

**Network Innovation Allowance
Annual Summary**

2016/17



Foreword

Beneath your feet runs 200 years of gas innovation; a network of underground pipes connecting 11 million homes and businesses. It's our invisible commitment to meet the UK's energy needs, today and tomorrow.

Our business owns, runs and maintains four of Britain's eight gas distribution networks. It's down to us to keep the energy flowing, so customers keep warm, safe and connected.

We work closely with other gas networks and energy companies. And we pursue innovation at every turn. Because forward thinking means a brighter future for our customers.

cadentgas.com

Transforming innovation into customer value

It has been a year of major change for our business, as we separated from National Grid to become our new company, Cadent. What hasn't changed is our ongoing commitment to innovation.

Innovation at Cadent is driven by the **courage** to ask the right questions about what could be improved in our business. The **curiosity** to find the best solutions, and the **commitment** to transform light bulb moments into fully-implemented programmes that bring real value to our customers.

This is our fourth innovation Annual Summary under RIIO and the Network Innovation Allowance (NIA). And it has been a very productive year.

Our NIA expenditure this year is £7.7m. This money has been carefully invested across our six strategic value areas. Some 30 projects were completed in the past year and 28 more are in development. 23 of these have been carried out collaboratively with other gas distribution network operators.

Our focus for this year has been on driving value from our innovation projects, both for our customers and our business; as well as how we can work more collaboratively with our colleagues in other gas distribution networks to accelerate industry innovation and share learning.

Highlights included measurable progress in rolling out new tools and techniques to increase efficiency in our day-to-day operational work. Alongside these is our continued focus on how gas can help the UK on its road to decarbonisation, with strong new projects in our portfolio.

As we reached the halfway point of the RIIO delivery framework, we also wanted to take stock of our progress so far. So we talked to colleagues across our business to get an up-to-date picture of our most pressing challenges. This has helped us focus our resources towards projects that will make the biggest difference to our customers for the remainder of the RIIO period.

We are incredibly excited about the year ahead. We will be focusing on the connection between innovation and change as we move more projects into implementation; as well as measuring the long-term benefits of new solutions.

Through innovation, we will give ourselves the best chance of delivering a secure, affordable and sustainable network for the UK's energy consumers.

David Parkin
Safety and Network Strategy Director
Cadent



■ We are committed to transform light bulb moments into fully-implemented programmes that bring real value to our customers.
David Parkin
Safety and Network Strategy Director

Innovating for today's and tomorrow's world

Delivering innovation

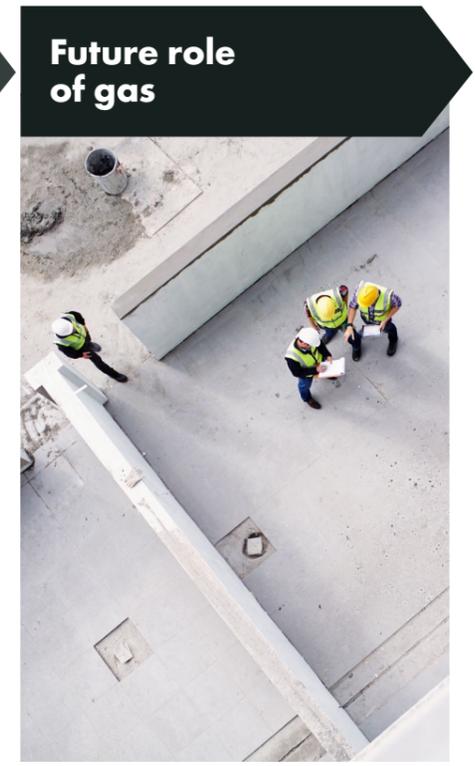
A culture of curiosity is at our core at Cadent. We constantly challenge ourselves to find new ways to solve existing and future problems. Making positive changes that benefit our customers is always at the front of our minds. We have three work portfolios that reflect our commitment to improving how we work. They provide us with a framework to ensure we keep energy flowing safely and reliably long into the future.



How we maintain and repair the existing gas pipe network.



Improving how we upgrade old iron gas mains – with minimum disruption to customers.



Exploring how low-carbon alternatives to natural gas could be used for heating and transport for generations to come.

The right projects

For innovation to be successful, it must be targeted where it is needed most. There should be a robust business case for each project, a clear problem to solve and a clear business need for the solution.

All our innovation projects are chosen to find answers to the biggest challenges facing our business and deliver clear benefits to our customers. Each one aligns to one or more of the following areas:

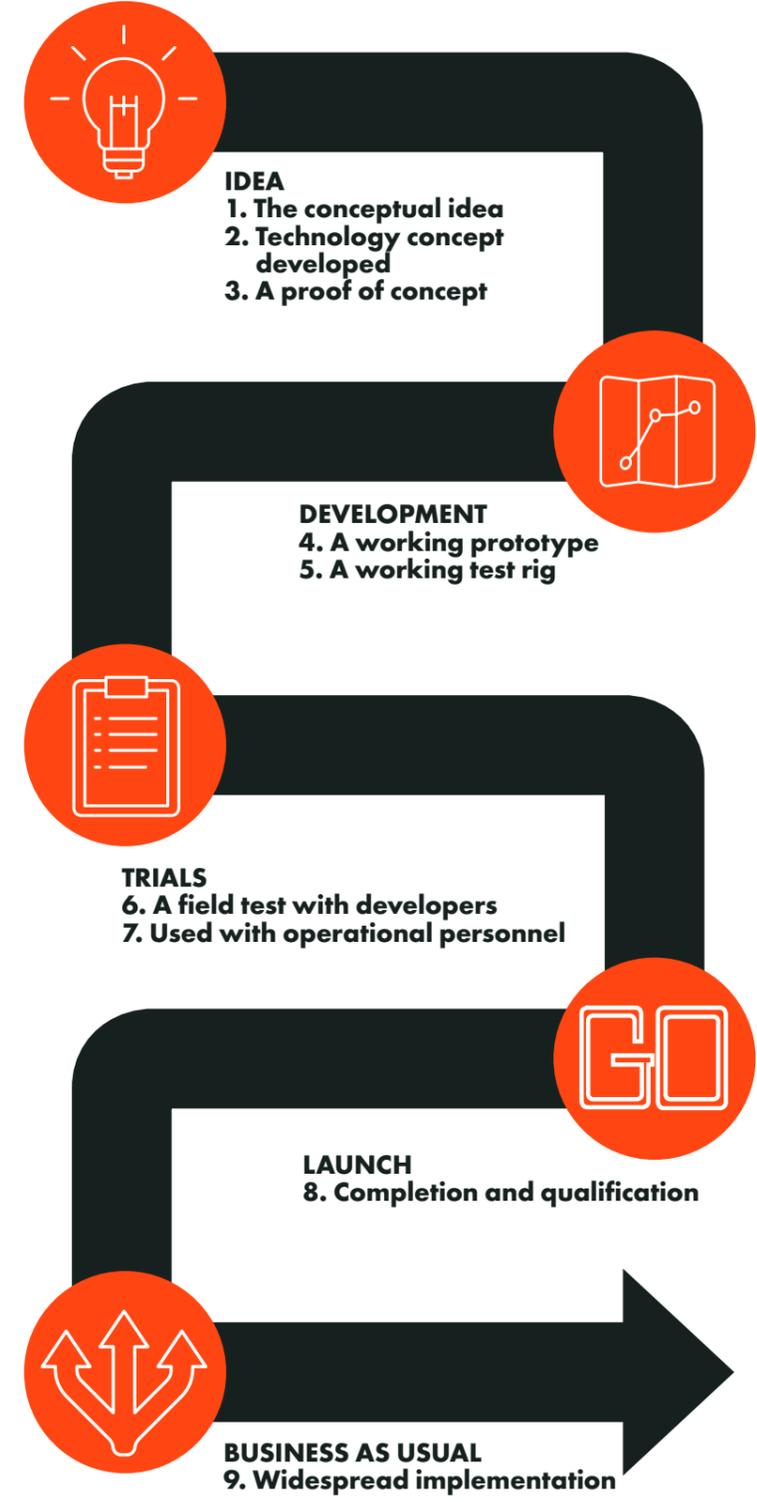
-  Customer experience
-  Cost efficiency
-  Life extension
-  Safety and environment
-  Unconventional supplies
-  Future network

From idea to implementation

Taking an idea from a flash of inspiration through to full implementation takes patience, dedication and perseverance.

We have a dedicated team of project managers who help transform bright ideas into reality.

It's their job to work with colleagues internally, as well as external partners across industry and academia, to make sure the best ideas are successfully developed, trialled and implemented. Only then is the full value of each innovation unlocked for our business and customers.



Our innovation year in numbers

NIA project activity in 2016/17 included:

58

total no. of projects



30 projects completed

£

£7.7m total NIA spend

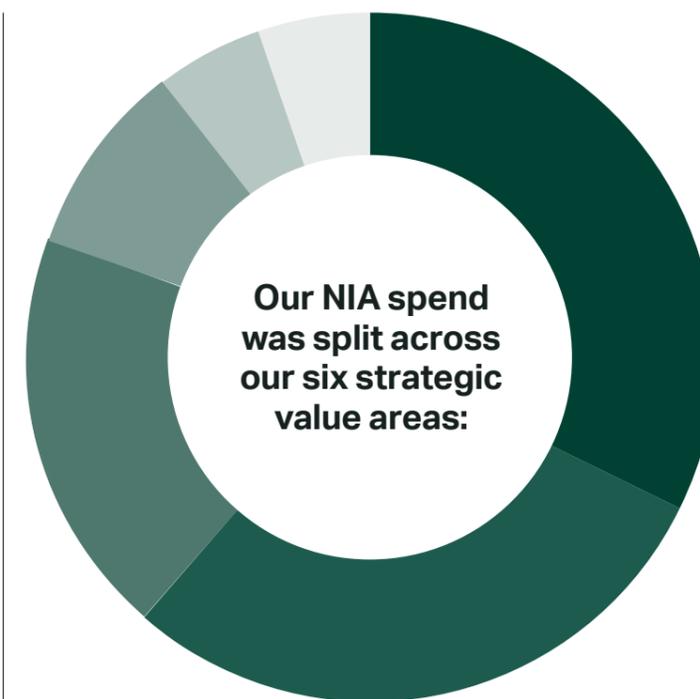


7 projects ready for implementation



4 projects to go into further development

Projects in development:



- 33% Cost efficiency
- 29% Customer experience
- 19% Future network
- 9% Safety and environment
- 5% Asset life extension
- 5% Unconventional supplies

Innovating to be better every day

We have been exploring new techniques and technology to support the work of our Emergency Response and Repair team, and our Operate and Maintain team. They look after our existing gas pipe network, which serves 11 million customers in Britain.



Faster discovery of gas leaks: OptoMole optical sensor

OptoMole solves an everyday challenge for our operational repair teams. The mobile, optical methane sensing system allows them to find the location of gas leaks in buried service cable ducts quickly, accurately and safely.

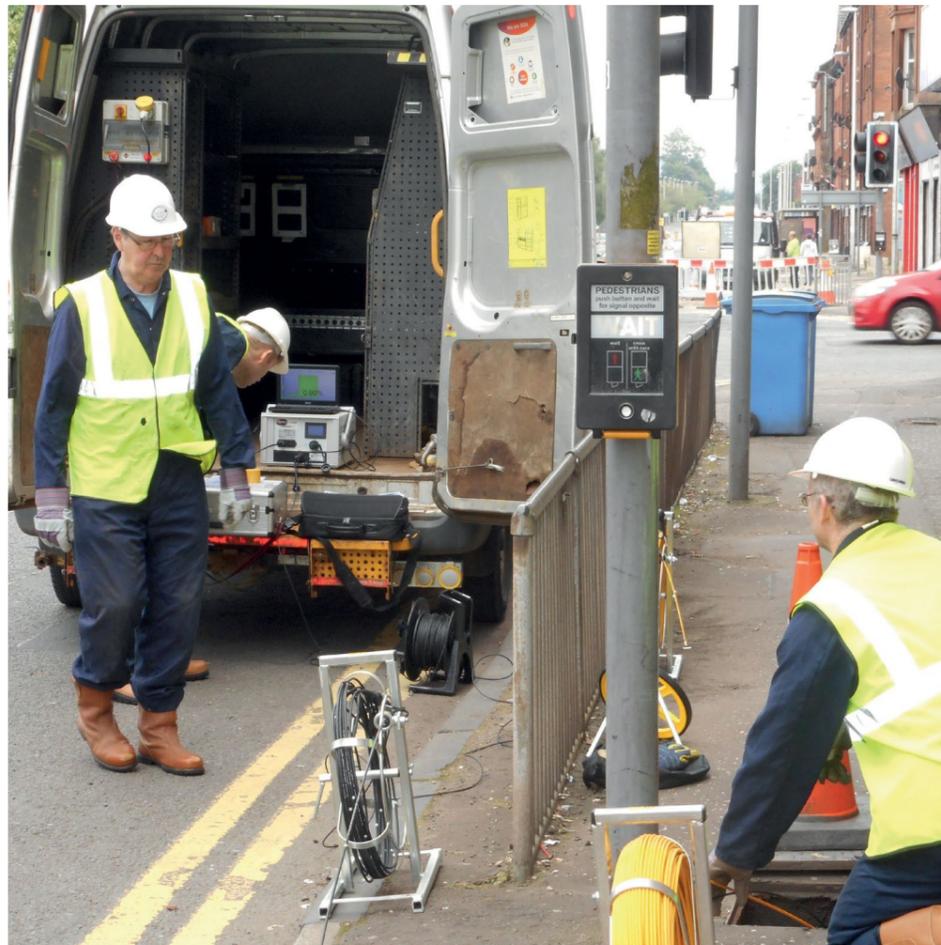
OptoMole builds on our partner, OptoSci Ltd's existing optical detection technology – known as tuneable diode laser spectroscopy – refining and developing it for use in narrow utility ducts.

It works by inserting a fibre optic gas sensor into the duct. A low-power laser signal is passed from a control unit through a fibre cable to the sensor. Any methane present in the duct is detected at the sensor. The return optical signal then travels back through the same fibre cable to the control unit where the methane concentration levels in the duct are immediately displayed.

This data highlights any points of gas entry into the duct, allowing the repair teams to identify the potential site of the gas leak, while minimising the need for streetworks. OptoMole also allows us to work with no risk of explosion or ignition.

Benefits

- No major excavation work required. This minimises disruption and cuts costs
- Improving how we identify leaks supports the integrity, safety and reliability of the network
- Safer for the public and our workforce, with reduced methane emissions and no spark risk.



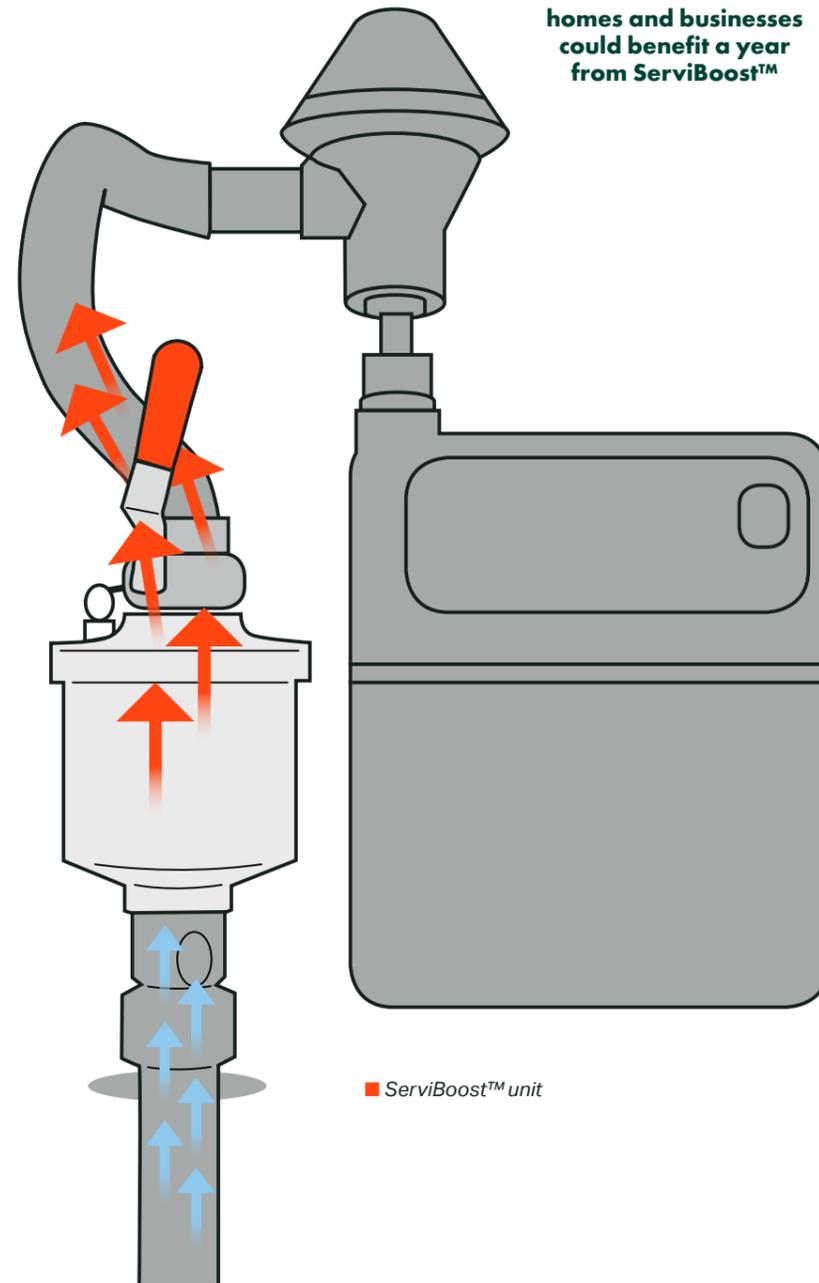
IN TRIALS

Progress in 2016/17
OptoMole units are now being trialled on live gas leaks by Cadent, Northern Gas Networks and Wales & West Utilities. The next phase of the project will make OptoMole ready to be fully implemented across the business.

Trials are showing a 30-60% cost saving where the unit is successfully used compared to traditional methods

Trials on **10 units** have proved the viability of ServiBoost™

4,000 homes and businesses could benefit a year from ServiBoost™



■ ServiBoost™ unit



Boosting gas pressure for our customers: ServiBoost™

ServiBoost™ ensures our customers can get enough gas, when demand is high or pressure in the network is limited.

The system, which can be installed in a meter box, boosts pressure within the service pipe. It works by detecting low flow and then activating a self-contained compressor unit to boost the pressure.

ServiBoost™ can provide an additional 5 mbar of pressure at the inlet to the gas meter.

Benefits

- Less gas supply interruptions for customers
- Service relay techniques can be carried out without turning off customers' gas.

Progress this year

The project has progressed through a feasibility study, design and 3D modelling. And trials on 10 units have now been completed. They successfully proved the performance of ServiBoost™, with the system maintaining constant network pressure through periods of high demand. The next phase will include live network trials to make sure the unit is tested against all relevant day-to-day challenges.



IN DEVELOPMENT



■ We have a very diverse range of projects in flight. We are committed to developing and delivering projects which improve operational efficiency, safety and deliver outstanding value to our customers.

Operations Portfolio Manager, Martin Lord

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Reducing the loss of gas through dry yarn joints: MEG fogger

We have been investigating a better way of injecting Monoethylene Glycol (MEG) into the parts of our network where there are still cast iron pipes. MEG swells the lead yarn in the joints to prevent gas leaks.

Following a significant change in direction in 2015/16, the project has now progressed to the manufacture of a prototype fogger for CE mark testing. Trials are expected to start in September 2017.

Reduction in leaks will be equivalent to the annual gas consumption of around

4,480 homes



Finding buried plastic pipes more quickly: Sensit APL

For engineers repairing our underground pipes, finding the exact location of polyethylene pipes (PE) can be difficult. Previous techniques involved digging trial holes and then excavating further until we found them.

Sensit Acoustic Pipe Locator (APL) helps to solve the problem by using a ground penetrating radar to quickly detect buried pipes and ducts to a depth of 3m. It reduces the number of excavations and can be done by a single technician, rather than a team in many cases.

The APL can pass through most surfaces including soil, grass, gravel and asphalt. It can also detect drains, fibre optics and other non-gas material. This allows us to identify where other parties', as well as our own kit, is located.

Benefits

■ Can be used across a variety of repair and new connections processes

■ Finding pipes first time reduces the number of excavations
This means:
- Less customer disruption.
- Lower risk of damage to third party equipment.
- Reduced risk to the public.
- Cost savings due to less time on site.

Progress this year

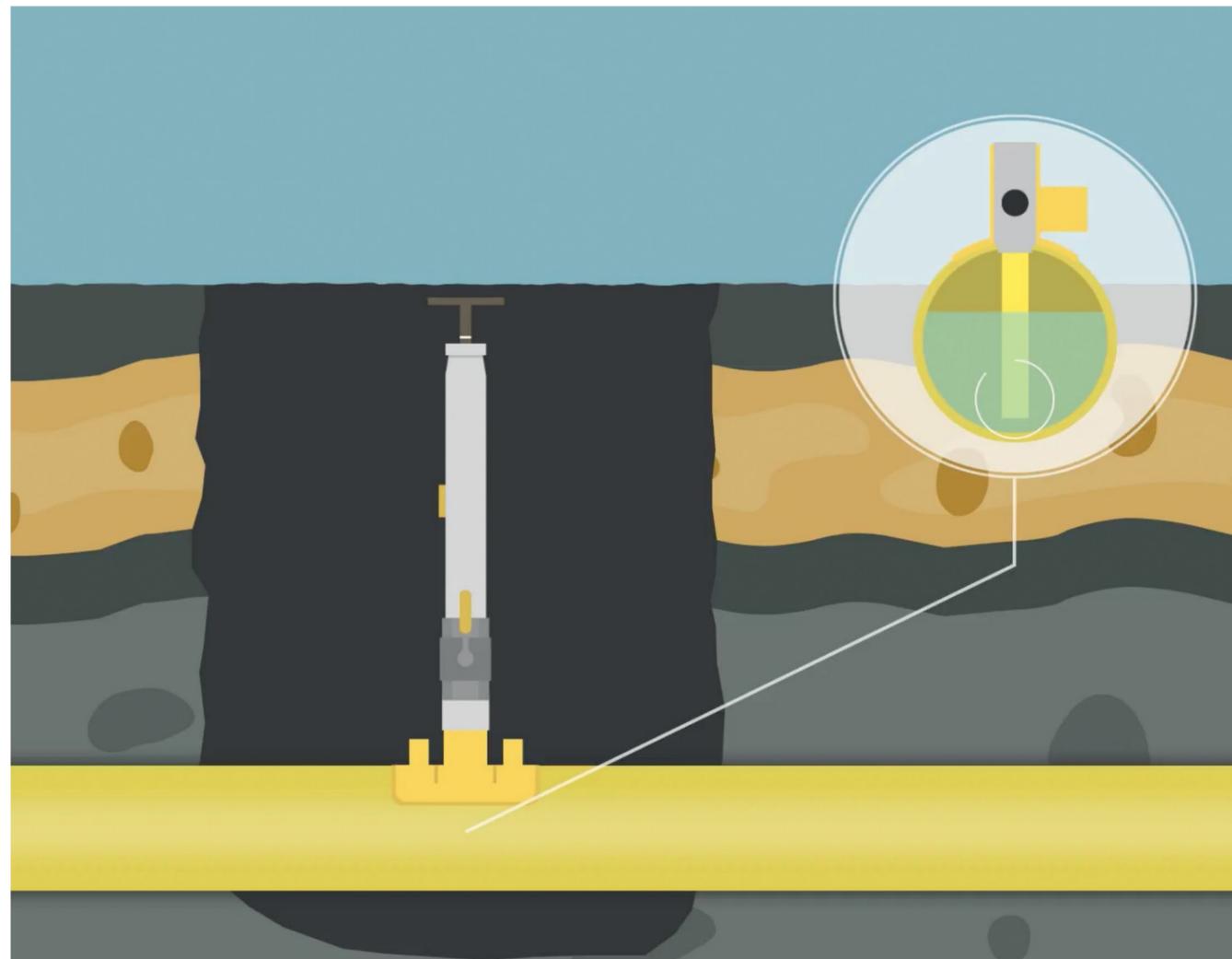
In the final phase of the project the system was developed to include a real time, underground 3D scan. Ten Sensit APL units were initially shared with our North London network and they are now available to order across all four of our networks.

Key stats

- Reduces average time on site to locate a pipe from 3.5 to 0.5 hours
- Sensit was used on more than 100 jobs across our four networks in 2016/17
- Deployed into all four of our networks.



IN TRIALS



Efficient removal of water from pipes: Top Tee Siphon Adaptor

This project aims to create an adaptor to remove water quickly and safely from pipes. Sometimes we need to flush water from our system, which has happened because of flooding or a burst water main. This means switching off gas to local people while we complete repairs.

The Top Tee Siphon Adaptor could remove the need for specialist equipment and fittings, allowing engineers to fit a siphon directly on to the pipe without installing a water collection pit. The speed of this solution should mean customers get their gas restored much faster than before.

Benefits

- Restores gas supply to customers more quickly
- Reduces excavation size and removes the need for a water collection pit

- Significant cost savings compared to existing methods
- Removes water from the gas main under no gas conditions
- No specialist equipment required.

Progress this year

Initial trial feedback is positive, and we expect to have this technology as business as usual in 2017/18.



IN TRIALS

■ To see an idea that myself and my previous line manager came up with go through research and development into live field trials is really exciting. Although this is a relatively simple innovation, the operational benefits it could provide have been apparent from the start.
Project Manager, Adam Hassall

Working collaboratively to boost benefits to customers

Utility companies face similar challenges. So it makes sense to collaborate closely with colleagues across other gas distribution networks – and more widely. By sharing new technology and effective ways of working, we can increase the positive impact innovation has for our customers.

Over the past year we have:

- Showcased our work at the Low Carbon Network Innovation (LCNI) Conference alongside other energy companies and third party suppliers
- Been involved in the Gas Innovation Governance Group (GIGG), where all the gas distribution networks and National Grid Gas Transmission work together to unearth the problems we are trying to solve with innovation
- Worked with the Energy Innovation Centre (EIC). The EIC helps us find solutions by reaching out to third party suppliers.

Let's explore what we are achieving with some of our collaborative projects.

■ It's great to work with others across the industry to try and solve some big issues and influence how the networks develop in the future.

Mains Replacement Portfolio Manager, Andy Newton



Extending the life of our pipes: Cured In-Place Pipe (CIPP)

This is an SGN-led collaborative project to develop commercially viable pipe-lining technology as an alternative to mains replacement, where it is appropriate.

The technology is called CIPP. It creates a new pipe within an old iron mains by feeding a resin-saturated lining tube inside and then curing it in place using UV light.

Rather than relying on the host pipe for its structural integrity, the solution is structurally stable in its own right. Side and end connection fittings can also be connected to the liner.

Benefits

- Reduces excavations
- Can be used in areas where there is limited space to work
- Quick to install
- Saves money.

Progress this year

Development of side and end connection fittings is progressing with field trials planned.



Repairing pipeline damage quicker: Composite repair system

This project sees all four gas distribution networks and National Grid Gas Transmission working together to explore composite repairs for piping.

Current solutions for repairing damage to complex parts of a pipeline, such as a bend or tee, are limited to cutting out and replacing the damaged section or making a bespoke steel encapsulation shell.

With a composite repair system, technicians can wrap defects with several layers of sleeves and adhesive. It is a fast and simple solution that could lower repair costs and reduce disruption for customers.

Benefits

- Reduced repair costs
- Gets the job done faster, reducing disruption for customers.

Progress this year

Our focus has been on making sure the right components and processes are in place, before we begin testing the technology on different pipe configurations and under a variety of environmental conditions.

The solution works on complex pipe shapes, both as an emergency repair system and a permanent, long-term solution.



How we're adapting to significant new learning

During the innovation process, new technical challenges come to light, circumstances change or alternative technologies come to market that require a change of direction. Getting the best outcome from projects means having the courage to adapt when there's a strong case to do so. This year, we've responded to significant new learning in the following ways:

PRISM/BAE programme review

The goal of the PRISM and BAE projects is to develop a resin-based pipe replacement solution which can be carried out with minimal disruption to the public.

While significant progress has been made, several key challenges remain. For this reason, we have put in place a review of the programme.

As part of this, we have made a further request for potential supporting solutions from innovators within the gas industry. We are also working with companies that have expertise across other industries to see what we can learn from across the sectors.



New pipes from plastic: Blown Air Extrusion (BAE)

BAE works on a similar principle to PRISM. It uses the old service pipe – the pipe connecting the customer to the mains – as a mould to create a new pipe. It differs from PRISM in that a vortex of air is used to distribute the polymer instead of a spray-head.

Learning this year
Trials have helped us gain a better understanding of how the resin is deposited on and around bends in pipes. This gives us confidence that the pipes we are forming will be of

consistent quality, and meet with safety requirements.

Following the trials, we have now successfully applied the BAE technique to service pipes. We will now move on to service pipe configurations.

Another key improvement saw us develop a chemically bonded connection between the service pipe, formed using BAE, and the mains pipe, formed using PRISM. We are now working to refine its design.

Minimising disruption with revolutionary robotics: TORS

Replacing gas service pipes used to mean digging holes outside every property with a connection. With our ground-breaking TORS (Tier One Replacement System) robot, the remotely controlled device can make these service connections from inside a mains pipe – without digging as many holes. Tier One is another name for our low-pressure gas system.



Learning this year

Following trials we discovered challenges related to the position and shape of the polyethylene (PE) pipe. This means it's more challenging to connect the services pipes with the TORS robot. We have worked to develop solutions to resolve these issues to help us make consistent, reliable connections with TORS. The electrofusion manufacturers have developed the remote electrofusion fittings which remotely weld the joints together underground.



■ We've overcome significant technical challenges to progress TORS to field trials, and have developed wider learning which will be applicable to other projects. Project Manager, Christine Gunter

The science of spray-lining: Pipe Replacement In Situ Manufacturing (PRISM)

PRISM is an innovative technique for replacing ageing gas mains. It creates a new, fully structural plastic pipe by blowing a liquid polymer inside an existing cast iron one. The polymer then sets, effectively using the old pipe as a mould to create the new plastic replacement.

Learning this year

Since our update last year, we have been working with suppliers to develop side and end fittings for PRISM. This is so the new pipes can be reliably connected back into the existing gas network. We have successfully demonstrated prototypes of each fitting and are continuing to fine tune them.

Eliminating excavations: KOBUS

KOBUS is a technology that removes the need for excavations when replacing service pipes. It allows the old pipe to be withdrawn, while pulling a new plastic pipe into place.

Learning this year

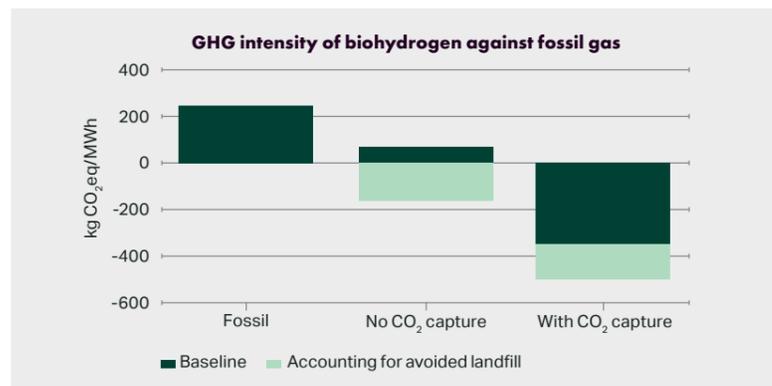
During field trials, we noticed that the new pipe was sustaining some surface damage during installation. We are currently reviewing potential solutions.

Innovating for a low carbon energy future

We believe the gas distribution network can continue to play an important role in meeting future energy needs. So we have been exploring how low carbon gas alternatives – delivered by our network – could help meet the nation’s heat and transport needs.



Producing hydrogen from waste: BioH2



This project set out to develop and demonstrate technology for producing hydrogen from waste. Known as biohydrogen (BioH₂), it can play a vital role in the UK’s future energy mix and significantly reduce carbon emissions.

The project saw us reconfigure existing equipment to successfully produce high-purity hydrogen from waste. We showed that the concept is both credible and commercially viable.

Progress this year

With the project complete, we will now look to research the technology further with the longer-term aim of fully using it across our business.

An optimised production flow scheme for a 50MW commercial-scale biohydrogen facility has been developed. This would be capable of producing both industrial and fuel-cell grade hydrogen, while achieving significant greenhouse gas savings.

Future role of gas projects

We have two important projects in progress that are funded by the Network Innovation Competition (NIC).

Future Billing Methodology

We are exploring different options for commercial billing in the gas industry as the current framework can be a barrier to providers of alternative sources of gas. This project will help maximise the potential of the gas network to distribute these gases, helping customers move to a low-carbon future. Find out more at futurebillingmethodology.com

HyDeploy

Alongside project partners, including Northern Gas Networks, we are leading on a project to establish and demonstrate the level of hydrogen that can be safely blended with natural gas for use in a GB network. The three year project will include live field trials on the Keele University campus. Find out [more here](#).

1.5

million tonnes of CO₂ per year could be captured and stored



Reducing network carbon intensity with hydrogen: Liverpool-Manchester Hydrogen Cluster

Liverpool-Manchester Hydrogen Cluster is a conceptual project to develop a low-cost framework for introducing hydrogen into the gas network.

It proposes converting natural gas into clean-burning hydrogen gas, using a process called steam methane reforming. The process also removes CO₂ from the gas, which can then be captured and stored using existing CCS (Carbon Capture and Storage) technology.

The hydrogen gas would then be fed into the Liverpool-Manchester distribution network as a blend with natural gas. The blending level of this mix is being set by the HyDeploy Network Innovation Competition project (see left).



Revolutionising fuel for transport: Leyland CNG filling station

The first ever Compressed Natural Gas (CNG) filling station connected to our Local Transmission System (LTS) in Leyland, Lancashire has now been operating for 12 months.

What makes it unique is that it is the first station to be connected to the LTS, the high-pressure tier (30 bar) in our distribution system. Well-to-wheel emissions (the total emissions from sourcing the gas to filling your truck) are substantially lower than those created by a diesel filling station.

The John Lewis Partnership uses the station to fuel its fleet of dedicated CNG HGVs, which are based at its nearby regional distribution centre.

Benefits demonstrated

- Compared to diesel, overall well-to-tank emissions at Leyland (total from source to station) are 56% to 69% lower
- Waitrose CNG lorries operating from the Leyland site are expected to save 100 tonnes of CO₂ per year
- Biomethane CNG dispensed from Leyland is 35%-40% cheaper than diesel, and costs no more than fossil gas.

Progress this year

This project has finished. We are exploring options for connecting more filling stations to our network.

Key stats

- The station has been dispensing 100% biomethane since September 2016
- The fuel is covered by the UK’s Renewable Transport Fuel Certificates
- Dedicated gas vehicles fuelled by renewable biomethane can deliver significant reductions in emissions compared to diesel. For example, up to 84% for carbon dioxide and up to 99% for nitrogen oxides.



BUSINESS AS USUAL

We believe that compressed natural gas provides a really strong technology for decarbonising heavy goods vehicle transport.

Future role of gas Portfolio Manager, Andy Lewis

How we're moving forward with other innovations

Every day at Cadent, our teams are sharing ideas and challenging what they know. So sometimes it makes sense to look at innovation outside the projects funded by the NIA or NIC. We are developing a strong portfolio of work in Information Service (IS) innovation, led by our dedicated in-house team.



Transport for London: Keyhole Site Planner

We have applied for funding under the Transport for London innovation fund. This makes money available to utility companies that have innovative ideas for reducing the problem of traffic disruption associated with roadworks in London.

As a result, we are currently developing a program that allows users to plan a keyhole excavation in 3D using real time information. Using this proactive approach allows us to not only plan the layout of the site, but to also gather information related to how the proposed setup will impact traffic flow.

The overall goal of the Keyhole Site Planner is to minimise traffic disruption by allowing engineers to see the effects any keyhole excavation will have when performed at a given location, allowing them to plan accordingly.

Benefits

- Allows users to plan for and reduce disruption, as well as save time on the job
- Gives a real time update on how a keyhole excavation will affect traffic flow
- Proactive gathering of cost data.

Progress this year

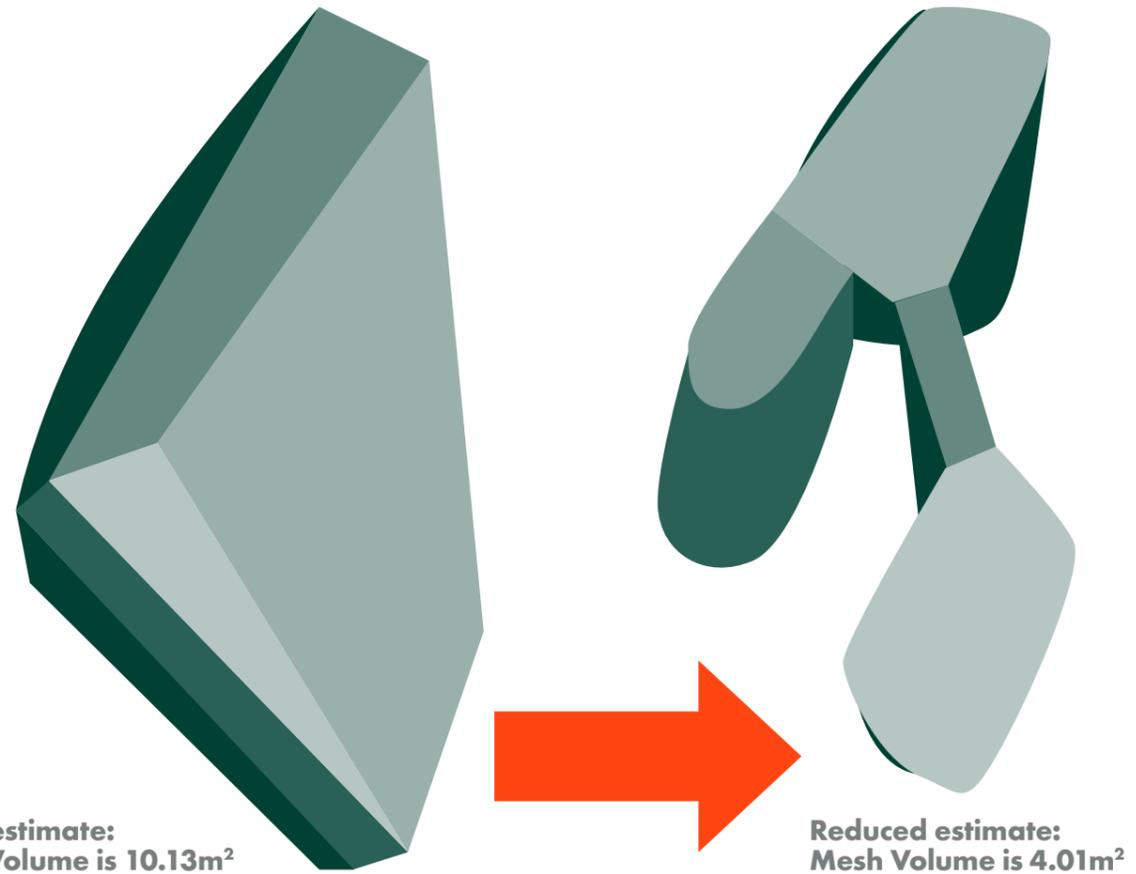
The project is being developed by our Catalyst Information Services innovation team.

This project is a great example of how smart thinking, combined with sharing resources across the industry can really benefit the public.



IN DEVELOPMENT

■ Scanning the shape and volume of an excavation



Accurate information about excavations: 3D Volume Scanner

The 3D Volume Scanner measures the volume, dimensions and layers of material in an excavation. This gives the next team on site all the information they need to bring the best equipment and the right materials for refilling the dig.

The product was designed in-house by our Catalyst Information Services Innovation team. They are passionate about using emerging technologies to improve the customer experience, and make us safer and more efficient.

Users scan the excavation with a handheld unit. Data is recorded and transferred back to the office, where records are updated. Traditionally, this process relied on technicians taking time-consuming manual measurements that were open to error.

Benefits

- Calculates the volume and dimensions of the excavation and the type of materials used in each layer

- Accurate data collected by the scanner helps reduce operating costs, safety risk and disruption to customers

- Reinstatement teams have the right information for backfilling

- Handheld scanning reduces time and risk on site compared to manual methods.

Progress this year

The 3D scanner is out for user testing with Northern Gas Networks, Wales & West Utilities and Cadent.

Key stats

- Around 90,000 excavations a year can now be accurately and digitally scanned
- By reducing our time on site, we will reduce the carbon footprint of our reinstatement work by 30%.



IN TRIALS

■ We are taking the latest technology and exploring how we can use it in new ways to keep people safe and improve efficiency. Technology Innovation Manager, Dave Goldsby



Final words

The progress we have made this year is underpinned by the dedication of everyone in our business to take on tough challenges and help our customers live better.

We are fully committed to pursuing innovation, decarbonising our future and being the kind of progressive business that impacts positively on households, businesses and communities across the UK.

A full list of our innovation projects can be found on the [ENA Smarter Networks Portal](#).



Looking ahead

Our **Challenge Statements** set out the high priority areas where we are looking for solutions in 2017/18 and beyond.

To do this, we need help from partners across business, industry and education. We are looking for ambitious, open-minded experts who have the ideas and technologies to build new solutions, or even totally transform the way we work.

- If you are interested in working with us and helping us shape a new future for gas, please get in touch via: box.gd.innovation@cadentgas.com.



Cadent

Your Gas Network

Cadent
Ashbrook Court
Central Boulevard
Coventry
CV7 8PE
cadentgas.com