Electricity Transmission

Network Innovation Allowance

2016/17

nationalgrid

Contents

Welcome to our innovation annual summary for 2016/17

We are in the midst of an energy revolution. The economic landscape, developments in technology, evolving business models and consumer behaviour are changing at an unprecedented rate – creating more opportunities than ever for our industry to innovate for our customers.

By engaging our colleagues throughout National Grid Electricity Transmission Owner and System Operator on innovation, we're transforming the way we do business and delivering significant results across our seven strategic areas for safety, reliability, connections, strategic, commercials, environment and system operation.

Over the past year, we've made excellent progress on a wide range of ground-breaking innovation projects that span the Electricity System Operator (ESO) and Transmission Owner (ETO) parts of our business. Our innovation projects portfolio continues to deliver best value to our industry, while also guaranteeing security of supply and preparing for emerging challenges facing the energy sector. National Grid does not claim to have all the answers, which is why we work in an open, collaborative way with partners such as network licensees, universities and suppliers. This year we delivered advances in areas as diverse as carbon reduction, improved solar forecasting and unlocking the potential of distributed energy sources.

As the energy sector revolutionises, we must make sure our operations are fit for the future. Our work within the ESO, for example, is closely linked with the wider industry challenges of decarbonisation, decentralisation and digitisation. As renewable generation increases, our projects to improve solar and wind forecasting will help manage the network.

Meanwhile, the Power Potential project shows how we're maximising the use of reactive power by working with the distribution networks – and potentially save consumers up to £412m by 2050. We're also finding new ways of using powerful data that can improve planning and deliver better insights to customers.

While continuing to develop new projects, our engineers in ETO have also been focusing on turning the outcomes of completed projects into tangible benefits for our customers and consumers. The Green Gas for Grid (g^3) project at Sellindge in Kent is now energised and operational. We're proud to be able to say that Great Britain's transmission network is the first 400kV network in the world to be using g^3, which has a global warming potential 98% lower than the gas that is currently widely used for high-voltage equipment.

During the year we have been using the results of the tape corrosion studies we reported on last year. The results of this research have been significant in enabling us to prioritise and reschedule the replacement of a number of underground cables. We are also building a new physical offline test bed, which is the first of its kind in Europe, which allows electricity assets to be tested off-grid, in real-life conditions and at any time. This innovation project at Deeside will give us a better understanding of how assets will perform in the networks of tomorrow and help us to accelerate the introduction of new technologies.

Of course, technology is only part of the answer; people make the real difference. That's why we are committed to making innovation part of everything we do day-to-day. As an example, within ESO and ETO, our new heads of innovation will be making sure we fully benefit from the talent and expertise within our teams to benefit our industry. We will continue to grow our portfolio of innovation and track the value we create to find better ways of developing safer, reliable and efficient energy solutions for the future, leading the way in research and development.

Nicola Shaw
Executive Director, UK
National Grid

"Technology is only part of the answer: people make the real difference. That's why we are committed to making innovation part of everything we do day-to-day"

Our innovation strategy

Our Network Innovation Allowance (NIA) projects and supporting activities continue to advance state-of-the-art technology and best practice. The following pages present a summary of how we have invested our £6.7m 2016/17 innovation allowance in four different ways: on this page we have aligned our activities with our RIIO innovation strategy, on page 5 by our consumer value themes, and on page 6 by asset / activity and finally by technology readiness level.

Safety £0.34m

We continue to monitor safety developments from around the world. We work with academic and industrial experts in high-voltage networks, and use our in-house expertise to develop innovative solutions that help us protect our employees, contractors and the people around us.

Reliability £1.31m

Last year we invested more than £1.3m in projects that will help us maintain a highly reliable system. These include developing an ever-better understanding of how our transmission equipment deteriorates, and developing new ways to refurbish the assets that consumers and our customers rely on for a safe and secure supply of electricity.

Connections £0.92m

We continue to find ways to minimise the cost of connecting new generation and demand to the transmission network. We do this by developing new ways to release capacity on the existing network, and finding smarter ways of operating the network so we can increase the flexibility of the whole system.

Strategic £0.80m

Through strategic research, we explore solutions to today's challenges – such as cybersecurity for our energy networks and systems – and scan the horizon for challenges and opportunities in the next decade and beyond.

Commercial £0.24m

We are working closely with other electricity system partners on two flagship Network Innovation Competition (NIC) funded projects. This will create opportunities for a wider range of stakeholders to support the operation of the electricity system.

Environment £0.85m

We have become the first transmission network in the world to deploy a new insulating gas, g^3, on a live network at 400kV. This gas has 98% less global warming potential than the conventionally used option, sulfur hexafluoride. We're also continuing to work with, and fund, materials scientists so they can identify even better solutions for the future.

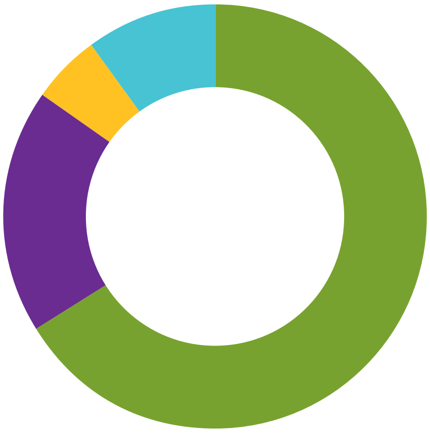
System Operation £2.26m

Balancing and maintaining a stable system is becoming more complex, especially with continually increasing solar generation connections across the country. We are researching methods to respond more rapidly to disturbances in the network.

Innovation consumer value themes

Transmission Owner (TO)

As the electricity transmission network owner for England and Wales, our innovation is focused on four consumer value themes:



Managing assets £3.55m

We're looking for innovative ways to manage the life of our assets. The better we understand what affects them, the better we can maintain them at the lowest cost and least disruption to our customers.

Efficient build £0.99m

We're finding ways to reduce the cost of building new infrastructure. Examples include ways to trial new materials and products, equipment that can be used more flexibly, and ways to improve the design of the network.

Service delivery £0.27m

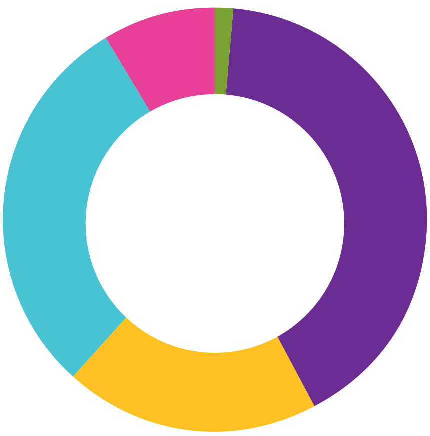
We're exploring new ways to provide value to our customers and consumers as the electricity system evolves. By understanding the present and future expectations of our customers and stakeholders, we can develop the right kind of products and services.

Corporate responsibility £0.46m

We're constantly researching and developing safer working practices. Two examples are: using remotely operated devices within our substations and using materials with less potential to cause harm to the environment.

System Operator (SO)

As the System Operator for Great Britain (GBSO), we are addressing the future challenges of operating the system securely, reliably and efficiently, as well as supporting low carbon generation and helping to deliver affordability.



Demand £0.02m

We're finding innovative ways to balance electricity generation with demand through projects on the distribution side of the network.

Operating with non-synchronous generation £0.60m

We're learning to run the network with higher levels of renewable generation, such as wind and solar.

Distributed generation £0.28m

We're learning to deal with local generation connected to the distribution networks, and improving our forecasting to accommodate the changing nature of demand.

Smart grids £0.44m

We're identifying and demonstrating smart solutions, such as communications technology, to improve transmission capacity and keep down costs for customers.

Risk management £0.12m

As our SO role evolves, we are learning how to manage new risks.

2016/17 Portfolio overview

2016/17 portfolio balance

Cables	£0.38m
HVDC	£0.16m
Other	£0.25m
Overhead lines	£0.80m
Safety, health, environment and security	£0.45m
Substation assets	£2.91m
System operation	£1.79m

The GB energy sector continues to change with the growth of renewable generation. Our innovation priorities for 2016/17 aimed to address and anticipate the transforming landscape we operate in as an electricity transmission business.

We've invested £6.7m into 116 NIA projects during the past year, covering a diverse range of assets and activities, they include investing £170,000 in our successful NIC bid, the Power Potential project (also known as TDI 2.0).

Overall, our innovation strategy reflects the evolving nature of the GB energy sector. In particular, it reflects the evolving roles the England and Wales electricity transmission network owner and the GB system operator play in delivering value to customers and stakeholders. Through this strategy, we can explore new lower cost / lower risk solutions, and identify environmental and safety benefits.

Such efforts are focused on the different assets that make up our network, and affect the way it is operated (see the chart, left). Notable changes compared to last year's summary include the completion of the T-Pylon development work and the start of a new project to develop a function specification and design for a mobile 400kV substation 'bay'.

Spending on TRL 2-8 during 2016/17

Research £2.13m
Development £3.94m
Demonstration £0.66m

Technology Readiness Levels (TRL)

We have a diverse and strong portfolio of projects that is continually developing, trialling and refining new technologies and operating procedures. We measure our projects against the TRL as defined by Ofgem.

For the purposes of the NIA, the TRL are defined as:

[Levels 2-3] Research: activity, often undertaken with university partners, to investigate the issue based on observable facts.

[Levels 4-6] Development: exploring and testing potential solutions to overcome the issue.

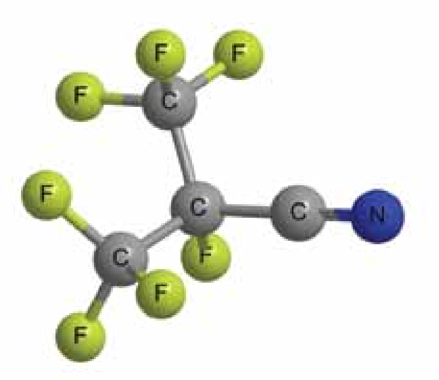
[Levels 7-8] Demonstration: work focused on generating and testing solutions on the network, to get them to the stage where they can be used in business-as-usual.

[Levels 1 and 9] Levels 1 ('blue sky' research) and 9 (fully developed, tested and ready to be deployed) are not eligible for NIA funding.

Working with partners

55

The number of suppliers and partners we have worked with during the year, including universities, distribution network operators (DNOs), original equipment manufacturers, infrastructure suppliers, technology companies and SMEs



The molecular structure for 3M's Novec™ 4710 Insulating Gas.

Effective collaboration and excellent supplier relationships are central to all our innovation projects. By working in partnership, we can achieve best value from our investment in innovation and can deliver benefits to consumers more effectively. We have been collaborating with:

University of Manchester and 3M

We've partnered with the University of Manchester and technology giant 3M to look at alternatives to sulphur hexafluoride (SF_6), an electrical insulator, that can be retro-filled into equipment. Despite being extremely effective, SF_6 is also a greenhouse gas, so we are working with Novec™, to trial a range of admixture gases that will form a suitable environmentally friendly combination.

Transformer Research Consortium

As part of this consortium, we support academic research on transformers, providing access to a fantastic range of material and data and applying the research to benefit our business. The consortium includes:

- National Grid
- University of Manchester
- M&I Materials Limited
- SP Power Systems Limited
- Shell Research Limited
- TJH2B Technology Services LLC
- UK Power Networks (Operations) Limited
- WEIDMANN Electrical Technology AG
- Cargill
- EPRI.

Sheffield and Reading Universities

We've been working with the University of Sheffield on the Sheffield Solar project, which is developing a live feed of national and regional solar generation. Meanwhile, our collaboration with The University of Reading looks at the probability of different weather scenarios and what effect they could have on renewable generation. See page 13 for more details.

UK Power Networks

We're working with UK Power Networks in the South East on the Power Potential project. Awarded £9.5m from Ofgem through the NIC, the project paves the way for distribution system operators (DSOs) to actively support the transmission network. There will be huge benefits to consumers if we can connect more distributed energy sources to a transmission system already at capacity. See page 12 for details.

Scottish Power Transmission

Our successful collaboration on project Phoenix, led by Scottish Power Transmission, looks at how we can use the innovative Hybrid Synchronous Compensator (H-SC), which may allow for greater use of renewables while maintaining security and stability of supply. The project has been awarded £17.4m from Ofgem through the NIC, a testament to the global significance of this technology.

NIC EFCC

In March 2017, the NIC EFCC team hosted their second dissemination event at Strathclyde University in Glasgow. Alongside National Grid, eight speakers from partner organisations GE, Belectric, Centrica, Flexitricity, University of Manchester, University of Strathclyde, Dong Energy and Siemens addressed a capacity crowd to share the latest developments in fast frequency response.

More information and videos of the speakers can be found at www2.nationalgrid.com/efcc

See page 17 for the project highlights.

The EFCC team hosted a dissemination event at project partners Strathclyde University in Glasgow.

Innovation portfolio in numbers

£6.7m

NIA investment

Out and about

Timeline of events

- **July 2016** At the VISOR (Visualisation of Real Time System Dynamics using Enhanced Monitoring) NIC event in London, we provided a TO perspective on the application of the first Wide Area Monitoring System (WAMS) nationwide IT infrastructure.
- **Aug 2016** We attended the CIGRE (International Council on Large Electric Systems) in Paris, where topics included mobile substation bays, IEC 61850 (the global standard for communication in substations), and alternative gases to SF_6 and Gas-Insulated Transmission Lines (GIL).
- **Sept 2016** We attended the European EMTP-ATP (Electro Magnetic Transients Program) Conference in Birmingham, where the EMTP-ATP user group (known as EEUG) discussed practical surge arrester protection distances in substation environments.
- **Oct 2016** Mark Osborne gave the opening address at the IET 'Challenges facing Electricity Transmission'.
- **Feb 2017** Mike Fairhurst, our Overhead Line Policy Technical Manager, presented at the EPRI (Electrical Power Research Institute) conference on the T-Pylon. Dechao Kong presented two papers on Real Time Digital Simulation project at the IET international ACDC conference in Manchester.

We are involved in broad collaboration within the industry, which enables us to share the learning from our own innovation work and benefit from the work of other innovators. Our colleagues regularly attend and take part in conferences, events, and high-profile industry meetings across the country.

LCNI October 2016

We attended the annual LCNI (Low Carbon Network and Innovation) conference for the third time. Our engineers were out in force talking through our latest exhibits and projects. They were on hand to explain how we're keeping the system balanced as renewable generation continues to grow, as well as our innovative work to find more environmentally friendly replacements for the oils, gases and other consumables we use.

Beyond NIA

Outside the NIA/NIC framework, we're working with numerous businesses and organisations. Together we are developing innovative approaches to reduce our own carbon emissions and to play our part in transforming thinking on decarbonisation and sustainability.

- We work with DNOs, the distributed generation community, Ofgem, and the Department for Business, Energy and Industrial Strategy to make access to networks easier for low-carbon energy developers.
- We chair the Linear Infrastructure Network's (LINet's) steering group, developing ways to incorporate 'green infrastructure' alongside other transport, water and energy infrastructure.

Environment

Transmission Owner **Title:** SF_6 management and alternative gases

NIA reference: NIA_NGET0163 **Supplier:** GE, University of Manchester and Cardiff University **Budget:** £1.2m

The g^3-filled equipment at Sellindge will now be closely monitored to prove its long-term reliability.

SF_6 management and alternative gases

Sulphur hexafluoride (SF_6) is an electrical insulator that is used widely in high-voltage electrical applications. It is also a potent greenhouse gas with a global warming impact 23,900 times as high as carbon dioxide.

Emissions of SF_6 currently make up a large proportion of our carbon footprint. It's been an effective insulator of substation equipment for more than 40 years and, due to to its unique characteristics, SF_6 has proven very difficult to substitute. This project aimed to identify and test a new low-carbon alternative to SF_6.

Cutting carbon

There are many environmental benefits to be gained by replacing SF_6. Equipment on UK electricity networks contains around 10,000 tonnes of the material, and relatively small amounts leaking from older equipment contribute the equivalent of around 370,000 tonnes of CO_2 per year. So finding a fully tested technological solution that could be shared in future with all GB licensees and electricity network owners globally would be a very positive development.

World-first solution

We launched the project in March 2015, with part funding from Ofgem's NIA. Since then we have made significant progress working in partnership with GE developing low-carbon alternatives to SF_6.

"In addition to the direct, local benefits, the project is an important step in finding alternatives to SF_6 worldwide. We hope that the live system experience from Sellindge will build confidence that SF_6-free solutions can be used more widely."
Mark Waldron, Switchgear Technical Leader

Innovation in numbers

98%

Reduction in the global warming potential ratio by using g^3

10,000

Tonnes of SF_6 currently installed on the UK electricity networks

At our Sellindge substation, we have trialled a novel alternative from GE Grid Solutions: g^3 (Green Gas for Grid). g^3 is a new gas mixture that delivers the same technical benefits as SF_6 while reducing the global warming potential ratio from 23,900 to 345, an amazing 98% improvement. We have successfully installed and pressurised g^3 on two new gas-insulated busbar sections. The equipment has passed its high-voltage test on site and was energised successfully in April 2017 – a worldwide first.

Next steps

The g^3-filled equipment at Sellindge will now be closely monitored to prove its long-term reliability.

Meanwhile, in November 2016, National Grid launched a new project with 3M and the University of Manchester to develop new gas mixtures that can replace SF_6 in existing equipment.

Innovation portfolio in numbers

150

individuals involved across innovation

Strategic

Transmission Owner **Title:** The Deeside project
NIC reference: NGETEN02 **Supplier:** Various **Budget:** £26m

The Deeside project

The creation of an innovation centre at Deeside will deliver value to consumers by accelerating the implementation of uncertain technologies and methodologies onto the transmission network. At the centre, a fully operational substation is being converted to become an offline test bed. The facility is the first in Europe where electricity assets can be tested off-grid, in real life conditions 24 hours a day, seven days a week.

Innovation portfolio in numbers

31,674

Man hours on innovation

Mirroring a live substation

We won £12m in Ofgem NIC funding in 2015 and are investing a further £14m in the project, which runs through to 2020.

The existing 400kV substation is due to be decommissioned, so converting it means we can research, develop and trial new technologies more successfully with no effect on security of supply. The facility is expected to break even in terms of cost to consumers by 2021.

The trials and benefits to consumers

Over a four-year period, we'll be carrying out a number of separate innovation project trials at voltages up to 400kV. The first phase of work focuses on overhead lines and cables.

There are three specific areas of research that will produce benefits for consumers. The first allows testing and implementation of new ideas that may otherwise be impractical because they are too risky to trial on the live network.

Second, the project will facilitate new learning about our existing assets that can help extend the working life of ageing assets. UK electricity transmission companies hold assets worth around £14bn and this value is expected to rise in future. Finding new methods to increase the life of assets has the potential to create operational savings and reduce capital spend.

Finally, the work aims to speed up the implementation of innovation. This means savings can be passed on to consumers earlier and we'll improve the reliability and efficiency of the network.

Over the past 12 months, the Deeside team has started to take shape. Stakeholder engagement with Scottish Power Transmission, Scottish and Southern Energy Networks, and internally at National Grid, provided a comprehensive list of potential innovation projects. In March 2017, the technical advisory board approved the first four projects for phase one. All site surveys have now been completed and the public consultation is about to begin on the new innovation centre.

The value of working off-grid

Jason Bewley, Deeside Innovation Manager explains: "Taking ideas from the laboratory into the real world is difficult. There are huge differences between the controlled environment of a laboratory and the reality of the transmission network that create barriers preventing the full implementation of new technologies. The new facility at Deeside will remove these barriers, allowing research to be undertaken and supporting faster overall development of ideas."

The Deeside facility is the first in Europe where electricity assets can be tested off-grid 24 hours a day, seven days a week.

Reliability and operability

Transmission Owner **Title:** Classification of wind exposed overhead line spans
NIA reference: NIA_NGET0181 **Supplier:** Digital Engineering **Budget:** £250k

Classification of wind exposed overhead line spans

Overhead line showing signs of deterioration.

Innovation in numbers

3,444

Line spans analysed across 15 OHL routes

£20m

Reduction in RIIO T2 costs

Environmental conditions play a major role in the deterioration of overhead line (OHL) conductors and fittings, influencing how long they can reliably operate before they need to be replaced.

This research project used advanced weather modelling techniques and mechanical response models, to more accurately assess the risk of overhead lines deteriorating due to wind exposure.

One of our findings was a greater variation between the mode and severity of the wind exposure calculated by the new model, compared to our current classification system. Importantly, when the new model was compared against actual defect reports for OHL circuits, we found an improved correlation between the two.

Another contributing factor to OHL deterioration is pollution. So we've begun to explore the potential of a new model that combines the effect of both wind and pollution on OHLs. The result will be the trial of a new classification system that uses advanced weather and pollution models, alongside mechanical wear models and asset condition information.

All of this will mean we can manage our assets more effectively. We'll have a greater understanding of how the environment contributes to the deterioration of conductors and fittings, and will be able to target spending on those assets at the highest risk.

More detailed environmental data will help us make better decisions when it comes to capital investment priorities. The estimated benefit is a reduction of around £20m on capital expenditure over the RIIO T2 period.

Safety

Transmission Owner **Title:** Determining a threshold for magnetophosphenes perception at 50Hz
NIA reference: NIA_NGET0130 **Supplier:** Lawson Health Research Institute **Budget:** £196k

Testing magnetic fields

The study measured the effects of different EMF strengths and frequencies on 130 volunteers.

This three-year project, which was completed earlier in 2017, was conducted by a consortium of partners and took place at the Lawson Health Institute in Canada. Its main objective was to learn more about how people are affected by exposure to electromagnetic fields (EMFs) at 50Hz – the frequency of the GB electricity transmission network.

The study measured the effects of different EMF strengths and frequencies on 130 volunteers. Research shows that the most sensitive response in humans is to something called magnetophosphenes – flickerings of light in a person's peripheral vision. The results of this project show that the public guidelines that we work with are orders of magnitude below the level of EMF that actually causes a detectable magnetophosphene effect at 50Hz. This reassures us that at 50Hz, the current guidelines more than adequately protect the public and employees from the acute biological effects of EMFs. We're now discussing the research with regulators and policy makers.

The results of this research will provide robust data that can be shared across the industry and can be used to formulate future guidelines on EMF exposure.

For more information about EMF please visit www.emfs.info

Commercial

System Operator **Title:** Power Potential – previously known as Transmission Distribution Interface 2.0
NIC reference: NGET_UKPN_TDI2.0 **Supplier:** UK Power Networks **Budget:** £9.5m

Power Potential

Renewable energy from sources such as wind turbines and solar panels plays an increasingly important role in the GB electricity network. Together with UK Power Networks, we're using £9.5m in Ofgem NIC funding to launch a project called Power Potential, which seeks to harness these technologies in a new way. By 2050, the project could result in savings for consumers of up to £412m.

"Working together, the System Operator and Distribution Network Owner will take network operation to the next level while creating an opportunity for new players like distributed energy resources (DER) to enter the market."
Biljana Stojkovska, Power Potential Project Lead

Biljana Stojkovska, Power Potential Project Lead.

Power Potential will explore whether sources of generation connected to the distribution network can provide important services such as dynamic voltage control. This is where reactive power is needed at short notice to maintain voltage after a system fault. The project will also explore the optimal re-dispatch of the active power.

The overall aim is to help us, as the GB System Operator, to access unexploited power, increase network capacity and make the system more affordable to run.

World-first trial

For the first time, the trial will take a 'whole system' approach that goes beyond the transmission network to include distributed generation i.e. those not connected directly to the transmission network. These untapped sources of energy could be used to keep the grid stable and allow additional connection of renewable sources.

The aim of the trial will be to assess whether large volumes of distributed power can be absorbed into the grid effectively.

Focus on the South East of England

The project will last for three years. The first stage will concentrate on the South East of England, through our project partner UK Power Networks. Distributed generation has grown significantly here in recent years, and the region is also at the limit of its capacity to import and export power to the rest of the transmission system. Our initial trials will gauge if services can be provided reliably and in real-time.

Power Potential also aims to improve co-ordination across the whole electricity system. By ensuring the transmission and distribution networks work in harmony, we'll be better able to manage constraints on the system and can also create new revenue streams for renewable energy generators.

Benefits and future opportunities

The potential benefits are significant. Connecting additional renewable energy and storage technology in the region will reduce the need to build more electricity assets. The estimated savings for consumers are up to £1m by 2020 and £29m by 2050. If successful, the regional power market model could be extended to 59 other sites, potentially saving consumers up to £412m by 2050.

Connections

System Operator	**Title:** Solar PV Forecasting Phase 1 and Phase 2
NIA reference: NIA_NGET0183 and NIA_NGET0177	**Suppliers:** The University of Reading and The Met Office
Budget: £750k	

Innovation portfolio in numbers

116

In flight projects

These projects will help realise solar PV's full potential as part of the future energy network.

Solar Forecasting

With solar photovoltaic (PV) playing an increasingly important role in the energy mix, we're undertaking a number of innovative projects to help realise its full potential.

The UK has seen a dramatic increase in the amount of installed solar photovoltaic (PV) over recent years, rising from 0.02 GW in 2000 to 12 GW by the end of April 2017. By its nature, solar power is variable, which makes maintaining a stable electricity network ever more challenging.

We're undertaking a series of innovation projects to improve understanding of both the exact output of solar generation on any given day and our ability to improve solar forecasting.

The Sheffield Solar project (covered on page 18) is developing a live data feed of national and regional solar generation. This will address the fact that we've not had any visibility of real time data on solar PV generation.

Met Office partnership

In April 2015, a separate project was launched with the Met Office, which aims to improve the solar radiation forecasts we receive.

The first phase involved changing the models used by the Met Office to produce solar radiation forecasts. Through blending the vast amount of data generated across multiple forecasting models, there has been a significant improvement in forecast accuracy.

This stage focuses on statistical post-processing of the forecasts. By comparing its original forecasts with actual observations, the Met Office team can assess the margin of error and use this knowledge to improve future forecasts. We're now testing this change ahead of its implementation.

The third piece of the research involves moving from the existing six-hourly forecasts of solar radiation to hourly forecasts, based on the latest weather observations. This would give us an hourly update of solar for the coming two weeks.

The project also supports further physics research within the Met Office, which will run until the summer of 2018 and enable more improvements in the field.

The University of Reading collaboration

We began a second NIA project recently with The University of Reading to assess the probability of different weather scenarios and what they might mean for solar PV and wind generation. The findings will help us understand more about the risks of high or low generation weather events. It will also help us determine the maximum amount of generation that can be connected regionally without overloading the network.

Why forecast accuracy matters

With solar PV playing an increasingly important role in the energy mix, better solar forecasting and a clearer picture of real-time solar generation have significant benefits. We need to know exactly how much generation we must have available on the network to meet demand, because holding too much generation in reserve costs consumers money. The projects above will help realise solar PV's full potential as part of the future energy network.

System operation

System Operator **Title:** Transmission Network Topology Optimisation

NIA reference: NIA_NGET0169 **Supplier:** The Brattle Group Inc **Budget:** £150k

Transmission Network Topology Optimisation

Supply and demand on the transmission network must be balanced continuously.

We're investigating the use of algorithms to fine tune the transmission network.

Supply and demand on the transmission network must be balanced continuously. Much like a busy road network, it can suffer from congestion at peak times, meaning that power cannot always be transmitted to where it is needed. The resulting constraint costs are ultimately passed on to consumers, which last year totalled £340m. As the generation mix changes, finding new ways to optimise the network is increasingly important, both to increase system capacity and to reduce costs to consumers.

Learning from US experience

The Transmission Network Topology Optimisation project aims to explore the use of algorithms to 'fine tune' the network by rerouting power flows away from heavily congested circuits to the rest of the system, where there is spare capacity.

The project builds on research work undertaken in the United States by consultancy firm Brattle, in collaboration with Boston University. By applying algorithms to parts of the US transmission network, the study improved thermal capacity by 5-10% across critical network boundaries.

If similar improvements were made on the GB transmission network, substantial constraint savings could be achieved. Looking at one constraint in isolation, the saving achieved could be between £1m and £5m per annum.

Applying lessons on the GB network

A year-long phase one study began in April 2015 as a proof of concept. Data on specific examples of network congestion were fed to partner consultants, Brattle. The project team tested whether existing algorithms could be used to identify changes to network topology, such as switching lines to reroute power flows.

The second phase, which finished in March 2017, added greater complexity by switching lines but also reconfiguring substations, switches and breakers from the grid to test whether the network could be configured in a more effective way.

Results and next steps

Phase one results showed that the limit – the overall capacity for power flows on a specific part of the network, without considering other bottlenecks – could be increased by up to 6.8% using existing algorithms. The success of this initial work fed into phase two, where the limit increased by up to 12.3%, again without considering other existing constraints on the network. Over the period of the constraint study, from April 2016 to January 2017, the constraint cost savings would have been more than £2m.

The project team has applied for further NIA funding to support a demonstration phase, where algorithms would be applied directly to the transmission network and ultimately mean implementation across the whole system. The overall benefits are a more flexible and responsive transmission system, alongside significant costs savings which benefit consumers directly.

Innovation in numbers

12.3%

Increase in capacity limit

£2m+

Potential annual savings

Innovation portfolio in numbers

23

New projects

IN

54

Completed projects

OUT

Updates on key projects

Transmission Owner **Title:** Modelling the tape corrosion process for oil-filled underground cables
NIA reference: NIA_NGET0103 **Supplier:** The University of Leicester **Budget:** £637k

If the tapes fail, an oil leak can occur, which not only damages the environment but causes unreliability in the system.

Tape corrosion

Project details

About a third of the underground cables on our transmission network are oil-filled cables installed in the 1960s and 1970s. They will need replacing in the next 10 to 20 years, costing billions of pounds. If we can understand more clearly how and why they fail, we can extend their life and manage the cost of replacement over a number of years, something that could save significant sums for our customers.

Several failures on this type of cable in the 1990s and early 2000s showed that the reinforcing tapes, which provide mechanical support to the cables, are vulnerable to corrosion. If the tapes fail, an oil leak can occur, which not only damages the environment, but also impacts on the reliability of the system.

Last year, we reported that National Grid was working with the University of Leicester to investigate tape corrosion and see if the remaining lifespan of cables could be predicted more accurately, something that has led to a novel mathematical model for corrosion fatigue.

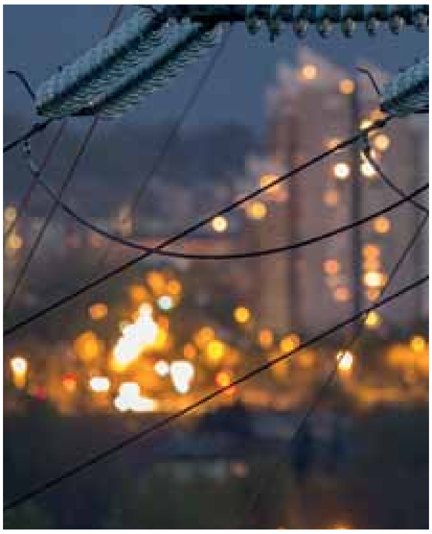
Results and learning

By examining tape samples to understand the deterioration process and by analysing how the corrosion pitting (cavities or holes in the material) is distributed, we can predict how the tape's operational performance will impact both circuit reliability and the environment. This means we can estimate the cable's remaining safe operational life using only limited reinforcing tape samples, which can be obtained at any point during the cable's life.

Benefits to consumers

The results of this project have provided us a better view of the priorities for circuit replacement, allowing us to deal with the most critical circuits first.

Transmission Owner **Title:** RESNET (Resilient Networks)
NIA reference: NIA_NGET0053 **Supplier:** The University of Manchester **Budget:** £136k



As part of RESNET (Resilient Networks) we investigated how climate change affects the operation of the electricity transmission network.

RESNET (Resilient Networks)

Project details

We have previously highlighted the work done to investigate how climate change affects the operation of the electricity transmission network, as part of RESNET (Resilient Networks), jointly funded by the Engineering and Physical Sciences Research Council (EPSRC) and National Grid.

Results and learning

We found that unless network planning and operation is changed, the amount of power that can be safely transmitted through key equipment on the network will most likely have to be reduced in future (known as de-rating). We've identified the need to complete a more detailed assessment of the effects on power transformers in particular. Transformers form an essential component of electricity networks and the amount of power that they can accommodate within safe limits is a vital part of planning and operating the system.

We will shortly be beginning work on a new project, Condition and Climatic Environment for Power Transformers, that brings together the learnings from RESNET, and three other recently completed projects, to develop a holistic approach to managing transformers in the decades to come.

Benefits to consumers

The combined results of these projects will be used to identify new ways to increase the overall resilience of the future electricity network. At a time of great change in the sector, this will mean consumers can continue to access reliable supplies of electricity.

Updates on key projects

Transmission Owner **Title:** Environment Containment Solution of MIDEL 7131
NIA reference: NIA_NGET0178 **Supplier:** Adler and Allen **Budget:** £310k

Field surveys will now assess where un-bunded Midel 7131-filled transformers could be used.

Synthetic ester MIDEL 7131

Project details
This project seeks to enhance industry understanding of appropriate environmental containment solutions using MIDEL 7131 – a synthetic ester used as an insulating fluid in transformers and known to be readily biodegradable.

Synthetic esters have been used in small low-voltage transformers for a number of years. Recently we researched the use of MIDEL 7131 at 400kV and developed a 400kV transformer design for using it; three are now installed at the new Highbury Substation.

The behaviour of esters, should they leak, is different to traditionally used mineral oil so conventional containment solutions (bunds and interceptors) may not be right for esters.

Results and learning
We found that biodegradation is rapid in a typical UK substation. Periodic stirring to aerate effluent in a bund enhances this process and minimises the formation of bio-films.

This means that for minor spillages and leakages, MIDEL 7131 doesn't present a risk to the environment.

A bund may still be required to contain a major leak, but because MIDEL 7131 is flame-resistant, alternative potentially lower-cost bund designs can be considered. In terms of assessing risk, transformer failures resulting in major leaks are extremely rare. There have been just five in the past 50 years over our network of 750 transformers: a probability of 1:7500.

For MIDEL 7131-filled transformers the flame resistance and high biodegradation mean it may be possible to take a risk-based approach to the need for containment, depending on location.

Benefits to consumers
This project has provided technical data that will enable National Grid to amend its technical specifications for MIDEL 7131-filled transformers so they can be considered for a broader range of applications.

Broadening the applications of these transformers will stimulate the market and help drive down cost for MIDEL 7131-filled equipment. This, together with alternative bund arrangements, and reduced requirement for firewalls, fire-suppressant systems and maintenance, could lead to lower overall costs, ultimately benefiting our customers.

Transmission Owner **Title:** Rapid Deployment Ballistic Screen
NIA reference: NIA_NGET0079 **Supplier:** Access Design and Engineering **Budget:** £190k

As well as providing safety benefits, the screens improve network resilience.

Ballistic screens

Project details
The catastrophic failure of substation assets is extremely rare, but the risks resulting from such a failure must be minimised. This NIA project was designed to deliver a cheap, effective and modular screen that could be easily deployed and withstand potential debris from porcelain-clad transmission assets.

Results and learning
Last year, following extensive tests to prove the capability of the screen, a trial installation of the screen's construction and dismantling techniques took place at a substation in North West England. We worked closely with Access Design and Engineering to develop the screen design.

This year, the lessons learned have led to an improved design and we have invested almost £700,000 to buy 82 ballistic screens of two sizes, ready to be deployed on substations across the transmission network. The screens will be stored centrally and used based on the need for system access. The first full deployment of 48 screens was carried out early in 2017 at a substation in the north of England. Further learning was captured for potential future improvements.

Benefits to consumers
The screens enable us to carry out inspection and maintenance work that would otherwise not be possible due to risk management exclusion zones on our sites. Carrying out inspection and maintenance when needed, rather than when it is possible, helps us to reduce costs by keeping substation equipment in good working order for longer.

Updates on key projects

System Operator **Title:** Enhanced Frequency Control Capability
NIC reference: NGETEN03 **Suppliers:** GE, Belectric, Centrica, Flexitricity, University of Manchester, University of Strathclyde, Dong Energy and Siemens **Budget:** £8.5m

As Great Britain's energy mix changes and more renewables are connected to the grid, the risk of rapid changes in system frequency increases.

Enhanced Frequency Control Capability (EFCC)

Project details
As Great Britain's energy mix changes and more renewables are connected to the grid, the risk of rapid changes in system frequency increases. Enhanced Frequency Control Capability (EFCC) is a three-year, £8.5m collaborative project that aims to test how established and newer technologies help to keep the electricity transmission system stable in the most cost-effective and efficient way.

Results and learning
Last year, we reported on plans to develop an innovative monitoring and control system (MCS), capable of collecting frequency data regionally. The MCS will be able to calculate the required rate and volume of fast responses and co-ordinate the response across all technologies.

This year, partner GE has conducted final development and factory acceptance testing of the MCS. It will now enter a series of trials, both in the field by resource providers and at test facilities housed at the two universities partnering with us on the project. The trials will determine the speed of the response and how well it can be sustained.

Benefits to consumers
The result will be a more flexible network. In addition, by developing a commercial framework to sit alongside this new approach to frequency response, a new generation of technologies will be able to compete in the balancing services market.

System Operator **Title:** SIM – SAMUEL Inertia Element
NIA reference: NIA_NGET0192 **Supplier:** Reactive Technologies **Budget:** £232k

The SAMUEL project used resistive load banks around the network to make tiny changes to demand and alter the system frequency.

SAMUEL and SIM

Project details
Last year, we reported how the SAMUEL project was developing a new way of communicating through the electricity grid. The principle is to use system frequency – which fluctuates throughout the day as the balance between supply and demand changes – as a communication channel.

Through the use of resistive load banks around the network, we can make tiny changes to demand, which alter the system frequency. Sensors then detect these frequency changes, which are used to encode messages that in turn control demand side response (DSR) services.

This new grid data and measurement system, developed by Reactive Technologies, means communication signals can travel through the entire grid, including the distribution network.

Results and learning
With SAMUEL ending, this innovation now continues in the form of SIM (Samuel Inertia Measurement), a project that uses the same technology and resistive load banks to measure system inertia.

It's the first time it has been possible to measure system inertia from a direct real-time impulse-response approach, which means we can achieve greater accuracy and, where possible, reduce system balancing costs.

Benefits to consumers
A significant amount of money is currently spent managing inertia. With better insight into how inertia changes in the GB system, plus the ability to quantify it more accurately, we can develop more cost-effective services to manage the system.

Updates on key projects

System Operator **Title:** DNO Investigation into Voltage Interaction and Dependancy Expectation (DIVIDE)
NIA reference: NIA_NGET0156 **Supplier:** EA Technology **Budget:** £376k

We are assessing how changes over the past decade might make managing system voltages more difficult in future.

DIVIDE

Project details
Voltage reduction is one way we manage the electricity network in times of stress, such as high demand for power. If Distribution Network Operators (DNOs) reduce their voltage within set standards, electricity demand falls while continuing to meet consumers' needs. However, over time this technique has become less effective. To understand why and to identify opportunities to reverse the trend, the DIVIDE project was created, bringing together National Grid, DNOs and technology consultancy EA Technology. This joint team is assessing how changes over the past decade might make managing system voltages more difficult in future.

Results and learning
Initial work focused on collaborating with DNOs to improve modelling and understanding of demand response to voltage control. Since then, further work has taken place to plan trials, decide the additional equipment that is needed and how this could be installed onto the DNO network. This approach has extended the original scope of the DIVIDE project, so we are looking at the possibility of developing the outcomes into a new NIA project.

Benefits to consumers
By understanding the relationship between demand response and voltage control, National Grid and DNOs will be able to use demand control as an alternative to disconnecting demand completely. This supports our wider effort to maintain secure and cost-effective electricity supplies.

System Operator **Title:** PV Monitoring Phase 2
NIA reference: NIA_NGET0170 **Supplier:** The University of Sheffield **Budget:** £439k

The partnership has produced near real-time estimates of national solar output.

Solar Monitoring Phase 2

Project details
Like other forms of embedded generation, solar PV output is connected to the local distribution network, rather than the transmission network. Embedded solar PV capacity is rising, increasing from 9.3 GW in February 2016, to 12 GW in April 2017. We expect this trend to continue, resulting in 13.5 GW of installed capacity by the end of February 2018. Live metering is not available for embedded generation. This makes it more difficult to know the precise generation output at any given point. In 2015, we launched a project with Sheffield Solar to improve visibility of solar PV output.

Results and learning
The partnership has produced near real-time estimates of national solar output, based on third-party metered data from live sites. This data helps us to manage flows on the electricity network and is also being used by the wider industry.

The project will soon provide more localised data to support local flows and help manage constraints on the electricity network. Live PV generation data can be accessed on the Sheffield Solar website – www.solar.sheffield.ac.uk.

Benefits to consumers
As solar PV capacity increases, balancing the network becomes more challenging because solar PV is less predictable and currently less visible. Greater knowledge of solar PV generation output will help to minimise constraint costs, which are ultimately passed on to consumers.

Project portfolio

To learn more about the projects, click the title to be taken to the ENA smarter networks portal or visit: **www.smarternetworks.org**

Corporate Responsibility		
NGET	**Project name**	**Partner**
NIA_NGET0012	Induced Voltages and Currents on Transmission Overhead Lines under NSI 4 Working Practices	Cardiff University
NIA_NGET0079	Rapid Deployment Ballistic Screens	Access Design and Engineering RS Components Photron (Europe) Doble PowerTest C3global Radnor Range
NIA_NGET0083	Cable Oil Regeneration	Enervac Corporation JSM Group Midlands Truck & Van Utilise
NIA_NGET0130	Determining a Threshold for Magnetophosphenes Perception at 50Hz	Lawson Health Research Institute
NIA_NGET0133	Identifying Opportunities and Developments in EMF Research	Inannacon Market Opinion Research Resource Strategies Torrance
NIA_NGET0143	Transient and Clearances in the Future Electrical Transmission Systems (ICASE Award)	The University of Manchester
NIA_NGET0171	EPRI EMF 2015	EPRI
NIA_NGET0163	SF_6 Management and Alternative Gases	Cardiff University GE Grid Solutions The University of Manchester
NIA_NGET0180	EPRI EMF 2016	EPRI
NIA_NGET0184	Identifying Opportunities and Developments in EMF Research (2016-2018)	Torrance
NIA_NGET0185	Investigation of Transient and Safety Issues in Gas Insulated Systems	Cardiff University
NIA_NGET0189	Security Assessment of Industrial Control Systems (ICS)	EPRI

Demand		
NIA_NGET0085	UK Regional Wind: Extreme Behaviour and Predictability	The University of Reading
NIA_NGET0097	Development of Dynamic Demand Models in DIgSILENT PowerFactory	Cardiff University
NIA_NGET0110	Electricity Demand Archetype Model (EDAM2)	Energy Savings Trust
NIA_NGET0156	DNO Investigation into Voltage Interaction and Dependency Expectation (DIVIDE)	EA Technology

Distributed Generation		
NIA_ENWL003	Review of Engineering Recommendations	Energy Networks Association
NIA_NGET0020	Modelling of Embedded Generation within Distribution Networks and Assessing the Impact on Load Profile at Transmission Level Grid Supply Points (GSPs)	The University of Bath
NIA_NGET0139	PV Monitoring Phase 1	Invisible Systems GMI Energy
NIA_NGET0170	PV Monitoring Phase 2	The University of Sheffield
NIA_NGET0183	Solar PV Forecasting Phase 2	The University of Reading

Efficient Build		
NIA_NGET0035	Long Term Performance of Silicon Based Composite Insulators	The University of Manchester
NIA_NGET0042	HVDC EngD – Richard Poole	Manitoba HVDC Research Centre The University of Hertfordshire

Project portfolio

Efficient build (continued)		
NGET	**Project name**	**Partner**
NIA_NGET0047	Dynamic Ratings for Improved Operational Performance (DROP)	The University of Southampton
NIA_NGET0057	DC Circuit-Breaker Technologies	The University of Manchester
NIA_NGET0060	Application of DC Circuit-Breakers in DC Grids	Cardiff University
NIA_NGET0087	Cable Installation Design & Innovation Project (CIDIP)	The University of Southampton
NIA_NGET0091	Impact Assessment of Seismic Analysis on Electricity Towers and Substation Equipment / Structures	Mott MacDonald
NIA_NGET0104	Proof of Concept for IED61850 Process Bus Technology	ABB GROUP
NIA_NGET0137	Noise Assessment of ACCR Conductor	Brüel & Kjær UK
NIA_NGET0153	Life Cycle Costing and Value Optimisation (ICase Award)	The University of Bath
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_NGET0168	A New Independent Methodology For P&C Coordination Studies Using Real Time Digital Simulation	The University of Birmingham
NIA_NGET0176	Feasibility Study on the Application of Advanced Materials	The University of Manchester
NIA_NGET0178	Environmental Containment Solutions for Midel 7131	Adler and Allan Parsons Brinckerhoff
NIA_NGET0182	Feasibility Study on Suitability of Protection Policy for Future Energy Scenarios	The University of Manchester
NIA_NGET0191	EPRI Research Collaboration on Grid Planning (P 40)	EPRI

Managing Assets		
NIA_NGET0013	Tablet Interface for a SF_6 Mass Flow Top-up Device	DILO Armaturen und Anlagen GmbH
NIA_NGET0015	Dinorwig Thermal Cycling and Cable Rating	The University of Southampton Doble PowerTest
NIA_NGET0018	Potentials and Profiles around Earth Electrodes and Opposite-Side Injection for Large-Area Earthing	Cardiff University
NIA_NGET0040	Magnetic Models for Transformers	Cardiff University The University of Manchester
NIA_NGET0043	Live Line Working Equipment	Ashbrook Engineering Ltd Bond Aviation Group Bond Helicopters Europe Eurocopter UK New and Renewable Energy Centre Northern Connectors Oxford Computer Consultants P&B Weir Electrical RS Components The University of Manchester The University of Southampton Clydesdale Bank TTI Testing Cunningham Design T. M. Utley Offshore PLC Du Monte UK Bridge Engineering UK Rotarywing Ltd Broadcast Media Services Hiatco John Werrell & Son Ltd Airbus Helicopters
NIA_NGET0044	Transformer Oil Passivation and Impact of Corrosive Sulphur (TOPICS)	Nynas The University of Southampton Doble PowerTest
NIA_NGET0048	Cables With Long Electrical Sections	The University of Southampton The University of Manchester
NIA_NGET0053	RESNET	The University of Manchester ECAS (UK)

Project portfolio

Managing Assets (continued)		
NGET	**Project name**	**Partner**
NIA_NGET0054	Load Cycling and Radial Flow in Mass Impregnated HVDC Submarine Cables	Energi AS Statnett SF
NIA_NGET0055	Electromagnetic Transients (EMT) in Future Power Systems – Phenomena, Stresses and Modelling	RS Components SINTEF Energi AS
NIA_NGET0073	Partial Discharge Monitoring of DC Cable (DCPD)	The University of Southampton
NIA_NGET0088	Transformer Research Consortium	The University of Manchester
NIA_NGET0089	Impact of HVDC Cable Operation on Telecommunication Lines	PowerSure Technology
NIA_NGET0092	Partial Discharge on Existing HV Cable	Elimpus Doble PowerTest Prysmian Group NDB Technologies
NIA_NGET0093	Online Gas in Oil Analysis on Existing HV Cables	Invisible Systems Doble PowerTest
NIA_NGET0102	13 kV Shunt Reactor Refurbishment	ABB Engineering Services
NIA_NGET0103	Modelling the Tape Corrosion Process for Oil-filled Underground Cables	The University of Leicester
NIA_NGET0109	Bushing and Instrument Transformer Test Tap Connection Condition Assessment Tool	Elisys Engineering Process Parameters Elimpus Invisible Systems GE Grid Solutions (UK) Macintosh Consultancy
NIA_NGET0113	Control of Debris and Dust from the Treatment of Grade 4 Tower Steelwork (G4T)	PDC Protective & Decorative Contractors CLC Contractors Fountains Environmental Spencer Coatings
NIA_NGET0117	Bulk Oil Circuit Breaker Bushing in Situ Refurbishment	NAREC Electrical Networks
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)	The University of Southampton
NIA_NGET0140	OHL Condition Assessment	Brunel University London Amey
NIA_NGET0147	Condition Monitoring of Power Assetts (COMPASS)	The Watt PSC Group
NIA_NGET0148	Network Reliability Asset Replacement Decision Support Tool	The University of Manchester
NIA_NGET0149	Investigation of Aeolian Insulator Noise	Cranfield School of Management The University of Manchester Campbell Associates Ltd
NIA_NGET0163	SF_6 Management and Alternative Gases	Nationwide Gas Care (NATGAS)
NIA_NGET0165	Transformer Rating Modelling Tool Enhancement	Oxford Computer Consultants Southampton Dielectric Consultants Ltd The University of Southampton
NIA_NGET0166	VSC-HVDC Model Validation and Improvement (iCASE)	The University of Manchester
NIA_NGET0172	EPRI Research Collaboration on Substations	EPRI
NIA_NGET0181	Classification of Wind Exposed Overhead Line Spans	Digital Engineering Ltd
NIA_NGET0186	Condition Monitoring of Circuit Breakers (iCASE)	The University of Liverpool
NIA_NGET0194	Detailed Design of 400 kV 240MVA Mobile Substation Bay	ABB
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
NIA_NGET0199	Alternatives to SF_6 for Retro-filling Existing Equipment	The University of Manchester
NIA_NGET0201	Portable Earthing Device	Aldercote Ltd

Project portfolio

Non-Sync Generation		
NGET	**Project name**	**Partner**
NIA_NGET0039	A Combined Approach to Wind Profile Prediction	The University of Sheffield
NIA_NGET0106	Control and Protection Challenges in Future Converter Dominated Power Systems	The University of Strathclyde
NIA_NGET0128	Clustering Effects of Major Offshore Wind Developments	The University of Reading
NIA_NGET0129	Investigation of Sub-Synchronous Interactions Between Wind Turbine Generators and Series Capacitors	IC Consultants
NIA_NGET0177	Solar PV Forecasting Phase 1	Met Office
NIA_NGET0187	Transient Voltage Stability of Inverter Dominated Grids and Options to Improve Stability	Power Nova Technology Ltd
NIA_NGET0188	Wind Turbine Control Interaction with Power Oscillation Damping Control Approaches (WI-POD)	The University of Warwick
NIA_NGET0192	SIM – Samuel Inertia Element	Reactive Technologies

Risk Management		
NIA_NGET0052	Mathematics of Balancing Energy Networks Under Uncertainty	Heriot-Watt University
NIA_NGET0058	Scalable Computational Tools and Infrastructure for Interoperable and Secure Control of Power System	Brunel University London
NIA_NGET0059	Protection and Fault Handling in Offshore HVDC Grids	SINTEF Energi AS
NIA_NGET0144	Integrated Electricity and Gas Transmission Network Operating Model (ICASE Award)	The University of Manchester
NIA_NGET0174	Embedded Cyber Risks within the Procurement Process	The University of Warwick

Service Delivery		
NIA_NGET0025	Feasibility Study for Sustainable Substation Design	Ove Arup & Partners
NIA_NGET0045	Multi-terminal VSC HVDC Operation, Control and AC System Integration	The University of Manchester Ampacimon Global Substation Solutions The University of Manchester Invisible Systems
NIA_NGET0084	Optimisation of Node Configuration In Offshore Supergrids	Imperial College London
NIA_NGET0107	Stakeholder Attitudes to Electricity Infrastruture	The University of Exeter
NIA_NGET0141	T-Pylon Structure and Composite Insulator Testing	Europea De Construcciones Metálicas SA Russell Ductile Castings Ltd STRI Valmont SM A/S EPL Composite Solutions Allied Insulators Eaves Machining Lapp Insulators SPIE SAG Group
NIA_NGET0164	Evaluation of a Novel Variant of ACCC HTLS Conductor	Lapp Insulators Nexans Benelux Central Engineering & Hydraulic Services CBS Products

Smart Grid		
N/A	NIC Bid Development 2016	IC Consultants Ltd Moeller Poeller Engineering
NIA_NGET0105	Enhanced Weather Modelling for Dynamic Line Rating (DLR)	The University of Strathclyde
NIA_NGET0119	Project Samuel – Grid Data and Measurement Systems	Reactive Technologies
NIA_NGET0134	Granular Voltage Control (GVC)	Power Perfector
NIA_NGET0154	Smart Grid Forum Work Stream 7 – DS2030	Energy Networks Association
NIA_NGET0161	Detection and Control of Inter-Area Oscillations (DACIAO)	The University of Warwick
NIA_NGET0167	South East Smart Grids	Siemens Transmission and Distribution
NIA_NGET0169	Transmission Network Topology Optimisation	The Brattle Group

So what next..?

We will connect you with the right part of National Grid or, if more appropriate, help you get in touch with one or more of the Distribution Networks Owners to explore it further.

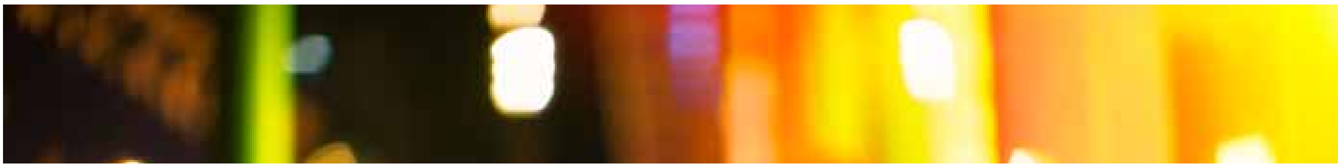
Over the next 12 months we'll continue to work with our partners and collaborators to advance the projects that are already underway.

National Grid does not have all the answers, which is why we work in an open, collaborative way with external partners who have something to contribute to delivering an affordable, secure and sustainable future for our networks. There are several opportunities to engage with us throughout the year.

Electricity networks innovation strategy
Later this year, with the support of the Energy Networks Association (ENA), we and the other GB electricity networks will be preparing an electricity networks innovation strategy. The plan and timeline for this will be published in August 2017 and the draft strategy will be released for consultation by the end of November 2017. We are keen to hear the views of all interested parties so we can make sure this first iteration of a whole networks strategy is as well developed from a whole system perspective as possible.

Call for NIC proposals
In the autumn of 2017 we plan to launch a call for proposals for the 2018 Network Innovation Competition. Potential projects should address specific strategic challenges facing the England and Wales Transmission Owner and GB System Operator.

LCNI
Come and see our innovation teams at the LCNI (Low Carbon Networks and Innovation) Conference on December 6 and 7 at the International Centre, Telford, Shropshire.



Innovation teams

Get in touch:

For the England Wales Transmission Owner:
box.eto.innovation @nationalgrid.com

For the GB System Operator:
box.so.innovation @nationalgrid.com

You can also contact both our innovation teams in the England and Wales Transmission Network Owner, led by Iliana Portugues, and the GB System Operator, led by Carolina Tortora, by sending an email with an outline of your idea explaining how it could be of value to electricity network users.

Carolina Tortora, Head of SO Innovation

An MIT alumna with an Aerospace Engineering background, Carolina first ventured into the energy field within the New Business Development department of Terna, an Italian energy group. Here, she was an advocate for the deployment of Energy Storage within the Italian national HV grid. Following her efforts, Terna secured the Italian Energy Authority's authorisation to install 75 MW of electrochemical energy storage solutions within its substations. Today she heads the Innovation Strategy department for the System Operator, focusing on future challenges to the UK energy system as well as any opportunities that may arise from them.

Iliana Portugues, Head of ETO Innovation

Iliana joined National Grid's ETO innovation team in 2014. She graduated from the University of Bath with a MEng in Electronic and Communications Engineering, where she also obtained sponsorship from National Grid and the Electric Power Research Institute (EPRI) for her PhD on developing a system for using antennas. Iliana then moved to the University of Strathclyde as a research fellow where in 2007 she spun-out the technology into Elimpus Ltd. In 2010 Iliana went to work as a Sensor Laboratory Manager and Senior Project Manager for EPRI, before moving back to the University of Strathclyde in 2012 as Director of the Power Networks Demonstration Centre.

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