

Network Innovation

Annual Summary 2019/20

we are
the **network**



About us

We are Northern Gas Networks (NGN), the gas distributor for the North of England.

Through our vast underground pipe network, we keep 2.7 million homes and businesses cooking on gas.

We are committed to providing a safe, reliable and great value service to our customers and stakeholders, while developing new forms of energy, such as hydrogen, to support a greener future.

Innovation underpins everything we do - whether we are replacing pipes, fixing leaks, reducing carbon emissions or supporting our most vulnerable customers.

By thinking differently, listening to our colleagues and considering our communities, we are helping to reinvent the utilities sector.

About this document

NGN receives funding from our regulator, Ofgem, to develop innovative products and techniques that allow us to do our core work more effectively, and to prepare for a greener future.

The funding is called the Network Innovation Allowance (NIA).

This document explores how we have used NIA funding in the 2019/20 business year to develop new products and services, invest in business-ready solutions and develop opportunities for collaborative, match-funded projects.



Cost-effective and cutting-edge: why innovation matters



Innovation at NGN is extremely diverse.

It can mean introducing a simple reusable rubber mat to put spoil on during streetworks to prevent scarring the road or customers' driveways.

It can mean developing highly sophisticated, low-cost sensors, that can be incorporated into pipes, so that our network can 'talk' to us.

And it can mean preparing for live network trials of hydrogen - a green and sustainable gas that can help the UK meet its 2050 net zero carbon target.

From the simple and everyday to the cutting-edge and revolutionary, innovation is allowing us to deliver a more cost-effective, high quality service for customers, while preparing for a greener future.

The way we are delivering innovation projects continues to evolve. The Network Innovation Allowance (NIA) still provides a vital catalyst, but we are also developing our own funding opportunities.

For example, our collaborators are starting to provide financial contributions towards projects, as they recognise that working with us gives them a reliable, speedy route to market.

This commercially savvy approach means that in our new business plan for the 2021-2026 period, we aim to increase overall innovation spend, while reducing our reliance on NIA funding. This translates to even better value for our customers.

In the pages that follow, we take a look at our latest crop of NIA funded projects. We also review recently completed projects that have since been rolled out onto the streets of the North of England.

There are many potentially game-changing projects in this year's report. Our work in hydrogen is especially exciting. Having proven the technical and financial viability of an all-hydrogen gas network, through several years of studies, we are now about to start live demonstrations.

These trials will see hydrogen flow through our existing pipe network and customers cook their food and heat their homes on a blend of 20% hydrogen and 80% natural gas.

Our use of data to make better decisions about our network, also deserves highlighting. Back at the office, our investment in a state-of-the-art IT and data management system is now paying dividends, while beneath the streets we are developing low cost sensors for pipes – giving us the prospect of an intelligent network.

We have come a long way, and there is still so much more to come. I hope you enjoy reading this year's report, and if you'd like to find out more about any of the projects featured, or explore opportunities to work together, please do get in touch.

A handwritten signature in black ink, reading 'Mark Horsley'.

Mark Horsley
Chief Executive Officer, Northern Gas Networks

1. Our performance, at a glance

2019/20 has been another boundary-pushing year for our innovation programme.

We completed 16 NIA-funded projects and launched 15 new projects, 13 of which were NIA funded and two alternatively funded. Some of these projects have the potential to be truly game-changing for the industry.

We maximised potential by investing 98% of our allocation of NIA funding for the year - £2.9 million - as well as leveraging £800,000 of additional, third party funding.

We continued to work closely with our supply chain and fellow utility companies, collaborating on a diverse portfolio of work, sharing knowledge and pooling resources.

Our colleagues enjoyed an enhanced support programme, so that they could tackle innovation projects with even greater confidence.

And we submitted our business plan for the RIIO-2 regulatory period (2021-2026). To ensure great value for bill payers, the plan includes £24 million of efficiency savings across the period. Innovation will play a crucial role in achieving these savings, while continuing to enhance levels of service.

Our impact, in figures

In 2019/20, innovation allowed us to:



Unlock more than **£3.2m in cost savings**.



Reduce the number of holes we needed to dig by 3086



Reduce the amount of spoil sent to landfill by 14912 m³



Complete **16** NIA funded projects



Start **15** new NIA funded projects, and 2 projects funded through other means.



Leverage **£800,000 funding from our supply chain** to support innovation projects.



Invest our **full £2.9 million NIA funding** allocation.



Cut vehicle journeys by **4,310 miles**



Collaborate with **31 partners**

Tracking our progress

To keep on top of our progress, we use a tracking solution and dashboard that records the benefits accrued through completed innovation projects.

This dashboard is routinely shared across the business.

We track both the quantitative and qualitative benefits of completed projects and wider solutions we've implemented.

Measuring the true impact and value of an innovation project is complex and often involves more than recording cost savings.

For this reason, we have worked with the Energy Innovation Centre (EIC), other gas distribution networks, the Energy Networks Association (ENA) and Baringa Partners to develop a collaborative, industry-wide framework to report on the outputs and outcomes of innovation. The framework enables comparable review.

This collaborative work has progressed this year to further develop a standard measurement for reporting across all the gas and electricity networks. The work undertaken this year, coordinated by the ENA, will allow us to roll out the final version of the framework in readiness for the start of RIIO-2.

2. Our innovation culture

At NGN, we believe innovation should be part of everyone's life, both at work and at home – from engineers on the front line to office-based staff.

We have created opportunities for all colleagues to share ideas, and to get involved in the project management and the delivery of innovation projects.

We have continued to enhance training and support opportunities for colleagues. This makes the experience of working on an innovation project an extremely fulfilling one, as well as increasing the likelihood of that project reaching completion.

Supporting project managers

Being a project manager on one of our innovation projects can be a tremendous career opportunity. It's a chance to manage a project with multiple stakeholders, strict budgets, ambitious timescales and many other challenges along the way.

To support project managers, we have developed a Project Management Tool – a means of tracking all the key elements of success, including finances, risks, dependencies and a broad range of internal and external stakeholder engagement.

"The tool brings uniformity to the way we deliver each project and provides colleagues with a roadmap for success."

"Anybody can become a project manager – the only requirement is to be a passionate and driven individual. Colleagues can have differing levels of project management experience, however, which is where this tool comes in."

Jarred Knott

Innovation Manager, Northern Gas Networks

With support and facilitation from our core innovation team, project managers lead monthly review sessions alongside collaborators, parties which jointly participate in the project. These are a great opportunity to review progress, remove roadblocks and capture lessons learned.

To ensure project managers receive appropriate support every project is supported by a senior sponsor. These are senior managers from within the business who can provide appropriate support, control and intervention should this be required.

Think Tank: stress-testing projects in a constructive environment

Our Innovation Think Tank is the monthly forum for colleagues from across the network to present potential new innovation projects. Each project is subject to rigorous, but constructive, scrutiny and debate, and then all members vote anonymously, on whether or not the project should be formally progressed.

These forums have grown in success over the past year, and their company-wide profile has increased too. We now publish the minutes of every meeting, so that all colleagues can see how decisions were reached.

We are in the process of recruiting an external stakeholder to become a member of Think Tank. This will bring even more credibility and focus to each monthly session and ensure the decisions we make internally truly reflect those of our stakeholders and help us to co-create solutions.

During the coronavirus lockdown, we utilised anonymous online voting during each video forum – bringing even more honesty and impartiality to the process.

"The Innovation Think Tank provides a forum for colleagues to inform decision making and collaborate on project proposals."

"Through the challenge and approval of proposed innovation projects, colleagues from all areas of the business are involved in decision-making and programme delivery. The forum ensures open discussion of project proposals and benefits, and constructive criticism along with anonymous voting, ensuring that collaborative engagement clearly drives decision making."

Jenny Wilkinson, Stakeholder Manager and core Think Tank member, Northern Gas Networks



Think tank



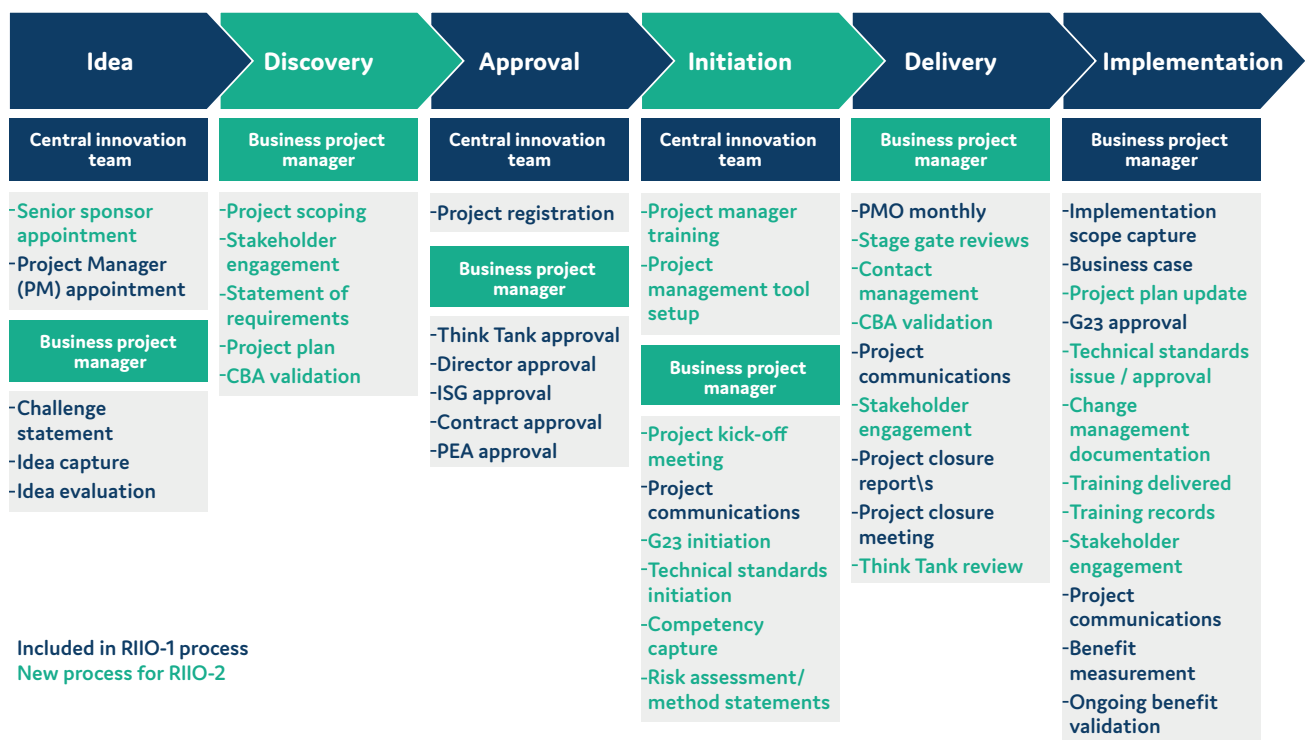
INNOVATION

Embedding our six-step approach

Last year we established a six-step process which acts as a roadmap for each innovation project.

The process is designed to reduce risk, improve likelihood of success and ensure that each project is delivered in a consistent way.

This process is now fully embedded across the business, and we will soon be introducing an online training portal to support project managers with each step.



3. A commercially-minded approach

NIA funding continues to be a tremendous enabler - allowing utilities to deliver bold and imaginative projects that would simply not have been possible otherwise. We pride ourselves on making the most of this allowance through delivering value-added innovations. We have capitalised on the 'use it or lose it' fund, using over 98% of it in 2019/2020.

However, we recognise the need to also use the NIA to leverage funding from other sources, including the supply chain. Monetary contributions, or 'in kind' contributions such as time, expertise and facilities, help to make projects more successful and even better value to our bill-paying customers.

Over the past 12 months, we've continued to pursue this commercially-focused mindset. We leveraged £800,000 of third-party funding across four projects, and in some cases, contributed nothing more than our time, expertise and network access to make projects happen.

Case study

Pooling resources to support biomethane producers

We are working with technology company Utonomy to make it easier for biomethane producers to get their product into our network and increasing the amount of green gas in our pipes.

During periods of low demand, biomethane producers can struggle to inject their gas, as there is no room on the network. This excess biomethane then has to be flared, resulting in lost income.

By remotely controlling gas pressure on our medium pressure network, we can create room for biomethane to be injected.

Utonomy is adapting existing remote-control technology, proven on the low-pressure network, for this new project.



"Our industry-leading track record of completing innovation projects at speed, resulting in market-ready products, has made us an attractive partner for third parties.

"Companies are more willing to contribute financially, when they feel confident of a clear and rapid route to market.

"We will continue to pursue this approach throughout the next regulatory period, using NIA funding as a catalyst – not just an end in itself."

Richard Hynes-Cooper

Head of Innovation, Northern Gas Networks

£800,000 of third party funding secured in 2019/20

The scheme is aligned to our future method of operation for innovation notably because it enables network innovation and does not require any funding from gas customers

"All the external funding for this project has come from Utonomy, who secured a grant from Innovate UK. We are making a commitment to this innovation and contributing our time, knowledge and access to our network. From Utonomy's perspective, this is a great opportunity to further develop a market-ready product.

"It's still early days for the project, but we have identified a site near York to conduct field trials, which we are hoping can begin later this year."

Liam Maclean

Planner, Northern Gas Networks

"We had already created a remote solution for the low pressure network, but we were getting lots of calls from the UK and international market to create a solution for the medium pressure network – where the challenges are even greater.

"Northern Gas Networks put their hands up to say they were keen to work with us, and it has been a great relationship so far. We're looking forward to working with them on field trials later in the year."

Claire-Elise Orleach

Head of Business Development, Utonomy



Case study

Making our pipe robot even smarter through joint funding

FACT FILE

Project name: LeakVision Smarter Networks Portal

Project Reference: NIA_NGN_256

Collaborators: Synovate

STASS (System Two Assess and Seal Solution), or more affectionately known on the patch as 'Stan', is a state-of-the-art robot that can travel down our pipes and show us what is happening beneath the surface.

The robot transmits live footage of a pipe's condition, as well as treating joints by applying a 'flex spray'. We began using STASS in January 2019, thanks to NIA funding, deploying it on an average of two jobs per week.

We have since begun working with collaborators Synthotech, through their sister company Synovate, to equip the robot with thermal imaging technology.

Adding this capability will enable the robot to detect the temperature change caused by flowing gas, and present this visually, allowing us to pinpoint leaks with even more accuracy.

This 23-month, £1.3 million project is being partly funded by Synovate, who are contributing 25% of the overall cost, with the remaining 75% of costs to be funded by NGN.

"The project involves a significant contribution from Synovate. By leveraging this third-party investment, we can continue to evolve a piece of technology that started life as an NIA project. This represents great value to the bill payer."

Richard Hynes-Cooper

Head of Innovation, Northern Gas Networks

"The STASS robot can detect the joints on a pipe and treat them with a special sealant – but it can't definitively show where the leak is occurring."

"By introducing thermal imaging technology, we can pinpoint the leak precisely. This will allow NGN to fix gas escapes even more quickly and efficiently, by tackling them from the inside out."

"We are very excited about the potential of this technology, which is why we are contributing significant funding to the project. It stands to be another game-changer for the industry."

Simon Langdale

Synovate



4. Industry-wide collaboration

To deliver great value to customers and meet the hugely complex challenges of a decarbonised economy, collaboration is essential.

We work closely with our fellow utility companies, industry bodies, government departments and academia – plus many other stakeholders – to share knowledge and pool resources and expertise.

Many of us face the same challenges. Working together makes us stronger than the sum of our parts.

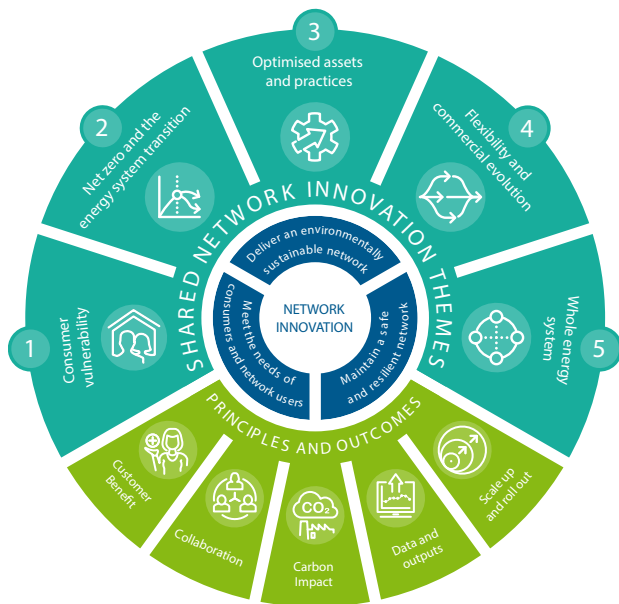
A shared innovation strategy

In 2018, we worked with the Energy Networks Association and our fellow UK gas distributors to develop a shared innovation strategy.

The Gas Network Innovation Strategy is designed to avoid duplication and increase collaboration among network companies, the supply chain and the wider energy sector.

A revised strategy was published in 2020. It contains a number of principles and themes to provide a shared strategic direction for all innovation project managers.

One area that we felt was missing from the original strategy, which has been addressed in the latest iteration, is the need for innovation projects to support vulnerable people.



Key themes now include:

Tackling customer vulnerability: supporting the needs of customers in vulnerable circumstances and making sure everyone can experience the benefits of energy transition.

Moving to net zero emissions: facilitating the UK's transition to net zero greenhouse gas emissions before 2050.

Optimising assets and practices: to deliver core services in an affordable and safe way, while minimising inconvenience to customers.

Supporting a whole system approach: enabling joined-up approaches across different aspects of the energy system.

Flexibility and commercial evolution: Developing and testing innovative solutions to increasing the flexibility, transparency and efficiency of the energy system, enabling information to be more open and networks to be more responsive to change.

Working closely with our supply chain

Without a close relationship with our supply chain, we couldn't hope to deliver so many ambitious and imaginative projects.

Over the past five years we have developed a strong partnership with the Energy Innovation Centre (EIC), a not-for-profit organisation which brings industry and innovators together. The organisation acts as a conduit to over 7,000 SMEs.

The process is simple. We inform the EIC about a particular challenge we are facing, or opportunity we have spotted, and they invite proposals from their member organisations.

The EIC also hosts innovation labs across our network – speaking to colleagues and teasing out issues – some of which lead to new projects.

In 2019/20, we had forecast to complete six projects with EIC members. We ended up doing ten, often working alongside other UK utility companies, including Northumbrian Water, Northern Powergrid and Yorkshire Water.

"2019/20 was another really productive year with Northern Gas Networks. We continued to develop great contacts among senior managers and staff working on the company's front line. These conversations gave rise to some very worthwhile projects."

"From a brand-new opportunity to look at reducing single use plastics, to a joint project with the other gas distributors focused on improving streetworks for pedestrians, these projects are extremely diverse."

"With access to 7,000 innovators, we can put briefs out to our members and be sure of getting imaginative, focused solutions."

Anthony Reid
Energy Innovation Centre

EIC
Collaborate to innovate

We completed 10 projects with the Energy Innovation Centre in 2019/20.

A shared experience through industry groups

Collaboration through recognised industry groups allows us to share knowledge, work together and avoid duplication of effort. These groups include:

The Energy Networks Association (ENA): hosts a gas innovation governance group which allows us to share learnings and ideas with other gas networks.

Gas Innovation Governance Group (GIGG): a monthly gathering of UK gas networks, providing an opportunity to share knowledge and opportunities for collaboration.

Cross Utility Innovation Group: a regular gathering of water, power and gas providers. Membership allows all members to widen their perspective beyond their own sector.

Hydrogen Programme Development Group (HPDG): this group includes BEIS and all the GDNs among its members and ensures coordination and knowledge sharing across UK hydrogen projects.

5. Our latest projects: a closer look

Over the next few pages, we take a closer look at some of our most recent Network Innovation Allowance (NIA) funded projects, with insights from NGN colleagues and our collaborators and NIC (Network Innovation Competition) projects.

In total this year we spent 98% of our NIA allowance.

Energy Systems Transition: Supporting the green revolution through hydrogen

In support of the Government's plan to transform the UK to a net zero carbon economy by 2050, we are reimagining the way gas networks will operate in the future.

Through our H21 programme, we are working on several projects to repurpose gas networks to transport hydrogen, instead of natural gas. When hydrogen is burnt, it produces heat and water – and nothing else – making it a clean, sustainable way of heating homes and businesses.

Through NIC and NIA funding over the past few years, we are proving viability of injection and blending of hydrogen into natural gas networks and providing evidence that long term conversion to hydrogen is technically and financially sustainable. This work continued in 2019/20, with projects embarking on an exciting new phase of real-world trials, made possible by additional £6.8 million Ofgem funding in 2019, to support research and development.

All of this work relies on collaboration and partnerships – with other GDNs, academia and the wider business community.



We also work collaboratively through the Hydrogen Programme Development Group (HPDG), which includes BEIS (Department for Business, Energy and Industrial Strategy) and all the gas distribution networks among its members. The group ensures coordination and knowledge sharing across UK hydrogen projects.

Case study

The road to a hydrogen future



To prove that hydrogen can be safely transported to customers' homes through the existing gas network, we are carrying out field trials in real-world conditions.

We have created a bespoke testing facility at RAF Spadeadam in Cumbria. The site is the size of a football field and comprises pipes of various sizes and pressures, plus above ground equipment, so we can simulate the entire network journey.

We have also identified a former council housing site in Redcar, North Yorkshire to conduct further real-world trials in 2021.



FACT FILE**Project name:** Hydrogen Field Trials**Smarter Networks Portal Project Reference:** NIA_NGN_225**Collaborators:** DNVGL, HSE SD

Project summary: The Spadeadam testing facility will allow us to assess how our existing network equipment behaves when hydrogen flows through it. Research into procedures led by HSE have been grouped into nine categories and will form the basis of the test plan. This will involve carrying out tests such as purging, flow stop operations and ignition.

We have also identified a disused site in South Bank in Redcar and Cleveland. The site was chosen because the gas pipes, while still intact, can be disconnected from the rest of the network.

As well as providing an opportunity to verify the testing from Spadeadam, we want to create a real-world environment at the South Bank site so that schools, the wider community and industry can learn more about hydrogen and its advantages.

"Hydrogen is lighter than natural gas, which means we need three times the volume to provide an equal amount of energy. We need to make sure that all our existing infrastructure and processes can still work as normal. For example, what will it mean when there is an unplanned interruption on the network? How will our existing pressure regulators and safety devices behave with hydrogen? Will pipes leak more because hydrogen is not as dense?"

"We will be carrying out extensive tests to explore all these issues under Phase 2 NIC (Network Innovation Competition). We also want to use the South Bank, site to help educate and inspire the public about the potential of hydrogen."

"After all the research, planning and desktop studies, the opportunity to test hydrogen in real-world conditions in this demonstrative phase of the project is very exciting. It brings the theory to life."

Neil Travers**Project Manager, Northern Gas Networks**

HyDeploy is a pioneering project to provide customers with a blend of 20% hydrogen and 80% natural gas.

The blend can be transported using the existing gas network, and there is no need for customers to change to domestic appliances – making this a cost effective and relatively simple first step towards a 100% hydrogen solution.

FACT FILE**Project name:** HyDeploy**Smarter Networks Portal Project Reference:** CADENT06**Partners:** Cadent Health and Safety Laboratory, Progressive Energy, ITM Power, Keele University

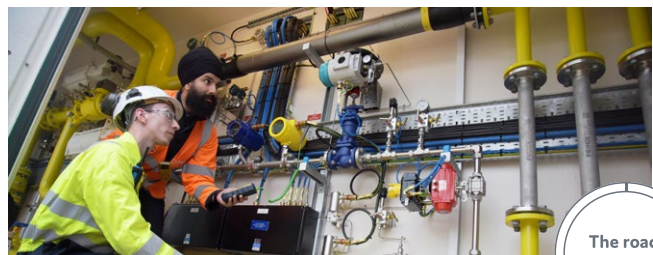
Project summary There are two phases to HyDeploy. The first, a live trial at Keele University began in late 2019. The blended gas is being delivered to 100 domestic properties and 30 businesses using the university's private network.

The second phase of HyDeploy will see two live field trials. The first will supply the hydrogen blend to 670 homes in NGN's network at Winlaton in the North East. In 2021, Cadent will undertake the second live field trial supplying a similar number of homes in the North West.

"The great advantage of HyDeploy is that customers don't need to make any changes to their appliances to take part in the trial. Customers have been finding that very reassuring."

"As networks, we also don't need to make big changes, as we are utilising the existing gas pipes. That means no excavations in the street."

"We see HyDeploy as an important stepping-stone to the ultimate creation of a 100% hydrogen network."

Adam Madgett**HyDeploy Project Manager, Northern Gas Networks**

The road to hydrogen

Case study

Supplying a natural gas/hydrogen blend to customers

The road to hydrogen



Case study

Hydrogen demand forecasting

Patterns of supply and demand are changing significantly across both gas and electricity networks, as new, sustainable forms of energy and technologies emerge.

To predict how the demand picture will look in the decades to come, the UK gas distribution networks collaborated on a series of studies to scope possible outcomes up to 2050.

The third and final phase of this work focused on hydrogen – with each gas distributor supplying information on current and future hydrogen projects to inform the study..

FACT FILE

Project name: Gas Demand Forecast - Phase 3 - Hydrogen Smarter Networks Portal Project Reference

Partners: Cadent, SGN, Delta Energy and Environment.

Project findings: The report concluded that by 2050 there will be a considerable shift to hydrogen for use in heating buildings and the industrial sector.

To make predictions, the project assessed the suitability of regional industry for hydrogen conversion, the current level of hydrogen activities in different parts of the UK, trials and the potential uptake timing.

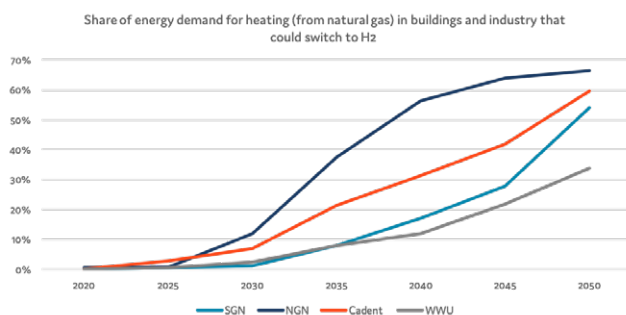
The study found that NGN's region will potentially see the highest deployment of hydrogen - 12% for buildings and industry by 2030, 56% by 2040 and 66% by 2050.

By 2050, we expect to see nearly 60% of total of energy demand for heating in buildings and industry provided by hydrogen. The expectation is that carbon emissions could fall between 60-80%, dependent on the type of hydrogen production.

"This project highlights that from around 2030, NGN will see an increase in the share of energy demand switching to hydrogen for buildings and industry. Our region could ultimately be the biggest user of hydrogen in the UK.

"The sector is developing very quickly, demonstrating the high level of ambition and success that NGN has had in pushing the hydrogen agenda. The H21 North of England project sets out how our network will be an important first mover in producing hydrogen hubs and there is an expectation that buildings and industry in the North East will see the earliest shift to full H2 conversion."

Emma Buckton
Planning and Capacity Manager
Northern Gas Networks



Case study

Planning the hydrogen cities of the future



Our original H21 - Leeds City Gate project, which concluded in 2017, was a detailed study which looked at the economic and technical feasibility of converting the city of Leeds into an all-hydrogen city.

Since then, a further 11 hydrogen conversion studies, in different parts of the UK, have been taking place.

These studies have adapted the methodology of our original Leeds study, to provide a much wider understanding of the UK's path to a hydrogen future – helping to inform future Government decision-making.

FACT FILE

Project name: Strategic Modelling, Major Urban Centres Smarter Networks Portal Project Reference: NIA_NGN_204

Partners: Cadent, SGN, Wales & West Utilities.

Progress: Analysis of a further three urban areas within Northern Gas Networks patch have been carried out, including Tyneside. Across the rest of the UK, studies have been completed in Bristol, Cardiff, Bournemouth, Edinburgh, Liverpool and Manchester.

A final report will be released later in 2020, which will contain detailed information about costings, timescales and technical requirements for the conversion of each urban area.

Case study

Hydrogen deblending

Project name: Hydrogen Deblending in the GB Gas Network Smarter Networks Portal Project Reference: NIA_NGGO156

Collaborators: National Grid Gas Transmission, Cadent, Northern Gas Networks, SGN and Wales & West Utilities

The success of a future 100% hydrogen network is partly dependent on the ability of UK networks to transport and store hydrogen cost-effectively.

One possible solution is to use the high-pressure gas transmission network to transport a blend of hydrogen and methane.

The two gases would then be deblended at offtake sites, before being transported separately on the low-pressure network to homes and businesses.

The project intends to evaluate, develop and demonstrate the concept of implementing hydrogen blending and point-of-use separation or deblending.

"To get hydrogen to homes and businesses in a cost-effective way, a possible solution is to use the gas transmission and distribution networks to transport a blend of hydrogen and natural gas - and then separate or 'deblend' the two gases, so that they can then be distributed locally. This would avoid the need to build a new hydrogen transmission system. The feasibility study includes an assessment of regional operating data of the transmission and distribution networks, and evaluation of separation technology from a technical and economic perspective."

Mark Danter

H21 Senior Strategy Manager, Northern Gas Networks

Intelligent pipes and the network of the future

We are working on two cutting-edge technology projects with the potential to transform our network into a smart network – one where our pipes can 'talk' to us, providing crucial data to inform decision-making.

The advent of low-cost, low maintenance Internet of Things (IoT) technology, is making this revolution possible.

Case study

Low cost pressure sensors: giving our pipes intelligence



CATAPULT
Digital

Working with a specialist technology partner, we are developing a low-cost sensor, which will allow us to monitor gas pressure remotely.

The sensor will be integrated into existing pipe components – providing data at a granular level.

Although this project is focused on gas pressures, there is future potential for the sensor to gather other crucial data, such as moisture levels and temperature.

FACT FILE

Project name: Printable pressure sensors

Smarter Networks Portal Project Reference: NIA_NGN_239

Supplier: HP1 Technologies Limited

Project Summary: Creation of a versatile, low cost pressure sensor which can be integrated into existing pipe components, to monitor gas pressure.

With a low unit cost of approximately £100 and a long battery life, there is an opportunity for these sensors to be installed throughout the network, transforming our infrastructure into a 21st century smart gas grid.

The project will develop a working prototype, which will be tested on our low-pressure network.

Benefits: The sensor will make it quicker, easier and cheaper to identify any problems on the network, such as gas escapes. In time, the data generated can be used to create predictive maintenance programmes – helping us to deliver a more reliable and cost-effective service.

The sensor technology can be adapted to measure different types of data, such as temperature and moisture levels, providing a comprehensive picture of network performance.

There is also scope for the sensors to be used in other utility sectors, including the water industry.

Status: In development

"We can already monitor gas pressure remotely, using current generation data loggers, but this new technology gives us the opportunity to do so on a much wider scale, at a fraction of the cost. As the UK's gas infrastructure becomes increasingly complex, with new forms of green gas emerging and closer integration with other energy networks, we will need large volumes of data to make the right decisions. The ability to integrate the sensors into our plastic pipes, so that pipe components come off the production line with a smart element already built-in, is especially exciting."

Keith Owen

**Head of Systems Development and Energy Strategy
Northern Gas Networks**

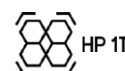
"Our original sensor system was developed four years ago after a colleague suffered a head injury following a cycling accident. We integrated a low-cost sensor into the helmet – creating a 'black box' for cyclists."

"Working with Northern Gas Networks to adapt this technology for the utilities sector is the realisation of the vision we had four years ago."

"We are well into the development stage and are looking forward to trailing the sensor beneath the streets of the North of England."

Mike Howes

HP1 Technologies



Case study

Universal IoT Monitoring


CATAPULT
Digital

Water ingress is a perennial problem for gas networks.

When water finds its way into the network, it can cause low pressure and even loss of supply for customers. To tackle this, we use water syphons on low-lying parts of the network, to collect water and prevent it from interrupting supply.

Following an innovation challenge with Digital Catapult North East, we have partnered with Internet of Things (IoT) experts, Invisible Systems, to create a next generation water syphon monitoring device.

The remote device will alert us when the pressure changes within syphons – indicating the presence of water.

There is enormous potential for this device to be applied to other aspects of our work, too, and to be utilised by the electricity and water sectors.

FACT FILE

Project name: Universal IoT Monitoring

Smarter Networks Portal Project Reference: NIA_NGN_260

Collaborators: Invisible Systems Limited

Project Summary: Creation of a universal monitoring device which will be used on water syphons in the first instance – with scope for a range of wider applications in the future.

The device will monitor pressure changes in the syphon and communicate this information through a smart IoT hub.

The scope of the project will include the design, creation and testing of the device.

Benefits: The monitoring device will provide real-time information on the status of syphons – allowing us to intervene in a timely manner to empty syphons or respond

to potential network issues.

It will reduce costs and carbon emissions, by avoiding unnecessary reactive journeys to site, and allow us to use data to drive proactive evidence-based action.

The monitoring device will be small and affordable with extended battery life, making scaling opportunities across the network possible.

Status: In development

"With a small battery, very low power requirements and the ability to transmit data via Narrowband IoT, this new device will be far more advanced than the current generation of data loggers.

"An affordable unit cost will make it possible to implement the device at scale – presenting exciting opportunities for gas distributors, and the wider utilities sector.

"Northern Gas Networks shares our vision for the product. We have a fantastic opportunity to prove the technology on NGN water syphons, before looking at wider applications across other sectors. From detecting leaks on water pipes, to alerting an electricity distributor when a power line goes down, there is enormous potential.

"By proactively highlighting potential network issues with precision, we can help companies like NGN work more efficiently, save money and reduce both carbon footprint and customer impact."

Pete Thompson

CEO

Invisible Systems Ltd.

invisible systems

Case study

A nose for efficiency: monitoring gas odorant

An odorant is added to natural gas before it is piped to customers' homes. This familiar gas smell helps alert customers to potential gas escapes and issues with appliances.

To ensure the odorant is being added at the right quantity, and is detectable, we rely on trained rhinologists to carry out tests out on the network.

The process is far from perfect, however, as it only provides a snapshot in time. We are developing a new automated system that can monitor odorant levels around the clock, using a process called optical spectroscopy.

FACT FILE

Project name: Rhino OLM

Smarter Networks Portal Project Reference: NIA_NGN_255

Supplier: Camlin Group

Project summary: Optical spectroscopy uses light rays to detect compounds within a gas and is already a proven technique for industrial gas sensing.

By applying the process to the domestic gas network, we can provide extremely accurate, 24-hour monitoring of odorant levels, to ensure compliance with regulatory standards.

Devices containing the optical spectroscopy equipment will be tested on the network in real world conditions, with the results automatically made available to NGN through computer software.

looking
after our
network more
efficiently

Current status: In development.

Benefits: Provides accurate, 24-hour monitoring of gas odorant, to ensure compliance with regulatory standards and keep our customer safe. The pilot will adapt proven technology, increasing likelihood of success.

It has the potential to deliver considerable cost savings over time, by preventing the need for rhinologists spot checks. It can also ensure easier, safer and consistent access for biomethane producers to inject into networks.

"We currently use trained rhinologists to carry out spot checks on the network. These specialists sample the gas and assign it an odour score.

"Unfortunately, this only provides us with a snapshot in time. If odorant levels were to change the day after an inspection, we would be none the wiser.

"Rhino OLM (Online Line Monitoring) will give us 24-hour assurance that the right levels of odorant are going into the network and provide a consistent level of security and automation.

"Importantly, it will also highlight the presence of any masking agents, such as terpenes, which may be affecting the odorant. This can be an issue with biomethane.

"If successful, this trial will give us the option to install monitoring devices at strategic locations across the network, giving us a continuous picture of odorant levels at current and future biomethane injection sites."

Luke Warner

Asset Integrity Engineer, Northern Gas Networks

"We have already developed a system to measure contaminates in biogas, called Biospec, and will be using this as the basis for the new product we are developing with Northern Gas Networks.

"The project will result in a robust and reliable online monitoring device that will provide continuous measurements of both the odorants and masking agents.

"Optical spectroscopy solutions can be extremely straightforward to use and retain reliability throughout their lifetime, with low maintenance costs – making them ideal for gas distribution networks.

We hope that the final product will become widely used in the industry, both in the UK and overseas."

Ian Hunter,

Camlin Group



Case study

A scheme for more accurate network plans

Schematics – simplified maps of the gas distribution network – provide an essential guide for gas engineers carrying out work below ground.

Historically, these maps have been created on paper using CAD software and need to be updated every time the network changes. This process is time consuming, expensive and sometimes unreliable – as not all network changes get reported, and the design of schematics can vary across operational areas.

Working with collaborators 1 Spatial, we are creating a software system that will automatically generate schematics, based on latest geographical data. This will ensure they are always reliable and up to date and take the legwork out of making them.

FACT FILE

Project name: Schematics Phase 2

Smarter Networks Portal Project Reference: NIA_NGN_245

Supplier: 1 Spatial

Project summary: Build a prototype system that will automatically create schematics in PDF form, using GIS data.

The schematics will be generated using a rules-based process, resulting in maps that are uniform in design, and reflect latest changes to the network.

Benefits: Accurate schematics will reduce risk, by ensuring our engineers have access to latest data about key underground assets.

The ability to generate schematics automatically, as our network changes, will remove considerable time and expense, as well as ensuring greater accuracy.

Status: Project is set to complete in summer 2020.

"Schematics are rather like the London Tube map. They show key information about the network, but in a stylised way that is not intended to be geographically accurate.

"It's not unusual in the gas industry for engineers to have their own annotated schematics of the local network – a single, well used hard copy that they rely on. The knowledge resides with them – but isn't shared across the business.

"This obviously isn't an ideal situation if that engineer retires and takes all that local knowledge with them.

"This project will use the GIS data that we are constantly gathering whenever there is a change to the network, to automatically create schematics – making the information available to all.

"The process will work behind the scenes and won't require manual input from CAD software specialists. This will allow us to save time and money, as well as improve accuracy."

Peter Crosier, Data and Information Centre of Excellence, Northern Gas Networks

"Schematics are a very complex type of artefact to generate, especially with any degree of automation.

"We have developed a rules-based process that will automatically generate PDF schematics for the network.

"The project is now at an advanced stage of development, with a number of sets of schematic drawings now generated quickly and efficiently."

Mark Droney, 1Spatial



Case study

Looking after our colleagues

If not properly managed, exposure to noise and vibrations can lead to long-term health conditions for engineers. These problems can include industrial deafness and HAVS (Hand Arm Vibration Syndrome).

To prevent this, we've been working with collaborators j3llyh34d 1ndu5tr135 limited, to develop a wearable health and safety monitor packed with sophisticated sensor technology.

Worn like a wristwatch, it records real-time data by logging exposure to noise and vibration, while measuring body heat. Early testing with engineers delivered impressive results and the monitor is now being refined, in response to colleague feedback.

FACT FILE

Project name: Health and Safety Monitor Phase 2

Smarter Networks Portal Project Reference: NIA_NGN_250

Supplier: j3llyh34d 1ndu5tr135 limited

Project summary: The project will further develop the wearable health and safety monitor for engineers, originally developed in through NIA funding 2017/18 (NIA_NGN_190).

The improved design will incorporate suggestions from our emergency response engineers, following field trials in the North East of England.

The central platform which gathers and displays the data from each device will also be simplified, with a dashboard system to provide 'at a glance' exposure results.

Benefits: A wearable device which can accurately monitor exposure to noise and vibrations that can help prevent long-term ill health issues for our colleagues – ensuring quality of life.

From a business perspective, the device will enable proactive intervention and protect the workforce to reduce absences from work, prevent injury leading to compensation payments and demonstrate compliance with health and safety legislation.

Status: Field trials of the original design have been completed, and users' comments fed back to develop and improved revised design. This refined version will be tested in the field in 2020/21.

"We tested the original Phase 1 monitor design with a team of 20 engineers in the North East. We deliberately chose emergency engineers – as their work is reactive which can frequently involve the use of hand digging tools.

"The feedback from the engineers was very useful. One of the most common requests was that the device tells the time – as engineers didn't want to wear both the monitor and a separate watch.

"They also asked for it to be made less bulky, the charging time improved and for the strap to be more comfortable.

"We are also looking forward to the creation of a results dashboard, which uses a traffic lights system – so we can see at a glance engineers' level of exposure to noise and vibrations.

"The improved design will be tested with the same team of engineers later in the year."

Derek Field, Health, Safety and Environment Assurance Manager, Northern Gas Networks

"It shall be the duty of every employer to ensure, so far as is reasonably practicable, the health, safety and welfare at work of all his employees."

UK Health and Safety Act, 1974

Case study

Getting smarter about streetworks


 Supporting vulnerable customers

Streetworks and the signs, barriers and lighting they require, can pose significant challenges to pedestrians. Customers with mobility issues, or with pushchairs and prams, for example, can often find them difficult to navigate.

We are working with members of the public, and creating a risk assessment for streetworks, so that common obstacles to the travelling public can be avoided when setting up sites, leading to an improved customer experience.

FACT FILE

Project name: Street Score

Smarter Networks Portal Project Reference: NIA_NGN_254

Supplier: Steer Energy, Wales & West Utilities, SGN

Project summary: Create a universal risk assessment for streetworks, to avoid or mitigate common impediments to the travelling public, with an emphasis on pedestrians.

The project will establish a working group of customers, including those on the Priority Services Register, to assess common issues at sites, and give each of these a risk score.

It is hoped that the resulting risk assessment can be adopted widely within the utilities sector and beyond, leading to a better and consistent customer experience.

Current status: In development

Benefits: An opportunity to create a universally adopted risk score for streetworks, resulting in sites that are safer and easier to navigate for customers.

"There are already strict standards around signing, lighting and guarding – but in practice, there is still more we could be doing."

"This project was inspired by an earlier pilot scheme by Wales & West Utilities, which looked at walk boards, and the difficulties they can pose to pedestrians, wheelchair users and parents with pushchairs."

"We want to expand on that project, by exploring other aspects of worksites that can cause difficulties, such as narrow passages, cluttered signage and hard-to-spot entrances."

"We are hoping that the resulting consistently-applied risk assessment can be widely adopted, to improve the customer experience, reduce complaints and make life a bit easier for people – especially for those with limited mobility."

Steve Dacre

**Customer Experience Development Manager
Northern Gas Networks**

"At best, streetworks can be an inconvenience. At worst, they can prevent people from going about their normal daily routines."

"By assembling a user group, including those on the Priority Service Register (PSR), we aim to get the insights we need to create a list of common challenges, and develop a scoring matrix for each."

"It is essential that the project has user engagement across all stages, to ensure sound concepts and rigorous testing."

"While it may be impractical to remove all challenges from work sites, it is hoped that significant reductions can be made."

Ian Chirnside
Steer Energy



To find out more about the PSR visit: northerngasnetworks.co.uk/network-supply/priority-customers



Case study

Fewer supply interruptions
are in the bag

Project complete

Making life
easier for
customers

FACT FILE

Project name: Project Zero**Smarter Networks Portal Project Reference** NIA_NGN_238**Collaborative Collaborators:** Synthotech

We carry out lots of daily operations that require us to switch off a customer's gas supply – including replacing old Emergency Control Valves (ECVs) and sending cameras down pipes to conduct surveys.

To keep the gas flowing, even while this work takes place, we have developed an encapsulation bag, which can be fitted over a pipe valve, forming a pressurised seal.

Gas continues to flow within the reinforced plastic, avoiding the need to switch off the gas supply.

The project has been successfully completed, and the trial results have been evaluated by the business and we are now planning roll-out into business as usual.

The device can be used in lots of different scenarios, including replacing old ECVs, replacing Service Isolation Valves (which control the flow of gas to high-rise buildings) and when sending cameras down pipes for surveys.

Its versatility stands to deliver major cost and time savings while avoiding the need to interrupt customers' gas supplies.

"The ability to exchange, or install, components without turning a customer's gas supply off is game changing. The concept could prove especially useful during the Covid 19 pandemic – to help reduce the need for customer interaction."

"Managing both projects has enabled me to see my own progression from a First Call engineer to Project Manager and use the skills this opportunity has provided to develop who I am and further my responsibilities within NGN."

Tom MacPherson**Rapid Response Engineer, Northern Gas Networks**

Case study

Traffic management plans
at the click of a button

Project complete

Making life
easier for
customers

FACT FILE

Project name: Smart SLG Phase 2**Smarter Networks Portal Project Reference** NIA_NGN_246**Collaborative Collaborators:** 1Spatial, Leeds City Council

Streetworks, and the impact on the road networks are a regular source of frustration to motorists and communities – but their impact can be lessened by well-planned schemes which are sensitive to local conditions.

Advances in computer coding and rules engines mean it is now possible to generate automated traffic plans, in-house, which are optimised for customer convenience.

We have developed a software programme that can produce automated traffic management plans, on a scheme-by-scheme basis, to be shared with local authorities and other key stakeholders.

A wide range of criteria can be used to generate each plan, including location of the works, proximity to local homes, businesses and schools, traffic flow data and compliance with industry rules and regulations.

The NIA-funded project has now been completed, and we have progressed to the implementation phase.

"The ability for our own designers, planners and engineers to generate traffic management plans, at the click of a button, is revolutionary."

"It will deliver efficiencies on the design element on every traffic management scheme we create, and ensure that our key stakeholders, such as local authorities, have quick and easy access to plans for sign-off."

"Most importantly, however, it will make our schemes even more customer-focused as it places the road network as a primary input factor."

Gareth Thomas**Project Manager, Northern Gas Networks**

Case study

The road to gas-powered vehicles

Our vehicle fleet is one of our biggest sources of carbon emissions, as it is predominantly made up of diesel vehicles.

As part of our efforts to become a net zero carbon business, we are exploring the feasibility of converting our fleet to Compressed Natural Gas (CNG).

To better understand the benefits and practicalities, we have commissioned a detailed piece of research, which includes a simulation of fleet activity.

FACT FILE

Project name: Vehicle Transition – CNG

Smarter Networks Portal Project Reference: NIA_NGN_258

Partners: Frazer Nash

Project Summary: The study will examine a wide range of factors to determine if conversion to CNG is cost effective and practically viable.

It will look at the environmental benefits of CNG compared with other fuels, the options for connecting CNG refuelling infrastructure to the gas network and the costs involved.

The project will also simulate fleet activity to see if conversion to CNG would present any practical challenges for our engineers – such as refuelling. Once we have modelled the NGN fleet we can work with other fleet operators to model theirs also to come up with common network areas that could be potential sources of CNG refuelling to help widen the market.

"We already have a huge amount of data about our journeys and driver behaviour through Green Road – an in-vehicle software solution that we have been using for a number of years.

"We are sharing data to Frazer Nash's simulation – to see how CNG vehicles could be integrated into the day-to-day work of our front-line teams.

"Bradford has been chosen as the area for the simulation, as City of Bradford Metropolitan District Council has already expressed an interest in CNG for its own larger vehicles.

"As well as helping NGN understand the business case for CNG, there is lots of scope for this simulation to be used across other sectors."

David Gill

**Head of Customer Energy Solutions,
Northern Gas Networks**

Case study

No longer stumped by stubs

FACT FILE

Project name: Tier 2 Foam bags

Smarter Networks Portal Project Reference: NIA_NGN_192

Collaborators: Steve Vick International

A technique to cap off small diameter gas pipes without leaving a short stub of live pipe was introduced to the network in 2015, following a successful NIA project (NIA_NGN_088).

Building upon the knowledge and successes gained from this development we undertook further research to apply to larger pipe diameters, and in turn deliver even more benefits.

The technique sees a foam bag inserted into the pipe, often from non-sensitive and minimal disruptive locations, preventing the need to dig up these stubs which can cause great impact on road users and customers of the local areas.

These adaptations and advancements to tried and tested commercial proven techniques are saving an average of £30,000 per job on Tier 2 pipes.

Benefits:

Not only does this avoid the need to dig up stubs, it reduces public inconvenience and delivers cost savings of £30,000 per job.

"The technique allows us to seal the entire stub and can be carried out remotely from a less sensitive part of the highway.

"It helps remove gas engineers and operatives from potentially dangerous environments, such as deep excavations and busy highways, reduces excavation size and lessens the overall environmental impact of each site. The system also reduces the need for traffic management and improves the safety to the public by removing excavations from busy traffic routes."

Rich Ditte

**Senior Development Manager,
Steve Vick International**



6. Going beyond NIA funding

Alongside NIA funding, we use our own TOTEX (Total Expenditure) allowance, time and resources, to develop products and techniques which can deliver customer benefits and cost-savings.

These projects are often the result of an earlier NIA-funded project, delivered by NGN or energy distribution network

Here are some recent examples:

Preventing road scarring with spoil boards

Spoil boards are rubber mats which can be laid on the ground during streetworks, to protect road and pavement surfaces from excavated spoil.

Traditionally, the industry uses Visqueen for this purpose – a plastic sheet which is thrown away after every use. Visqueen often leads to damage of road surfaces, kills grass by sweating it, and is classed as contaminated waste when taken to landfill.

The spoil boards, on the other hand, last three years and avoid damage to grass, roads and paving.

Benefits:

- Potential to save more than £153,000 in the first year of use alone, with subsequent savings of at least £100,000 per annum.
- Environmentally friendly solution.
- Avoids customer complaints by protecting street surfaces and grass.
- Quick and easy to use and saves time on jobs.



"The spoil boards project was as basic as it comes. We trialled the use of 60cm x 120cm rubber mats to lay spoil on when excavating. While the project may not sound as exciting as some of the other projects we have done, the results and subsequent benefits have been widely welcomed. The boards were initially only expected to protect the surface underneath from scarring and staining. However, once we started to use them, we discovered that they are also easier to shovel off, making reinstatements faster. We also found the boards do not 'sweat' grass, meaning we can avoid customer complaints and finally, they can be laid over drains, preventing spoil from going in while allowing water to drain away."

Michael Charlton
Innovation Implementation Manager,
Northern Gas Networks

Flexible pipe avoids digging outside customers' properties



ServiFlex is an industry-standard PE pipe, originally developed by Radius Systems for SGN. We have adopted a 40mm version of the product, which can be inserted inside two-inch steel service pipes outside customers' homes.

By avoiding the need to relay the original pipe, jobs can be completed at a lower cost and quickly, with less disruption to customers. It also avoids the need to move the location of customers' gas meters.

Following successful trials, 40mm ServiFlex is now used regularly on the network.

We have invested in 132 kits to date, saving over £122k.

Benefits

- Minimises customer disruption.
- Quick and efficient to install.
- Saves £926 per job.

Case study

Creating a joint utilities map

Making sure utility companies have reliable maps of what is below the street surface is crucial to keep colleagues safe and deliver jobs efficiently.

Last year, we worked with our water, electricity and telecoms collaborators, as well as local authorities and Ordnance Survey, to share asset data and create a combined underground infrastructure map.

What began as a small, initial pilot project has rapidly expanded. We now have a shared digital map of the North East underworld, covering an area from Berwick upon Tweed down to Middlesbrough.

We are also supporting work to develop a national underground asset register – a project that will be funded by the Geospatial Commission.



**Geospatial
Commission**

"This project is a great example of collaboration between different organisations. It's also significant that all this has been achieved without NIA funding, with companies simply contributing time and resources."

Shannon Telfer

Innovation Manager, Northern Gas Networks

"For the last 20 years, people have been talking about why a single map would be such a great idea, and although many have tried, until now nobody has managed to produce such a functional and valuable system."

"So many of the key players have all signed up to and shared data and so, as a result, we've have one, single view of the very complicated underworld."

Heidi Mottram

CEO, Northumbrian Water

**NORTHUMBRIAN
WATER** *living water*



Preparing for the next regulatory period

Close relationships with partners, an internal culture of innovation and a commercially minded approach to the development of new projects places us in a strong position as we enter the next regulatory period.

Our RIIO-2 plan includes £24 million of efficiency savings. Innovation will be key to achieving these savings, through modernisation of processes, techniques and systems.

For the 2021-2026 period (known as RIIO-2) we are set to increase our innovation spend by 35%, but have asked our regulator, Ofgem, for less funding than in RIIO-1.

We will achieve this by leveraging around £6 million of matched funding through contributions from the broad range of other funding sources, such as Innovate UK grants and academia.

Key principles which will underpin our approach in RIIO-2 include:

Leveraging additional funding from our supply chain and other sources: to deliver projects which provide even better value to our bill payers.

Fast-tracking 'no brainer' innovations: which can deliver immediate benefits to our customers and stakeholders.

Expanding colleague training: with an online training portal to help colleagues successfully manage projects with key support from the Innovation team.

Greater use of automation and robotics: to reduce disruption, cost, time and environmental impact.

Using real-time data: to make evidence-based decisions and work more efficiently. We will make use of emerging Internet of Things (IoT) technology to make our network smarter, and will build on our recent investment in a SAP 4 HANA solution to make it easier for colleagues, customers and stakeholders to access the data they need.

Even closer collaboration: with our fellow GDNs and stakeholders, to address the big challenges facing gas distributors and the wider energy industry. This will include setting up a forum for innovation conversations and sharing our data.



7. Meet our team

Our core innovation team helps keep NGN at the cutting edge.

The team looks after the overall management of our Network Innovation Allowance (NIA) and key business funded innovation projects, sets our strategic direction and identifies new opportunities and partnerships.

Team members also provide support and training for colleagues who take on the project management of innovation projects.

Anyone in the business who is involved in innovation is treated as part of the team, so in fact, we are hundreds strong!



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**we are
the network**