Gas Transmission

nationalgrid

Network Innovation Allowance

Annual Summary 2018/2019

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Welcome to our annual summary for 2018/2019

"As we develop our plans for RIIO-2, our next price control period, innovation remains at the heart of what we do."

Nicola Shaw,
Executive Director, UK
National Grid

Throughout 2018/19 we have pushed the boundaries of our innovation to deliver projects that seek to decarbonise our network and provide a safe, reliable and efficient energy system for the future.

We have embedded the Gas Network Innovation Strategy, published in March 2018, and realigned our portfolio against the five key themes – Future of Gas, Safety and Emergency, Reliability and Maintenance, Environment and Low Carbon, and Security. This has ensured our portfolio has remained diverse and focused on the issues our stakeholders are facing.

Across these themes, we've delivered 36 NIA projects, including our HyNTS programme of hydrogen projects, Valve Pits Insulation, and open source SCADA projects. This year also saw the completion of our two NIC projects. With Project GRAID (Gas Robotic Agile Inspection Device), we created a robot that gives us rich inspection data in a more sustainable and cost-effective way. On Project CLoCC (Customer Low Cost Connections), we transformed the connection process to make it faster and cheaper to connect to our network.

With our Value Tracking Process embedded across the business, we have been identifying further opportunities for projects that are now completing. Several of these are set to be implemented within ongoing capital projects, so we expect the £8.6m of value delivered to date to increase.

We continued to collaborate with the Gas and Electricity Networks, alongside the Energy Innovation Centre (EIC), to develop a Benefit Measurement Framework. This 'scorecard' rates network companies' innovation activities, irrespective of how they're funded. It is currently under trial and will be published in due course. In addition, this year we've closely collaborated with the gas networks to develop an implementation log and launched the Energy Network Association's joint gas and electricity call for ideas.

Our ambition for 2019/20 is to drive innovation that helps to deliver a decarbonised network of the future. We are also committed to working with our stakeholders to determine the best tools that can help them understand the value that innovation has delivered, and can deliver in the future.

As we develop our plans for RIIO-2, our next price control period, innovation remains at the heart of what we do. Our innovation vision is: 'Innovating to create your network of the future and facilitate UK decarbonisation'. We are working closely with our stakeholders to develop how we will innovate, using a wide range of funding routes to drive real change in our business, bring value to customers, and decarbonise our network for the future.

Nicola Shaw,
Executive Director, UK
National Grid

RIIO-1 innovation in numbers

As we transitioned from six years of Innovation Funding Incentive (IFI) funding into RIIO-1 innovation, at National Grid Gas Transmission (NGGT) we set out with a goal to embed innovation into what we do. Through this, we've expanded our network of collaborators, working with a wider range of third parties with expertise in a range of technical fields. We also work more closely with the other gas and electricity networks to deliver co-ordination across the innovation portfolios for maximum benefit to consumers.

Here are a few key figures:

Gas innovation strategy in place

Robust governance process in place

300+
project ideas received

154
Network Innovation Allowance (NIA) projects:

£22.7m
spent

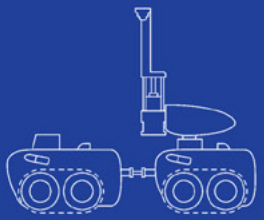
£8.6m
benefits on

£2.1m
spend

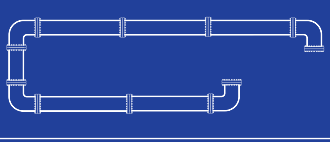
4:1
return on investment

2
Network Innovation Competition (NIC) projects:

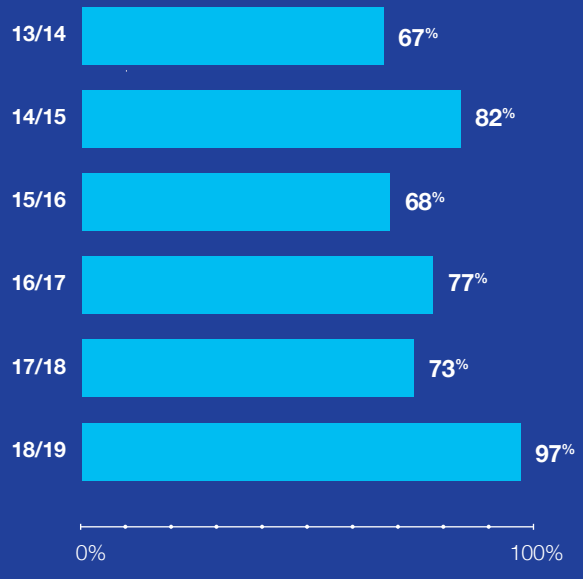
£6.5m
Project GRAID



£4.5m
Project CLoCC



Utilisation of allowance (% used per year):



Note: NIA allowance is calculated at 0.7% revenue so varies each year as revenue fluctuates. All numbers are up to the end of March 2019.

37 collaborative projects

70+ third parties involved

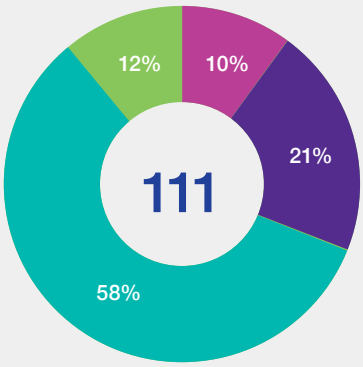
100+ business experts involved

34 originated from another project

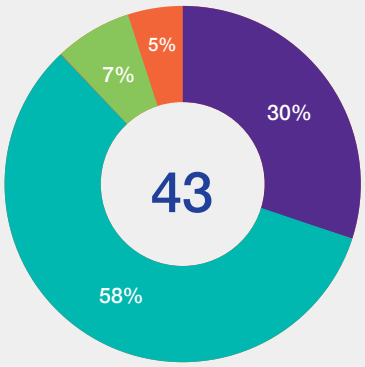
17 project outcomes not as expected

52 driven by safety and/or emissions

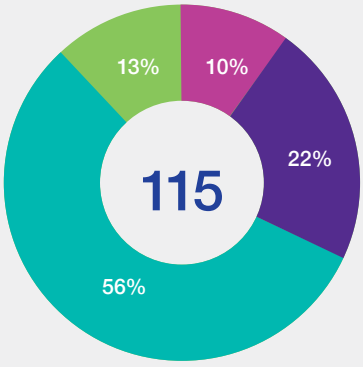
Start TRL 4 or less



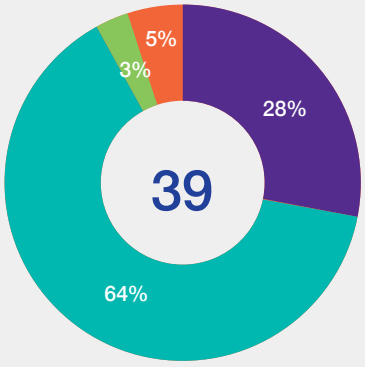
Start TRL 5 or more



End TRL 7 and below



End TRL 8 and above

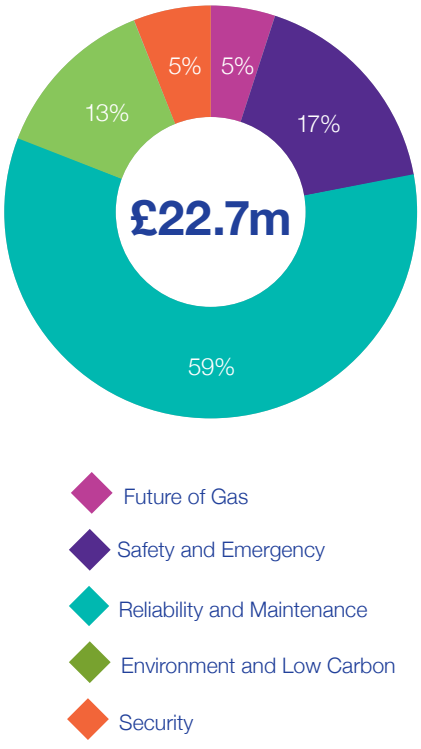


TRL = Technology Readiness Level

Future of Gas | Safety and Emergency | Reliability and Maintenance | Environment and Low Carbon | Security

Our RIIO-1 story: putting innovation at the heart of our business

Total spend per theme (NIA), up to March 2019



Over the past six years of RIIO-1, we've established innovation as a cornerstone of our business. The £34.6m of funding across NIA and NIC that we have invested has helped us unlock new opportunities, make things better for our customers and communities, and deliver proven value across the board.

When we transitioned from six years of IFI into RIIO-1 innovation, we set a goal of embedding innovation into everything we do. In the six years of RIIO-1 that have followed, we've invested £22.7m in 154 NIA projects and £11.9m in two NIC projects across NGGT. This compares with £14m spent during the six years of IFI funding and shows a significant increase in our focus on innovation.

We also introduced key innovation themes, organisational and process improvements, and a much more stakeholder-focused approach. This helped us expand our reach of innovation, unlock new opportunities for third parties to innovate, and deliver more value to our customers.

Our focus hasn't just been on large-scale projects, often referred to as 'Big I' innovation, but also smaller-scale work and process improvements – or 'Little I' innovation. We stayed committed to exploring ideas and opportunities across the spectrum, recognising that value can be delivered from any scale of innovation.

After the successful launch of the first ever Gas Network Innovation Strategy, shared with the Gas Distribution Networks in March 2018, we aligned our portfolio to the five key areas: Future of Gas, Safety and Emergency, Reliability and Maintenance, Environment and Low Carbon, and Security.

For all our success across RIIO-1, we know we can do better. Projects haven't always succeeded, but we always learned from them, updating our processes and organisational structures wherever necessary. Our culture of innovation has significantly improved; but there are areas we need to keep working on.

Collaboration is at the heart of how we innovate and it allows us to unlock the best potential from a wide range of experts and get the best outcome. Throughout RIIO-1, we built up a rich mix of 76 third party collaborators across innovation projects past and present. A wide range of knowledge and experience has been shared across the Gas and Electricity Networks.

Implementation categories

Per use:

7 projects

£6.7m

benefits realised to date

Annually accruing:

2 projects

£474k

total to date

Implementation complete:

3 projects

£1.38m

Delivering and measuring value from innovation

It can be a challenge to quantify the true value of innovation, particularly where less tangible benefits are generated, or the benefits that are realised extend beyond the current price control period.

There is no one-size-fits-all way to track value. Our own method has been to develop a strong methodology that gives us the flexibility to capture a range of benefits, but also assurance that our data is accurate.

As a result, we don't have a standard spreadsheet for capturing data and calculating a benefit figure. Instead, we use a set of processes and checks to identify benefits and then test the values we associate to these. This ensures the figures accurately represent the value achieved. We compare this with the predicted value we set out at the start of the project.

Projects that have been implemented are categorised in three ways (also see figure left):

- **Implementation complete** – fully implemented and no further value is expected.
- **Annually accruing** – each year we expect a recurring value to be achieved. A validation exercise is carried out to confirm the additional benefit has been achieved.
- **Per use** – there have been specific applications that have been quantified and recorded, but further applications would require specific analysis.

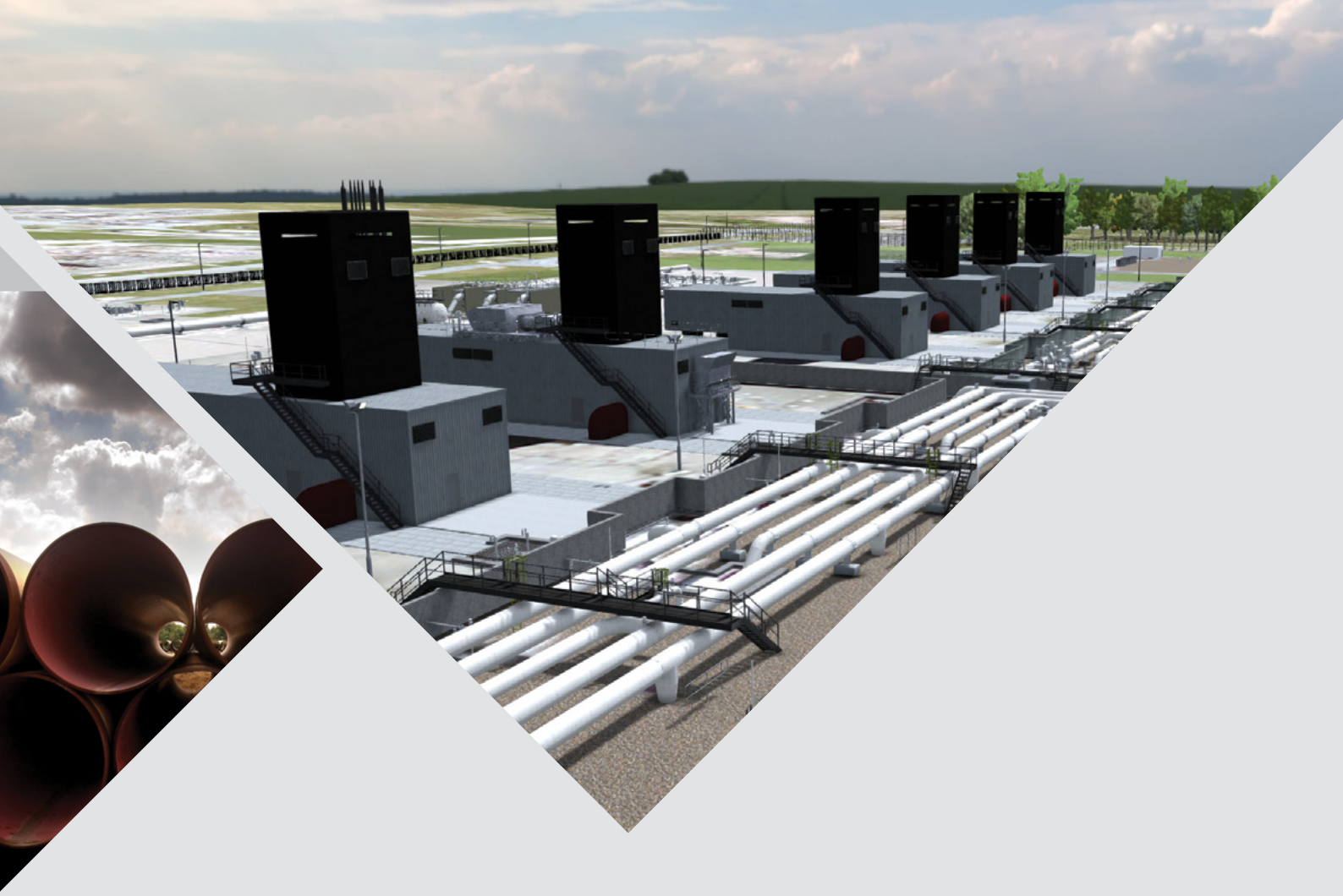
The value of innovation can't just be tracked by the return on investment. There are broader factors, such as any resulting change in culture, approach to innovation and improvements in how we interact with our stakeholders.

Since March 2018, we have been working with the Energy Innovation Centre (EIC) and several of the gas and electricity networks to develop a new way to measure innovation benefits, called the Benefits Measurement Framework. It provides a 'scorecard' for assessing network companies' performance across innovation activities. To support its development, we engaged with stakeholders including Ofgem, Ofwat, BEIS, Sustainability First, Energy UK and Citizens Advice.

It can take time to deliver a positive return on innovation. That's why it's key we have a mechanism that accurately tracks the benefits across our portfolio as a whole.

As we've progressed through RIIO-1, we've honed how we track the benefits of these projects, while making sure the projects themselves have clear value to be delivered.

In 2018/19, we continued to drive innovation forward with a strong portfolio of projects. This report is an update of some of our key work and achievements, all aligned to the five value themes outlined in our gas strategy.



Future of Gas

Exploring new opportunities to decarbonise our network for the future

The gas network plays an important role in transporting energy across the UK. As the energy ecosystem changes, our network must adapt to support the decarbonisation of heat, transport and energy. To achieve this, we're busy exploring what the future holds for heat. We're scrutinising how technology, policy and customer demands are evolving, and plan to use network innovation as a platform to become a world leader in greener gas.

As the UK aims to cut its 1990 baseline greenhouse gas emissions by 80% by 2050, we're set on radically changing how homes are heated. One route is to use hydrogen as an alternative to natural gas – and we're investigating how our network could support a UK-wide transition. In 2018/19 we launched our HyNTS programme, which covers work in this area.

Transforming heat with hydrogen

The energy industry faces a formidable challenge: how to heat the nation's homes with minimal environmental impact. Currently, four out of five of the UK's 26 million homes use natural gas as a fuel for heat, and this produces more than a quarter of UK carbon emissions. Antony Green, NGGT Head of Engineering and Asset Management, tells us more.

"We need to understand what role the NTS could play in a hydrogen future for the UK. Using the NTS to facilitate the transition to a hydrogen heating system will be a key enabler."

Antony Green,
NGGT Head of Engineering and Asset Management, National Grid

The Government is considering a range of options to decarbonise heat, and hydrogen is increasingly part of the conversation. This is because hydrogen potentially offers a greener alternative to natural gas. While natural gas produces carbon dioxide when burned, hydrogen only produces water.

Both here in the UK and internationally, a lot of work is under way to establish whether a transition to hydrogen is genuinely viable.

As the owner of the UK's gas transmission system, we have a significant role to play. The National Transmission System (NTS) is a critical part of the UK's infrastructure and will likely remain so for at least the next 40 years. If we can repurpose our existing infrastructure – or come up with alternative novel solutions – we can be at the forefront of delivering a decarbonised, countrywide heating solution.

There are many strands to the work we're doing to investigate the future for hydrogen. All our activity is brought together under the banner of HyNTS (Hydrogen in the NTS) to provide a focal point for our programmes both internally and in collaboration with the wider industry.

Projects in the pipeline

There are three significant NIA-funded pieces of work under way. All three are at the feasibility stage, with NGGT working closely with industry partners and suppliers to inform policy makers on the potential of hydrogen.

HyNTS

Turn the page to learn more about three fascinating projects.

For the decarbonisation of heat to be successful, around

20,000 homes

will need to switch to a low-carbon heat source every week between 2025 and 2050

Watch our HyNTS projects video

Laying the foundations for a hydrogen-fuelled future

Across three key projects, we're collaborating with our gas partners to drive forward the potential for hydrogen-fuelled heating at a rapid pace.

HyNTS

Gearing up the transmission network for greener gas

Our network consists of more than 7,000km of high-pressure natural gas pipelines, 24 compressor stations and over 600 Above Ground Installations (AGIs).

Title:
Hydrogen in the NTS – foundation research and project roadmap

NIA reference:
NIA_NGGT0139

Supplier:
Health and Safety Executive

PEA cost:
£228,809

While we understand how conventional blends of natural gas affect our equipment, we don't know what impact blends containing hydrogen could have.

In this project, we're trying to unravel the full story. Not just the impact hydrogen has on our pipework, but on all associated equipment, including our compressors, valves, pressure reduction and pre-heating equipment.

Work will include thorough research into the physical capabilities of the NTS. For example, we'll explore what steps we might take to reduce the impact of hydrogen on our infrastructure, and how we might have to operate differently. This will include looking at the variety of materials on our network and how hydrogen will impact across the different manufacturing methods. We're also reviewing all UK and European standards relating to hydrogen, noting which standards are best suited for transportation on the NTS and where any gaps lie.

We're considering locations for an offline trial at a dedicated testing facility, followed by a real-world trial to further test our assumptions – for example putting hydrogen to use at a power station or industrial plant. Ultimately, the project will answer key questions around the suitability of the NTS to transport hydrogen and help us develop a roadmap for the role of the NTS in a hydrogen future.

"In this project, we're trying to unravel the impact hydrogen has on not just our pipework, but on all associated equipment, including our compressors, valves, pressure reduction and pre-heating equipment."

Lloyd Mitchell,
Asset Engineer,
National Grid

HyNTS

Exploring hydrogen production and injection in Scotland

We're doing some groundbreaking work alongside SGN at our St Fergus gas terminal, which will give us really useful answers to a range of hydrogen-related questions. Some 35% of the UK's gas comes ashore at St Fergus, so it's a great place to carry out this research.

Title:
Feasibility study into 2% hydrogen blending at St Fergus and H2 pipeline and hub at Aberdeen

NIA reference:
NIA_SGN0134

Supplier:
Pale Blue Dot supported by DNV-GL and ERM

PEA cost:
£143,375

Collaborative partners:
SGN (lead)

First up, we're exploring if it's possible to produce hydrogen at the facility using methane reformation. Work so far has included an assessment of the St Fergus facility. We explored the site's configuration and spoke with specialists there to understand how we might connect a hydrogen production plant.

Next on the project is a study into the technical, regulatory and commercial implications of injecting hydrogen into the NTS at St Fergus. We'll then carry out an assessment of the impact on both distribution networks and gas consumers of blending 2% hydrogen into the normal gas mix.

Following this, we'll investigate the performance of hydrogen, with a focus on how its emissions compare with those of natural gas. In the final part of the project, we'll outline innovative ways in which 100% hydrogen could be supplied across the region.

The project concludes later this year and will feed into the next steps, including a potential engineering design.

HyNTS

Laying out London's low-carbon future

We're examining whether existing gas infrastructure in the Isle of Grain region, in Kent, could be used to supply hydrogen – and ultimately deliver decarbonised heat – to London and the South East of England.

Title:
Project Cavendish

NIA reference:
NIA_NGGT0143

Supplier:
Arup

PEA cost:
£259,583

Collaborative partners:
Cadent
SGN

The Isle of Grain is already home to major facilities including an LNG (Liquefied Natural Gas) terminal, gas and electricity transmission infrastructure, offshore wind power and potential offshore carbon storage. All of this can be used to support the development of a decarbonised network.

In the project, which takes the form of a desktop study and collaborative engagement, we'll be examining the financial and economic impact of repurposing our infrastructure for hydrogen. We'll establish what additional infrastructure would be required, create an outline design of a functioning hydrogen gas network, and generate a business case showing the benefit to consumers and the country.

It's an exciting project with huge potential. If we can devise a workable outline for using our existing facilities, it could become the catalyst for significant decarbonisation in some of the UK's most densely populated areas.

Safety and Emergency

Seeking out solutions that keep people safe in everything that we do

We're committed to minimising the risks to our stakeholders and society that come from operating the gas network. Our goal is to sustain world-leading levels of safety and find innovative solutions that reduce the risk on our network. We always comply with Health and Safety Executive (HSE) standards and make it a priority to deepen what we know about our assets and equipment.

Throughout 2018/19, we've been developing revolutionary innovations that protect people's safety. Third-party interference remains a risk we're committed to reducing and we're working with land owners to ensure our assets are visible, so any damage or incidents are avoided.

Operating our assets safely is another key area. We have projects under way that further reduce the risk from our day-to-day operations and give us greater understanding of the issues we might face in the future.

Transferring condensate in a safer and more efficient way

A novel solution to replace our fleet of condensate storage tanks with easy-to-operate mobile units is set to reduce the number of hazards on our sites, enhance health and safety, and significantly reduce maintenance and other associated costs.

Title:
Mobile Condensate Tanks

NIA reference:
NIA_NGGT0134

Supplier:
Premtech

PEA cost:
£271,875

£650k

could be saved in three years just by removing the need for at least three condensate tanks to be replaced

For gas to flow efficiently though our network it must be free from impurities, such as natural gas condensates.

These liquids are present in the raw natural gas produced from many natural gas fields. While most of them are removed during processing, we occasionally find them in the NTS.

We use equipment called scrubbers to capture them and a level measurement tells us when we need to transfer the collected material to a condensate tank, where it's held until being taken away for safe disposal. Transferring condensate is a hazardous job, with two technicians required to follow special operating procedures and use complex pressure reduction equipment to mitigate against the potential delivery of high pressure into low-pressure tanks.

Currently, the majority of our compressor stations (16) have a permanent condensate tank installed. They're classed as pressure vessels, which means they're tightly regulated and require regular safety inspections and maintenance.

Side-stepping avoidable site safety risks

We've noticed that these tanks are collecting very small amounts of condensate, with some collecting none in the past 25 years. This means we're not only wasting money on unnecessary maintenance, we're also creating avoidable site safety risks. What's more, many of these tanks are approaching the end of their design life, so a more prudent, cost-effective solution is needed.

In this project, we're aiming to replace many of the tanks currently installed on the NTS with a mobile storage solution. This solution will be based at a central location and transported to sites if and when their scrubbers need emptying.

So far, we've completed the conceptual stage and, after close engagement with stakeholders, have selected a preferred operating philosophy. This will now be developed into a detailed design, before going into construction.

The mobile solution will be rated to 95 bar of pressure. This will allow the condensate to be transferred at full line pressure. Technicians will no longer need to use pressure reduction equipment, which makes the process inherently safer.

The project will also help to save money. We hope to eliminate the future need for these tanks to be installed as part of plant upgrades, as well as eventually decommissioning and removing existing tanks, giving significant future savings.

"Our new mobile tanks will allow condensate to be transferred at full line pressure. Technicians will no longer need to use hazardous pressure reduction equipment, which makes the process inherently safer."

Steve Johnstone,
Senior Innovation Specialist,
National Grid

Sky's the limit for drone inspections

Drone technology could transform the gas industry – and we're at the forefront of an exciting collaborative project to unlock its potential.

Title:
Eye in the Sky

NIA reference:
NIA_WWU_045

Supplier:
N/A

PEA cost:
£1,854,504

Collaborative partners:
Wales & West Utilities (lead)
Cadent
Eastern Power Networks
London Power Networks
Northern Gas Networks
Northern Powergrid
Scottish and Southern Electricity Networks
South Eastern Power Networks

The use of drones across our network could revolutionise how we monitor and maintain our assets – improving safety and reducing costs. That's why we are collaborating on a pioneering cross-country project to establish a common, network-wide framework for their use.

The project, led by Wales & West Utilities, sees us working alongside gas and electricity networks and industry partners, including the Civil Aviation Authority (CAA) and Department for Transport (DfT).

Defining the future

The main aim of the project is to develop agreed standards and define the regulatory environment, so drone technology can be used by our industry. By adopting these standards, the industry would be able to fly drones beyond the visual line of sight of their operator (BVLOS) – which only the military can currently do.

The first trials were held in spring on both the electricity and gas networks. They were carried out by aviation specialists Callen-Lenz in airspace over Lincolnshire and South Wales, free of other aircraft.

In the trials, existing technologies were evaluated, the suitability of various aircraft was assessed, and risk management options were considered. The results will help shape the next phase of trials, which will be held in airspace where light aircraft and other operators are likely to fly.

Safer inspections at a reduced cost

Our current method of using manned helicopters to inspect our infrastructure is expensive and has health and safety risks. Using drones in their place will bring significant advantages.

By changing the rules, so drones can be used for out-of-sight inspections, we'll be able to inspect large swathes of pipeline at a low cost. With no pilot required, we'll make the process safer. And we'll be able to carry out more regular inspections, improving the quality of data we collect.

By setting out an agreed framework for BVLOS drone flights, the project could unlock even more uses for this technology by the energy industry in future. With the project progressing well, we could see the first drones enter service by the end of 2021.

"At Wales & West Utilities we're really excited to be leading this project. BVLOS flight will bring real benefits to gas and electricity networks. This project emphasises the innovative approach the utilities industry is taking to meet the challenges of today and tomorrow."

Lucy Mason,
Innovation Manager,
Wales & West Utilities

Reducing risk to workers and the public with high-visibility mesh

Protecting pipelines from damage from third parties is an ongoing challenge for our business. We've been exploring whether modern protective mesh systems can help alert excavator drivers to the presence of our pipelines – and prevent their buckets from digging dangerously low.

Title:
Overpipe Geogrid Protection Against Third Party Damage

NIA reference:
NIA_NGGT0131

Supplier:
N/A

PEA cost:
£37,078

Third-party damage, caused by people digging or doing agricultural work near our network, continues to pose a significant threat to our gas pipelines. A single incident can put the safety of the public, contractors and our engineers at risk and cause significant disruption. Costs can easily run into the millions, especially if the pipeline has to be shut down while the damage is repaired.

We're also finding more examples of reduced soil cover and shallower ditch crossings above our pipes, which only adds to the challenge.

We've carried out a number of innovation projects to reduce the threat of third-party damage. These include the development of low-cost plastic (PE) protection slabs and new in-line inspections that accurately measure soil depth.

During research for these projects, we identified another potential solution – overpipe protective netting – which is used in parts of Europe.

For this project, we put two versions of this protection mesh through their paces – a yellow warning mesh, designed to alert anyone working near our pipes, and a high-strength protection mesh, designed to restrict the digging capabilities of excavators.

Still intact after 22-tonne attack

To test the warning mesh, we installed it under half a metre of soil. Excavators weighing 15 and 22 tonnes then attacked it with their digger buckets from various positions. The high-visibility mesh not only provided an early warning to the driver, it survived attempts to lift and tear it.

We installed the mechanical mesh 0.3m above a 12m length of 900mm diameter pipe and 0.8m below ground level. It successfully resisted attack from the excavators and the pipe remained undamaged. An additional benefit of the mechanical mesh is it's significantly cheaper than installing concrete slabs.

Our next step is to define types of high-risk areas where these new protection measures can be best put to use. Once we've done that, we'll update our standards so these innovative solutions can be rolled out on future projects.

Millions
of pounds saved for every incident prevented

Cost of concrete slabs per 100m –
£13k

Cost of mechanical mesh per 100m –
£2.85k

Reliability and Maintenance

Using innovation to keep our network safe, secure and reliable for the future

As our network continues to evolve to meet the changing needs of customers, new opportunities and challenges arise around network reliability and maintenance. We're committed to improving the health of our assets and ensuring the network operates reliably and flexibly – and delivers the best possible service.

During 2018/19, our innovation projects focused on asset remediation and we've been searching out the least intrusive and most efficient ways to inspect, assess and repair our assets. Our projects have challenged how and why we do things, so we find a better way of ensuring our assets keep providing a reliable service to our customers.

With the emergence of new digital inspection techniques, we've been exploring how they can give us more accurate information about our network condition and its future use.

Networks combine to refine inspection standards

Across the gas networks, there's a growing belief that specifying fixed time-based inspection frequencies is an inefficient way to schedule pressure vessel inspections. We're working with our network partners on a project to build an improved risk-based inspection regime based on updated defect acceptance limits and operating history of the pressure vessel – which could save more than half a million pounds a year.

Title:
Derivation of a Risk Based Approach to High Pressure Filter & Pig Trap Closure Inspection Frequencies

NIA reference:
NIA_SGN0140

Supplier:
DNV-GL

PEA cost:
£781,397

Collaborative partners:
SGN (lead)

£540k
potential annual savings

Stored energy, such as the pressurised gas in our network, is known to be potentially hazardous. Back in 1999, Pressure Systems Safety Regulations (PSSR) were introduced to help prevent serious injury that could be caused by the failure of such systems.

Ever since, UK gas networks have followed an approved code of practice for the safe design and use of their pressure systems. Since this time the gas networks have inspected filters and pig traps at fixed intervals. As a result, each network must inspect its filters and pig traps on fixed yearly intervals for minor and major inspections.

During these inspections, defects are regularly found in the cast steel materials. This requires an assessment to be undertaken to determine if the defect is within the allowable limits. If the defect is outside of the safe operating limits further action has to be undertaken, which may include increased monitoring, repairs, revalidation by hydrotest or replacement. This is expensive and time-consuming work, and also has health and safety implications.

There is a strong suspicion within the gas industry that the inspection standards currently being followed are overly conservative. There has never been a single gas escape from any of the defects on either type of equipment and we feel that many of the flaws we do find are original manufacturing defects. Up to now, we haven't been able to prove this.

Teaming up to develop risk-based inspections

This project, which is led by SGN, brings together all the UK gas networks – Cadent, Northern Gas Networks, SGN, Wales & West Utilities and NGGT – in a bid to prove that the defects we find are stable and risk free.

Together, we'll be carrying out network-wide data collection, extensive testing and analysis, with the goal of developing an inspection process that's based more firmly on the facts. We hope to safely reduce the frequency of inspections and increase the acceptable size of defects and repair limits.

Once all this evidence is in place, the project will develop a new digital tool for all network partners. It will allow everyone to easily manage this new, risk-based inspection programme – and ensure the whole gas network benefits.

While the project is in its early stages, we believe it will help reduce unnecessary inspections, repair and replacement work, saving the networks £540,000 a year.

"We're aiming to develop a risk-based inspection regime for filters and pig traps and improve our understanding of the acceptable size of defects before action is required. This will save huge amounts of wasted time and money across all the UK gas networks."

James Gilliver,
Engineering Manager,
National Grid

Significantly improving the sensors on GRAID

Title:
GRAID ART

NIA reference:
NIA_NGGT0145

Supplier:
Halfwave
PIE
Premtech
DNV-GL
Murphys
Synthotech
Pressure Force
Key Engineering Solutions

PEA cost:
£1,276,760

"£9.2m could be saved during the RIIO-2 period if we pair ART with GRAID on 20 sites."

Josh Blake,
Project Lead,
National Grid

Q&A with Project Lead Josh Blake on how integrating Acoustic Resonance Technology with our world-first GRAID robot could help us collect highly accurate pipe condition data faster and cheaper than before.

Q: Our GRAID project was an ambitious four-year NIC winner which completed at the end of last year. But what next to continue the success?

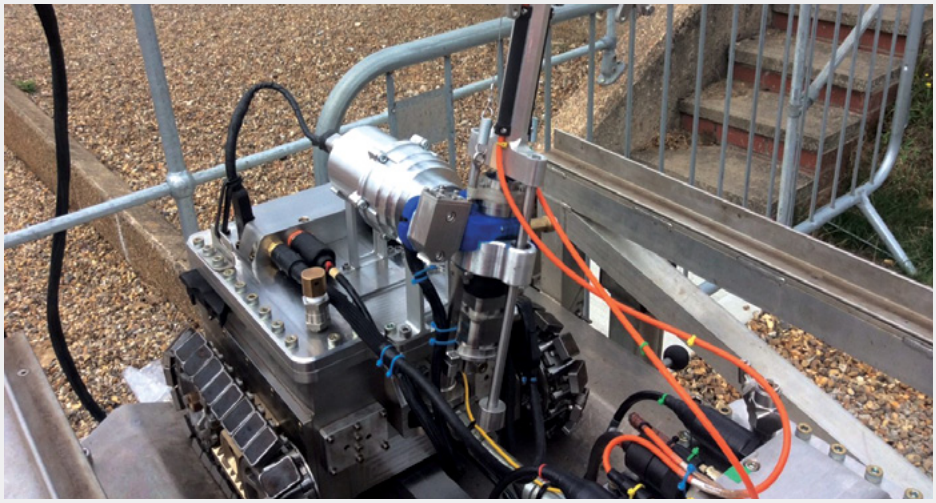
A. In GRAID, we developed a groundbreaking robot that can inspect the inside of live, high-pressure gas pipes on previously inaccessible parts of our network. To get the maximum benefit from having GRAID inside our pipelines, it needs to be able to collect data about the condition of the pipe in high quantities and at high quality. During GRAID's development, we used EMAT (Electromagnetic Acoustic Transducers) technology to collect this. However, with a resolution of 22mm^2, the EMAT sensors weren't as precise as we needed. We also calculated that scanning 100% of a single metre of pipe using EMAT would take 49 hours. It was clear that we needed to find a faster, more accurate solution. Previously, our business trialled Acoustic Resonance Technology (ART) for pigging inspections where an intelligent pig (pipeline inspection gauge) is propelled through the pipeline and it looked to have a lot of potential. So with this project, we are integrating ART with GRAID to see if it can help us gain as much benefit as possible from future robotic inspections.

Q: How exactly are you putting ART to the test?

A. Project partner Halfwave has updated its algorithms and electronics to ensure it can take measurements through the coal tar enamel (CTE) coating that covers much of our pipework. This has historically been a challenge so our first job is to prove the technology and verify the updates by completing a structured lab test. Once complete, Halfwave will work in tandem with GRAID's creators, Synthotech, to design and build a tailored sensor package for the platform. This will be tested at our offline rig at DNV-GL's Spadeadam testing and research centre. We then aim to carry out a live test at our National Grid terminal in Bacton.

Q: If ART proves to be the right partner for GRAID, what will the benefits be?

A. We believe that ART can provide us with significantly more detailed scans of around 3mm^2 accuracy and should also be able to scan an entire metre-long section of pipe in less than an hour. By returning a higher quality and quantity of data than EMAT, we believe we could cut the operating costs of carrying out inspection from around £537k to £75k at a given site. Our RIIO-2 plans include up to 20 robotic site connections, which could see savings of around £9.2m.



Revolutionising valve maintenance with novel toolkit

Title:
Valve Care Toolbox 2

NIA reference:
NIA_NGGT0142

Supplier:
Steer Energy Solutions Ltd

PEA cost:
£432,500

£265k
could be saved every time our valve care toolbox provides a repair that means valve replacement isn't required

We're reducing the need for expensive excavations with a range of new tools that allow technicians to assess, clean and protect buried valves from the surface.

Our transmission system contains more than 9,500 valves, which measure over eight inches in diameter. They're used to control the direction of flow and pressure of gas on the network, so they play a vital role in its effective operation and maintenance.

Many of these valves are now over 40 years old and a significant number are buried. Their underground location makes them susceptible to taking on water. When that happens, it can lead to corrosion and damage, which can ultimately cause a valve to fail. This can have severe implications on the safe management of our gas system.

In the past, our only option for inspecting buried valves was to dig down, lift off the actuator and remove the stem extension with heavy lifting equipment, and then check the condition of the valve. This process, historically, is expensive and time consuming, so we set up the valve care toolbox project to find a better, more efficient way of doing things.

Overground not underground

Instead of excavating, the new range of tools will allow technicians to access the valve stem at ground level, via the valve's tiny vent port situated on the stem extension.

They'll use a newly developed flexible dipstick (similar to those used to check motor oil) to determine the depth of the valve stem. The tool will also tell them whether water is present.

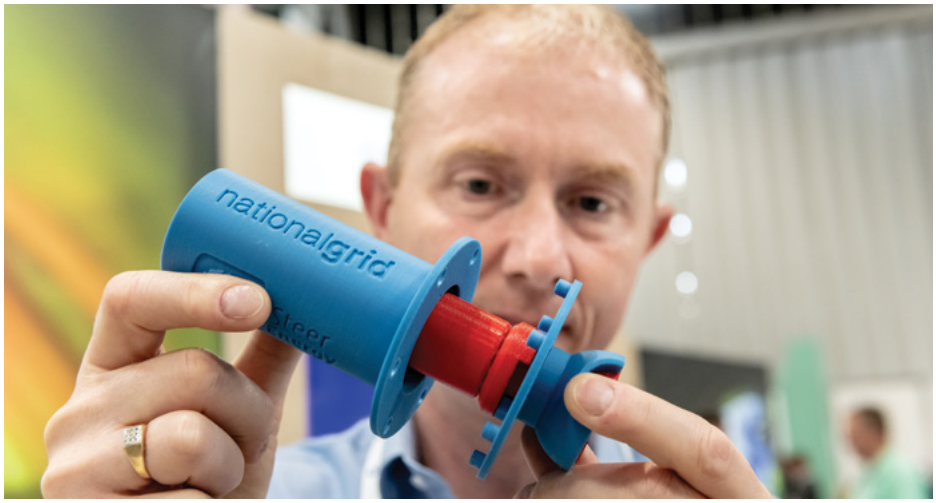
If they find it, they'll have new pumps to drain off the water, tools to inspect the base of the valve for corrosion, and further equipment to flush and clean the inside of the buried stem, and protect it against future damage.

All the answers online

We're also developing an operational database, which will guide our technicians through the best course of action to take – and the right tools to use – under various scenarios.

During stage one of the project, we successfully designed and tested prototypes of the tools. At stage two, we're now completing testing, before providing our technicians with a working toolbox of techniques and processes that will allow them to solve valve-related issues quickly and cost effectively.

By being able to find damage faster, and in many cases reverse the effects of corrosion, we'll reduce the need for costly valve replacements. We'll also increase the effective working life of many of the valves on our network.



Finding hidden flaws in complex weld points

We've been testing the potential of advanced ultrasonic techniques to detect internal flaws in complex welds on our network. This will allow us to pre-empt potential problems, carry out repairs sooner, and avoid the immense expense that follows an unexpected weld failure.

Title:
Destructive Testing of Set-In and Set-On Nozzle Connection Welds

NIA reference:
NIA_NGGT0136

Supplier:
Pipeline Maintenance Centre (PMC)
Phoenix Inspection Systems Limited
M2M

PEA cost:
£123,516

£300k
potentially saved over 20 years just on hot tap welds if implemented across the network

With gas flowing at high pressure through our pipelines, it's vitally important that any welding that's carried out on our network meets the highest standards and is free from defects.

Most welding points are tested both externally for visual cracks and internally for issues within the metal itself. However, some of our more complex connections – namely our hot tap and set-in and set-on nozzle connections – have always proved more of a challenge. Limitations with traditional testing methods meant these weld points could only have been inspected for surface breakages. Internal investigation was impossible.

Across two recent NIA projects, we've been working hard to solve this problem. Our focus has been on testing the latest advanced ultrasonic phased array technology to see whether it's capable of finding internal flaws in these welds. The system works by sending outgoing ultrasonic pulses at varying times. All the individual wave patterns are then combined to provide a clearer picture of any defects and their location.

Getting the inside story on welds

In our first project, we put the technology to work on hot tap connections, where a sleeve is welded around the full circumference of an existing pipe. Our second project investigated whether the same techniques could discover flaws in set-in and set-on nozzle connections, which are used for attaching smaller pipework to a mains gas pipe.

For each project, we designed test blocks that mimicked pipework on the live transmission system. Artificial defects were introduced and we carried out controlled inspections to see if the equipment could detect the defects – and pinpoint their size and position.

On both the hot tap and set-in nozzle connections, the technology consistently detected all internal anomalies. We were impressed with how easy it was to interpret the results, thanks to a feature called phased array scanner overlays. During our tests on set-on nozzles, the equipment wasn't able to routinely locate and size defects. Further work is required in this area.

Sharing project success countrywide

Changes will now be made to our standards and specifications to include this type of testing on hot tap welds and set-in nozzle connections, whenever a project engineer feels it's required.

With a new way of spotting weld defects, we'll be able to act sooner and prevent more expensive maintenance issues from occurring. We'll share everything we've learned with other network owners, so the techniques can be used with confidence by all UK gas transmission and distribution companies.

Managing corrosion with an innovative isolation solution

Innovation Delivery Specialist Mathew Currell explains how a novel gas vapour barrier system is set to make the process of repairing corroded riser pipework faster and cheaper – and save weeks of disruption.

Title:
Sarco Stopper

NIA reference:
NIA_NGGT0141

Supplier:
Sarco Stopper
DNV-GL

PEA cost:
£95,000

"More than £1m could be saved as a result of fewer excavations and less pipeline purging."

Mathew Currell,
Innovation Delivery Specialist,
National Grid

Q: What challenge are you trying to overcome with this innovation project?

A. Our St Fergus gas terminal is home to more than 200 two-inch steel riser stabbings and valve bridle lines. These are smaller-diameter pipes that are connected to the main pipeline and allow us to monitor flow rates/pressures at various points on the system and provide the ability to equalise pressure across main line valves. Many of these pipes were installed in the 1970s. They're also subject to external corrosion, due to the site's coastal location. So we need to do a lot of work maintaining and replacing them. This involves welding and cutting the pipe (hot work), which are potentially dangerous processes in a high-pressure gas environment. To reduce risk, we need to isolate the line safely, which involves carrying out vast site outages, excavations, venting and purging. All of this is expensive, time consuming and operationally challenging.

Q: What work are you doing – and what have you achieved so far?

A. We're developing a new way of isolating our working area, which allows us to carry out hot work on the riser pipework in a less disruptive, cheaper and safer way. We're working with a company called Sarco Stopper to create a bespoke vapour barrier system. It takes the form of two inflatable bags which are inserted into the pipeline and block out either side of our work area. While the section of mains that the riser is connected to will still need to be de-pressurised, we'll no longer need to purge any residual gas that remains in the isolated pipe section. On each job, this will potentially save weeks of operational disruption and bring major cost savings. So far, Sarco Stopper has designed a pilot solution. We've tested it and provided feedback on its strengths and limitations. They're now further developing the design. Once it's at the right level of maturity, we'll carry out detailed workshop and field trials.

Q: What potential benefits can the project bring St Fergus and the wider network?

A. Currently, isolating our pipework before we can carry out repairs can take a considerable amount of time and effort. We estimate that our new solution will considerably reduce this timeline. By simplifying the process, we could remove the need for between five and 20 excavations across our full programme of work, with a potential saving of £250,000. St Fergus was chosen as the trial site for this project due to the volume of riser pipework sections. However, with some adaptations we believe the solution could be used across the NTS and beyond.

Environment and Low Carbon

Reducing our impact on the world around us and making the most of everything we use

Improving our environmental performance is more important than ever. We're committed to reducing the environmental impact that our network and operations have, while drawing the most value from the resources we use. Innovation is playing a key role in helping us reduce our emissions and shift to a low-carbon future.

In 2018/19, we put a strong focus on identifying and monitoring potential emissions from our network and assets. We also explored how we can significantly reduce the direct emissions that come from our operations. Through our future of gas projects, we're also working to establish a more decarbonised gas source.

Our environmental impact also includes the noise and visual impact of our equipment. We've been developing novel ways to reduce noise from our operational sites.

Reducing noise and cutting costs with industry-first acoustic panels

Noise emissions caused by the operation of our equipment can be a nuisance to communities living nearby. We've been investigating whether acoustic panelling – a solution never used in the gas industry before – could do a better job of decreasing the decibels than the fibreglass lagging we traditionally use.

Title:
Valve Pits Insulation

NIA reference:
NIA_NGGT0127

Supplier:
Husht Acoustics
Centrotherm

PEA cost:
£221,250

£550k
could potentially be saved over 10 years at a single site

Covered valve pits, which are found across our network, provide our engineers with easy access points to large underground gas pipes.

The normal flow of compressed gas through pipes situated in these pits can cause a significant level of noise emissions. This can impact local communities living near our sites and lead to complaints.

To bring these noise levels down, we've traditionally insulated the pipework with fibreglass lagging. However, the method has several flaws.

Firstly, it isn't wholly effective at reducing decibel levels, with low-frequency noises continuing to be emitted. Secondly, the lagging absorbs water over time. This reduces its lifespan and means expensive replacements are required. What's more, any moisture that becomes trapped between the lagging and pipework creates a perfect environment for corrosion.

With this project, we explored whether acoustic panels – a technology never before used by the gas industry – could provide a more acoustically effective, sustainable and lower-cost solution.

Insulating the pit, not the pipes

We carried out the project at our Wormington site, in the Midlands.

After removing all the existing insulation from the pipes and valves in the pit, we fitted 4cm-thick acoustic panels across the full span of the pit's roof. So instead of insulating the pipes, the focus was on insulating the room itself.

With the panels in place, we measured noise at 10 points above the covered pit and compared it with previous assessments. The results were outstanding.

With the new solution installed, sound levels were recorded at 54.28 dB compared with 66.78 dB with the old insulation in place. This is a significant and noticeable reduction in sound.

We identified further benefits too. The surface of the panels is resistant to moisture, which gives them a longer lifespan than lagging. Because they're not placed around pipework, they also reduce the risk and costs associated with water damage and corrosion. Over 10 years of use on a single site, we predict potential savings of £550,979.

We're now in the process of assessing the rollout of the technology across five of our sites and we believe the distribution network could greatly benefit from this innovative solution. We also intend to carry out trials on open pits at our Wormington site.

"We're now looking at the possibility of rolling out the solution across five of our sites and we believe the material can also be successfully put to use across the distribution network."

Dave Kerr,
Operations Engineer,
National Grid

Reconstructing how we tackle carbon emissions

We're building and trialling groundbreaking carbon capture technology to see if it can help us – and ultimately all network licensees – reduce the environmental impact of operational emissions.

Title:
Captivate – Proof of Concept

NIA reference:
NIA_NGGT0146

Supplier:
Cambridge Carbon Capture (CCC)
Cullum Detuners
Premtech

PEA cost:
£1,250,000

594k tonnes

of carbon emissions from all our compressor stations in 2017/18. The outcome of this – and future projects – could help significantly reduce that

Carbon dioxide emissions are thought to be the leading cause of global warming. As one of the UK's leading infrastructure businesses, some of our day-to-day activities result in these emissions.

We're committed to combating climate change and, through an ambitious project called Captivate, we're radically rethinking how we tackle the challenge of reducing our operational emissions.

Alongside partners Cambridge Carbon Capture (CCC) and Premtech, we're aiming to prove that emissions from our activities can be captured – and then locked into a solid rock form.

To do this, we're building a system that captures CO_2 and then reacts it with magnesium hydroxide (or brucite) to create hard materials called carbonates. What makes this particularly innovative is that as well as preventing harmful carbon entering the atmosphere, the system creates byproducts that could potentially be used as a building material.

The project builds on previous NIA-funded work, which included a techno-economic analysis that proved the technology is a potentially viable option to help reduce our overall environmental impact.

Cullum Detuners will be supplying the civil aspects of the project, undertaking the required groundworks such as running cable trunking and tapping into current water supplies.

The project's parameters

Through the project, we will test the feasibility and effectiveness of a small-scale system – or demonstrator – at a single National Grid site. Work is split into four stages: building, commissioning and testing of the demonstrator; trial site selection and conceptual design; detailed design; and finally the implementation, demonstration and assessment of the system.

Alongside our on-site trials, we'll also assess if it's feasible for other gas transmission sites to adopt the process – and ultimately whether it could be scaled up for use on larger sites, such as compressor stations.

If we can prove this carbon capture technology is a viable and cost-effective process, we can fundamentally shift how all network licensees tackle reducing their operational emissions.

The output from this project can also feed into the future development of this technology on a much larger scale – in turn, supporting the UK government's own action plan for carbon capture to be deployed at scale by the 2030s.

Supporting our climate commitment with innovative fugitive emission monitoring

Title:
Monitoring of real-time Fugitive Emissions (MORFE)

NIA reference:
NIA_NGGT0137

Supplier:
National Physical Laboratory

PEA cost:
£622,000

"If we could end our existing emission survey programme using these outputs, we could save £60k per year."

Matthew Williams,
Environmental Assurance Engineer,
National Grid

Q&A with Environmental Assurance Engineer Matthew Williams about a pioneering method for measuring fugitive natural gas leaks – and its potential to help all network operators meet their environmental responsibilities.

Q: What's the challenge and how could this project help the environment?

A. Under the Ofgem Greenhouse Gas Investigation Mechanism (GHGIM) we were funded to research new techniques that would improve understanding and allow for cost-effective mitigation of greenhouse gas venting and fugitive emissions on the NTS. Venting is the release of natural gas from the NTS, which predominantly occurs when compressors are shut down and depressurised when no longer required or when maintenance is undertaken. Fugitive emissions are leaks in components caused by loss of tightness of an item which is designed to be tight. Any leak of natural gas is concerning either from a process safety or environmental perspective or both. The environmental concern is because natural gas is made up of approximately 90% methane, which is 25 times more potent as a greenhouse gas than carbon dioxide (CO_2).

Q: What have you previously done?

A. For many years, we've carried out four-yearly periodic fugitive leak detection and repair surveys over and above the daily site checks undertaken at manned installations on the NTS. However, the periodic nature of the surveys means that not every leak is detected swiftly.

In search of a better way forward, we built and trialled a prototype continuous fugitive emission and vent detection system. It was successful at detecting venting and estimating mass emission and likely locations of fugitive emissions. However, to roll the system out across the NTS, we need to ensure it can provide robust results across a range of operating conditions and be economically viable. So in this project, we're refining the prototype and aiming to reduce its cost, so we get the same level of reliability and accuracy at less cost to consumers.

Q: How are you planning to develop and innovate the existing system?

A. We'll be working on a range of different areas. First, we'll explore different solutions for reducing the system's installation costs. We'll also be developing and testing lower-cost sensors and developments in Optical Gas Imaging (OGI) technology to identify the exact leaking components when the likely source area is determined by the monitoring system. We will develop a Standard Operating Protocol – essentially an operating manual that will allow the system to be used across our sites. Every refinement will be tested against the prototype to ensure it performs better than the original. Once the new methods have been proven, we'll carry out further trials at two installations on the NTS.

Q: What will success look like on the project and what will the benefits be?

A. We hope to prove that by combining technologies in an innovative way, testing less costly materials and methane sensors and refining standard operating procedures (SOPs) we can create a real-time fugitive monitoring system that offers considerable benefits to all network operators. Currently, the cost for the prototype device is £70,000 per site. We're aiming to reduce that by at least 50%. Ultimately, success is about creating a novel solution that helps us cut our greenhouse gas emissions and ensures the environment isn't put at risk by our actions.

Security

Innovating to improve security and minimise threats to the network

Cyber and information security are being taken increasingly seriously by all types of business – and network operators are no exception. A strong feature of tomorrow's energy world will be a growth in connectivity, so it's crucial we do all we can to protect the integrity of our network. The years ahead will bring ever more sophisticated threats and innovation will help strengthen our physical and cyber security.

Throughout 2018/19, we've made exciting progress around the use of open source software for protecting systems at our compressor sites. We successfully showed that this method increases our security and saves the business and consumers money. We've also focused on security at our AGIs through the development of intruder detection systems.

All of this progress has helped continue to improve our cyber and network resilience.

Engineering an affordable alert system for AGIs

Standard intruder detection systems are too expensive for smaller sites, such as our AGIs. Engineering Support Manager Jeremy Hunns explains how we're devising a solution that's just as effective – for around a tenth of the usual cost.

Title:
Secure AGI – Intrusion Detection System (IDS)

NIA reference:
NIA_NGGT0138

Supplier:
Lagoni Engineering Ltd

PEA cost:
£1,144,800

Q: What problem is the project attempting to solve?

A. The threat of cyber-attacks on IT networks and operational technology is a growing challenge for all network operators. One measure that's used to good effect is intruder detection systems (IDS). Like a burglar alarm, they provide an early warning of cyber-attacks. However, because these solutions are aimed at large, centralised IT networks, they're incredibly expensive and can cost more than £100,000. This puts them out of reach for smaller operational systems, such as our AGIs. These sites, which are found along the route of our cross-country pipeline, are managed remotely from our central control centre in Warwick using telemetry systems. With this project, we're exploring whether we can build a low-cost IDS solution that can be fitted to existing telemetry systems and give us an early warning if security at our AGIs is compromised.

Q: What progress has been made so far?

A. We've successfully built a platform that uses the open source supervisory control and data acquisition (SCADA) system we developed for our SCADA project to host the IDS. The next step is to engineer the platform so the IDS can work in tandem with our telemetry units. If we can do that, we'll be able to identify how serious an attack is likely to be and rank it accordingly. If it's a low-risk attack, we can balance that with the needs of the network and keep the gas flowing. If it's more serious, we can take appropriate action. This will help us focus on the most significant events and ensure our essential services continue to operate when the risk is low.

Q: What benefits can the project bring?

A. The project will provide a strong case for using open source technologies and low-cost hardware to meet our cyber security needs. Where current solutions would cost £125,000 a site, our new system would cost a fraction of that – between £10,000 and £25,000. If successful, we'll roll out the solution to all our AGIs and promote its use across the distribution networks.

"If the solution was rolled out across all 180 AGIs we could save up to £20m."

Jeremy Hunns,
Engineering Support Manager,
National Grid

Safeguarding our compressor sites with open source SCADA

Title:
Open Source SCADA Platform Phase 2

NIA reference:
NIA_NGGT0128

Supplier:
Lagoni Engineering Ltd

PEA cost:
£1,339,215

£1.63m

estimated annual savings by running an open source SCADA platform across our entire compressor fleet of 26 sites

We're strengthening our cyber security and stripping complexity and cost from our compressor control systems with our open source SCADA project.

As a business that operates an essential service in the UK, we need to make sure the physical assets at the heart of our network are safe from cyber-attacks. This includes the compressor installations that are depended upon to boost gas pressure, increase transmission capacity and move gas through our pipelines.

We're committed to enhancing our cyber resilience and have been looking at how we can make the high-level systems we use to control our compressors – called SCADA – more robust to cyber-attacks.

SCADA systems are used across our fleet of gas compressor installations. They provide an interface through which our engineers can control the equipment, see the status of the system and access relevant data for analysis or archiving.

These systems pose several challenges for our business. Being the access point for operations and maintenance activities they can provide access throughout the control system and provide the natural access point for any cyber-attack on our assets. They are complex and expensive to design, install, commission and operate with relatively short asset lives and a need for regular software updates to maintain their integrity.

Most of the systems are bespoke to each compressor station, so any upgrades or maintenance work are similarly bespoke to each site. The intellectual property for the different systems belongs to the system manufacturers, rather than us, so we're reliant on the system suppliers for service support, locking us into their terms, conditions and costs with little freedom to shop around for support.

Cyber secure and financially secure

Through our open source SCADA project, we're aiming to eliminate the complexity and cost that's inherent in these systems, while toughening up our cyber security.

Open source software is software which has been developed by and is maintained and supported by its user community. This provides independence from OEMs and vendors, is cheaper and simpler to secure and upgrade, and is highly flexible and customisable.

During phase one of the project we successfully designed, built, installed and commissioned an innovative open source SCADA system on one of our compressors. The installation and testing was completed in just four days. This compressor and the new control system has provided baseline compression for a large part of the past winter.

The project has now progressed to phase two, where we're further improving the platform and deploying it across an entire compressor site as a precursor to a wider rollout program.

Meeting stringent EU standards

Our work on open source SCADA supports our compliance with newly implemented EU Network and Information Security (NIS) Directive 62443. This aims to increase the levels of cyber security for operators of critical infrastructures and services. Organisations that fail to co-operate face fines of up to £17m.

With the support of engineering partners Lagoni, we've made it harder to access the system with the addition of two-factor authentication. We're also investigating whether technicians could gain access using their National Grid swipe cards.

We've designed the platform to be fully upgradable and maintainable from a single remote location.

Security features can be introduced and managed without going to site. The platform has also been future-proofed, so that as new security features are developed, we can incorporate them without having to change the system's architecture.

Watch our SCADA/Secure AGI project video here: https://bcove.video/2XUNWTz

Software updates, which are an essential element of keeping systems secure, can also be introduced and controlled remotely, removing the risk of human error at individual sites.

All of this means that instead of having to do multiple upgrades across multiple sites, we can do things once, without costly duplication – and every site will be consistently protected.

With rigorous testing and evaluation continuing, we will soon have a cost-effective, secure and consistent open source SCADA solution that can be rolled out across our entire fleet of compressor sites.

"Our new open source solution means National Grid can have a common strategy across its compressor fleet. It will be simpler to secure key assets from cyber threats, cheaper to operate, and offer a step change in managing essential software upgrades."

Thomas Olsen,
Managing Director,
Lagoni Engineering Ltd

Project CLoCC: opening our network to newer forms of gas

Start:
April 2015

Finish:
November 2018

NIC cost:
£4.5m

Back in 2015, we set out to take a significant step forward in how our network is used. Through Project CLoCC (Customer Low Cost Connections), we sought to transform the connection process and make it faster and cheaper for new sources of gas to connect. With the project complete, let's look back on this incredible story…

In the beginning

Several years ago, we recognised that new sources of gas, such as biomethane and shale gas, had the potential to complement the UK's conventional supply. We wanted to open up the NTS to these emerging customers, but the process was too long and expensive. We set up Project CLoCC to halve the cost, cut connection time to less than a year – and give customers more choice and flexibility than ever before.

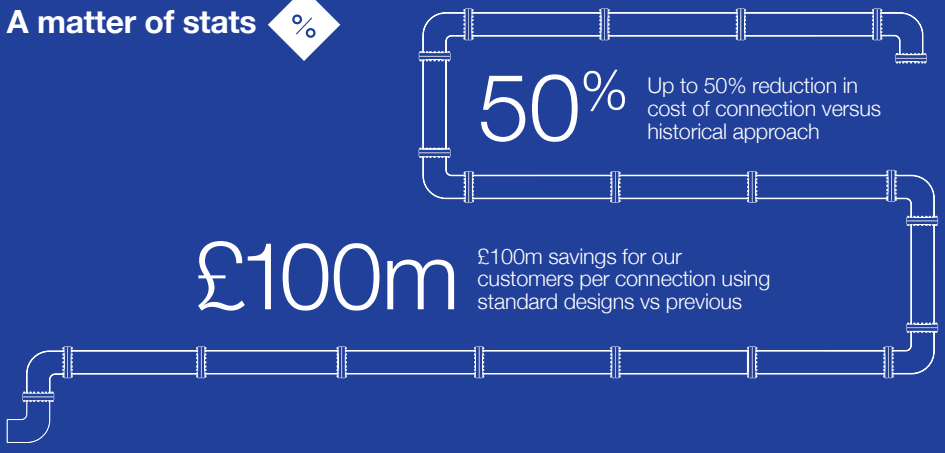
The journey

During our three-year initiative, the project team worked tirelessly to challenge every aspect of our connection process. This is what they achieved:

1. Created an online portal where customers can track their connection from start to finish and get an estimate of likely costs in minutes.
2. Developed a suite of standardised connection designs, covering pipe diameters of 80, 200 and 300mm. This saves customers months of bespoke design work.
3. Removed obstacles for emerging customers. Exit connections no longer need a remotely operable valve, we've made oxygen specification more flexible, and we've reduced application fees by up to 88%.

Next, we selected a pilot customer – an anaerobic digestion plant called Somerset Farm – to trial the process. For the first time, we are proving that biomethane connections are viable to the NTS, and will provide a glimpse of how our network can be used to help decarbonise transport, heat and power generation.

A matter of stats



Title:
Customer Low Cost Connections (CLoCC)

NIC reference:
NGGTGN03

Suppliers:
Premtech
Aqua Consultants
ProTech

What's next?

Soon, a new generation of gas customer will be able to easily access the NTS – and it will be a cheaper and quicker process. We're incredibly excited about how CLoCC can enable the future use of gas within the UK.

Cutting costs and connection time

Learn more and hear from the project team in our end-of-project video.

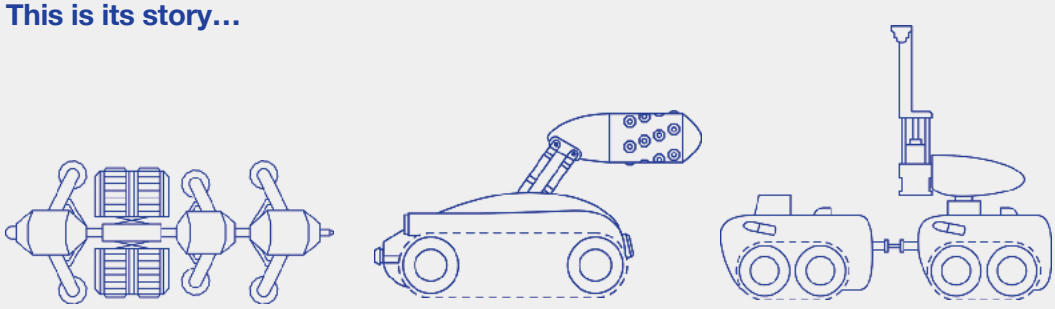
Project GRAID: the future of robotics today

Start:
April 2014

Finish:
November 2018

NIC cost:
£6.5m

Four years ago, we set ourselves an immense engineering challenge: to create a world-first robot that could go inside previously unreachable, high-pressure buried pipes and tell us their true condition. Today, our GRAID robot is ready to revolutionise how we maintain our network. This is its story…



In the beginning

Back in 2014 we took on one of our biggest challenges to date. More than 350km of our buried network was too complex to be inspected using normal inspection processes. Expensive excavations were the only option – and they came with a high carbon footprint. We needed a more sustainable and cost-effective solution.

The journey

With the support of three leading engineering firms – Premtech, PIE and Synthotech – we set about developing a robot that could navigate the complex bends and climbs found in these parts of the network, and also withstand extreme pressure of up to 100 bar(g).

There was a lot of development along the way. Our initial design, which mimicked the aerodynamic shape of a dolphin, evolved into two connected modules, like a truck pulling a trailer. This gave the robot better steering and agility, while remaining robust enough to handle peak flows.

We redesigned and patented new magnetic tracks to give GRAID the magnetic strength it needed to climb 45-degree angles.

We developed a unique launch vessel, 360-degree rotating monitoring arm, and an umbilical management system that connects the robot to our technicians at ground level.

After a series of gruelling offline tests, GRAID was ready to be used on a live National Grid site. We began at an Offtake site and finished the project inspecting the live pipework at Bacton Terminal, which was a huge milestone for the team and well received by our Operations colleagues.

A matter of stats

Predicted savings of around

£60m

over a 20-year period

2,000

tonnes of carbon saved annually

Title:
Gas Robotic Agile Inspection Device (GRAID)

NIC reference:
NGGTGN02

Suppliers:
Synthotech
Premtech
Pipeline Integrity Engineers (PIE)

What's next?

Much like a first-generation mobile phone, this is just the start for GRAID. Already, we're exploring a new inspection technology to integrate with GRAID (see p18). We're also considering a smaller GRAID robot which could enter distribution networks. In fact, GRAID could benefit owners of any underground network.

GRAID in action

Watch GRAID navigate our pipes and hear from the project team in our end-of-project video.

A successful year, and the road ahead

"2018/19 has been a great year for innovation at National Grid. We want to thank everyone who's collaborated with us to make it so successful."

Tom Neal,
Innovation Delivery Manager, National Grid

Our year in innovation has been one to be proud of, as we completed world-first NIC projects and continued to build the technologies and solutions that will help support a better future for gas.

Our innovation year of 2018/19 has been a great success. We've stayed focused on innovation that delivers a step change for our customers, with a range of projects designed to provide a safe, reliable and efficient decarbonised energy system for the future.

In 2018/19, we invested the most in NIA since the start of RIIO-1, with a diverse and focused portfolio that meets the needs and challenges of our stakeholders. With decarbonisation high on the agenda, our HyNTS programme and Captivate demonstrator project are important areas where we've significantly developed our knowledge during the year.

A huge success has been the completion of our two flagship NIC projects: GRAID and CLoCC. Each of these landmark innovations will help us build a more reliable, sustainable and cost-effective future for gas.

We also broadened our reach externally to find new partners and opportunities to innovate, establishing a wider range of third parties to work with us.

Plus, we collaborated and engaged with the industry in lots of meaningful ways:

- We launched and engaged in several calls for innovation ideas. This included the ENA joint gas and electricity call for ideas for the 2019 NIC as well as our own call. Responses were positive, with both new and existing partners sharing their ideas.
- We attended industry conferences, both as exhibitors and delegates. Exhibitor highlights included the Utility Week Live Conference 2018, where we showcased key innovation projects. We also used the event to reach out to new third parties. We shared the challenges facing our business with them and discussed opportunities to work together. The Low Carbon Networks and Innovation (LCNI) conference in Telford in October 2018 was another success.
- We continued to work closely with the gas and electricity networks to share our learning and work collaboratively across a number of areas. Highlights included the development of the Gas Innovation Governance Group's (GIGG) Implementation Log, which tracks all completed NIA projects that are being rolled out across the networks.

As we continue into 2019/20, we'll remain focused on delivering a strong portfolio of innovation projects, while working closely with our stakeholders to develop plans for the next price control period.

Building our blueprint for RIIO-2

Our innovation vision

"Innovating to create your network of the future and facilitate UK decarbonisation."

Innovation continues to form a pivotal part of the National Grid strategy for RIIO-2, which will help us deliver a safe, efficient and reliable Gas Transmission Network that meets the needs of our stakeholders.

The NTS has a vital role to play in linking up the whole gas energy network. It is central to a decarbonised energy system and has the potential to transport a variety of decarbonised gases around the country.

It's our ambition in Gas Transmission Innovation to build and develop the innovation completed in RIIO-1, learn from the successes and failures of the past, and ensure that collaboration and dissemination across the utilities grows and flourishes. All of this will help us deliver a decarbonised energy system.

By working closely with our stakeholders and third parties, we can address these challenges and help build the decarbonised energy system of the future. We plan to innovate through business-funded innovation as well as Ofgem's proposed allowances – and really drive forward the energy system transition.

Our ambitious plans for RIIO-2 see an accelerated plan to develop and deliver innovation to meet our decarbonisation challenges.

We will aim to embed successful innovation within our business to realise value for our customers. In our October 29 submission we will provide more detail on our plans for RIIO-2 and highlight the specific RIIO-1 projects we'll continue to focus on.

Our focus for innovation in RIIO-2 is in three key areas:

Fit for the Future:

Safeguarding and preparing our assets for the challenges in operating for the next 50 years and towards a decarbonised future.

Ready for Decarbonisation:

Focusing strongly on how the NTS will transport a blended mix of 'green' gases and focus on future technology to better manage the assets we own.

Decarbonised Energy System:

Working predominantly on hydrogen, we'll explore how the gas will interact with the NTS, how trading could be managed, and whether direct offtakes for hydrogen can support the transport and commercial markets.

List of projects in 2018/19

We had 36 innovation projects running in 2018/19. To learn more about the projects, click the title to be taken to the ENA smarter networks portal.

Reference	Registered Title
NIA_NGGT0049	Investigation into the use of constrained-layer damping
NIA_NGGT0051	Wireless Gas Detection Assessment
NIA_NGGT0086	Mathematical Baseline and Error Detection Techniques for the Analysis of Unaccounted For Gas (UAG)
NIA_NGGT0097	Permanent PE slab protection
NIA_NGGT0103	Artificial Intelligence for Pipe Coating Inspection
NIA_NGGT0107	Project EVA – Extreme Value Analysis
NIA_NGGT0110	Advanced Manufacturing (3D Printing) of NTS ready components
NIA_NGGT0111	Aerial Imaging Research (AIR)
NIA_NGGT0112	Noise Mitigation Tool
NIA_NGGT0113	Induction Heating
NIA_NGGT0118	Compressor Data Analytics
NIA_NGGT0123	RUL Determination for Compressors 2
NIA_NGGT0125	Generation of Intelligent P&IDs from Plant3D models
NIA_NGGT0126	In Pipe NTS Liquid Monitoring Systems
NIA_NGGT0127	Valve Pits Insulation
NIA_NGGT0128	Open Source SCADA Platform Phase 2
NIA_NGGT0129	Investigate integrity of plain dents in grade L555 pipe
NIA_NGGT0130	European Pipeline Research Group 2018
NIA_NGGT0131	Overpipe geogrid protection against third party damage
NIA_NGGT0132	PRCI (Pipeline Research Council International) 2018
NIA_NGGT0133	Risk Assessment Methodologies for Pipelines and AGIs 2018
NIA_NGGT0134	Mobile Condensate Tanks
NIA_NGGT0135	Techno-Economic Feasibility of Solid State CO_2 Capture
NIA_NGGT0136	Destructive Testing of Set-In and Set-on Nozzle connection welds
NIA_NGGT0137	Monitoring of real-time Fugitive Emissions (MORFE)
NIA_NGGT0138	Secure AGI – Intrusion Detection System (IDS)
NIA_NGGT0139	Hydrogen in the NTS – foundation research and project roadmap
NIA_NGGT0142	Valve Care Toolbox 2
NIA_NGGT0143	Project Cavendish
NIA_NGGT0145	GRAID ART
NIA_NGGT0146	Captivate – Proof of Concept

Projects led by other networks

Reference	Registered Title
NIA_NGGD0094	Composite Repairs to Complex Shapes
NIA_SGN0134	Feasibility study into 2% hydrogen blending at St Fergus and H2 pipeline and hub at Aberdeen
NIA_SGN0140	Derivation of a Risk Based Approach to High Pressure Filter & Pig Trap Closure Inspection Frequencies
NIA_SGN0144	Assessing the Gas Network Decarbonisation Pathway
NIA_WWU_045	Eye In The Sky

How to get involved in NGGT innovation

Funding for innovation projects is available through a range of different routes

Network Innovation Allowance (NIA)

NIA funding is accessible throughout the year. It provides opportunities for innovation programmes to be developed across the gas industry. The NIA requires projects to satisfy the following criteria:

- **Demonstrate customer value**
- **Directly impact the gas network**
- **Share learning and intellectual property**
- **Avoid duplication**

Network Innovation Competition (NIC)

The NIC is an annual competition to fund flagship innovative projects that can bring financial and environmental benefits for gas customers. A fund of £20m is available each year to Gas Transmission and Distribution Networks. To secure NIC funding, projects should:

- **Deliver value for money for gas customers**
- **Accelerate the development of a low carbon energy sector**
- **Creates knowledge that can be shared across the GB network**
- **Be innovative – requires a project to demonstrate effectiveness**

Other routes

While the NIA and NIC are the most prominent types of funding, other options are available – from extra competitions to NGGT-funded projects. Get in touch with the team to find out more.

Get in touch

If you'd like to be added to our mailing list, or have a question or idea you'd like to discuss, just email us.

Or find us on social media. Click on the icons below:

nationalgrid

National Grid Gas Transmission
National Grid House
Warwick Technology Park
Gallows Hill
Warwick
CV34 6DA

www.nationalgrid.com/innovation