

Gas Transmission

**Network
Innovation
Allowance**

Annual Summary 2015/16



Welcome to our annual summary for 2015/16

Our innovation programme continued to break fresh ground in 2015/16, as we work towards minimising costs for customers, ensuring security of supply, reducing carbon emissions and setting even higher standards of safety. Our project portfolio demonstrates an approach based on collaborating with experts, sharing lessons learned and delivering maximum value.

In the past 12 months, we've made good progress across our five strategic areas for innovation: safety, sustainability, financial, customer and stakeholder, and reliability and availability.

These five areas are designed to address the main challenges currently facing the gas transmission network, such as the growing need for more flexible operations, the management of ageing assets, the changing needs of stakeholders, and the delivery of more affordable and sustainable gas transmission over the long-term.

Underpinning all our work is a partnership approach: one characterised by sharing best practice, striving for continual improvement and generating tangible benefits. In this respect, we've continued to foster strong, productive relationships with many specialist organisations over the past year, harnessing a wealth of skills and expertise across a diverse range of projects.

Many of these collaborations are now starting to come to fruition. In our meter validation application project, we've worked with licensed networks and other directly-connected customers to create a digital tool that gives stakeholders improved access to meter information, plus the ability to carry out analysis in real-time.

Elsewhere, Project GRAID (Gas Robotic Agile Inspection Device) is a partnership that's developing a revolutionary approach to managing the condition of pipework at our high-pressure gas

installations. Through this innovative robotic system, we will be able to generate meaningful intelligence about our assets so we can maintain them more efficiently.

Already delivering savings is our Building Information Modelling work, which uses 3D laser scanning technology to design, build and manage construction projects, delivering access, construction, operation, cost and safety benefits before site work even commences.

Such projects have delivered additional advantages in terms of valuable new insights and lessons learned. We've been very proactive at sharing these with our peers, most notably at events like the Low Carbon Networks and Innovation Conference in Liverpool, and also through initiatives like the Gas Innovation Governance Group, where we're working effectively with other network licensees to spread innovation knowledge.

As you'll see from this report, our innovation strategy covers a broad spectrum of transmission areas. Our ambition for the next 12 months is to build on the positive outcomes delivered so far and make them business-as-usual, helping create more reliable, efficient and safer gas transmission long into the future.

Nicola Shaw
Executive Director, UK
National Grid



“Our ambition for the next 12 months is to build on the positive outcomes delivered so far and make them business-as-usual”

The blueprint for better innovation

It's our goal to be known as the world's leading gas transmission business and this is underpinned by five areas of focus – safety, sustainability, financial, customer and stakeholder, and finally, reliability and availability. Our innovation portfolio, which contains 44 NIA projects, is designed to deliver benefits across this strategic spectrum.

£ Financial

Striving for a strong financial performance and delivering maximum value for our customers.

Creating sustainable returns for our stakeholders is at the heart of our business. Our best opportunity to exceed financial expectations is by delivering compressor replacement and work connected to the health of our assets in the most efficient way possible.

In the longer term, our ability to deliver pipeline projects at significantly lower cost is also essential. Our **BIM (Building Information Modelling)** project, pictured, strongly supports these aims. It delivers substantial cost savings throughout the design, build and ongoing management of construction projects. Sixteen of our gas projects are already using BIM and it promises cost savings of up to 20% over any asset's lifetime.



🔧 Reliability and availability

Maintaining and managing our assets in an intelligent way to minimise disruption and save on costs and carbon.

We need to manage our assets efficiently to provide customers with the reliable supply of gas they need for their homes and businesses. We're committed to investigating new techniques to meet a growing need for flexible operation of the network, while effectively managing our ageing asset base.

Project GRAID (Gas Robotic Agile Inspection Device), pictured below, continues to be a major project in this area. The new generation of robot that we're developing will allow us to manage our high-pressure pipelines in a more intelligent, risk-based way, saving consumers c.£60m and 2,000 tonnes of carbon a year. We've also been exploring a new, non-invasive survey technique in our **Stress Concentration Tomography (SCT) Pipeline Inspection System** project, which can help us identify defects in pipes that we can't inspect with standard internal methods.



2,000
tonnes of
carbon will
be saved
a year
through
GRAID

20%
costs
could be
saved
across an
asset's
lifetime
using BIM

Safety

Keeping people safe is our main priority, whether that's our own people, contractors or the public.

Damage to the network by third parties continues to be the biggest threat to safety and we're continually seeking innovative solutions to reduce risk.

Through Wireless Gas Detection Assessment, we're exploring the possibility of using wireless gas detection in Gas Transmission compressor cabs. Traditional wired gas detectors can place constraints on where gas detectors can be located, due to material, design and installation costs. With a number of existing installations becoming obsolete and new standards requiring at least one gas detector located in a ventilation outlet, this is also an opportunity to innovate.

Our Removable Composite Transition Pieces (CTP) project, pictured, also promises significant safety and cost benefits. We've developed a plastic seal that makes it safer, easier and cheaper to inspect and repair failed seals on gas pipes exiting concrete walls. It will significantly improve safety and could save up to £5m in the next five to ten years.



Customer and stakeholder

Focusing on the needs of our customers and stakeholders to drive forward our commercial success.

We're committed to working closely with customers and stakeholders to ensure the work we do reflects their needs and priorities, now and in the future. A key customer-focused project is National Transmission System (NTS) Constraint Modelling. We're using the latest statistical methods and algorithms to improve our forecasting of certain capacity constraints. By having more robust information, we'll be able to avoid certain capacity scenarios that impact on the service we provide to our customers and which can result in financial penalties.

Sustainability

Building a brighter future for all by embedding sustainable practices in everything we do.

We're committed to making the most of the resources we use, while reducing our environmental impact. In our Renewable Power on Remote Installations project, pictured below, we investigated the possibility of powering our block valve sites, which have no grid connection, solely with renewable power.

We have several hundred of these on the NTS, each requiring staff to visit the site when we need to turn off a valve. Our solution is the renewable kiosk. It's powered by solar, wind and a certain amount of battery power, eliminating the need to bring expensive power connections on sites, and allowing technicians to close valves remotely.



Project: Gas Robotic Agile Inspection Device (GRAID)

Gathering reliable data about our assets

Project GRAID, one of our most significant innovations, gathered real momentum this year. This new generation of robot will revolutionise how we manage our assets – and we're well on our way to making it a reality.

Major progress was made in the development of our GRAID robot this year. Once complete, it will give us hard, reliable data on the condition of pipework at our high-pressure gas installations, allowing us to manage, maintain and replace them more efficiently.

The main focus in the first part of the year was the first project milestone, called solution development. We completed this in October and learned a huge amount along the way. With the support of project partners Synthotech Ltd, we produced three conceptual designs for the robot and selected a preferred option to take forward into stage two, where we're continuing to test and develop it.

Aerodynamic and robust

Our design solution was shaped by the demanding conditions in which the robot will need to survive and thrive. For example, natural gas is much denser at high pressure, so aerodynamics were critical. It also needed to be robust enough to hold its own against a potential 200kg force that would push against it at peak flow.

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Benefits in brief

- Predicted savings of c.£60m over a 20-year period
- 2,000 tonnes of carbon will be saved annually
- Robot's data will provide meaningful intelligence about our assets.

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The Synthotech team turned to nature for aerodynamic inspiration and found it in the shape of the dolphin. These marine mammals are incredibly efficient at cutting through liquid because of their body shape – with quite a rounded but wide front-end, and then a slimmer body at the back. Our robot's design follows the same principles. Another key part of the robotic solution is the use of a magnetised track system. This will keep the robot firmly fastened to the pipe wall, but also give it the flexibility to drive freely around it.

Real-time control

A unique aspect that GRAID brings to inline inspection is that it will be user-operated. The Synthotech team is creating an intuitive control system to allow a technician to steer the robot through the pipework, investigating areas they feel need closer attention and receiving real-time data feeds.

Partners Premtech have been busy designing a launch and retrieve vessel for the robot. Alongside this, they're developing an offline test facility, to verify that the robot is capable of operating effectively before it's used on a live site.

Other work has included laser scanning sites where we'll hold online trials in 2017, and building up computerised 3D models of exactly what's there. From these, we'll carefully plan the robot's access and exit points to ensure the pipes have the features we need to fulfil the project's success criteria: to travel a minimum of 100m and negotiate two bends.

Project Lead Jon Lelliott said: "We still have some significant engineering challenges to overcome, but through collaboration, innovative thinking and hard work, GRAID will become a reality, revolutionising the way we manage our assets – and providing a catalyst for the technology to be taken up across our industry and in other sectors."



A magnetised track system will keep the GRAID robot firmly fastened to the pipe wall, but also give it the flexibility to drive freely

Fast forward – what's coming next on GRAID

Offline trials: Early next year, we'll begin testing the robot at an offline facility developed with advisory business DNV GL. Construction of this has begun and it will recreate the extreme conditions the robot will face when it carries out inspections in the real world. We'll conduct a minimum of 10 offline trials.

Online trials: We'll continue to prepare for live trials in 2017 by carrying out further research into the best access points for the robot.

The robot: We'll continue to develop the device's subsystems, and begin construction of the launch and retrieve vessel which will do the crucial job of getting the robot safely in and out of the pipe.

Watch the video

nationalgridconnecting.com/making-the-graid-2/



Visit the project website

nationalgridconnecting.com/Robotic_innovation/



Project: Removable Composite Transition Pieces (CTP)

Safer by design

Replacing and repairing failed seals on pipes that exit our concrete inspection pits will become safer and less expensive thanks to our Removable CTP project.

Historically, when seals failed on gas pipes exiting concrete walls, costly, high-risk works involving the breaking out of steel and concrete were required to inspect and repair them.

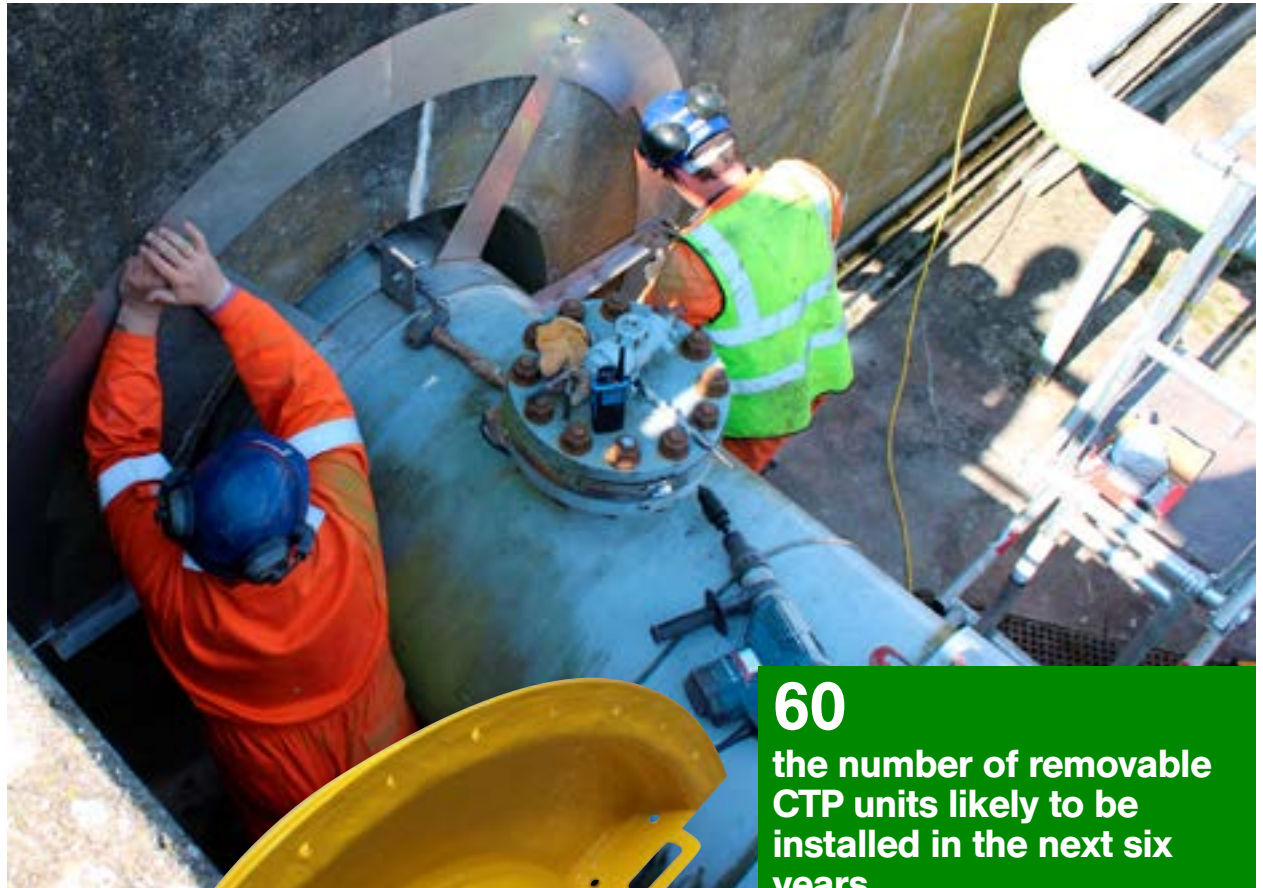
The project addressed these issues by developing a composite gas transition seal unit which plugs the gap between pipe and wall, pictured. Technicians can easily remove it, inspect the pipe for corrosion or damage, and then replace it in a fast and simple operation.

With the new units fully designed and tested, Senior Civil Engineer Paul Ogden is now working with a commercial partner to get them into full production.

“During the next six years, up to 60 of these units are likely to be installed on the National Transmission System,” said Paul. “That will significantly improve safety as well as creating savings of up to £5m in the next five to ten years. We also hope to see other utility companies use them in the future.”

Watch the video

nationalgridconnecting.com/safer-by-design/



60

the number of removable CTP units likely to be installed in the next six years

£5m

costs predicted to be saved in the next five to ten years

Project: Stress Concentration Tomography (SCT) Pipeline Inspection System

Improved inspections

An investigation into the potential of a new, non-invasive survey technique to identify defects and features in buried pipelines delivered some significant results.

Stress Concentration Tomography (SCT) is operated at ground level and uses high-sensitivity magnetometers to identify anomalies in the pipes. It's useful to us because a number of our pipelines can't be internally inspected through inline inspections (ILI).

We've already been able to demonstrate that SCT works in practice. For this project, we set out to understand whether SCT could improve on current survey standards, and we identified three areas where we felt this was possible: identifying welds, estimating pipeline depth and capturing the lateral position of the pipe. Our results showed that:

- SCT is more effective at locating the position and depth of a pipeline than existing methods, including ILI.

- SCT's performance in measuring the depth of cover above a pipeline was broadly equivalent to the current best available technique, but in some cases it was noticeably better.

- SCT's performance in weld detection for individual weld lengths was broadly similar to the performance of ILI. However, SCT cannot currently differentiate between welds on short pipeline sections, fabricated bends or where pipework is at or near a vertical position due to the overlapping magnetic information.

"SCT provides a non-invasive, complementary survey technique which can be used in combination with other inspection methods," said Peter Martin, Senior Pipeline Technical Engineer. "We'll now look at doing further work to improve the system's capabilities and embed the technology into our business."

Project: Enhanced operational forecasting tool

Better predictions

A new tool for improving our supply and demand forecasts is set to benefit National Grid and the wider gas community. National Grid's Abhijit Dash, pictured, explains.

Q. What prompted the project?

A. We use forecasting tools to help us predict supply and demand on the system and to help us plan. We also publish these forecasts externally to help our customers make efficient decisions about their energy balance. While our current tools had been fit-for-purpose, they were becoming less effective in today's volatile gas market. We needed more up-to-date methods of forecasting to continue to operate the system reliably and cost-effectively.

Q. Why is the project important to National Grid and end consumers?

A. National Grid and the wider industry spend vast sums trading gas to ensure supply and demand is balanced every day. By providing a more accurate forecast, we'll reduce the need for balancing actions and bring down overall network management costs, which benefit the whole gas community.

Q. What exactly have you achieved?

A. We've developed a prototype supply and demand forecasting tool that takes into account the more volatile characteristics of the gas market. It can predict volumes for up to 14 days ahead and generates hourly forecasts for each day. The project was completed in May and we'll spend the following three to six months evaluating its performance, before deciding how best to take it forward to bring maximum benefit to the business.



Project: BIM (Building Information Modelling)

Putting our learning into practice

This year saw Business Information Modelling (BIM) really take seed in our business. It's revolutionising the way we design, build and manage construction projects – and it's already delivering value for our business and end consumers.

BIM has been an important part of our innovation portfolio for several years now. After investigating how it could benefit our business through two NIA-funded projects, this year we put what we learned into practice. We're now applying its methods to 16 gas projects – and already saving the business millions of pounds.

Here's a snapshot of how we've implemented BIM and the value it's delivering.

- 3D laser scanning was trialled as an accurate and fast way to survey sites and build models during phase one



of the project. This year, we successfully used it on two compressor projects in Huntingdon and Peterborough, as well as on our **Feeder 9** project at the River Humber, the biggest pipeline river crossing anywhere in the world.

- In Bacton, we took the technique even further, using laser scanning to capture exactly what was being built on the site for the first time. This took a third of the time of more traditional methods and has given us an accurate record of the installation. So any work carried out on the site in future will be delivered safer, faster and cheaper.

- Another area where BIM is excelling is its ability to help suppliers and stakeholders visualise a project more

What is BIM?

BIM is a move away from traditional 2D CAD drawings into more easily visualised 3D designs, providing access to data-rich, intelligent 3D models, which contain all the critical data about an asset. We can then use these to improve the way we manage them throughout their lifetime, saving cost and carbon every step of the way.

clearly. On Feeder 9, for example, we issued 3D models to suppliers during a tender event. Through helping them visualise design elements, such as tunnel length and profile, this early contractor involvement achieved significant savings.

- We used BIM at a national consent hearing for Feeder 9. Having 3D models to hand made it easier to demonstrate how robust our plans were and justify our design decisions. It also came to the fore when Natural England raised concerns over the project's impact on local birds. We created enhanced models that relieved their concerns, eliminating the delays that would have been caused by a formal objection.

It's not only large projects that will profit. We've just completed a best practice guide which lays out the case for applying BIM on smaller sites, meaning BIM can now flourish across every scale of National Grid project.

Read more about BIM here
nationalgridconnecting.com/bim-begins-to-blossom/



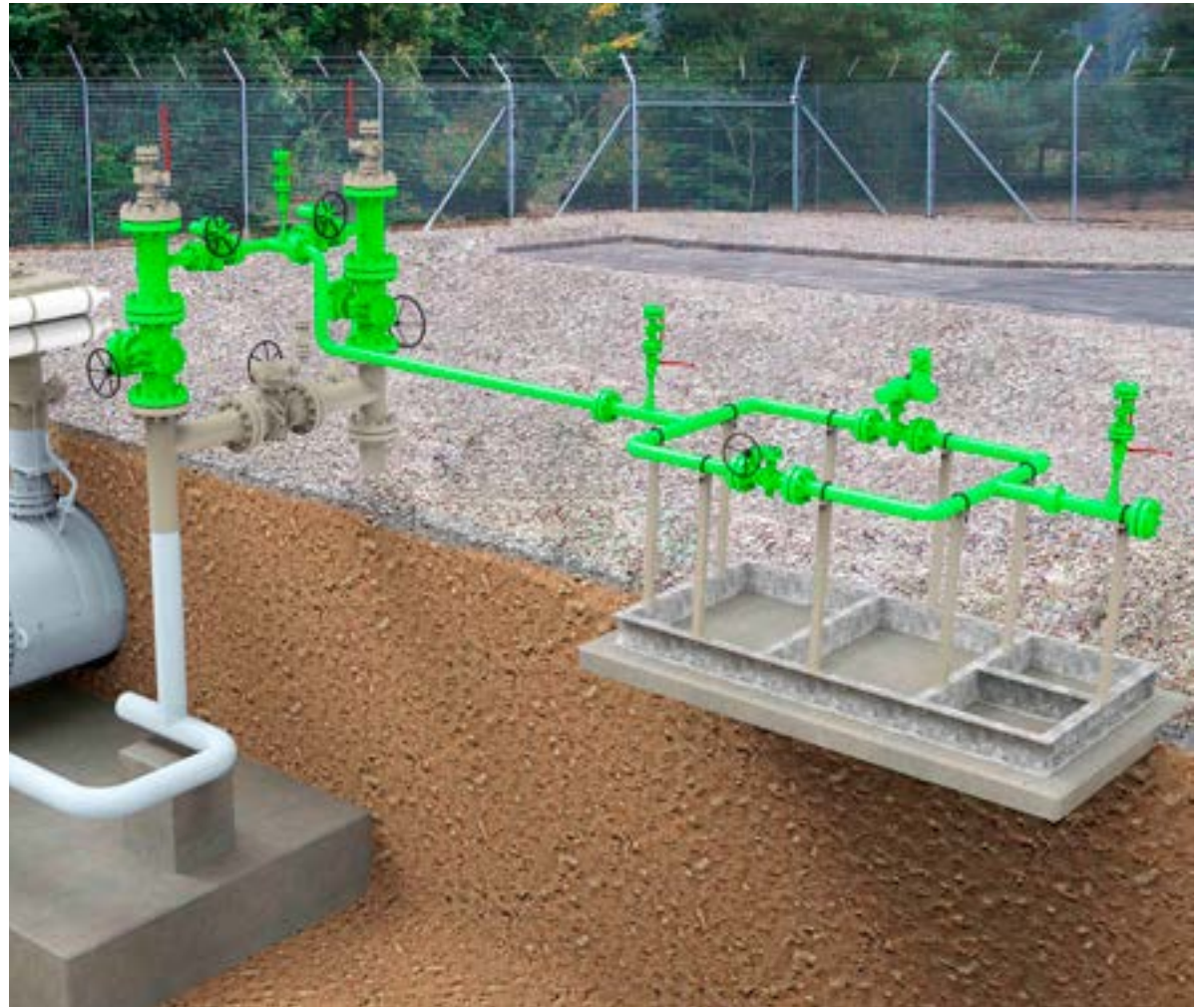
Project: CLoCC (Customer Low Cost Connections)

Opening up the network

Through Project CLoCC, we are minimising the time and cost to connect to the National Transmission System (NTS). The project aims to offer greater customer choice so the NTS can support both large and small connections.

Based on National Grid's Slow Progression scenario, Britain could be 80% reliant on gas imports by 2030. By supporting potential new customers to the NTS, we believe we can help offset our reliance on these imports and future-proof the NTS here in Britain.

Through **Project CLoCC**, we're aiming to address the main obstacles that hold entry and exit customers back from getting connected – the current cost (up to £2m) and duration (up to three years). Our goal is to halve the cost of a connection to less than £1m, whilst reducing the time it takes from initial enquiry to being connected to less than one year.



Project CLoCC aims to minimise the cost and time of connections to the National Transmission System (NTS), by producing 'off-the-shelf' standardised designs for connections that can be used regardless of the customer, size of connection or type of gas

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The project, which began at the start of the year and is due to be completed towards the end of 2018, focuses on three key areas:

- Developing a new physical connection solution that is tailored to the needs of unconventional gas customers
- Creating a web-based connections platform that allows producers to compare suitable options for an NTS connection and track progress once their application is under way
- Designing new commercial processes to meet the needs of non-traditional customers.

The project reaches the end of stage one at the end of July. Work so far has included a global 'tech watch',

Benefits in brief

- Minimising the cost for gas producers to connect to the National Transmission System (NTS) to less than £1m from its current cost of £2m
- Minimising the time it takes to connect to less than a year from its current timescale of three years
- By opening up the network to more home-grown and unconventional gas customers, we increase the choices available for where our gas may come from in the future. This helps improve our energy security and maximise the potential for newer forms of indigenous gas.

where we've met with a wide range of businesses and stakeholders to understand what technology is currently available to help us deliver our objectives. We've also attended key conferences for unconventional producers to find out exactly what customers are struggling with and what they want a new connection to the NTS to look like.

This research is now being used by project partners Premtech, who are beginning to design and develop the physical connection solution.

Going overground

"Up to now, all connections to the NTS have been made underground, which means there are excavation and burial costs involved," said Anne-Marie Liszczyk from the project team. "The logical way to cut costs is for our solution to be above ground, portable and mobile – and that's what Premtech is primarily focusing on.

"We have also learnt from stakeholder feedback, particularly during visits to the US, that a sensible approach is for our project to create a set of pre-approved, off-the-shelf designs for customers to choose from. These would then be scalable to their needs."

Anne-Marie is excited about the benefits CLoCC will bring to National Grid and Britain's gas community.

"The NTS has traditionally accommodated larger customers, but CLoCC offers the opportunity to support smaller players such as those producing unconventional, indigenous gas sources," said Anne-Marie. "There's a real push to produce greener energy here in the UK

and Project CLoCC aims to support greater choice of connection options for customers.

"We've got a great opportunity through this innovation project to push forward what customers really need in a way that future-proofs connections for years to come."

Fast forward – what's coming next on CLoCC?

Stage 1 – our global tech watch and feasibility study finished at the end of July.

Stage 2 – runs until the end of April 2017. During this period we'll complete our prototype of the project's online portal (December). In collaboration with our project partners we'll also refine the designs for our connections solution, test its costs and make sure the designs hit our less than £1m target.

Stage 3 – runs from start of May 2017 until the end of October 2018, when the project is due to close out. During this stage we'll build the final solution – a real connection that could be connected to the NTS. Alongside this, we'll complete work on the online portal, and make sure all commercial arrangements and contracts with customers are in place to ensure the tools are used effectively and efficiently.

Don't miss out on the latest news from CLoCC. Sign up to the project newsletter [here](#)



Project: Meter Validation Assessment Tool (NGage)

Reducing Unaccounted for Gas

The NGage app is set to standardise the recording of meter validations and help reduce Unaccounted for Gas (UAG) by up to £8m. Meter Assurance Engineer Zoe Thorpe explains.

Q. What have you achieved in the past 12 months?

A. We released the beta test version of **NGage** and a gas properties calculator app called **NGage CALC** in June this year. The full versions will be released at the end of summer. Following feedback from users, we've been improving the functionality of the apps, which will increase the breadth of its user base and offer real-time analysis. The final validation app will contain features including an overall view of a meter's health. We've been busy promoting the technology both to potential users and the wider energy sector at events including Utility Week Live.

Q. Why is the project so important?

A. If meter validators use the **NGage** app, both National Grid and the meter owners will have instant access to meter validation data and be able to carry out analysis in real time within the app. We'll be able to better detect



how well meters are performing, identify measurement errors and make faster decisions on whether equipment associated to the metering requires calibration or replacing. Also, the time spent reviewing, logging and providing results will be massively reduced. By improving asset health and measurement performance in this way there is potential to save the end consumer up to 400GW of UAG and between £6m to £8m a year.

How to access the apps

The beta version of the gas properties calculator, **NGage CALC**, is available now on the App and Play stores:

iOS **Android**

To access the **NGage validation app**, you'll need to input the user's details, including the site, user name and email address associated with the validation. If you're on iOS, your device's UDID will also be required.



Q. What challenges do you face getting customers to A. use the app?

The main challenge has been to support users in overcoming their natural reluctance to change to a new tool from one they have used for many years. We've put a particular focus on encouraging the distribution networks (DNs) to take up using **NGage** and have offered a group of users the chance to trial the app on tablets that we own, so they can try before they buy. Through continued liaison visits we aim to encourage all the DNs to use the technology, which will enable us to have half the population of meter validators covered in the first phase of the full release. Benefits of the app will include time saved entering test data and the ability to transfer data between tests, which will reduce time and the risk of input error.

Q. What's coming next?

A. We're currently working on phase two of development, which will add the extra functions I mentioned. We'll continue to meet and support users, and further market the app to potential customers. By doing so, we expect take-up to really gather momentum in the next six to 12 months.

Project: Nitrogen sleeve epoxy end-seal repair solution

Speeding up repairs

We're entering exciting new territory with our nitrogen sleeve epoxy end-seal repair solution project. It explores how composite wrap technology, something we've never used before, could help repair leaking nitrogen sleeves.

Nitrogen sleeves were installed between the 1960s and 80s to provide extra protection to pipes that run under high-risk locations, such as motorways. Many of them have an epoxy (or synthetic) end-seal, and a number of these are known to be leaking.

Composite wrap technology promises a fast, cost-effective method of sealing these leaks. It takes the form of a simple fabric and resin that can be wrapped around a pipe. This then cures and hardens, sealing the leak. The project team is currently testing the viability of the technology through a series of pressure tests, including one which will push it to destruction. This will show us what the technology might ultimately be capable of.

"It potentially gives us new options

for keeping the NTS safe in the most effective way," said Pipelines Team Leader Graham Harvey. "As for next steps, we are reviewing the outcome of the pressure tests to decide how and where we can apply the solution across the NTS. It's important that we embrace newer technologies and this project is a great opportunity to work out how and where we can use it."



Project: Hot tap buried sample probe

Smarter sampling

A unique piece of innovation that makes gas sampling safer and less expensive has been installed across the majority of our sample points in the past year.



Sample probes are used to collect gas from pressurised pipes. **In this innovative project**, a team led by Senior Gas Quality Engineer Roger Wood designed a new installation that brought the operation of the sample probe itself, and the isolation of the valve above ground.

Traditional sample pits require technicians to climb down to isolate the valve and remove the probe. Now this new design means this whole process can be done at ground level, making it safer and more cost-effective.

Lower cost, better safety

"The new probe installations cost a quarter of the £120,000 for a traditional pit, and maintenance costs are much lower," said Roger. "By moving the maintenance

points above ground, safety is also much improved."

The new probes also break new ground in their ability to reduce the pressure of the gas they sample to meet the gas handling requirements of the new breed of analyser.

After two-and-half years it has been possible to implement the results of this innovative approach at 34 of 37 installations due for this upgrade. The final few are to follow in the coming months.

"The project demonstrates how great innovation can deliver real value to customers," added Roger.

Project: Asset Information Models (AIM) for component/pattern recognition

AIM on target to accelerate asset modelling

Producing intelligent models of Gas Transmission assets is set to become quicker, cheaper and more accurate thanks to an extension of our Building Information Modelling (BIM) project, called AIM.

An **AIM**, or Asset Information Model, provides all the information necessary to support the management of an asset. For example, it logs its precise location, operational data, information about work carried out and its existing condition. Traditional methods for gathering this data have proved time-consuming and, at times, inaccurate.

Through BIM, we've already proven that laser scanning brings huge time and cost benefits in creating these models. AIM sets out to build on this success, adding sophisticated component recognition software to the mix. The software quickly identifies assets picked up in the scans and converts them into detailed 3D models.

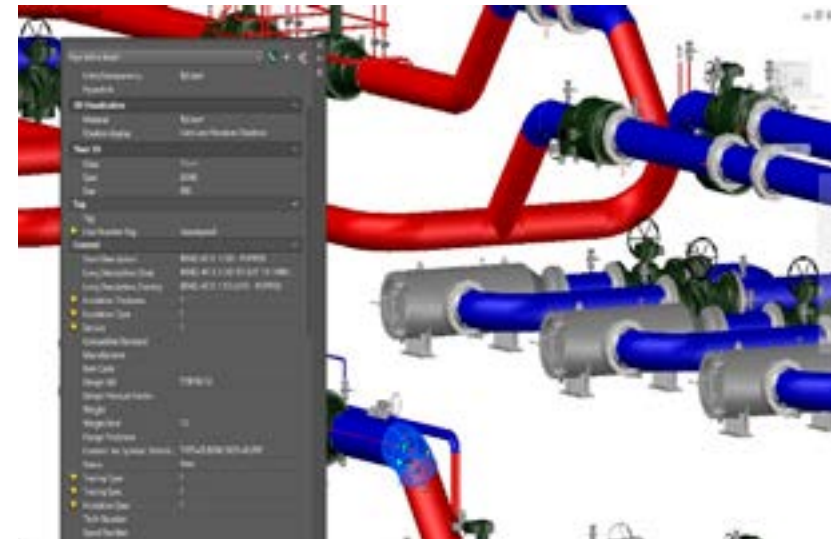
Shape of things to come

In the first stage of the project we're exploring whether the software can actually deliver the cost and time savings we expect. Then, in the longer term, we'll look to build a library of complex gas components that the software will be able to identify from just the basic shapes picked up in scans.

Early estimates suggest that the software could reduce the time it takes to design a 3D model of a site by at least 40%. With around 650 sites on the NTS the time and cost savings could add up to significant business value.

"Asset records traditionally exist in 2D electronic format or as hard copies, and depend on the continuous transfer of data to remain accurate," said Investment Delivery Engineer Martin Cahill. "It's time-consuming and difficult to keep track of whether records have been kept fully up to date.

"Through AIM, we hope to replace this process, saving on time and cost and improving the accuracy of our records. It will be easier to track any changes that have been made, and the 3D model will allow for more in-depth, better targeted planning for any future work."



Early estimates suggest the AIM software could reduce design time for 3D models by 40%

Benefits in brief

- Faster production of intelligent 3D models
- Generates accurate records that can capture and reference key asset data
- Assist in the understanding and management of an asset's condition and the delivery of any future work.

Project: Remaining Useful Life (RUL) for compressors

Predictive modelling

We're transforming the way we forecast the future condition of our compressor assets with our Remaining Useful Life (RUL) determination for compressors project.

The RUL project is all about developing new ways to predict the onset of degradation in the components of a compressor train (gas turbines and compressor), which are essential to the continued, reliable supply of gas in the UK.

We're using prognostics, a process of using computer models, to identify problems early on. Through a process called pattern matching, previous and current states of the system are compared and a prediction is made about the condition of the asset in the future.

Detection of a potential failure

gives us the early warning we need to take preventative action and ensure the system continues to operate reliably, with the minimum impact on customers. It also provides an opportunity to consider changing to more favourable operating conditions, which may extend the asset life.

"The project is still in the early stages, but success could lead to the implementation of real-time analysis, possibly in the form of an alert system, which would further enhance our condition-based approach to maintenance," said Steve Reveley, Maintenance Manager.

Project: Spatial district heating analysis and its impact on gas and power demand

District heating

This year we unlocked fresh knowledge about district heating and its potential future impact on gas demand. The data will help us improve the accuracy of our future gas scenarios and make more intelligent network investment decisions.

District heat networks generate heat centrally, for example from a power station's waste heat or a gas combined heat and power unit, and then distribute that through a group of buildings. This provides those buildings with a low-carbon heat source.

While district heat provides less than 2% of the UK's heat, studies have suggested that growth between 14-40% is possible. Our project aimed to find out more about the location and development of future networks and the impact this could have. We learned some useful things:

- When district heat schemes use waste heat from power stations as their source, a system of top-up



Valuable data has been gathered about district heating centres, like this one at London's Olympic Park

heating is also required. The most economical solution for these are gas boilers, but this cancels out the scheme's environmental benefits. For district heat to have a positive contribution to the 2050 carbon targets, top-up heat will need to come from lower carbon sources.

- Cost difficulties are likely to limit the growth of district heat. The high cost of retro-fitting a street with a new district heat system, and replacing appliances in homes, is generally uneconomical when compared to incumbent gas boilers.

- Based on all our data, our highest scenario was that 10% of heat demand in Britain could be satisfied by district heat by 2050, while our lowest scenario was less than 2%.

Iain Shepherd, Energy Demand Analyst, said: "We've only scratched the surface and will be doing further work into what part gas can play in all of this and the opportunities it can create."

Strength in numbers

National Grid, like any other network operator, can't achieve great things alone. That's why collaboration is such an important part of our innovation philosophy. Here are five ways we connected with our peers and the wider industry this year to tackle common challenges, share ideas and maximise the potential of innovation.



The GIGG shares lessons learned from innovation across the different networks

1. Gas Innovation Governance Group (GIGG)

We continued to play a key role in the Gas Innovation Governance Group (GIGG). Each month, we meet with a range of network licensees to share what we're learning on current innovation projects and discuss how we can work together to meet future challenges.

By joining forces and sharing knowledge, we're able to spread the benefits of our innovations across the wider network community. Among the year's big achievements was the creation of a centralised log of lessons learnt through innovation projects. All licensees can now access this pool of knowledge and apply it to their own networks.



2. Utility Week Live

We joined innovators from across the utilities to share and explore the latest NIA and NIC innovations at Utility Week Live. The event brought together more than 150 innovators from the UK's utility industries. Our stand was really well received with colleagues in the water industry, in particular, showing a lot of interest in how they could apply what we're learning from GRAID. It was also a chance to generate new ideas by exploring other utilities' innovations and making new contacts in the supply chain.

3. Innovation roundtable

The organisation unites innovation professionals from large, multinational businesses at events throughout the year. It's a unique opportunity to learn about the latest trends and innovations across sectors, across the globe.

The main outputs from this year's innovation roundtable events included focusing on technology trends and unmet customer needs. They also provided interesting insights into how one business used a new forecasting technique to evaluate the impact of trends on its operations. What we took away from the roundtable was the idea of developing our own vision of how our network could look in 2030 and engaging our people in its evolution.

Other events focused on the challenge of moving business innovation into saleable products and demonstrating the pros and cons of various new technologies. This led us to consider the potential operational use of NFCs (near field communication) and smart tags in the business. We're considering whether we could install these devices, which would contain maintenance schedules and product details, when we undertake work on site.

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4. LCNI Conference

The Low Carbon Networks and Innovation (LCNI) Conference, held in Liverpool in November, was a fantastic success. Along with showcasing our latest innovations, it was the perfect platform to share new knowledge generated across the networks and find fresh ways to collaborate.

Our own exhibition stand featured a scale model of our renewable powered telemetry kiosk, which proved a real talking point, a test version of our NGage tablet app so delegates could experience the software for themselves, and a model of the Project GRAID robot, which caught the imagination of visitors. We're looking forward to building on this success when the event returns on 11-13 October at Manchester Central Convention Complex.



5. Memberships

We have three ongoing industry memberships that allow us to collaborate on a global scale and benefit from international experience that can help us build a better business.

Pipeline Research Council International (PRCI) and European Pipeline Research Group (EPRG)

Our memberships of PRCI and EPRG give us access to research projects that we would otherwise find difficult to fund for ourselves. They also give us the opportunity to test and validate innovation projects carried out by the groups, which is often a source of considerable learning. There are also extensive opportunities to network with other gas transporters and the wider industry. Collaboration with these organisations plays a key role in the development of our innovation portfolio.

The Joint Industry projects

The Pipesafe Group was founded in 1994 with the collaboration of gas transporters including National Grid, Energinet.dk (Denmark), Fluxys (Belgium), Enagas (Spain), Gasunie (The Netherlands), TransCanada Corporation (Canada), Alliance Pipeline (Canada/USA), KOGAS (Korea) and Statoil (Norway). It is responsible for carrying out research into the ongoing management of risks on pipelines and above ground installations. The group also implements the results of the research through tools and methodologies. These are aligned specifically to our needs at National Grid, but can also be applied across the gas industry.

Our innovation portfolio

The 2015/16 portfolio consisted of 44 projects. For more information on each project please click on the arrows.

National Grid Gas Transmission Projects

Ref number	Project name	i
Gas Transmission Lead		
NIA_NGGT0009	Removable Composite Transition Pieces (CTP)	>
NIA_NGGT0011	Composite Pipe Supports	>
NIA_NGGT0012	Development of a New Design Vent Silencer	>
NIA_NGGT0022	National Transmission System (NTS) Constraint Modelling	>
NIA_NGGT0023	Development of "AGI safe"	>
NIA_NGGT0033	Hot Tap Buried Sample Probe	>
NIA_NGGT0035	Investigation of Flow Physics in Gas Pipe Network	>
NIA_NGGT0044	SCT Pipeline Inspection System	>
NIA_NGGT0045	Acoustic Emission Measurements in Valve Leakage Detection and Quantification	>
NIA_NGGT0047	Resource and Asset Reuse Toolkit	>
NIA_NGGT0049	Investigation into the use of constrained-layer damping	>
NIA_NGGT0051	Wireless Gas Detection Assessment	>
NIA_NGGT0055	Above Ground Installation Integrity Decision Support Tool	>
NIA_NGGT0058	Variable Envelope Compressor Economic Study (VECES)	>
NIA_NGGT0059	Renewable Power Trial and Demonstration	>

Ref number	Project name	i
Gas Transmission Lead		
NIA_NGGT0060	Gas Generator Preservation Assessment	>
NIA_NGGT0063	Investigation into Novel Robotics Locomotion Techniques	>
NIA_NGGT0064	High Altitude Aerial Surveillance (HAAS)	>
NIA_NGGT0066	Meter Validation Assessment Tool (MVAT)	>
NIA_NGGT0067	Sensitivity and Specificity of Stress Concentration Tomography – I CASE award	>
NIA_NGGT0069	Pipeline Installation Techniques	>
NIA_NGGT0070	NTS Block Valve Connections	>
NIA_NGGT0071	Spatial district heating analysis and impact on gas and power demand	>
NIA_NGGT0072	Portable Valve Actuation	>
NIA_NGGT0073	Investigation into LPRC pipeline material	>
NIA_NGGT0074	Next Generation Predictive Emission Monitoring Validation (PEMS)	>
NIA_NGGT0075	Enhanced Operational Forecasting	>

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Our innovation portfolio

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National Grid Gas Transmission Projects

Ref number	Project name	i
Gas Transmission Lead		
NIA_NGGT0076	Gas Quality Study for NTS Unconventional Gas Supplies	>
NIA_NGGT0077	Cathodic Protection for Pipelines within a Tunnel	>
NIA_NGGT0079	Remaining Useful Life (RUL) determination for compressors	>
NIA_NGGT0080	EPRG – European Pipeline Research Group - 2015	
NIA_NGGT0081	PRCI – Pipeline Research Council International - 2015	
NIA_NGGT0082	Risk Assessment Methodologies for Pipelines and AGIs 2015	
NIA_NGGT0083	Geospatial Information System (GIS) Pipeline Costing Tool	>
NIA_NGGT0085	New techniques for the measurement of pipeline depth of cover	>
NIA_NGGT0087	Selective Catalytic Reduction (SCR) Pre-FEED Environmental and Technical Study	>
NIA_NGGT0088	Nitrogen Sleeve Epoxy End-Seal Repair Solution	>
NIA_NGGT0089	Asset Information Models (AIM) for Component/Pattern Recognition	>

Ref number	Project name	i
Gas Transmission Participated		
NIA_SGN0094	Energy Map and Plan	>
NIA_NGET0135	Enhanced Sensor Development (ICASE Award)	>
NIA_NGET0144	Integrated Electricity and Gas Transmission Network Operating Model (ICASE Award)	>
NIA_NGGD0007	Development of DANINT FWAVC software for New Gas Chromatograph	>
NIA_NGGD0019	Pipeline Failure Rate Determination Due To Inland Natural Landsliding	>
NIA_NGGD0022	Study of Crater Formation Threshold During Gas Leakage on High Pressure Pipes	>

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