Deeside Centre for Innovation continued

Delivery programme



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6 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 in this 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 / 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, there estimated benefits and justification for how the trials satisfy the Electricity NIC criteria. The plan will also include any Network Innovation Allowance (NIA) projects which 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, there estimated benefits and justification for how the trials satisfy the Electricity NIC criteria. The plan will also include any Network Innovation Allowance (NIA) projects which 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, there estimated benefits and justification for how the trials satisfy the Electricity NIC criteria. The plan will also include any Network Innovation Allowance (NIA) projects which are able to be undertaken at this time.	Complete
9.9	Commencement of phase 3 innovation programme	The delivery of the innovation programme testing / 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.	Sep-21
9.10	Completion of stage 3 c onstruction 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 / evaluation projects	Jun-21
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.	Mar-21
9.12	Project close down	All project learning will be consolidated and disseminated appropriately.	Oct-21

7 Retrofit Insulated Cross Arms (RICA)

“The Retrofit Insulated Cross Arm (RICA) Project is both interesting and technically challenging. I am excited to deliver a novel innovation, benefitting a broad range of customers and stakeholders.”

James Deas
RICA Senior Innovation Engineer,
National Grid Electricity Transmission

Project update

In December 2020 Ofgem awarded us £8.1m funding through the Network Innovation Competition (NIC) to deliver our Retrofit Insulated Cross Arms (RICA) project.

The UK has set an ambitious, but necessary, target of net zero carbon emissions by 2050. Achieving this target will require an increase in renewable generation and the electrification of transport and heat, leading to the need for the increased transmission network capacity.

At the same time, it’s becoming more difficult to deliver increased transmission capacity when it’s needed, while meeting environmental and community objectives.

Through our RICA project, we’re aiming to find innovative ways to deliver network capacity at minimum credible cost – providing better value for money to consumers and accelerating the drive towards a low carbon future.

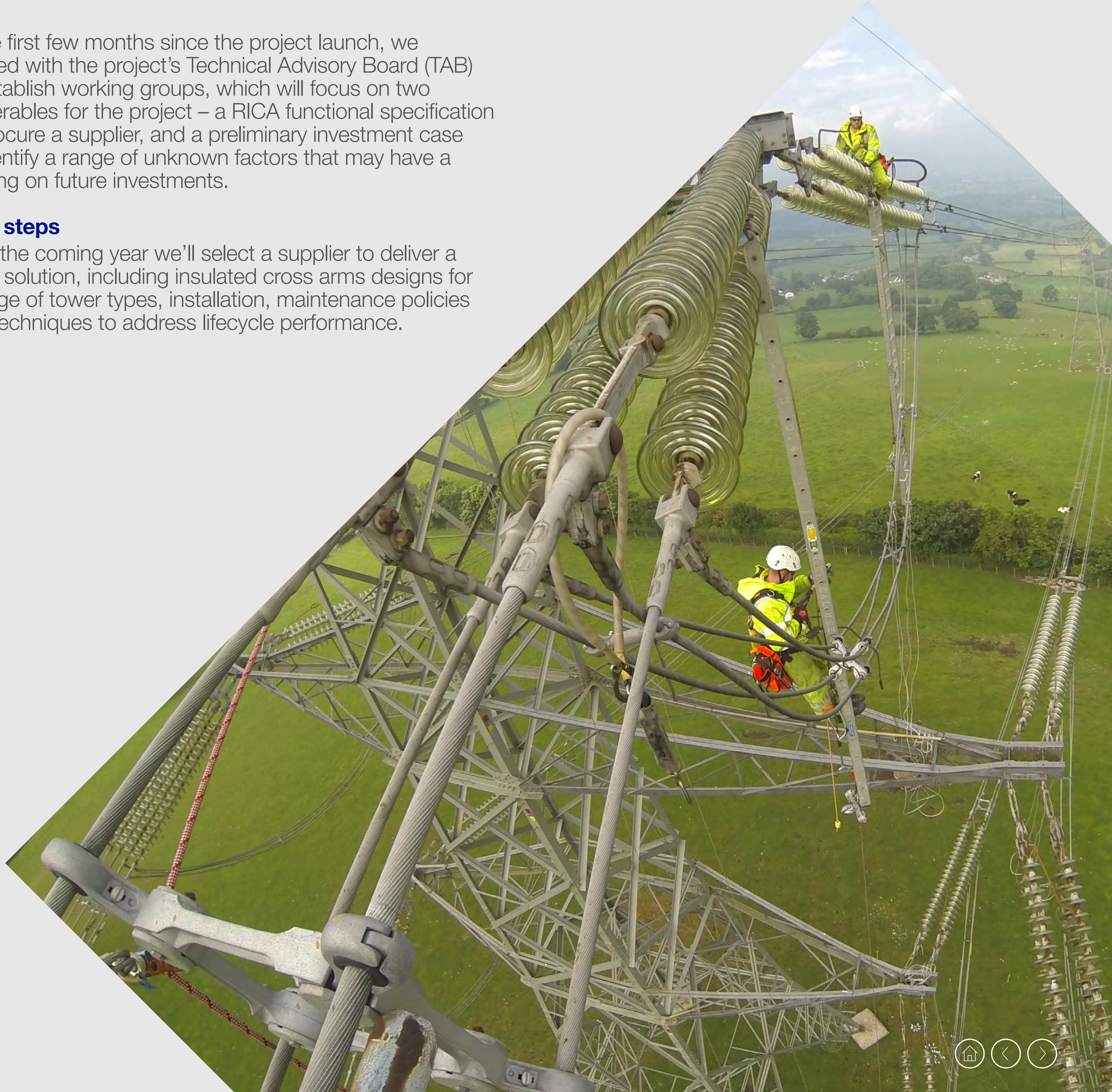
Insulated cross arms replace the standard metallic crossarms from which insulators and conductors are suspended. Retrofit insulated cross arms enable licensees to upgrade the voltage rating on their existing towers from 275kV to 400kV, increasing transmission capacity by over 40 per cent.

This project will provide a pathway for Britain’s first full-scale implementation of RICA technology, by mitigating technology risks and accelerating its adoption onto the network. The project will remove the current process, technology, and specification hurdles that have prevented licensees from adopting RICA previously.

In the first few months since the project launch, we worked with the project’s Technical Advisory Board (TAB) to establish working groups, which will focus on two deliverables for the project – a RICA functional specification to procure a supplier, and a preliminary investment case to identify a range of unknown factors that may have a bearing on future investments.

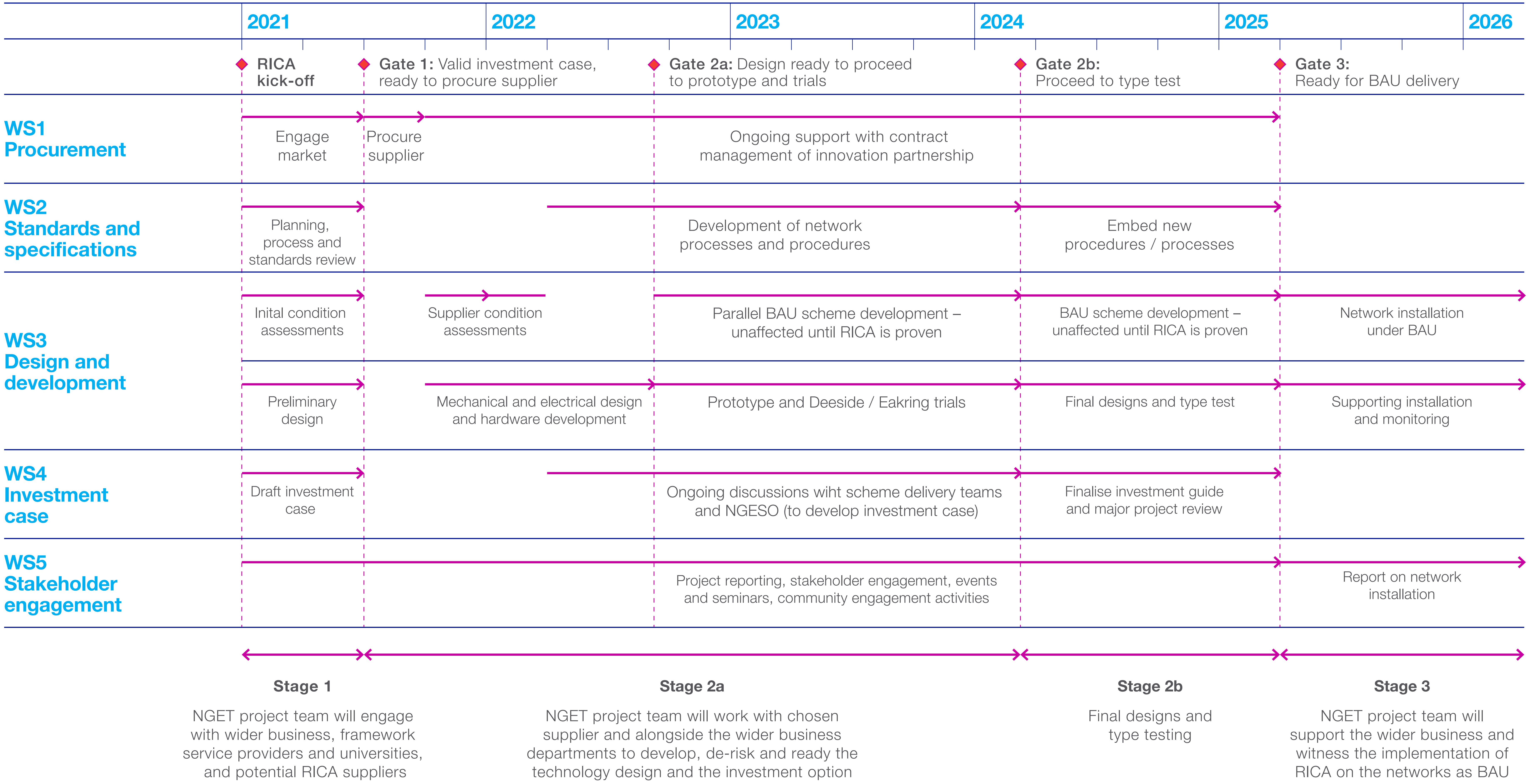
Next steps

Over the coming year we’ll select a supplier to deliver a RICA solution, including insulated cross arms designs for a range of tower types, installation, maintenance policies and techniques to address lifecycle performance.



7 RICA continued

Delivery programme



7 RICA continued

Successful Delivery Reward Criteria reference table

Ref	Project Deliverable	Evidence	Deadline
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	Jul-21
D.S1.2	Preliminary investment case	• Report on the preliminary investment case • Shared with licensees through TAB • Workshop with TAB members to review benefits from technology on their networks	Jul-21
D.S2a.1	Draft functional specification	• Draft functional specification • Workshop with stakeholders to incorporate feedback into specifications • Disseminated through TAB	Sep-22
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	Dec-22
D.S2a.3	Report detailing trial outcomes and lessons learned	• Report on hardware trials of RICAs • Evidence of workshops and lessons learnt from trails • 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 rational 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 rational 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	Feb-25
D.S3.1	Enhanced stakeholder engagement	• Record of RICA engagement with stakeholders • Materials for stakeholder engagement posted publicly	Mar-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	End of Project

8 Our focus in RIIO-2

As the pace of climate change and its effects increase, we can expect the technology evolution and delivery of the energy transition to accelerate. Responding to this challenge will mean having to think very broadly about the art of the possible.

The energy transition presents us with both a unique challenge and the opportunity to really make a difference. Although the transition covers a greater timeframe than the regulatory period, RIIO-2 is a critical time for us to take a bold approach – being willing to take a greater risk approach around the type of innovation we take forward.

To achieve success, we need to be open to new ways of doing things. We'll need to further increase our collaboration efforts and our engagement activities – listening to the views of stakeholders, as well as insights from a wide range of subject matter experts throughout the industry and beyond.

Our innovation strategy for RIIO-2 identifies two strategy areas for innovation:

Delivering cleaner energy

We'll create a road to net zero by reducing our carbon footprint and helping industry and society to decarbonise activities.

Delivering cheaper energy

Through a long-term innovation programme, we'll deliver a whole energy system net zero strategy at lowest achievable cost.

These areas will be critically enabled through our third strategy area:

Delivering an innovative culture

We'll develop a more externally referenced, collaborative, open and innovative approach across all of our organisational disciplines, while building capability and unlocking our people's potential.

Within National Grid Electricity Transmission, we recognise the importance of leadership commitment to innovation. Which is why we now have an NGET Board Innovation Charter. This charter sets out the Board's commitment to our innovation ambition and approach set out in our RIIO-2 business plan.

Our ambition – to innovate collaboratively, to deliver a safe and reliable net zero carbon energy system at lowest cost for consumers.

Our approach – to deliver greener and cheaper energy through embedding an innovative culture.

All this helps set the tone from the top – delivering a strong message that encourages and empowers people throughout our business to incorporate innovation into their business activities, resulting in a culture of innovation becoming part of our DNA.

Cleaner

Cheaper

Innovative culture

8 Our focus in RIIO-2 continued

We'll achieve success in our strategy by being agile and creating robust solutions around our six key priorities:

Transforming the business through digitisation
We'll develop tools and techniques that allow the digitisation of many of our processes, and overall management of data, as well as exploring the application of artificial intelligence across many of our activities.

Facilitate decarbonisation of wider industries
We'll collaborate with and support industries cross-sector to decarbonise transport, explore opportunities for achieving net zero in industrial clusters, explore the appetite for transition to a hydrogen economy and the implications on network providers.

Provide long-term system benefits through Deeside Centre for Innovation
We'll open the innovation centre up to a wide range of stakeholders to allow improved development, better testing and faster implementation of low-carbon technologies.

Being responsive to customers
We'll create new construction and installation techniques that will improve our agility for connecting renewable energy customers, while and delivering better customer experience.

Reducing the environmental impact of our activities
We'll develop options for driving down greenhouse gas emissions from SF_6 and other emitters, identify methods for minimising impact of construction, utilise novel materials, and develop new techniques to monitor and measure our performance.

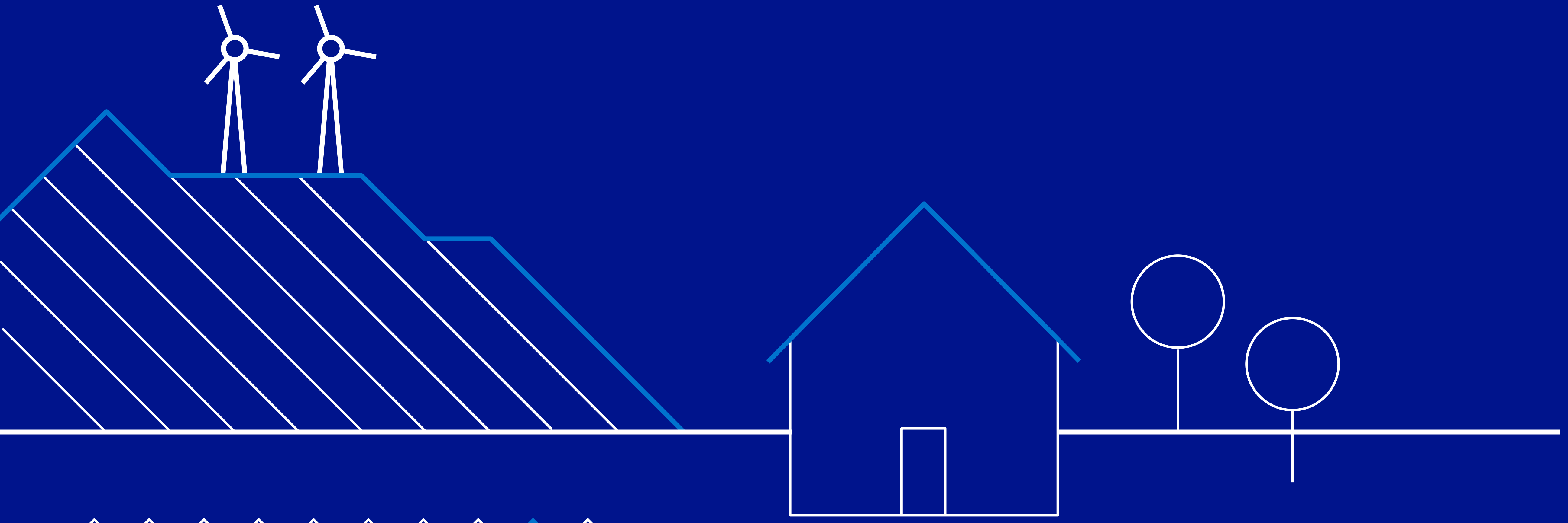
Continue to deliver technical innovation
We'll continue to technically innovate on the equipment and technologies we utilise across the network to drive down costs, minimise carbon impacts and deliver the levels of reliability that our stakeholders require.

To find out more…

Click here to visit the strategy section of the Electricity Transmission website

Click here to watch the Innovation Strategy Film or scan the QR code

NIA project case studies



9 Developing protection against cyber threats

Title: Cyber Resilient Electric Substation Technologies

Consumer value theme: Managing assets

Project number: NGTO020

"Cyber threats pose real risks as we use more digital technology. We need to manage those risks appropriately and deploy the right mitigation measures."

Thomas Charton
Senior Innovation Engineer,
National Grid Electricity Transmission

Project overview

Thomas Charton, Senior Innovation Engineer, talks about the work we've been doing to better understand the extent and nature of cyber security risks to digital substation technology.

What risks do cyber threats pose to the network?

A cyber breach of our infrastructure could have a significant impact on our business and customers. It has the potential to shut down part of the grid in the worst case.

That's why innovating in cyber security is so important. With the ongoing digitalisation of substation secondary equipment, we need to be more aware of the risks and vulnerabilities associated with the technology before embarking on a widespread rollout. We need to ensure that appropriate mitigation measures are in place.

Who have you worked with on the project?

We worked with a team from the University of Manchester, as well as a range of stakeholders from the industry – including GE, SEL and Siemens – to examine the best ways to protect the business. Products we've identified as effective control measures include cryptography, data flow controllers, firewalls and intrusion detection systems based on various technologies, including artificial intelligence.

How severe is the risk of a cyber attack?

The risk is small, but very credible – and a significant attack on our infrastructure could have a huge impact. The wrong kind of attack could lead to a blackout – we've already seen that in Ukraine, where thousands were left without electricity after hackers hit electrical substations.

What comes next for the project?

One of the next steps could be to further develop the concept of collaborative defence mechanisms. We could work on trials with a supplier partner to discover what the added value of such defence mechanisms could be.

9 Protecting our legacy equipment

Title: Cyber Security Solutions for Legacy Equipment

Consumer value theme: Managing assets

Project number: NGTO054

"The risk of compromised cyber security can range up to a countrywide blackout, which would cost potentially several days of GDP. Mitigating this huge risk will deliver large benefits to consumers."

Thomas Charton
Senior Innovation Engineer,
National Grid Electricity Transmission

Project overview

The gradual switch over from traditional substations to digital technology has brought with it huge benefits. Digital substations are more efficient, easier to operate, and safer.

While the latest modern digital equipment provides the required cyber security features, some of the older equipment was designed at a time when cyber security wasn't too much of an issue. Hundreds of older electrical substations still use this equipment, though. They'll continue to play a crucial role in supporting our critical power infrastructure for many years to come.

Cyber threats are now an increasing risk to our network, so it's vital to make sure these assets are secure.

This project has involved assessing the potential risk these older substations face from hackers, working with the University of Manchester to find possible solutions.

What have we learned?

The project team looked at what equipment is being used, how it's connected, and what technology is currently available to protect these devices. The work included a risk assessment of legacy equipment, categorising it, ranking them according to relative risk, and putting forward options to make them more secure.

Most of the equipment is still in use, so we can't simply disconnect it. Some software can be updated, but this is usually only possible on newer devices. The solution we adopt is likely to be based on strict security zones with firewalls, so we can inspect the network traffic and make sure anyone who communicates with that device has the right authentication. A firewall can also check messages coming out of the device.

9 Ensuring a stable power flow for renewables

Title: Risk Mitigation of Power Electronics Connections: Impedance Modelling

Consumer value theme: Efficient build

Project number: NGTO045

"We see this core ideology becoming an important part of a future toolset that's needed to ensure system stability, particularly with more renewable energy sources coming onto the network."

Mingyu Sun
Associate Innovation Engineer,
National Grid Electricity Transmission

Project overview

When power flows from renewable energy sources come onto the electricity transmission network, there's a risk of integration issues that can potentially lead to unplanned outages.

This project, which has been delivered in partnership with Imperial College London, has involved developing a methodology that anticipates these integration issues. The aim is to help us anticipate power conversion problems so we can take steps to avoid them.

The methodology encompasses modelling and measurement tools designed to find the root cause of any instability factors, such as high loading conditions or a fault in the nearby transmission line.

By ensuring a more stable power flow from renewable sources, we'll be able to avoid delays in connections projects and prevent future outages. Stability guidelines arising from this project could also help avoid grid reinforcement work that would be needed to solve control interaction problems – between £5m and £10m for each renewable source connecting to the network.

What have we learned?

This study will contribute to helping achieve the Government's net zero goal, as it gives us a greater understanding of problems associated with new renewable connections, and how we might solve them.

Although currently in the academic phase, there's potential for the outputs from the project to be used in the network, integrating the coding we've developed into our current simulation software.

The methodology can benefit all TNOs and DNOs in the UK.

9 Advanced weather reports

Title: Advanced Weather Forecasts for Dynamic Line Rating

Consumer value theme: Managing assets

Project number: NGTO046

"Weather forecasting has improved significantly over the past 20 years and holds great potential to improve OHL ratings through dynamic line rating (DLR) technology. We'll need to carry out further research and trials to build in-depth understanding and confidence levels in this technology."

Anusha Arva
Innovation Engineer,
National Grid Electricity Transmission

Project overview

Dynamic line rating (DLR) allows us to vary the capacity of an overhead transmission power line dynamically, depending on environmental factors such as wind speed, wind direction, ambient temperature, and solar radiation.

If weather conditions cool conductors sufficiently, we can push more power through our lines, helping us meet the country's energy needs. We already know from previous innovation projects that we have certain circuits that can carry more capacity if conditions are favourable.

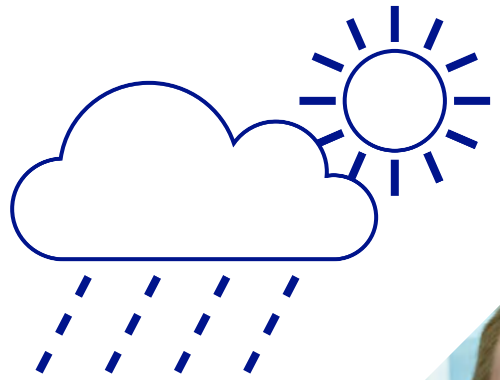
Through this project, we're looking to exploit the significant advances in weather forecasting by assessing the feasibility of integrating a cloud-based weather forecasting service into our present line rating calculation methodology. With more accurate and granular weather data, we can better determine where and when we can boost capacity.

It also means that we can become less reliant on fossil fuel-based generation, avoiding constraint payments to generators when we need to address grid congestion.

What stage is the project at now?

We've developed the first version of the demonstrator system. We've determined that it's feasible to integrate the forecasting technology and that it can help ease constraints in the network if we carry out all the necessary validations before putting it into regular use. In our initial validation of the forecasting data against historical measurement data, we also confirmed that urban and dense vegetation areas would need more vigilance when considering uprating a line using DLR, as they lack sufficient cooling conditions.

As with any forecasting method, there's a degree of uncertainty around the data, and this can potentially influence our computed ratings. We'll need to explore these uncertainties in depth and validate them on some sections of the network, either by installing local weather stations only or by combining these with OHL measurement sensors.



"Significant improvements in weather forecast accuracy alongside novel approaches to quantifying uncertainty in the forecast can be applied to increase confidence in uprating decisions to help achieve the flexibility requirements on our path towards net zero."

Ian Pearman,
Senior Scientist,
Met Office

9 A holistic approach to resilience

Title: Forward Resilience Measures (Stage 1)

Consumer value theme: Corporate responsibility

Project number: NGTO049

"Through our holistic approach to developing these resilience tools, we can now look beyond the immediate horizon. It's a strong proof of concept that has the potential to allow us to better anticipate, absorb, adapt and rapidly recover from disruptive events."

Ben Kuchta
Associate Innovation Engineer,
National Grid Electricity Transmission

What does this project involve?

Given the pace and extent of change to the energy landscape, the resilience requirements of electricity networks need to evolve. Drawing on global best practice, we've developed a resilience assessment framework and model that combines qualitative and quantitative assessments, as well as forward-looking measures.

Throughout the project we've focused on the current and future resilience of the electricity transmission network across England and Wales. The holistic framework enables decision-makers to understand the system's current resilience performance, identifying opportunities for development and continuous improvement. We've also developed a quantitative model that helps inform resilience decision making around current and future hazards and network stresses, such as extreme weather.

These new tools integrate with established resilience processes and allow business to respond to disruptive events – ensuring electricity continues to reach consumers safely, reliably and efficiently.

What sources have you used to determine best practice?

The Government and the NIC's vision for integrated infrastructure resilience demonstrates the growing momentum to move beyond resilience theory into practice.

To inform our approach, we've explored best practice across the energy sector and other infrastructure sectors, such as the Dynamic Resilience Framework from the World Energy Council, the Energy Resilience Framework, the US Transmission Resilience Maturity Model and the UK Energy Research Partnership.

What are the next steps for the project?

We've developed the concept of resilience further and established a strong foundation for making positive change. As we review the project's outputs in detail and consider implementation, our continuing development work will reflect the interconnectedness of the energy industry.

9 Preparing our network for greener gases

SF_6 is an effective insulator with unique characteristics that's been used in substation equipment for some 50 years. It's proven very difficult to substitute.

However, work to find an alternative gained pace in recent years. In 2014, GE was the first to announce a breakthrough, unveiling g^3, its ground-breaking solution for replacing SF_6 in high-voltage equipment.

This represented a significant shift in gear for SF_6 research and development, heralding a period of rapid evolution in associated technology and products. Exploring the suitability of the new alternative gases for our network has been a hallmark of our innovation work during RIIO-1.

SF_6 Management and Alternative Gases (NIA reference: NGET0163)

During 2016/17 we energised our Green Gas for Grid (g^3) project at Sellindge in Kent, becoming the world's first 400 kV network to use g^3, which has a global warming potential 98% lower than SF_6.

The project gave us an opportunity to gain an early understanding of the technology, so we could make sure we were ready to adopt it as early as possible when it became commercially available. We also wanted to demonstrate its use to the industry and market, encouraging wider adoption of all SF_6-free technologies, including g^3.

Since then, our project team has closely monitored the g^3-filled equipment at Sellindge to gauge its long-term reliability.

We've also continued our work to look at other potential gases, such as CF_3I, testing their dielectric and long-term stability properties. However, we haven't established further alternatives for a single gas that meets all our needs.

9 Preparing our network for greener gases continued

Alternatives to SF_6 for retro-filling existing equipment. (NIA reference: NGET0199)

If we're to remove SF_6 from our operations by 2050, there are two main options open to us. We could replace our assets with new ones that are designed to be compatible with alternatives to SF_6. But we believe a more efficient way – and one that comes at significantly less cost to consumers – is to use an alternative gas in our existing assets wherever we can.

Our collaborative project with the University of Manchester and 3M has been about finding the right balance between testing the right mix of 3M's Novec™ 4710 and CO_2, and finding the right operating pressure at which its performance most closely mirrors that of SF_6.

As we reported last year, we've found that we can mirror the performance of SF_6 using a roughly 80/20 mixture of CO_2 and Novec™ 4710. Since then, we've done further work to test operating pressure and develop our understanding of the mixture we could potentially use.

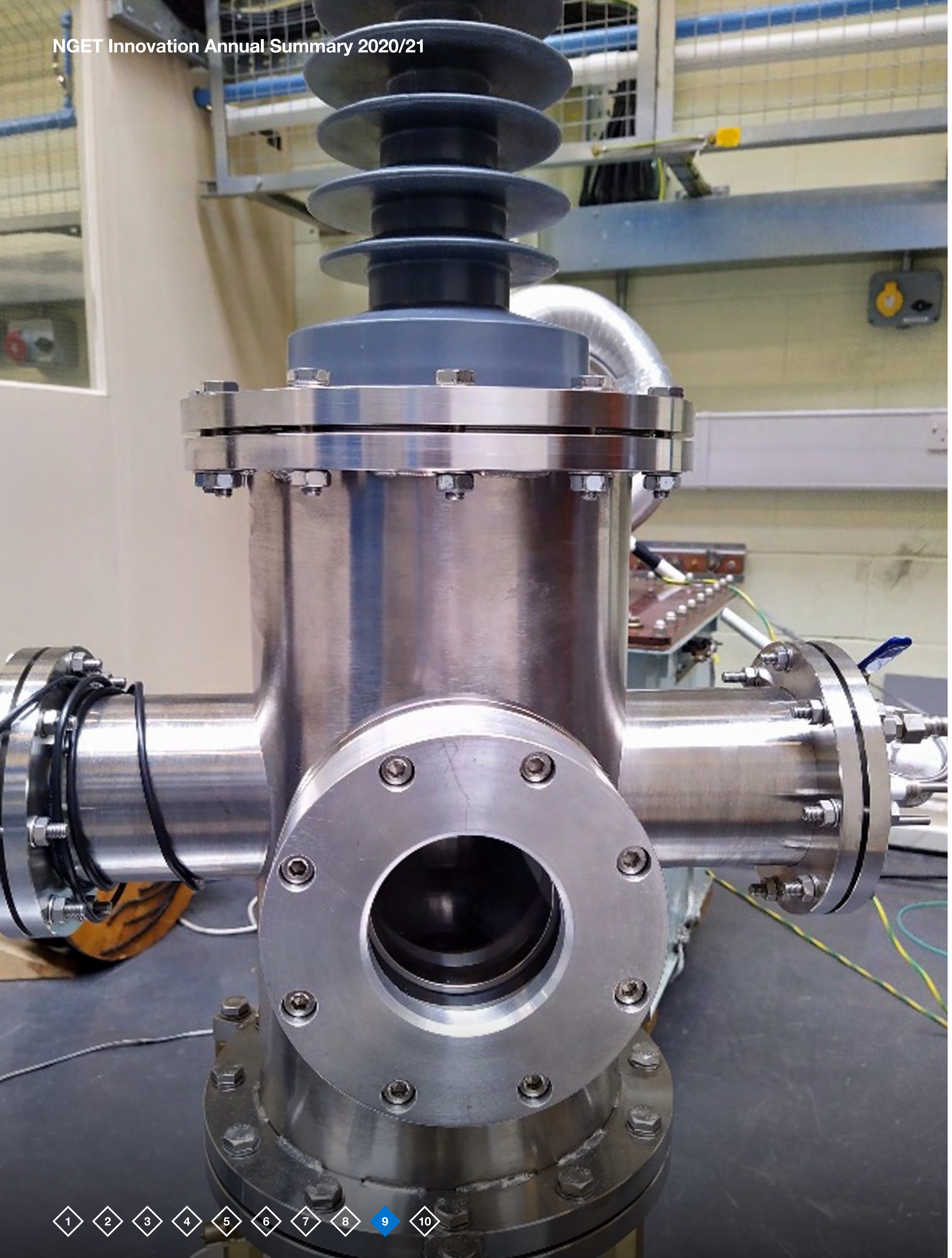
We're now planning to develop further monitoring techniques so we can understand more about what happens when the gas breaks down. We plan to do this through a fresh project, using our new Centre for Innovation at Deeside. The project will be a natural fit for the facility, which has been designed for enabling high voltage testing of full-scale equipment.

Given the scale of retro-filling our assets, we anticipate launching pilot projects during RIIO-2, leading to wider deployment in RIIO-3 and beyond.

Our work in this area has influenced the market's debate and approach to retro-filling assets, with some suppliers now developing retro-fill solutions.

Click here to hear our webinar about Alternatives to SF_6 for retro-filling existing equipment

Emissions of sulphur hexafluoride (SF_6) make up a large proportion of our carbon emissions. Replacing it on our network is one of the biggest environmental contributions we can make – and our ambition is to do so entirely by 2050, helping meet the Government's target of net zero carbon emissions.



9 Preparing our network for greener gases continued

Long Term Stability of Alternative Gases (NIA projects NGTO002 and NGTO051)

While we want to retro-fill existing assets wherever possible, we've also been doing work to examine gases being offered in new equipment.

This has involved understanding how the gases – mixtures based on C_4F_7N and $C_5F_{10}O$ – perform over the long term under operational stresses. It's also looked at which by-products are created when the gases degrade, together with how this affects performance and implications for safety.

The work has shown us that if we take the same precautions we take for SF_6 by-products, our approach will be appropriate for the alternative gases. It gives our future approach the scientific backing we would need to proceed safely.

Evolution in the technology market during the project meant that the $C_5F_{10}O$ option became less relevant for our needs.

The project is now complete and its findings being drafted ready for publication.

Click here to hear our webinar about the long-term stability of alternative gases

Looking ahead

For RIIO-2, we expect to continue examining the application of alternative gases – especially as more of it comes onto the network. Our focus will be on preparing our assets, considering health and safety, long-term performance, degradation and monitoring techniques.

Development of alternative gases is happening at pace across the globe – we intend to be as well prepared for its widespread introduction as we can.

9 Better understanding electrical discharge phenomena

Title: Investigation of transient and safety issues in gas insulated systems

Consumer value theme: Managing assets

Project number: NGET0185

"This has been a really good example of collaboration, with a strong working relationship forged between Cardiff University and the operational team at our substation."

Gordon Wilson
Senior Innovation Engineer,
National Grid Electricity Transmission

Senior Innovation Engineer Gordon Wilson tells us about a unique study into electrical phenomena at one of our gas insulated substations (GIS).

Can you tell us a little about GIS?

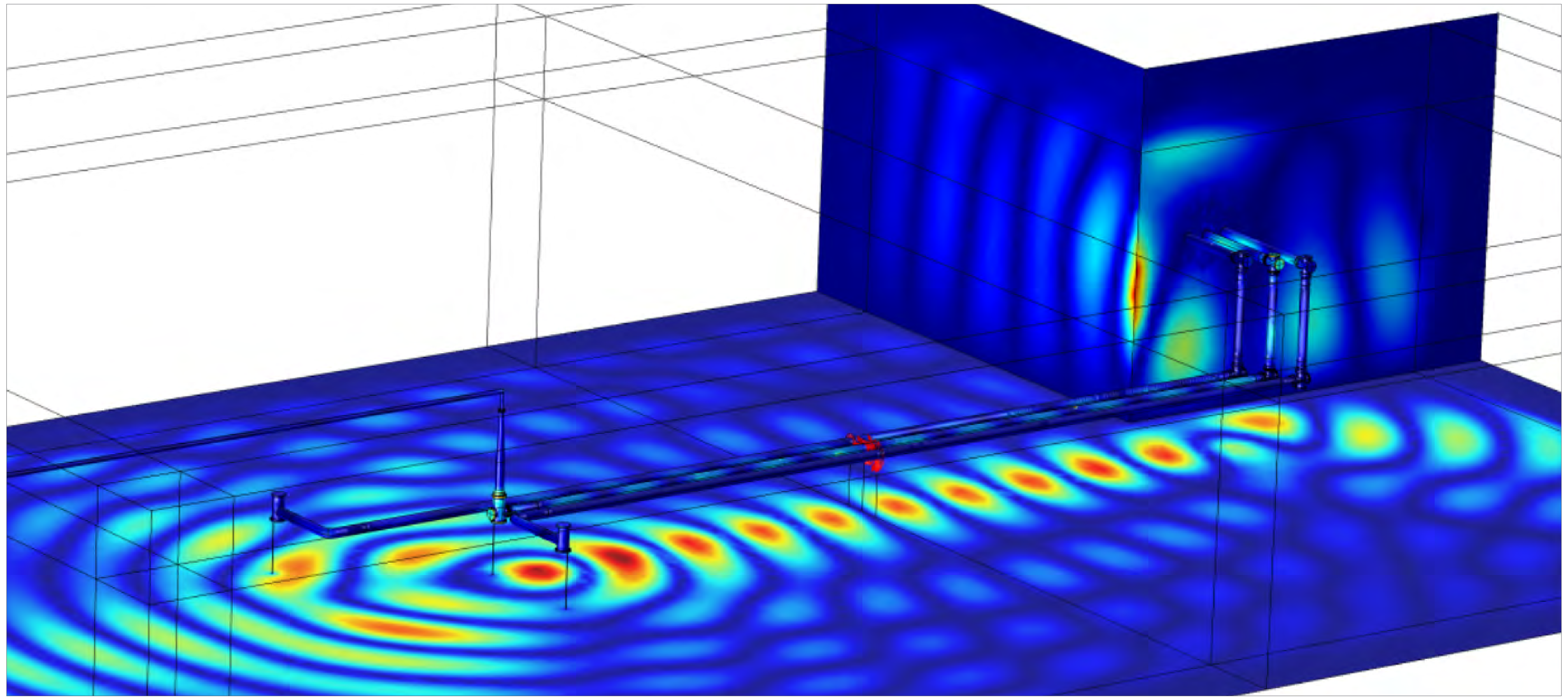
They're substations where all the high voltage equipment is encapsulated in a high-pressure sealed environment, using SF_6 gas as the insulating medium. They need less space than a conventional substation. And because they're enclosed, they're less sensitive to pollution and the weather.

What's the background to this study?

Normal switching operations generate an electrical discharge that can go from zero to maximum voltage in about 250 microseconds. By comparison, lightning goes to its maximum in about one microsecond.

At our Swansea North substation, we detected some unusual discharges occurring during switching that were taking only two nanoseconds (0.002 microseconds) to peak. Called very fast transients (VFTs), they put a lot of stress on the insulation and have been linked to failures.

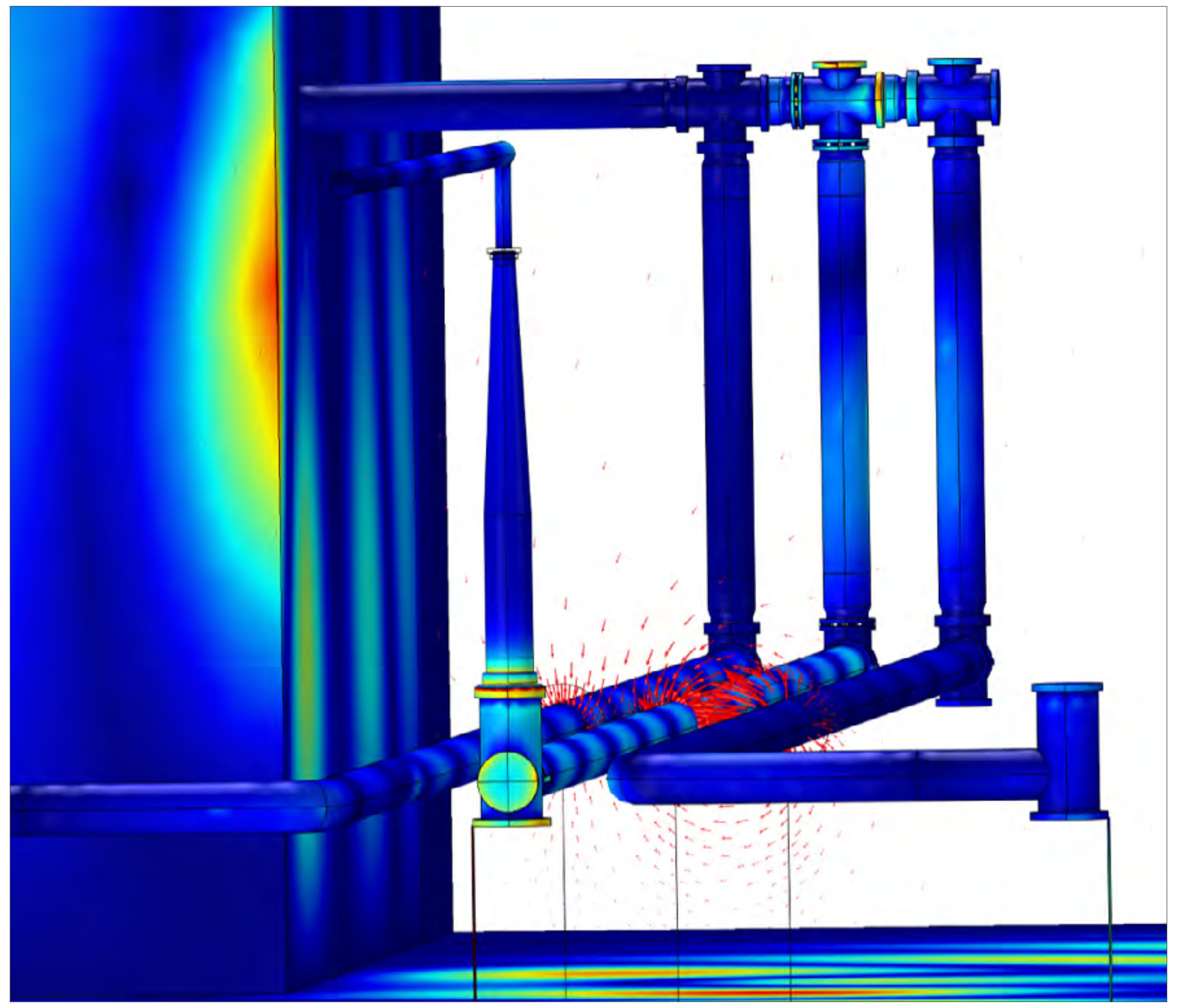
When a failure occurred at Swansea North, we needed to understand the cause of these VFTs, confirm they were responsible for the failure and find a way to prevent them causing further failures. That's been the focus for this study with Cardiff University, which has NIA top-up funding, and funding from the EPSRC.



What has the study found?

The research has developed and validated a method for modelling VFTs in a way that wasn't possible before. We now know VFTs of sufficient magnitude can contribute to insulation ageing and, eventually, failure. We've reduced the risk of this happening by adopting an alternative switching sequence. The model can be adapted to other GIS installations where we experience VFTs.

However, this doesn't solve the root cause of the issue at Swansea North – and we have some way to go to really understand it. The research is set to continue and is helping inform a CIGRE working group looking at VFTs in GIS.



Title: Zero-2050: South Wales (Whole System Analysis)

Consumer value theme: Corporate responsibility

Project number: NGTO040

"While this hugely collaborative project relates to South Wales, it also demonstrates an approach we can apply to the wider decarbonisation agenda."

Xiaolin Ding
Senior Innovation Engineer,
National Grid Electricity Transmission

9 A carbon-free path for South Wales

Project overview

Through this project, which we described in last year's report, we're partnering with network providers operating in South Wales to speed up progress towards making the region carbon-free by 2050.

Co-funded by Wales and West Utilities, Western Power Distribution, and National Grid, the project is also backed by the Welsh Government and the South Wales Industrial Cluster (SWIC) – a group of major industrial and manufacturing companies who aim to develop a world-leading, sustainable industry.

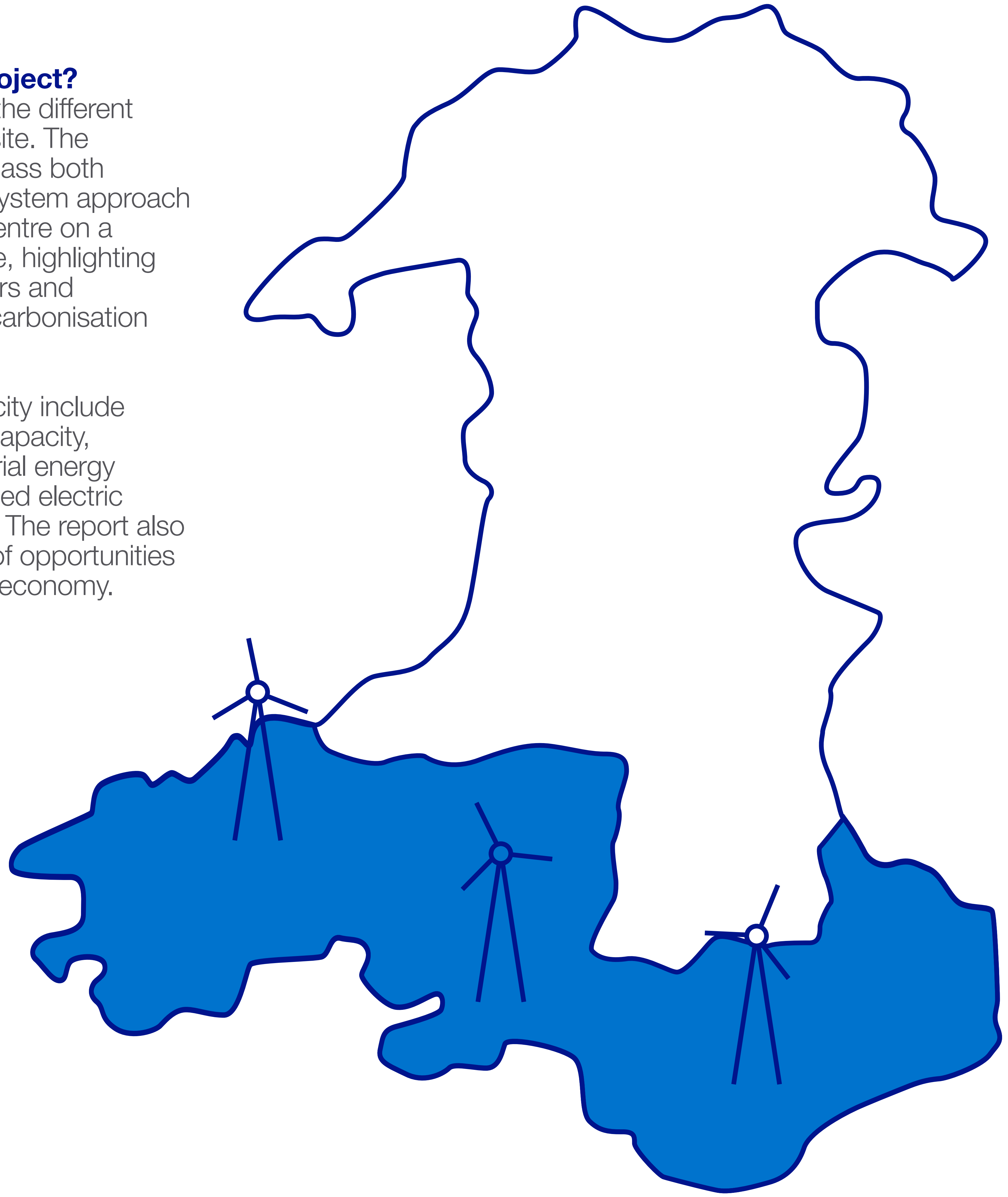
Zero 2050 is a notable example of how our innovation portfolio is evolving, in this instance encompassing crucial work to explore options and ideas rather than specifying technical solutions. It has spanned areas that include cities, industry, transport, generation and network reinforcement, as well using the combined outputs to develop optimised pathways for various decarbonisation scenarios.

ZERO 2050 South Wales

What have we learnt from the project?

In June, we published reports from the different working groups on the project website. The project's recommendations encompass both electricity and gas, taking a whole-system approach to decarbonising the region. They centre on a progressive move to a resilient future, highlighting the need to monitor economic factors and approaches taken elsewhere as decarbonisation evolves more widely.

Specific measures relating to electricity include increasing onshore wind and solar capacity, incentivising commercial and industrial energy efficiency, and delivering a coordinated electric vehicle charging rollout programme. The report also recommends further consideration of opportunities for industry co-location and circular economy.



9 Improving asset maintenance

Title: Electrical characterisation of silicone oil (ECOSO)

Consumer value theme: Managing assets

Project number: NGTO009

"The findings of this project have much improved our knowledge on the potential failure mechanisms in the electrical degradation of the silicone oil-solid insulation system used in the CSEs."

Dr Siyu Gao
Innovation Engineer,
National Grid Electricity Transmission

Project overview

Managing the replacement strategy of our cable sealing ends (CSEs), which are used at the termination of our cables, is a time-consuming and expensive task. With thousands in the network, understanding the conditions that cause them to degrade over time is vital.

Silicone oil is used as both a coolant and an insulator in the assets and comes in two forms: high and low viscosity. This project sought to better understand the degradation mechanism and aging process for these two types of silicone oil and the best ways to maintain and replace them, so we can extend the life of our assets.

What stage is the project at now?

We've now completed the project, which was carried out in conjunction with the University of Manchester. The university is currently drafting a journal article, and the findings were shared at the Cable Research Workshop conference in 2020.

What have we learned?

We were able to successfully replicate one of the aging phenomena of the CSE in the lab, which improves our knowledge on the effect of contamination on the degradation process in the insulation system of the CSEs. With the replacement of 153 sets of CSEs estimated to cost over £10m, and over 1,200 spread across the network, improved management of our silicone-filled assets could result in large savings over their lifetime.

What are the next steps?

We're proposing to extend the scope of this research based on the findings from ECOSO for RIIO-2. One proposal is to look to a longer-term test to provide more in-depth results in the University's new lab.

9 Unlocking new capacity with PEETs

Title: Power electronic enabled transformers (PEETs)

Consumer value theme: Service delivery

Project number: NGTO035

"This project shows that we may be able to find more options for our customers' connections using our existing infrastructure. With further research, this could potentially result in a lowering of our tariffs and customer savings – while also avoiding the need to build more expensive substations."

Dr Siyu Gao
Innovation Engineer,
National Grid Electricity Transmission

Project overview

Power electronic enabled transformers (PEETs) have the potential to unlock additional capacity from our transformers that could reduce the need to build additional substations at new locations.

SGT transformers have three windings, and our customers can currently connect to two of these. The tertiary windings are usually not used for connections since there is no tap changer to control the voltage. This is where PEETs could come in – these devices can adapt to a range of inputs and stabilise the output.

What stage is the project at now?

This project, run in conjunction with the University of Manchester, is now complete and the team is currently writing a paper to present the findings.

What have we learned?

We haven't used tertiary windings for connections due to the limitations of available technology, but that could now change with PEETs. This project found no evidence that PEETs would affect the stability and reliability of the grid when operated correctly. PEET can help to stabilise the system frequency and voltage effectively. A 10% increase in the maximum rating of a transformer would result in a cost saving of £6m for consumers per site.

What are the next steps?

We're now looking into the wider investigation of these early findings since now we have mitigated the potential risks. We used the data from one substation, so the next steps could be to involve more substations in the study.

9 Augmented reality check highlights benefits

Title: Assessing Wearable Technology Applications for Transmission Operation and Design

Consumer value theme: Managing assets

Project number: NGTO052

"We're unaware of any other organisation delivering this scale of test in the utilities sector. This is the latest generation technology and we're proud to be pioneering it for the industry with our tests."

Mingyu Sun
Associate Innovation Engineer,
National Grid Electricity Transmission

Mingyu Sun, Associate Innovation Engineer, provides an overview of pioneering work to test augmented reality (AR) within our operations.

What can you tell us about the technology you've been testing?

"HoloLens2 is wearable technology featuring an AR lens that operates via wireless communication. Team members can wear the lens from home or the substation and show others what they're seeing – equipment, objects and documents. Remote users can also remotely assist and convey information, instructions and guides to colleagues at work on site in real time.

"The original plan was to employ HoloLens2 for a specific range of benefits, but it's also been useful during the pandemic, as it's allowed us to connect while working remotely."

What benefits does the lens bring?

"It has lots of practical applications. It helps engineers on-site and at home and allows us to communicate quickly across teams. It offers the user great functionality and flexibility. For example, when a substation team does maintenance checks, a document outlining the job details is needed. The engineer has to carry this on their laptop or have a printed version to hand – and this can be difficult if they're wearing PPE. With the lens they can access that documentation easily.

"If you factor in travel, the technology can change a two-day site visit into a two-hour footage review from an office. That reduces asset down-time and potentially saves up to £0.5m annually on each scheme."

What was the outcome of the trials?

"We're currently assessing an implementation plan, but what we do know is that the technology is practical – and it works. We're excited about the opportunities it offers."

"Although impressive today, this technology is clearly only at the beginning of delivering on its full potential to boost productivity, stream insights, and unlock safer more situationally aware working. The challenge for energy networks will be making sure their asset data and integration capabilities are good enough to extract these performance benefits."

Peter Amos
Senior Product Development Engineer,
Strategy & Innovation

10 RIIO-1 project portfolio

Here is our full list of NIA projects throughout the RIIO-1 period. To find out further information about any of our innovation projects please click on the project name.

PRN list	Name	Partners
NIA_NGET0003	Simulation of multi-terminal VSC HVDC system by means of Real Time Digital Simulation (RTDS)	University of Birmingham
NIA_NGET0010	Optimised Location for Surge Arresters on the Transmission Network	Cardiff University
NIA_NGET0011	Detection and Measurement of ACSR Corrosion	HYDRO-QUÉBEC
NIA_NGET0012	Induced voltages and currents on transmission overhead lines under NSI 4 working practices	Cardiff University
NIA_NGET0013	Tablet interface for a SF6 mass flow top-up device	The University of Herfordshire, DILO
NIA_NGET0014	Transformer & System Reliability	The University of Manchester
NIA_NGET0015	Dinorwig Thermal Cycling and Cable Rating	Doble Powertest Ltd, University of Southampton
NIA_NGET0017	Oil/Paper Insulation HVDC Performance	University of Southampton
NIA_NGET0018	Potentials and profiles around earth electrodes and opposite-side injection for large-area earthing	Cardiff University
NIA_NGET0019	Reliability Assessment of System Integrity Protection Schemes (SIPS)	The University of Manchester
NIA_NGET0024	Composite Cross-Arms Study	The University of Manchester
NIA_NGET0025	Feasibility Study for Sustainable Substation Design	Ove Arup And Partners Ltd
NIA_NGET0033	Wireless Condition Monitoring Sensors with Integrated Diagnostics	The University of Strathclyde
NIA_NGET0034	Fibre-optic Acoustic Monitoring	none - project never started
NIA_NGET0035	Long Term Performance of Silicon Based Composite Insulators	The University of Manchester
NIA_NGET0036	ThermoMechanical Forces in XLPE Cable	University Of Southampton, Mott Macdonald, Cable Consulting Incorporated
NIA_NGET0038	Design of a smart tool for detecting hidden errors in protection setting files	The University of Strathclyde, Alstom Grid
NIA_NGET0040	Magnetic Models for Transformers	The University of Manchester, Cardiff University
NIA_NGET0042	HVDC EngD – Richard Poole	The University of Hertfordshire
NIA_NGET0043	Live Line Working Equipment	Bond Helicopters Europe
NIA_NGET0044	Transformer Oil Passivation and Impact of Corrosive Sulphur (TOPICS)	University of Southampton, Doble
NIA_NGET0045	Multi-terminal VSC HVDC operation, control and ac system integration	The University of Manchester
NIA_NGET0046	Flexible rating options for DC operation	University of Southampton

PRN list	Name	Partners
NIA_NGET0047	Dynamic Ratings for improved Operational Performance (DROP)	University of Southampton
NIA_NGET0048	Cables with Long Electrical Sections	University of Southampton
NIA_NGET0051	33kV Superconducting Fault Current Limiter	Applied Superconductor
NIA_NGET0053	RESNET	The University of Manchester
NIA_NGET0054	Load cycling and radial flow in mass impregnated HVDC Submarine cables	Sintef Energy and NTNU (Trondheim) via a consortium with Statnett & Tennet
NIA_NGET0055	Electromagnetic transients (EMT) in future power systems – Phenomena, stresses & modelling	Sintef Energy As
NIA_NGET0056	Humber Smartzone Pilot Project	The University of Manchester
NIA_NGET0057	DC Circuit Breaker Technologies	The University of Manchester, Ampacimon
NIA_NGET0060	Application of DC circuit-breakers in DC Grids	Cardiff University
NIA_NGET0064	Alternative Bus Bar Protection Solution	Schweitzer Engineering Ltd
NIA_NGET0065	Voltage Optimiser Pilot	EMS Powerstar
NIA_NGET0067	Trial & Performance Assessment of ACCR Conductor (3M)	3M
NIA_NGET0072	Alternative Differential Unit Protection for Cable only and Cable & OHL hybrid installations	Cooper Power System
NIA_NGET0073	Partial discharge monitoring of DC cable (DCPD)	University of Southampton
NIA_NGET0074	SF6 Capture & Leakage Repair	The University of Liverpool, Furmanite, Belzona, Siemens
NIA_NGET0075	Temporary Oil Containment	N/A see note
NIA_NGET0079	Rapid Deployment Ballistic Screens	Doble, RADNOR, Redman Composites
NIA_NGET0080	400kV Synthetic Ester Filled Transformer Pilot Project	Alstom, M & I Materials
NIA_NGET0082	Rating Impact of Non-isothermal Ground Surface (RINGS)	Doble, C3, University of Southampton
NIA_NGET0083	Cable Oil Regeneration	Enervac Corporation, JSM Construction
NIA_NGET0087	Cable Installation Design & Innovation Project (CIDIP)	University of Southampton
NIA_NGET0088	Transformer Research Consortium	The University Of Manchester
NIA_NGET0089	Impact of HVDC Cable Operation on Telecommunication Lines	Powersure Technology Limited

RIIO-1 project portfolio

PRN list	Name	Partners
NIA_NGET0090	Cable Extraction	JSM
NIA_NGET0091	Impact Assessment of Seismic Analysis on Electricity Towers and Substation Equipment / Structures	Mott MacDonald
NIA_NGET0092	Partial Discharge on Existing HV Cable	Elimpus Limited, NDB Technologies, Prysmian Cable and Systems Limited, Doble PowerTest
NIA_NGET0093	Online Gas in Oil Analysis on Existing HV Cables	Doble, ISL and C3 Global
NIA_NGET0098	Computer Vision For Cable Tunnels	none - project never started
NIA_NGET0099	Thermal Efficiency Trials	Rook Services
NIA_NGET0102	13kV Shunt Reactor Refurbishment	ABB
NIA_NGET0103	Modelling the tape corrosion process for oil-filled underground cables	University Of Leicester
NIA_NGET0104	Proof of Concept for IEC61850 Process Bus Technology	ABB
NIA_NGET0107	Stakeholder attitudes to electricity infrastructure	University Of Exeter
NIA_NGET0108	Incident Investigation Review	Taproot, Sigma
NIA_NGET0109	Bushing and Instrument Transformer Test Tap Connection Condition Assessment Tool	Elimpus Limited, Elysis Engineering, GE Grid Solutions, Invisible Systems, Process Parameters
NIA_NGET0112	Enhanced AC and DC safety voltage limits assessment	Cardiff University
NIA_NGET0113	Control of Debris and Dust from the Treatment of Grade 4 Tower Steelwork (G4T)	CLC Contractors Ltd, Spencer Coatings Ltd, PDC Protective & Decorative, Fountains Environmental Limited
NIA_NGET0115	Cable Stripping Truck	Utilise
NIA_NGET0116	Combustible Gases in Redundant Oil Filled Cables	Utilise Environmental
NIA_NGET0117	Bulk Oil Circuit Breaker Bushing In Situ Refurbishment	NAREC Electrical Networks or Narec Development Services?
NIA_NGET0118	Understand and Improving Condition, Performance, and Life Expectancy of Substation Assets	The Watt Consultancy
NIA_NGET0122	Identification and Mitigation of Large Equipment Transport Issues	Wynns LTD
NIA_NGET0123	EPRI Research Collaboration on Substations	EPRI
NIA_NGET0124	EPRI Research Collaboration on Electromagnetic Fields and Radio Frequencies	EPRI
NIA_NGET0126	EPRI Research Collaboration on Overhead Circuits.	EPRI
NIA_NGET0130	Determining a threshold for magnetophosphenes perception at 50Hz	Lawson Health Research Institute
NIA_NGET0132	UltraWire	University of Cambridge
NIA_NGET0133	Identifying Opportunities and Developments in Electric and Magnetic Fields Research	Formex Archive Services Ltd, Torrance Ltd, Market Opinion Research Ltd, RESOURCE STRATEGIES LTD
NIA_NGET0135	Enhanced Sensor Development (ICASE Award)	The University of Manchester
NIA_NGET0136	Impact of Seabed Properties on Ampacity and Reliability of Cables (ICASE Award)	University Of Southampton
NIA_NGET0137	Noise Assessment of ACCR Conductor	3M, Bruel & Kjaer
NIA_NGET0140	OHL Condition Assessment	Brunel University, Amey OWR
NIA_NGET0141	T-pylon Structure and Composite Insulator Testing	LAPP/Mosdorfer,Pfisterer and Allied Insulators, STRI (Sweden) & CEPRI (China), EPL Composites (England), MIRA, University of Southampton, University of Cranfield (England)
NIA_NGET0143	Transient and Clearances in the Future Electrical Transmission Systems (ICASE Award)	The University Of Manchester
NIA_NGET0146	Assessment of Electronic (analogue and Numeric) Protection equipment end of life mechanisms	Quanta Technology, The University of Manchester University, Nottingham University
NIA_NGET0147	Condition Monitoring of Power Assets (COMPASS)	The Watt
NIA_NGET0148	Network Reliability Asset Replacement Decision Support Tool	The University of Manchester
NIA_NGET0149	Investigation of Aeolian Insulator Noise	Cranfield University School of Management, University of Manchester, Campbell Associates
NIA_NGET0150	EPRI Research Collaboration on Underground Transmission	EPRI Solutions Fx Usd
NIA_NGET0153	Life Cycle Costing and Value Optimisation (ICase Award)	University Of Bath
NIA_NGET0157	EPRI Research Collaboration on Substations	EPRI
NIA_NGET0158	EPRI Research Collaboration on Overhead Transmission Lines Project	EPRI
NIA_NGET0160	Feasibility of Risk based Network Planning	The University Of Manchester
NIA_NGET0162	Digital Substation – Virtual Site Acceptance Testing & Training	The University Of Manchester
NIA_NGET0163	SF6 Management and Alternative Gases	Cardiff University
NIA_NGET0164	Evaluation of a Novel Variant of ACCC HTLS Conductor	Nexans Benelux SA, LAPP Insulators GMBH
NIA_NGET0165	Transformer Rating Modelling Tool Enhancement	Oxford Computer Consultants, Southampton Dielectric Consultants, University of Southampton
NIA_NGET0166	VSC-HVDC Model Validation and Improvement (iCASE)	The University Of Manchester

RIIO-1 project portfolio

PRN list	Name	Partners
NIA_NGET0168	A New Independent Methodology For P&C Coordination Studies Using Real Time Digital Simulation	Birmingham University
NIA_NGET0171	EPRI Research Collaboration on Electric and Magnetic Fields Health and Safety	EPRI
NIA_NGET0172	EPRI Research Collaboration on Substations	EPRI
NIA_NGET0173	EPRI Research Collaboration on Overhead Transmission Lines Project	EPRI
NIA_NGET0176	Feasibility study on the application of advanced materials	The University Of Manchester
NIA_NGET0178	Environmental Containment solutions for Midel 7131	WSP-PB, Adler and Allen
NIA_NGET0179	Travelling Wave Fault Locator Trial	Qualitrol
NIA_NGET0180	EPRI Research Collaboration on Electric & Magnetic Fields Health & Safety (P60) 2016	EPRI
NIA_NGET0181	Classification of Wind Exposed Overhead line Spans	Digital Engineering
NIA_NGET0182	Feasibility study on suitability of protection policy for future energy scenarios	The University Of Manchester, Quanta Technology
NIA_NGET0184	Identify opportunities and developments in EMF Research (2016-2018)	Formex Archive Services Ltd, Torrance Ltd, Market Opinion Research Ltd
NIA_NGET0185	Investigation of transient and safety issues in gas insulated systems	Cardiff University
NIA_NGET0186	Condition Monitoring of Circuit Breakers - iCASE	University Of Liverpool
NIA_NGET0189	Security Assessment of Industrial Control Systems (ICS)	The University Of Birmingham
NIA_NGET0190	EPRI Research Collaboration on Cyber Security 2016 (P183)	EPRI
NIA_NGET0191	EPRI Research Collaboration on Grid Planning (P 40)	EPRI
NIA_NGET0194	Detailed design of 400 kV 240MVA Mobile Substation Bay	Abb Ltd (Alliance)
NIA_NGET0195	EPRI Research Collaboration on Substations 2016 (P37)	EPRI
NIA_NGET0196	EPRI Research Collaboration on Overhead Lines 2016 (P35)	EPRI
NIA_NGET0197	Development of fittings analysis model	Amey Owr Ltd
NIA_NGET0198	Cost effective removal of conductor crossing clearance constraints	Jacobs U.K. Limited
NIA_NGET0199	Alternatives to SF6 for retro-filling existing equipment	The University Of Manchester
NIA_NGET0200	Study into the Concept of High Impact, Low Probability Events	The University of Oxford, Strathclyde University, EA Technology, and Ernst & Young (EY)
NIA_NGET0201	Portable Earthing Device	Aldercote Limited

PRN list	Name	Partners
NIA_NGET0202	Development of a Universal Bushing	BTRAC
NIA_NGET0203	Novel acoustic attenuation feasibility study	WSP Environmental Ltd
NIA_NGET0204	Frequency Response Analysis for Transformer Characterisation and Objective Interpretation of Results	The University Of Manchester
NIA_NGET0206	Novel methodology for assessing environmental exposure of OHL routes	Digital Engineering
NIA_NGET0207	Development of Tools for the Assessment and Control of Impressed Voltage	P&B Weir Electrical
NIA_NGET0208	EPRI Research Collaboration on Electric & Magnetic Fields Health & Safety (P60) 2017 -2021	EPRI
NIA_NGET0209	EPRI Research Collaboration on Overhead Lines (P35) 2017	EPRI
NIA_NGET0210	EPRI Research Collaboration on Substations (P37) 2017 - 2020	EPRI
NIA_NGET0211	Controllable Series Impedance at 275 and 400kV (CSI)	Smart Wire Grid Inc
NIA_NGET0212	Positioning ballistic screening on substation sites	none - project never started
NIA_NGET0213	Condition and Climatic Environment for Power Transformers (ConCEPT)	University Of Southampton
NIA_NGET0214	Transformer and Transformer Oil Life Optimisation and Management Through Analysis and Modelling	The University Of Manchester, University of Southampton
NIA_NGET0215	Automated assessment of steelwork condition using innovative imaging techniques	Nottingham Trent University
NIA_NGTO005	EPRI Research Collaboration on Information and Communication Technology (P161)	EPRI
NIA_NGTO007	EPRI Research Collaboration on Electric Transportation (P18)	EPRI
NIA_NGTO001	Electric Road System for Dynamic Charging of Electric Vehicles	Cardiff University
NIA_NGTO002	Long Term Stability of Alternative Gases	Cardiff University
NIA_NGTO006	Automated identification of failures in HV assets	University of Manchester
NIA_NGTO003	EPRI Research Collaboration on Overhead Lines (P35) 2018-2021	EPRI
NIA_NGTO0031	Feasibility study in to unlocking flexibility within UK Steel Works	Cardiff University
NIA_NGTO008	The FMEA Studies and Risk-based Maintenance for Emerging Power Electronics Assets within GB Power Networks	The University Of Manchester
NIA_NGTO009	Electrical Characterisation of Silicone Oil (ECOSO)	Unviersity of Manchester
NIA_NGTO010	Liquids for cable sealing ends (LiCaSE)	University Of Southampton
NIA_NGTO011	Energy Highways	BMT Defence Services

RIIO-1 project portfolio

PRN list	Name	Partners
NIA_NGTO012	The application of Parametric Design to automate substation development	Atkins
NIA_NGTO013	Predicting Vibration Fatigue for Overhead Line Conductor Systems	The University Of Manchester
NIA_NGTO014	Advanced Line Rating Analysis (ALiRA)	Digital Engineering
NIA_NGTO015	CSE fault analysis by 3D monitoring	The University Of Manchester
NIA_NGTO016	WATTS – Weather Analytics for The Transmission System	Digital Engineering
NIA_NGTO017	Voltage source converter based series controlled impedance technology	Smart Wire Grid Inc
NIA_NGTO018	Harmonic Compliance	Power System Consulting Ltd
NIA_NGTO019	UnlockingTransmission Transfer Capacity	Quanta Technology
NIA_NGTO020	IEC 61850 Cyber Resilient Electric Substation Technologies	The University Of Manchester
NIA_NGTO021	Decarbonisation vision for South Wales	Progressive Energy Limited
NIA_NGTO022	High frequency earthing and its impact on the transmission system	Cardiff University
NIA_NGTO023	Increasing Transmission Boundary Power Flows using an Active Power Control Unita	Siemens Transmission & Distrib Ltd
NIA_NGTO033	Investigation into the Properties and Behaviour of Liquid Soil (LS) Technology	Cardiff University
NIA_NGTO025	Substation Time Synchronisation to Safeguard the Network	National Physical Laboratory
NIA_NGTO026	Health Monitoring of cables using Acoustic Emission Measurement Techniques	Cardiff University
NIA_NGTO027	Smart Geo Grid	Cardiff University
NIA_NGTO028	EPRI Research Collaboration on Underground Transmission (P36+ P34 part) 2018 - 2021	EPRI
NIA_NGTO029	Assessment of Wireless Technologies in a Substaion Environment	Affini
NIA_NGTO030	Overload Rotation to Increase Capacity of Transmission Boundaries	The University Of Manchester
NIA_NGTO032	Novel O-ring Designs (NORD)	Cardiff University
NIA_NGTO034	Environmental Exposure of Overhead Lines: Data Delivery for Physical Testing	Digital Engineering
NIA_NGTO035	Power Electronic Enabled Transformers (PEETs)	University of Manchester
NIA_NGTO036	Optimised Infra-Red Image Systems (OsIRIS)	NATIONAL PHYSICAL LABORATORY LIMITED
NIA_NGTO037	Multi energy vector modelling	University of Manchester

PRN list	Name	Partners
NIA_NGTO038	Economic Ageing of Transformers (EAT)	University of Southampton
NIA_NGTO040	Zero-2050: South Wales (Whole system analysis)	NG Gas Transmission, Wales and West Utilities and Western Power Distribution
NIA_NGTO041	Big Data Analytics for Cable Systems	Digital Engineering
NIA_NGTO042	Impact of System inertia on the Critical Clearance Times (CCT) on the GB Transmission Network	Atkins Ltd
NIA_NGTO043	Short-term Voltage Stability Monitoring Using PMU data	University of Manchester
NIA_NGTO044	Sub/Near Synchronous Instability in the GB Network	Cardiff University
NIA_NGTO045	Risk mitigation of power electronics connections	Imperial College of London
NIA_NGTO046	Advanced Weather Forecasts for Dynamic Line Rating	The Met Office
NIA_NGTO047	Challenging Composite Insulator Design Rules (Champions)	Cardiff University
NIA_NGTO048	Future power network simulations	Electranix Corporation
NIA_NGTO0050	New online tools for assessment of bushing condition (Not-ABC)	Doble Powertest Ltd
NIA_NGTO051	Long term stability testing of alternative gases 2: C5F10O	Cardiff University
NIA_NGTO052	Assessing wearable technology applications for transmission operation and design	Microsoft, VGIS, Coeus
NIA_NGTO053	Evaluation of Travelling Wave based Transmission Line Protection for Low-Fault Level Networks	University of Manchester
NIA_NGTO054	Cyber Security Solutions for Legacy Equipment	University of Manchester
NIA_NGTO055	Feasibility study on upgrading transmission network capability for renewable integration	University of Manchester
NIA_NGGT0047	Resource and asset reuse toolkit	SKM Global
NIA_SHET0008	HVDC Nanocomposite Insulation	Led by SHET
NIA_NGET0084	Optimisation of Node Configuration In Offshore Supergrids	Imperial College of London
NIA_SHET_0032	TOTEM (Transmission Owner Tools for EMT Modelling)	Led by SHET
NIA_NGT0049	Forward Resilience Measures (Stage 1)	Arup and the University of Manchester

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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