

The Annual Network Innovation Allowance Report 2015



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Innovating for success

In our relentless focus to offer increasingly better value and deliver the highest standards of safety and reliability, technological innovation continues to have a profound effect on many aspects of our business.

From new excavation methods that reduce the number and sizes of holes that we need to dig, to smarter ways to reduce the impact of our activities on the environment and keep our customers and colleagues safe, we continue to embrace new technology and processes.

To deliver our ambition to provide the very best service for our customers and stakeholders, which is future proof for tomorrow, we have established a more robust Innovation strategy that is embedded in our business and acknowledges both the current and future needs of the communities in which we work and, ultimately, our industry as a whole.

It also recognises that industry collaboration is vital to develop effective models which deliver sustainable, transferable benefits for customers and stakeholders UK-wide.

It feels great to be part of a sector that's working together to produce results that would have been unthinkable just a few years ago. The NIA funding is vital in supporting this process, underpinning our culture of innovation and bringing the industry closer to unearthing those 'golden nuggets' that have the potential to revolutionise the way we do things, both now and in the future.

In our efforts to deliver industry leading customer service we have been benchmarking our performance against the very best of UK businesses and these relationships continue to help us innovate.

This document provides a snapshot of some of the key Network Innovation Allowance funded initiatives that NGN (often working directly with our industry colleagues) has been involved with over the past 12 months, highlighting how we've innovated around our key focus areas of Safety, Environment, Asset and Network Management, Customer Service and the Future role of gas, and brought to life with quotes from customers and stakeholders.

Further information about all of our projects can be found at

www.smarternetworks.org



Mark Horsley

Chief Executive Officer, Northern Gas Networks

Refining our Innovation strategy

In the last 12 months NGN has developed and re-shaped its Innovation strategy so that it is reflective of the UK's current and future energy needs and the issues that matter most to our stakeholders.

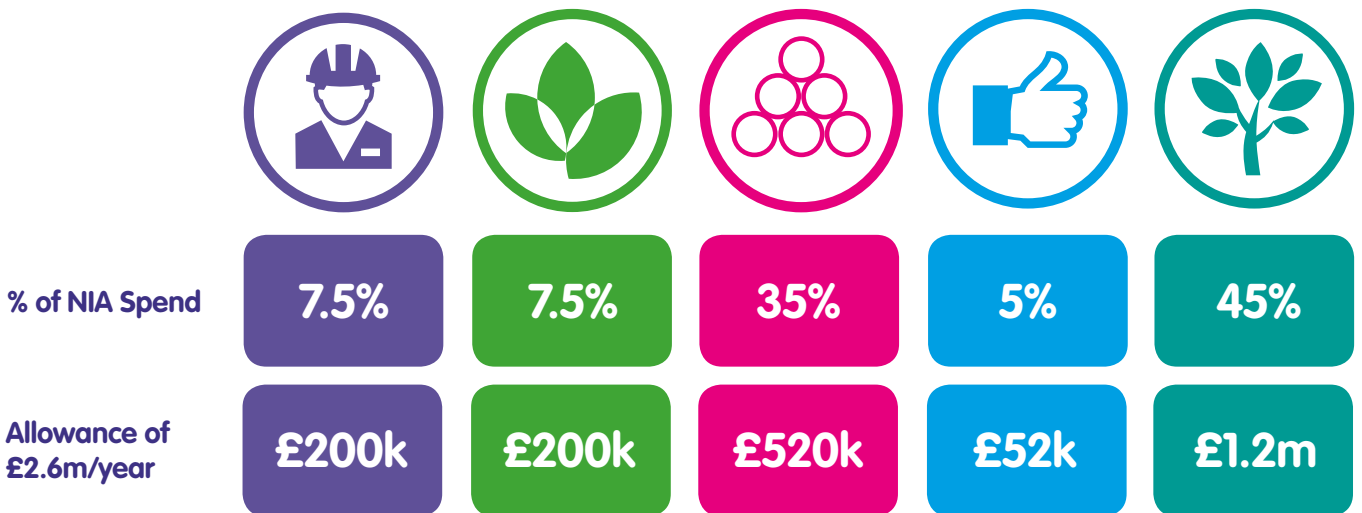
In last year's submission we outlined six core themes for our innovation work: Safety, Environment, Asset and Network Management, Customer Service, Value for money and the Future role of gas.

Our new strategy retains many of these original areas of focus, with the exception of Value for money, which is no longer defined as a stand-alone theme, as it is integral to everything that we do and should be evident in all NIA projects across all priority areas.

2014/15 Innovation Focus Areas



2015/16 Innovation Focus Areas



Although our team is small our strategy seeks to leverage expertise and support from all of the key business areas. At the heart of our strategy is a collaborative approach which enables us to harness the power of multiple partner organisations and deliver increasingly high impact initiatives today whilst planning for tomorrow.

Our approach has also matured, recognising that some innovation is best developed internally before sharing with the industry while other initiatives are best developed and delivered collaboratively.

NGN plans to progress projects in line with the strategy however recognises that to be effective the approach must remain flexible. As such the above is a guide to our investment and the projects that are undertaken will be those that provide the most significant overall benefit for customers when assessed against our internal eligibility criteria.

A culture of innovation

The structure of our business is one where innovation is encouraged, enabled and rewarded.

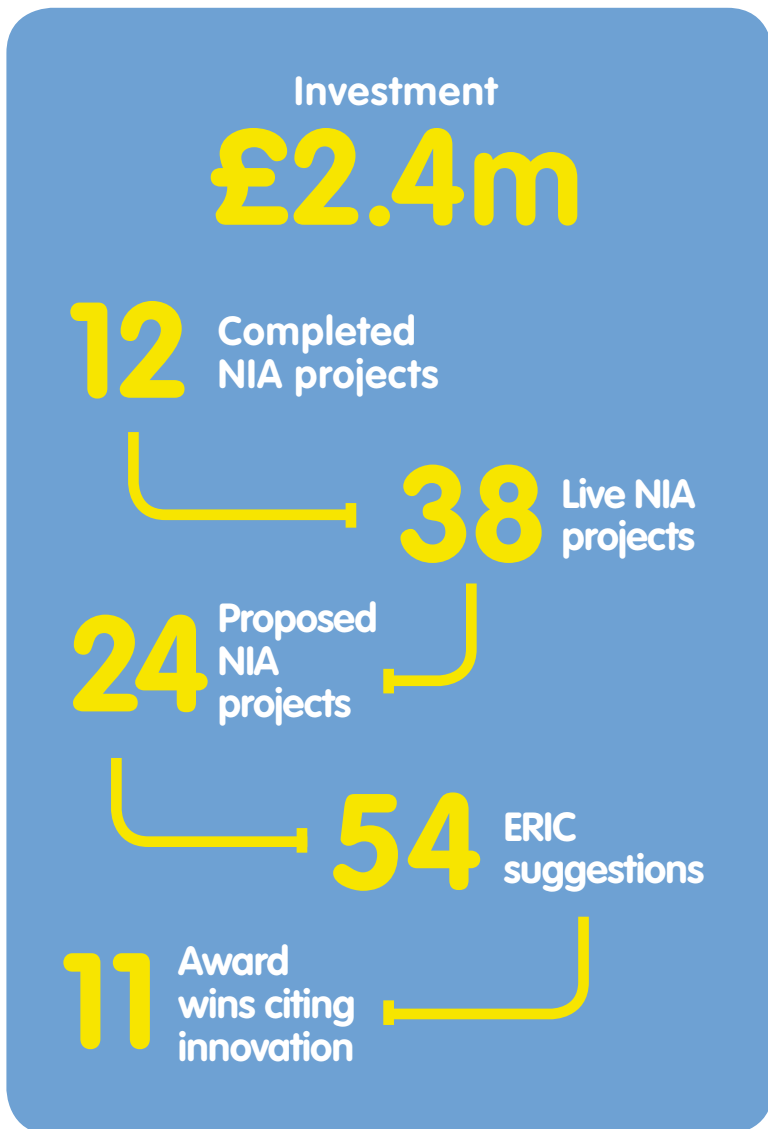
We have introduced a mechanism that makes it easy to capture the outputs of all those 'light bulb' moments our team members have on a daily basis.

Encourage Real Innovation Culture (ERIC) is our new, easy to use smartphone app which lets colleagues share their ideas or work related challenges wherever they are.

With a quick and simple interface, the ability to attach photos and save any work in progress, ERIC allows feedback to be provided in real-time, as well as earning rewards.

The app has been developed by NGN in collaboration with the Energy Innovation Centre (EIC) and its innovative name was suggested by a colleague as part of an internal competition.

There have already been 54 ideas submitted since ERIC was launched in April 2014.



Significant new learning

As demonstrated by the implementation of our new structure and strategy, NGN is continually looking for ways to develop and improve its innovation function and outputs.

Collaboration

As the various networks' innovations functions mature, it's feeling more and more natural to work collaboratively and share best practice as evidenced by the growing number of forums for us to compare notes both within and outside our industry such as:

- **The Gas Innovation Governance Group (held monthly and hosted by a different GDN each time)**
- **Low Carbon Network Innovation Conference (Aberdeen, October 2014) – something we have pledged to support each year including the 2015 event, taking place in Liverpool in November 2015.**
- **Gas Futures Group (held monthly and hosted by ENA)**

Implementation

To date we have successfully introduced a number of innovation projects into business as usual, such as magnetometers and CO Gascoseekers. This year we have continued to implement further technologies which have been developed using the funding, such as the Acoustic Camera and Core & Vac, as well as introducing new analytical tools which will help us better define our replacement model.

We've learned a lot through the process of transitioning projects into business as usual, and this learning will be used to inform future strategy and approaches.

Competitive tendering

Having recognised the benefits of accessing the knowledge of SMEs, who were previously invisible to us, in the last 12 months we've also become more aware of the value of two-way flow of communication.

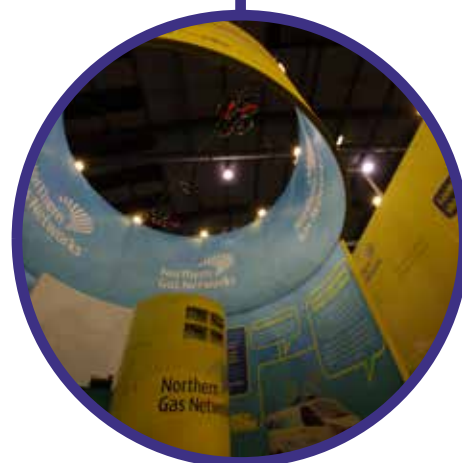
We decided to be more proactive in developing calls for interest for specific projects from SMEs via the Energy Innovation Centre (EIC), rather than waiting for the approaches to come to us.

Now, when a colleague flags up an issue, we share this with all of the SMEs on EIC's database to ask for them to submit details of their potential solutions. This has been successful in producing a wide variety of solutions we may not even have thought of, enabling us to develop informed projects that not only seek to solve a specific internal problem, but also open the doors to input from brand new SME partners.

With theft of gas being a major issue for all GDNs, NGN approached the EIC to develop and issue a call for interest that included a detailed problem statement. We received a huge response ranging from proof of concepts through to recommendations for using pieces of kit already being used overseas. We are now developing this response into a project that will be open for all GDNs to collaborate on.

Impact of standards

This year we included a review of existing policies and procedures as part of the project and, where necessary developed new ones; supporting rather than dictating innovation.



NIA project updates

Significant progress has been made with a number of innovations that initially kicked off in 2013/14.

Acoustic Camera and Core & Vac



2013/14 status

In 2014, we brought together acoustic leak detection equipment (used successfully in the water industry before we modified it for gas) and our existing Core & Vac minimal excavation technique to deliver some impressive results during trials carried out on 167 repair jobs:

- Increased accuracy of leak reduction
- 33% reduction in the time taken to pinpoint leaks
- Average repair time down from 4 days to 4 hours
- 95% of trial jobs delivered a cost saving of 12%
- Size of typical excavation decreased from 1.4 m sq to a replaceable core of between 450 and 600mm diameter
- Vehicles deployed to site reduced by 50%
- Use of virgin material reduced by 96%
- Greatly reduced risk of cable strikes and physical impact



2014/15 developments

The trials were so resoundingly successful that our application to bring the technology into business as usual was accepted. We have invested an initial £750,000 to introduce two units as well as appointing a full-time Acoustic Camera Operator and Specialist Site Manager.

The technology has been shared with our colleagues at National Grid and SGN. Overseas it is being adopted this year in New York, San Diego and Toronto after visitors from America came to Durham to witness it in action and in May we also showcased the kit to Melchers Oil and Gas Co in Singapore.

The technology won a 2015 IGEM award for Innovation.

In 2015/16 we're hoping to commence a project to support the development of the acoustic technology so that we can reap the same benefits and help us locate leakage in larger diameter pipes.

95% of trial jobs delivered a cost saving of **12%**

Customer benefits

In addition to the benefits highlighted above, we're now looking at ways to further minimise customer disruption by combining this technology with emerging innovations such as Acoustek (see full project details later in this document) which will help further minimise customer disruption.



2013/14 status

With water ingress being one of the biggest issues facing our industry, last year we registered a two-part project to look at finding workable solutions for the future.

This project was kicked off following a prototype that was developed by one of our Emergency Technicians to aid in the extraction of water from services after struggling with a particularly challenging job in Withernsea, a remote location on the East Coast of Yorkshire, around 25 miles from our nearest depot. Part two of the project was initiated following a suggestion from our Tees Area to explore the possibility of developing a CCTV camera system that could withdraw water from inside the main via the camera head, thus seeing the water before and during removal. We asked for support from Synthotech – a SME that specialises in developing pipework engineering solutions for utility businesses worldwide – on the back of their success with developing a solution to a similar problem being experienced by a client in Brazil.

For NGN the process of getting customers back on supply is a lengthy one. Upon being notified of an interruption, we have to send a First Call Engineer (FCE) to site who, upon confirming the presence of water in the services, will isolate the supply and call in a Repair team.

Once the Repair team has finished, the FCE will return to reconnect the supply - by which time customers may have been without gas for several hours.

Working with Synthotech, we developed a two-stage programme to significantly shorten the time that customers are without gas.

Stage one of the project began in 2013/14 with an initial research and planning exercise. We embarked on a scope of work with Synthotech and Macaw Engineering to help us quantify the scale of the water ingress problem in our gas mains network and identify weaknesses with our existing water management processes, including how water moves around within our network.

At the end of this process, we had:

- **Developed a detailed report on the root causes, behaviours and current solutions used by NGN to tackle water ingress and its removal from the mains network**
- **Laboratory tested prototype technologies based on a CCTV Water Extraction system developed by Synthotech**
- **Prepared a proposal for field testing two versions of the prototype (one for mains and one for services)**

2014/15 developments

Stage two of the project, to physically test the two prototypes (one for services and one for mains), kicked off in May 2015.

Both units combine a CCTV camera with an in-built water extraction device that can be operated without the need to interrupt the gas supply. The gas main camera/ extraction technology not only separates gas from water, but can also inject gas back into the network, reducing environmental impact and ensuring customers aren't given cause for concern because they can smell gas. At the end of the water removal process, the camera can be used to ensure that no water is remaining or identify the point of entry.



We have been successful in launching the camera unit up to

55m

into all types of mains pipe

Service water extraction system

Synthotech developed two water extraction units for us to trial in Withernsea for water problems in services.

Each mobile unit is specifically designed so that one man can transport and operate it, meaning the current very complex and lengthy call out, isolation, extraction and reconnection process can be substantially reduced – the first engineer on site will be able to do everything.

The unit has been deployed to three incidents so far and early indications are that both the unit and process around its one-man operation work well with PE services, but may need modifying for steel services.

Field trials will continue for the rest of 2015 so that the technology can be tested in all seasons before a final specification and recommendation is developed.

Mains water extraction system

Trials of this system commenced in January 2015 in the Tees area and are ongoing. The unit is being trialled in plastic, steel and cast mains and we have been successful in launching the camera unit up to 55 metres into all types of pipe. In May we were successful in extracting water up to the same distances across three different test sites and, at one site, we were able to identify the actual point of water ingress after the main body of water had been removed.

Although very encouraging, the trials have also pointed to some changes that need to be made to both the system and operational procedures:

- **We've asked for the electric pump unit to be replaced with a pneumatic one to reduce risk**
- **We're adjusting the procedure to specify that the filter unit needs to be removed and cleaned after each use, otherwise it clogs up**
- **We're about to finalise our preferred specification for the length of the cobra hose so that we achieve the optimum balance between the length of hose and the end water pressure (we believe we are likely to recommend a 50m hose)**

Customer benefits

NGN experiences approximately 400 water ingress events each year so, if adopted, the system has the potential to deliver substantial benefits.

Interim outputs from the system trials indicate it will reduce the time taken to extract water, the number of excavations and resource required by 50%.

New innovations for 2014/15

Intelligent CO detector



Effective CO detection and awareness is a real focus area for NGN – in 2013 we invested £1.8 million in equipping every single one of our customer facing engineers with a handheld Gascoseeker which has significantly increased the number of instances of us detecting CO presence – from 86 recorded incidents in 2012 to 169 in 2013 and 194 in 2014 (in 11 of these instances those reporting an incident were not aware of the presence of CO, so this initiative has already helped save lives).

So we were very keen from the start when the Energy Innovation Centre (EIC) approached us to see if we'd be interested in taking part in a trial of an Intelligent CO detector developed by Smartco, an SME they'd been approached by.

Developed with vulnerable people in mind, the detector is a CO alarm meets mobile phone. As well as sounding an alarm if CO is detected or if the unit is tampered with, it also incorporates a SIM that can send a text alert to a central monitoring point (a social landlord or warden for example).

Along with two GDNs, we are installing 600 alarms nationwide as part of a year long trial that began in April 2015.

At NGN, we're working with Kirklees Neighbourhood Housing where we've installed 150 alarms and where, during the installation process, we identified CO in a resident's boiler house. As well as testing the technology, we'll be sending quarterly updates out to all of those involved in the trial and we'll also be gauging their awareness of CO before, during and after the trial to help inform our future education activities.



£1.8m

invested in equipping every single one of our customer facing engineers with a handheld Gascoseeker.

Customer benefits

We're working closely with Kirklees CO awareness charity, The Dominic Rodgers Trust, run by Stacey Rodgers, whose ten-year old son tragically died of CO poisoning in 2004, to keep our customers safe. We have saved an estimated 22 lives through raising awareness of CO poisoning.

“ I think these alarms are an important development, not just in that they'll protect vulnerable people, but that they'll also raise awareness generally about the dangers of CO poisoning and how to look out for signs of it in your home. NGN has supported us over a number of years now and it's great the gas distribution networks are working together on this. ”

Stacey Rodgers, The Dominic Rodgers Trust

PE riser lining projects



This suite of interlinking projects has been kicked off to clarify the processes around the use and repair of PE pipes, as well as trialling new technologies that could extend their life. There is the potential for this to impact significantly across a number of our focus areas.

Development of gas industry specification for Polymeric pipe lining systems for multi-occupancy buildings

Replacing steel riser pipes in multi occupancy buildings is fraught with issues. When ageing pipe starts to leak or deteriorate through corrosion, the only solution currently is to isolate the old internal pipe and strap a new one to the exterior of the building. This not only looks unsightly, but the process of co-ordinating outages and gaining access to multiple households over a number of floors is also time-consuming, frustrating and expensive.

All of the GDNs are collaborating on a project established via the Energy Innovation Centre (EIC) with DNV GL to explore the feasibility of using similar pipeline lining technologies to those used in the water industry to extend the life of the existing metal risers in order to provide a cost effective, long-term, sustainable solution.



Testing new technologies

Having researched a number of systems, two of the most promising, NuFlow (an epoxy coating) and HTC WhirlWind Serline System are now being fully trialled on a test rig at DNV GL's test site at Spadeadam in Cumbria, with a view to not only validating their effectiveness for use within the gas industry, but also producing a specification for their application.



Customer benefits

It is estimated that using lining technology will generate cost savings of around 25-50%, equating to approximately £3 - £6 million for NGN alone over a five year period. In addition to the financial benefit, the method avoids disruption to customers' gas supply and ultimately increases overall customer satisfaction.



As an industry, we're continuing to push the boundaries when it comes to speeding up the process and improving the accuracy of detecting the location of leaks and blockages in our pipes to reduce risk and environmental impact and improve efficiency and customer service as a whole.

The adoption, in 2015, by NGN of Acoustic Camera technology combined with Core & Vac techniques is already transforming the repairs part of our business, but we're keen to continue to look for ways for making further improvements.

When Manchester University approached the Energy Innovation Centre (EIC) with an idea for adapting their existing Acoustek technology, used successfully to detect blockages, leaks and lost 'PIGs (pipeline inspection gauge)' in high pressure offshore gas pipelines, all four gas distribution networks were interested in exploring its potential.

Acoustek comprises a probe and a microphone which, when inserted in to the pipe can shoot a sound wave up to 500m in either direction. If the sound wave encounters a leak, blockage (and potentially water ingress), it will bounce back to the probe where the resulting sound graph provides a precise indication of the location of the anomaly.

A huge advantage of this technology is its range – 1km of pipe can be surveyed on the back of just one excavation, whereas existing camera technology can only survey around 100 metres at a time resulting in ten times the number of excavations.

We're collaboratively involved in a trial which has seen Manchester University gain some impressive results in lab tests and work with pipeline technology experts Synthotech to develop a bespoke device for carrying out field trials on 4 to 8" diameter pipes.

Field trials will be ongoing UK wide over the rest of 2015, after which HSE approval for the technology will be sought before individual GDNs prepare their own business cases for its adoption.



Customer benefits

It is predicted that Acoustek could deliver estimated cost savings of around 70% as well as reducing the number of excavations that need to be dug and the associated disruption.

💬 We know this technology works offshore, so we're confident it can have just as big an impact with gas distribution. What's really exciting is the possibility of combining Acoustek with existing techniques like Acoustic Camera + Core and Vac to make the whole leak/blockage/water detection process optimally efficient and minimally disruptive. 💬

Barry Lennox, Professor of Applied Control, who leads the Manchester University research team

Stub end abandonment developments



By 2032, GDNs are required by the HSE to fully abandon all Tier One pipes (iron pipes not exceeding 8"/200mm diameter) within 30m of a building. This requires that the total pipe length be removed so that it no longer contains gas.

Where a Tier One pipe joins on to a parent main by means of a 'T' section this can be very difficult to do. Existing techniques mean that the GDNs have to leave a 'stub' (often up to a metre) of live Tier One pipe adjoining the 'T' section or cut a section of the parent main out by costly and complex operations.

The practice of leaving a short stub could leave the industry with potentially thousands of stub ends that need to be removed at some point in the future. The potential impact on the customer, the environment and the efficiency of our individual businesses is huge.

As an industry, we needed to find a solution that both ensures compliance with future HSE requirements, as well as reducing impact on customers and the environment.

NGN is working with Steve Vick International (SVI), to develop a remote technology that allows us to abandon the whole pipe without leaving a stub end, meaning we don't have to return and cause more disruption in future

We currently use a technology where a bag is introduced into the pipe and pushed up towards the 'T' section before being filled with foam to form a barrier between the Tier One pipe and the parent pipe. This process ensures an effective seal, but it isn't possible to position the bag with any degree of accuracy, hence the need to leave a 'stub' of live pipe.

NGN and SVI have developed a trial technology combining a number of elements including:

- **A more robust, modified version of the existing foam bag with an impervious front face**
- **The introduction of a camera to help position the bag right at the end of the Tier One main but also ensuring it doesn't enter the parent main (doing away with the 'stub' while also avoiding any impact on flow within the live main)**

This new approach was tested extensively in a laboratory setting during 2014. We then commenced field trials in January 2015 where we worked in an unpopulated brownfield site in Middlesbrough to abandon pipes, before cutting them out to test whether there had been any leakage past the bags.

The January trials were a resounding success and we have since broadened the trial to 17 more locations across the NGN network. The data gathered from this trial will be developed into a business case during Q3 2015 and we are already confident of this being accepted by the business.



Customer benefits

Where a Tier One main connects to a large diameter main of 14" and larger, the complex flow stopping operations require large excavations, specialist resources and can take weeks to perform, causing prolonged disruption and increased risk to safety. Using the new technology, we can now abandon a pipe remotely and permanently within two to three days, without the need for major excavations.

During one trial we have successfully abandoned a Tier One main from a footpath with minimal impact on road users and pedestrians, where using the traditional method of cutting a section of the parent out would have resulted in weeks of major traffic management on a major road in North Shields. On another trial in the congested town centre of Beverley, East Yorkshire during May 2015, we completed a job in a day with minimal digging without blocking the entrances to shops, which would otherwise have been unavoidable.



NGN is looking at the possibilities and challenges around the development of the shale gas industry in the UK, as demonstrated through two projects currently ongoing under the NIA.

T-Shale 1 – Scoping

Aware of how little is really understood about shale gas in the UK and how shale gas development will impact the UK gas transportation networks, this project was established to help us as an industry understand more by talking to producers and transporters in countries with an established shale gas industry, i.e. US.

In March 2015, representatives from NGN were joined by colleagues from National Grid on a fact finding trip to the US, where they met with US gas transportation operators to gain a better understanding of the steps needed to accommodate the potential onset of shale gas development in the UK.

A summary of the learnings from this trip will be included in our next NIA progress report and we are also planning to develop a presentation of these outputs to share across the industry.



T-Shale 2 – Flow measurement

There are a number of questions around how the existing gas distribution infrastructure will be able to accommodate lots of smaller entry points for new unconventional sources of gas (biomethane and shale gas for example) directly into the distribution network rather than current offtakes from the National Transmission System (NTS).

Another big question is how will developers know there will be enough demand year round for the gas they produce?

The answer to this could be the difference between a production project being viable or otherwise, but the industry currently only has a very vague idea of the difference between peak winter demand and summer demand. We think that the summer flow is estimated at around 1.5% to 2.5% of the winter peak flow, however there is still work to do to validate this assumption for different network archetypes.

We're hoping in stage two to kick off a project to install meters at strategic points around our network so that we can monitor seasonal flow rates over a two-year period to enable us to build a more accurate picture.

Stage 1

NGN is managing Stage 1 of this process to source and test the most suitable meter technology and this will take place during the remainder of 2015.

Ultrasonic meters do not require outages and therefore minimise disruption to customers, but they are unproven for measuring low flow conditions on a gas distribution network. Initial lab tests have helped us to understand the possible applications and limitations of these meters for measuring low flows, so we're now in the process of validating the results with field tests before commencing with the next stage of the study.

Stage 2

We'll be looking to work collaboratively with our GDN colleagues to install test meters UK wide for a two-year monitoring project to take place over 2016 and 2017, before working together to analyse the findings so that we can more clearly quantify the opportunity for producers.

Customer benefits

Alternative forms of gas have a major part to play in securing a sustainable and affordable energy future for our customers. The exploratory work that we've conducted to date has highlighted how little anyone knows about the potential issues and opportunities around the UK shale gas industry. The projects described above are of vital importance and will help potential producers understand whether or not they have a viable project.

