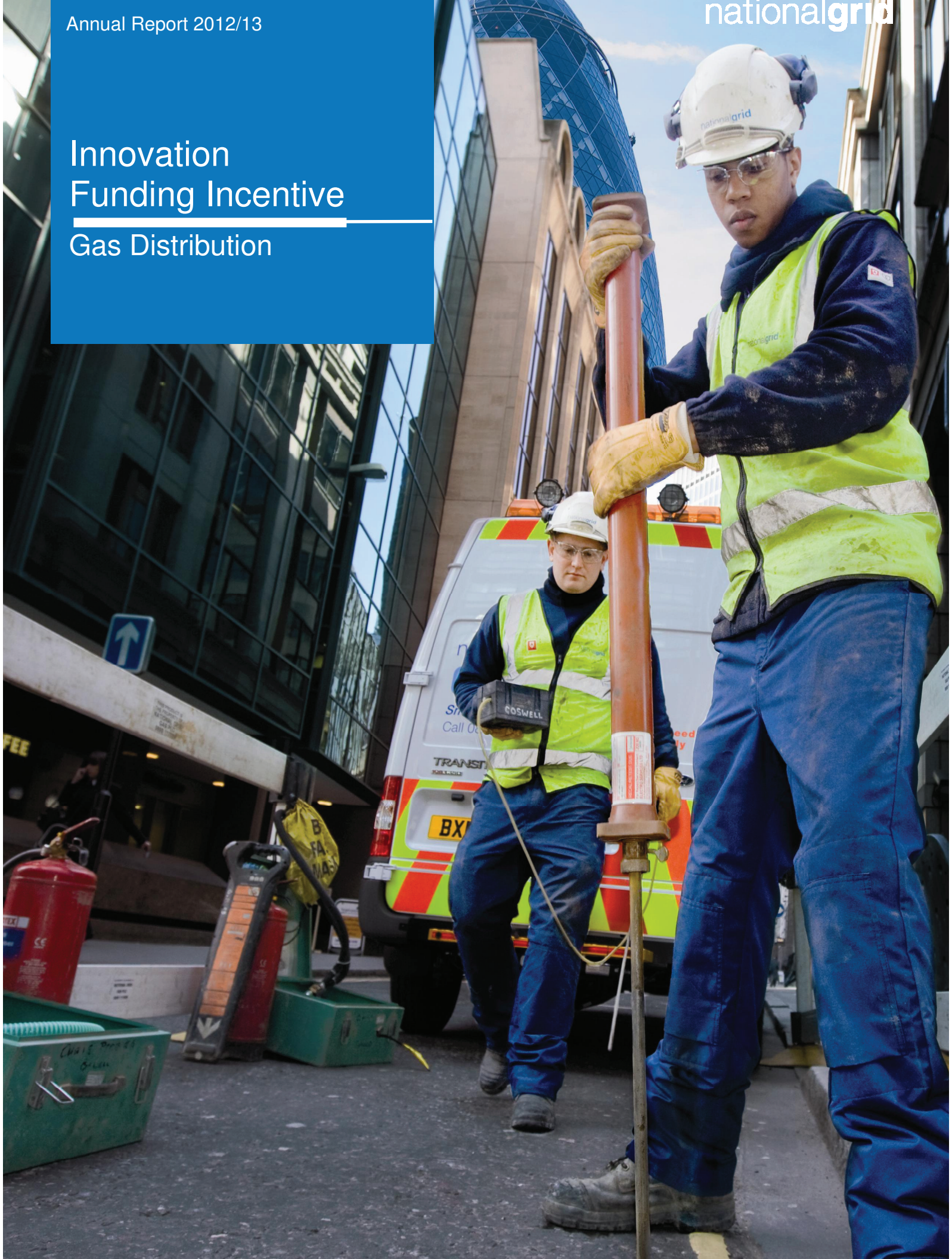
Annual Report 2012/13

Innovation Funding Incentive

Gas Distribution



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Introduction from Jeremy Bending

Welcome to the fifth and final Innovation report for Gas Distribution under the Innovation Funding Incentive for Sustainable Development (IFI).

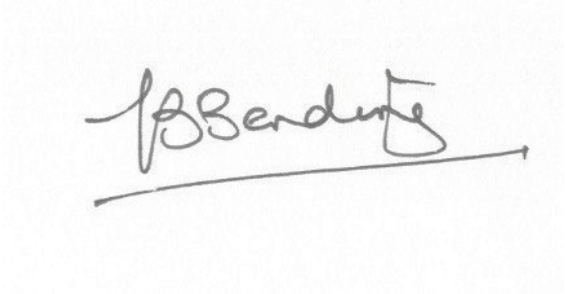
The challenge we set ourselves was to utilise the IFI to support future delivery and culturally re-energise technical research and development in our organisation. It has been a valuable journey to re-establish research and development in our core business processes.

We have used innovation successfully to support our ambition on leading the exploration of the role of gas in the energy pathways for a low carbon future as well as facilitating renewable gas into the Gas Distribution network through biogas demonstration plants. We have also used innovation successfully in our core work delivery processes, for example flowstopping trials were completed on large diameter, medium pressure Polyethylene pipes. The successful completion of these trials now enables National Grid to maintain and intervene on these pipes by using new stopple equipment for isolation and cut out operations. The benefits are, safer working practices, no residual damage left on asset, reduces costs and improves environmental footprint.

In the 5 years since IFI commenced, we have commissioned a total of 103 projects with 40% of projects being commissioned via collaborative partnerships. The projects cover a wide spectrum of activities with predominately short to medium term delivery horizons and at various stages of the innovation project lifecycle.

During 2012/13 we re-focussed our portfolio in preparation for transition to RIIO. As a result we have closed projects or reassessed the objectives against our new priorities and challenges and have presented specific project highlights within this report. The report details each active project in the 12/13 portfolio totalling £6.3m.

Innovation is at the heart of our plans for the future. With the forthcoming appointment of Emma FitzGerald, Gas Distribution looks forward to developing into a more innovative organisation to help improve our performance and deliver exceptional services to customers.



Jeremy Bending – Director, Gas Distribution

About National Grid and Gas Distribution

National Grid

National Grid is an international electricity and gas company and one of the largest investor-owned energy companies in the world. We play a vital role in providing energy to millions of customers across Great Britain and the Northeast US in an efficient, reliable and safe manner.

National Grid own and operate the gas distribution system in the UK and comprises of four of the eight regional gas distribution networks in Great Britain.

Gas Distribution

Our network comprises of 139,600 kilometres of gas distribution pipelines and we transport gas on behalf of approximately 25 active gas shippers from the gas national transmission system to around 10.8 million consumers.

We also manage the national gas emergency number and contact centre service for all gas distribution networks and for other transporters in the UK.

Overview of IFI Programme & 2012/13 Highlights

Introduction

The establishment of IFI has been a key enabler to culturally re-energise technical research and development in our organization during the 5 year PCR period. Without this focus research associated with the provision of safe, reliable and secure networks would have significantly declined as it did following privatisation during the early 90's.

Throughout IFI our aim has been to balance our portfolio to improve efficiency, improve asset and energy management, and support improvements in all aspects of the environment. In conjunction with balancing our portfolio across these key themes, we have utilised the Technology Readiness Level (TRL) model as a key part of understanding the risk associated with a project, and to ensure that we balance both tactical and strategic projects within our portfolio (see figure 4.1).

Over the past five years our focus on innovation has been growing year on year in our core business processes. We have continued to build strong working relationships with suppliers, developed collaborative partnerships with research bodies, network operators and other utilities, and sought new collaborative ways of working to bring forward new innovations and technologies from around the world.

As a result of direct feedback from our stakeholders through our 'Talking Networks' sessions we have improved the ability for smaller businesses to work with us. National Grid and the other GDN's entered into a new collaborative agreement with the Energy Innovation Centre (EIC). The EIC work with Small Medium Enterprises (SMEs) to bring forward new innovations and technologies from around the world that could potentially be applied to the gas network. This partnership acts as a key enabler to source new and exciting ideas, whilst facilitating industry collaboration across the other gas network providers.

IFI Projects Activity

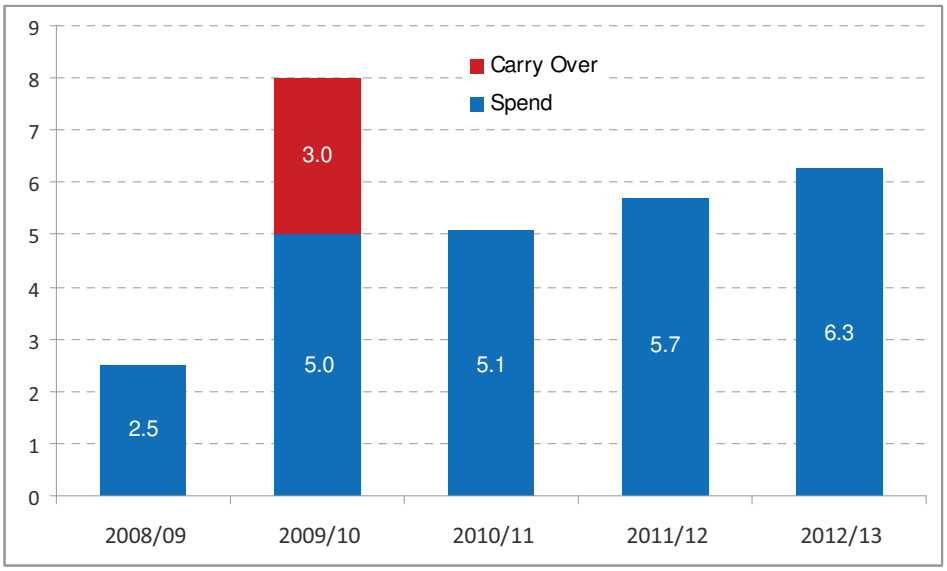
We have commissioned a total of 103 innovation projects and approximately 40% of projects commissioned to date have secured funding via collaborative partnership with various other organizations and other GDNs. The projects covered a wide spectrum of gas distribution activities with predominately short to medium term delivery horizons and at various stages in the innovation project lifecycle.

We have used innovation successfully to help facilitate the drive towards a low carbon economy, as well as facilitating renewable gas into the network through sources such as biogas. In partnership with Northern Gas Networks we have successfully demonstrated the use of compression to pump gas into higher pressure tiers at times of low demand and to maximise the capacity for bio methane injection into the gas network. This in turn may maximise greenhouse gas emission reductions and the continued use of the gas network for the high efficiency provision of domestic heat into the long term future.

We have also used innovation successfully in our core work delivery processes through the through the development and implementation of mobile data capture technology. Mobile data capture involves the use of mobile data apps to support data capture and storage in a field-working environment. The design, building and testing of bespoke apps has led to operational efficiencies associated with data collection, communication, compliance, and customer service activities with both our Alliance partners and Operations function.

- Total expenditure over the five years of £24.6m, breakdown as follows:

Figure 3.1 - Expenditure (£m)



The total potential benefits within our portfolio have always shown a positive net benefit overall, ranging from £900k to £9 million, over the PCR period. During the IFI period it has been important to always ensure the portfolio is balanced and potential net benefits are demonstrated to our customers.

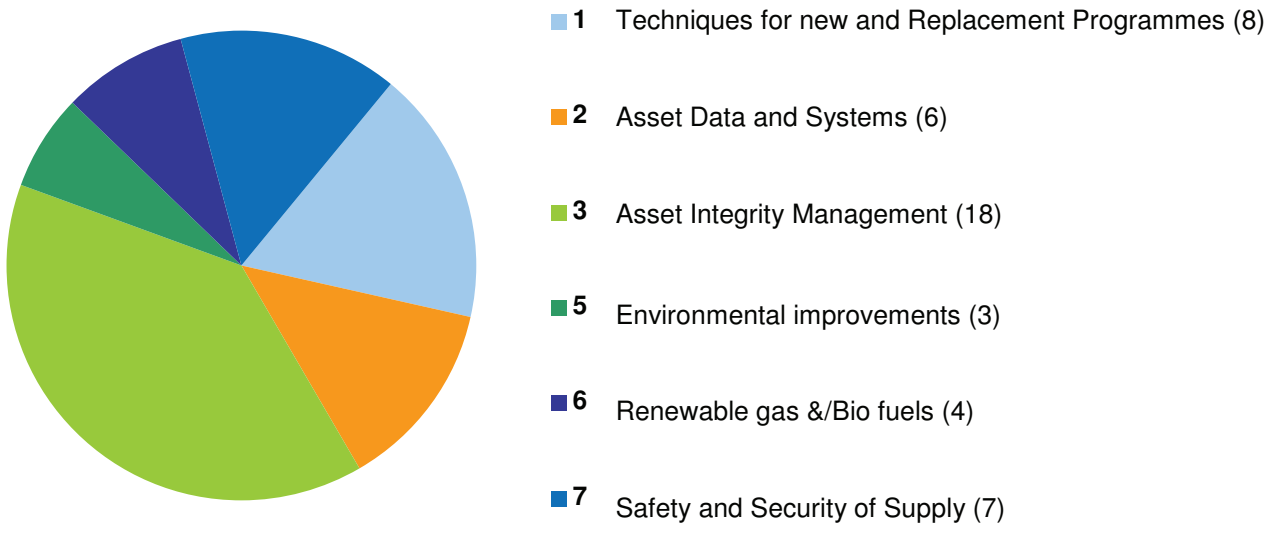
Since IFI began in 2008/09 we have seen a steady increase in utilisation of the incentive, as the above diagram illustrates, and we expect to see this increase even further as we move forward into RIIO.

The introduction of the new stimulus package brings about increased funding opportunities, enabling us to broaden our areas of focus under NIA. This has meant that in the final year of IFI we have re-assessed our priorities and challenges which we will face over the next decade.

The following highlights the broad range of challenges within our 2012/13 innovation portfolio, which we expect to change and evolve as we transition into NIA.

- Challenges within our 2012/13 innovation portfolio:

Figure 3.3 - Challenges within our Innovation portfolio (Numbers of live projects)



Internal Research and Development (Non-IFI Funded)

Although IFI has been an excellent incentive to re-energise our R&D activities, we have also continued to fund Innovation directly from our business. We have completed a number of small scale field trials throughout our network, to test various new tools and techniques, to aid efficiency in replacement and repair activities. We have also used our own resources to make improvements to our network analysis, planning tools and connection processes to accommodate biogas connections in the future.

Our intent is to continue to fund innovation from directly within our business as well as utilise the innovation funding opportunity available under RIIO-GD1 in the future.

Current Internal Capabilities

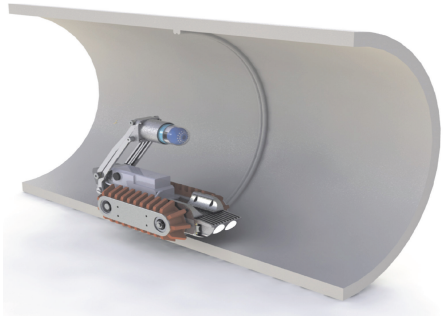
We have a dedicated innovation team that manages the strategy, funding, governance and regulatory reporting, and compliance with the Good Practice Guide for IFI funded projects.

Whilst the small central innovation team coordinates innovative activities, responsibility for sanctioning and prioritising these projects is shared with the Distribution Innovation Governance Group (DIGG), which is attended by representatives from all our functions and processes. This has served us well as the specialist knowledge, learning and output is retained within the responsible line management departments, whilst the innovation team maintains accountability for the strategic alignment of outputs and goals. This will now be reviewed as we move forward to the RIIO period.

Completed Innovation Projects

The following are examples of completed Innovation Funding Incentive (IFI) projects during 2012/13:

- Internal Joint Profiling System for PE Pipes (IFI46): Completed the development and field trial demonstration of an internal measurement profile tool, with a launch and retrieve system, to provide a visual inspection of Polyethylene (PE) pipes and joints. The Laser Profiler is inserted into PE mains under 'live gas' conditions to provide a complete profile of the inside of the pipe through use of a mounted HD camera. This allows for detection of obstructions, debris, water, bends, connections, breaks or leaks, pipe dimensions and ovality, in order to make important investment decisions regarding pipe remediation. Traditionally this type of assessment would require a large excavation, whereas this new device enables the pipe to be accessed through a small hole vertically, resulting in a 97% reduction in excavation size, thereby reducing customer impact and disruption, as well as being a critical safety management tool. This project was nominated for a Chairman's Award within National Grid.



- Air Driven Water Extraction Unit (IFI80): Developed and trialled new air driven water extraction units to extract water from gas mains. This has resulted in reduced noise levels, which are within compliance limits. The balance of the unit when full is now safer for use by field operatives and offers environmental benefits associated with reduced carbon emissions. It is anticipated that the new design units will improve response to water ingress incidents.

- Emergency Optimisation (IFI91): The trialling of a new innovative software solution has improved the overall efficiency of the emergency process by optimising resources, and providing knowledge to define business requirements for the strategic software emergency solution of the future.

- Operational & Integrity Challenges (Small Projects) 2012/13: A range of small projects were undertaken and highlights include:
    - 'Bar Coding Solution Feasibility Study' to investigate options for the application of bar coding technology for asset tracking and stock inventory of plant, tools and equipment.
    - 'PE Material Performance for Bio Methane Entry Connection' to investigate the effects of operating all sizes of PE for use in <7barg Gas Distribution systems at 40℃ and at pressures up to 7 barg.
    - 'Numerical modelling of excavations' to develop knowledge and understanding around the stability, and mechanisms of instability, of our excavations through use of the 'Plaxis Model'.
    - 'Waste Water Analysis', to develop an on-site filter for mains waste water extraction to enable sewer disposal.

2012/13 Live Project Highlights

The projects highlighted in the following pages outline the range of Technology Readiness Levels (see figure 4.1) currently in progress and illustrate National Grid's approach to maintaining a balanced portfolio.

There are four categories highlighted:

1. Asset and Energy Management

Asset and Energy management has been, and will remain to be, a key focus area for innovation under IFI and moving forward into RIIO. We need to make sure we know where our assets are, what we want from them, get the best value from them, and be confident they are safe and reliable for our customers.

We are seeking to identify a number of innovative solutions in this area, including improved inspection techniques, improved monitoring techniques and improved maintenance and repair techniques, in order to increase the life span and recover maximum value from our assets. The following section highlights example projects in this area:

Application of Fracture Alert Monitoring

TRL : **3-4**
Focus : **Long Term**
Positioning : **Strategic**
Theme : **Asset and Risk Management**

Using cutting edge acoustic technologies to receive instant alerts of pipe fractures in high risk pipes

The Gas Networks have a responsibility to replace all cast iron pipework within 30 metres of a property. The aim of this project is to research, test and develop an automated monitoring/alert system to detect fractures in larger diameter cast-iron gas mains and report them automatically to the pipeline operator. To achieve this, technology designed by project partner Syrinix that has been successfully implemented in some Water Companies, is to be trialled and developed for use on the gas network to detect mains fracture and provide an accurate location of where the fracture has occurred. This will enable the source of leak to be excavated and safely managed, as well as providing an alternative to replacement in certain high profile, urban areas.

A one stage feasibility study to assess the possible application of this technique was completed by National Grid during 2012, under IFI78. The feasibility study concluded that it will be possible to design and manufacture an acoustic technology system that can be applied to gas to successfully detect the fracture event.

Following the successful completion of the feasibility study, the project has now progressed into Stage 2, as a GDN collaborative project facilitated by the Energy Innovation Centre (EIC), which will transition into NIA under IL143. Stage 2 seeks to set up an experiment to record the signals created by real pipe fractures. Detailed analysis will then be undertaken to determine the practicalities of the proposed detection system.

Pipe Condition Assessment System

TRL : **4-5**
Focus : **Medium Term**
Positioning : **Strategic**
Theme : **Asset and Risk Management**

Developing pipeline condition assessment equipment

The aim of this project is to develop pipeline condition assessment equipment, capable of measuring the anisotropy within the metallic substrate to allow for detection of hairline cracks, corrosion on the inner and outer wall face, wall thickness, and inferred stresses. This will enable the pipeline owner to gain complete and accurate knowledge of the condition of the entire asset and therefore potentially predict the likelihood of the pipe failing. This may enable large diameter pipes to be categorised in such a way to prioritise for remediation including internal repair or semi structural linings.

This is a collaboratively funded project between National Grid and Wales and West Utilities (WWU). Following a successful stage 1 study during 2012 to assess the feasibility of the technique on an abandoned section of 10" Spun Iron main, the aim of the project is to further develop the capability of the equipment in a field trial environment, under NIA.

SupaSpray

TRL : **4-5**
Focus : **Short/Medium Term**
Positioning : **Tactical**
Theme : **Asset and Risk Management**

To improve the way in which joints can be internally remediated and repaired from remote locations, than can currently be achieved through traditional spraying techniques

Internal main spraying of metallic mains has been available within the industry for the last 20 years. Success of the system is dependant upon a number of factors, including diameter of the main, jointing technique, length of insertion, sealing material and sealing technique. The current technique is successfully proven, however there are a number of perceived blockers to its utilisation. The objective of this project is to break these down into small incremental improvements and deliver output that could be utilised more readily.

A prototype combined internal spray and camera head has been developed, manufactured, and field trailed in a working environment which has proven the new innovative technique to be a success. This main spraying solution offers ease of use, extended range of spraying and improved spray coverage. Combination of the spray head with a camera enables a full survey to be carried out to identify and locate the potential source of leakage and ensure accurate spraying of the joint.

A future stage is planned under NIA to further enhance the capabilities of the technique, including providing a more eco-friendly solution. Improvements in internal spraying should see a number of benefits associated with increased targeted use, including reduction in costs, reduced excavation requirements necessary to resolve public reported escapes, and reduced customer impact.

2. Engineering technologies and techniques to improve Operational Performance

We have continued our drive for operational efficiency with aims to further improve the safety of our field force, minimise disruption to the public, and ultimately provide greater value to our customers.

The following section highlights example projects associated with the development of new and novel technologies and techniques within our portfolio:

Proximity Effects of Squeeze Off upon PE Joints

TRL : **6**
Focus : **Medium Term**
Positioning : **Tactical**
Theme : **Risk Management and Knowledge**

Redefining the squeeze off limits of PE mains

Temporary squeeze off of Polyethylene (PE) pipe has been adopted as a routine operation; however the current squeeze-off methodology, which requires set separation distances to be maintained between fittings/joints and squeeze off positions, has never been supported by way of formal detailed stress analysis.

The aim of this project was to undergo Finite Element (FE) analysis to establish the background stresses on pipework during squeeze off operations, and to determine whether these impact upon the integrity of the pipe, particularly when in close proximity to butt fusion joints.

The project began in 2009/10 and commenced with initial research and proof of concept stages to develop a methodology, which was then subsequently validated against a range of PE pipe materials and geometries. Following the successful completion of these initial 3 stages, which showed good results around predicting the squeeze-off stresses, the project progressed into the final stage, Stage 4.

The field trial demonstrations, under Stage 4, were carried out in 2012/13 to analyse the strain gauge measurements on five different real-time squeeze-off jobs, in a live working environment. The main conclusion from the trials undertaken revealed that the stress levels were higher than expected, and that separation distances cannot be reduced, however for PE100 and PE80 can be increased.

This valuable learning will be implemented into the business by way of a policy and procedure update. The expected associated benefits of the project are the avoidance of an uncontrolled gas escape release due to a joint failure, and improved safety and security of supply to our customers.

Sealback II

TRL : **4**
Focus : **Short/Medium Term**
Positioning : **Tactical**
Theme : **Efficiency and Customer**

To develop a live mains replacement and renovation system for short length and stub end pipes that are situated in locations of engineering difficulty

The aim of this project is to develop and successfully trial an improved method to replace short lengths of metallic main in specific locations of engineering difficulty, for instance short lengths of main that connect onto its parent main in a major road junction, in a safe, efficient and practical manner.

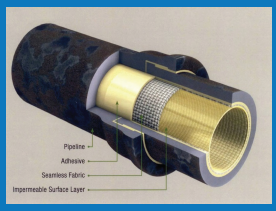
Sealback I is being incrementally innovated to accommodate non-linear pipe, tapered pipe sections, change in pipe diameters, etc, and to have better support from camera systems.

The project began in 2012 and commenced with a feasibility study which sought to address the limitations of the Sealback I technique. This feasibility study saw the identification of an innovative solution and has now progressed to Stage 2, which will look at the development and field trial of the identified 'Sealback II' solution. This will incorporate camera technology advances, development and recommendation of an appropriate sealant, and agreement of a suitable implementation strategy and delivery method. If successful Sealback II will allow mains located in areas of engineering difficulty to be replaced via live transfer leading to a reduction in operational expenditure and risk. Also reduced environmental impact, including the requirement for landfill disposal of excavated spoil.

Cured-in-Place and Polyurethane Spray Linings >12"

TRL : **4**
Focus : **Medium/Long Term**
Positioning : **Strategic**
Theme : **Efficiency and Customer**

To develop an efficient alternative technique to Polyethylene (PE) and steel for the replacement of large diameter metallic mains



The aim of this project is to develop an efficient and cost effective replacement and remediation lining technology, as an alternative to polyethylene (PE) for larger diameter metallic mains. The scope of this project includes conducting fitness for purpose testing on Cured In-Place Pipe (CIPP) linings, laboratory and site trials, and assessment of installation practicalities, quality assurance and quality control procedures.

It is anticipated that this technology will provide a more efficient technical solution particularly in urban areas by, for example, reduced customer impact and environmental benefits associated with reduced operating footprint and use of imported materials.

This collaborative project, joint with Scotia Gas Networks (SGN), began in 2012 and commenced with development of performance specifications and best practice guides for two types of lining techniques.

Following the successful completion of Stage1, the project will progress into Stage 2 to conduct testing and auditing of selected lining systems to demonstrate these techniques, under NIA.

3. Environmental and Climate Change

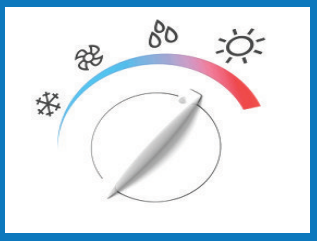
Reducing our impact on the environment and the minimisation of our Business Carbon Footprint emissions remains at the forefront of our innovation activities. We recognise the changing energy landscape and the need for us to transition to a low carbon economy.

Our 2012/13 portfolio reflects the continued need for research and development in these areas in order to reduce our carbon emissions, promote energy savings, and improve environmental performance, whilst exploring opportunities for diverse fuel sources. Examples of such projects are highlighted below:

Domestic Heating Project

TRL : **3**
Focus : **Long Term**
Positioning : **Strategic**
Theme : **Environment and Customer**

A study on the optimal appliance technology pathways, based on known and emerging heating technology, required to meet carbon and renewable targets to 2050.



The objective of this project was to provide a study on the optimal appliance technology pathways, by property type, based on known and emerging heating technology required to meet carbon and renewable targets, highlighting the impact on consumers (cost to change and behavioural) and the impact on the gas and electricity distribution networks out to 2050.

This project output reported essential knowledge concerning the suitable technologies and processes the energy industry could adopt that will assist the UK in meeting its 2050 renewable targets, which was used to inform the DECC Heating Strategy. In order to review the options within the report a model was produced in order to analyse the recognised scenarios. This was well received by the wider energy industry and the funding participants will be able to use the model going forward as a tool in deciding what technologies it should pursue in meeting their own renewable targets.

Optimise Own Energy Use

TRL : **7**
Focus : **Medium/Long Term**
Positioning : **Strategic**
Theme : **Environment and Efficiency**

To reduce energy use at above ground installation and other operational sites using alternative forms of pre-heating

This project seeks to reduce and optimise the energy used by National Grid, through use of novel preheating systems that have been installed and commissioned on Gas Distribution above ground installation sites. The primary benefit of which will be a reduction in National Grid's carbon emissions.

This project has successfully delivered a feasibility study, proof of concept, detailed design and site installation and commissioning, over the four years since IFI began. Two types of pre-heat technology has been installed at four National Grid sites, and during 2012/13 there has been ongoing monitoring and evaluation of the operational performance of the preheating systems, with particular focus on the winter heating seasons. Further work will continue through into 2013/14, under NIA, which includes production of pre-heater performance and Life Cycle Analysis (LCA) reports, providing baseline comparisons with National Grid's existing preheater (water bath and modular boiler) technologies. Reporting produced will enable associated recommendations to be made regarding future installation of novel pre-heating systems across our distribution network.

4. Collaboration

We believe that a process of external collaboration is essential to the delivery of a successful programme of innovation. In the final year of IFI we have set out to leverage existing and new partnerships with research groups and academia. We have also sought to collaborate with and share best practise with the wider industry, including Gas Transmission, network operators and other utilities, to maximise opportunities and share operational knowledge for the benefit of the energy industry.

We have continued to maintain relationships with numerous research organisations. For example, we have been the only network operator who has collaborated with the European Gas Research Group (GERG), gaining knowledge around improving the integrity and safety of gas distribution systems through a network of European experts. In addition we have collaborated with the Pipeline Research Council International (PRCI), an external research body, which has enabled learning around assessment, prevention and mitigation of integrity threats, such as mechanical damage and external corrosion, and the European Pipeline Research Group (EPRG), which undertakes a wide range of research directed to increase integrity and safety of gas pipelines. See IFI24 and IFI25 in the appendix for more information. Membership and involvement in these groups enables not only the opportunity to generate more innovative ideas with a wider group, but also allows for the leverage of benefits from these collaborative opportunities and the sharing of knowledge and information to the benefit of the wider energy industry.

In our first year of EIC membership a total of 29 synopses were received and 6 projects were collaboratively commissioned with the other GDN's. Examples of these recently commissioned EIC projects are as follows:

Internal Stress Corrosion Cracking – Collaborative with NGN, SGN and WWU

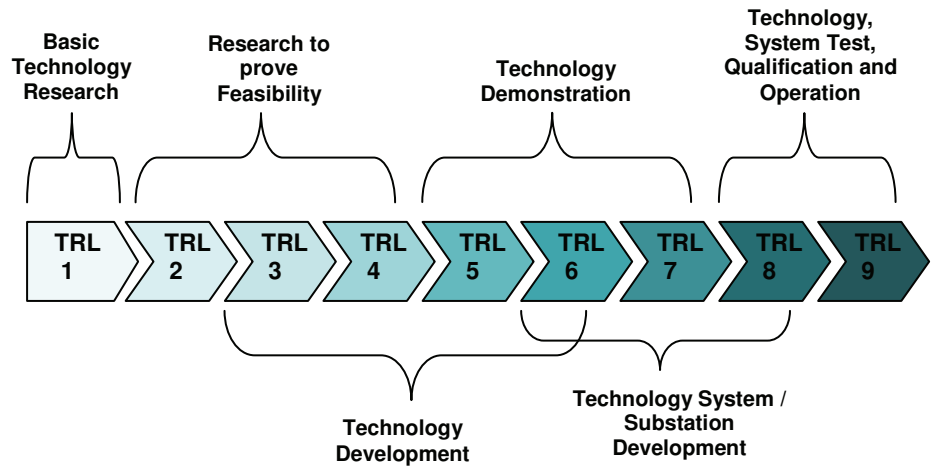
To develop a method to assess the threat of internal stress corrosion cracking (ISCC) in pipelines previously used to transport manufactured gas. This will enable greater understanding of the threat of ISCC to the integrity of the gas pipeline networks, and will help to deliver an improved security of supply for gas consumers.

E-Pipes – Collaborative with NGN, SGN and WWU

To progress the development of the ePIPE riser repair technique, currently used within the water industry in the United States, for the application of high risers within multi occupancy buildings in the UK. If successful this technology will prevent leaks and provide a more cost effective and less disruptive repair mechanism for gas consumers.

The widely used Technology Readiness Level (TRL) model indicates how close a technology is to becoming both technically and commercially viable and can be seen above. Level 1 relates to research with no obvious purpose more commonly known as “Blue Sky Research” and Level 9 on the TRL scale indicates products/information readily available with no development required. Currently Gas Distribution innovation activities have been focused between TRL’s 2 and 8. This range ensures that the innovation money is being used for innovation activities and not purchasing existing solutions.

Figure 4.1



TRL1: Basic principles observed and reported.
TRL2: Technology concept and / or application formulated.
TRL3: Analytical and experimental critical function and / or characteristic proof of concept.
TRL4: Technology component and / or basic technology subsystem validation in a laboratory environment.
TRL5: Technology component and / or basic technology subsystem validation in a relevant environment.
TRL6: Technology system / subsystem model or prototype demonstration in a relevant environment.
TRL7: Technology systems prototype demonstration in an operational environment.
TRL8: Actual Technology system completed and qualified through test and demonstration.
TRL9: Actual Technology system qualified through successful implementation.

Finance Overview

This section of the report gives the financial information associated with the 2012/13 programme as agreed within the IFI/SD Good Practice Guide (GPG).

In year 5 there were 46 live projects, with 18 new projects started and 28 continued from year 3, and 25 projects completed. This amounted in a total spend of £6.3m, utilising 79% of the gas allowance.

Potential benefits are assessed on a project by project basis against the GPG benefit criteria and reassessed at each stage gate to ensure consumer value. Overall portfolio benefits total £17,067 positive NPV overall.

Anticipated benefits are documented against each project in Appendix 1 and are achieved by:

- Reduced Direct Costs e.g. through reduced planned capital expenditure, maintenance expenditure or efficient operations.
- Avoided Costs e.g. deferred investment, reduced failures, establishing conditions of equipment to feed capital or maintenance plans and improved ratings.
- Enhanced Risk Management e.g. understanding the application of new technology and minimising the impact of our networks on the environment.
- Strategic Knowledge e.g. working with others to address sustainability in the energy industry, maintaining awareness of new technology in the industry.

Revenue	**£1593.00m**
IFI Allowance	**£ 7.96m**
IFI Carry over	**£0**
External Expenditure	**£ 5.422m**
Internal Expenditure	**£ 0.841m**
Total Expenditure	**£ 6.263m**
Number of Active Projects	**46**

Looking Forward

As we transition from IFI to NIA we are fully supportive of the RIIO-GD1 stimulus package and believe that it provides the appropriate mechanism and incentive to encourage all Gas Distribution Networks to drive innovation.

In preparation for transition we have re-assessed the objectives and challenges of our projects to ensure they add value under the new RIIO-GD1. As a result, 21 projects will transition into NIA.

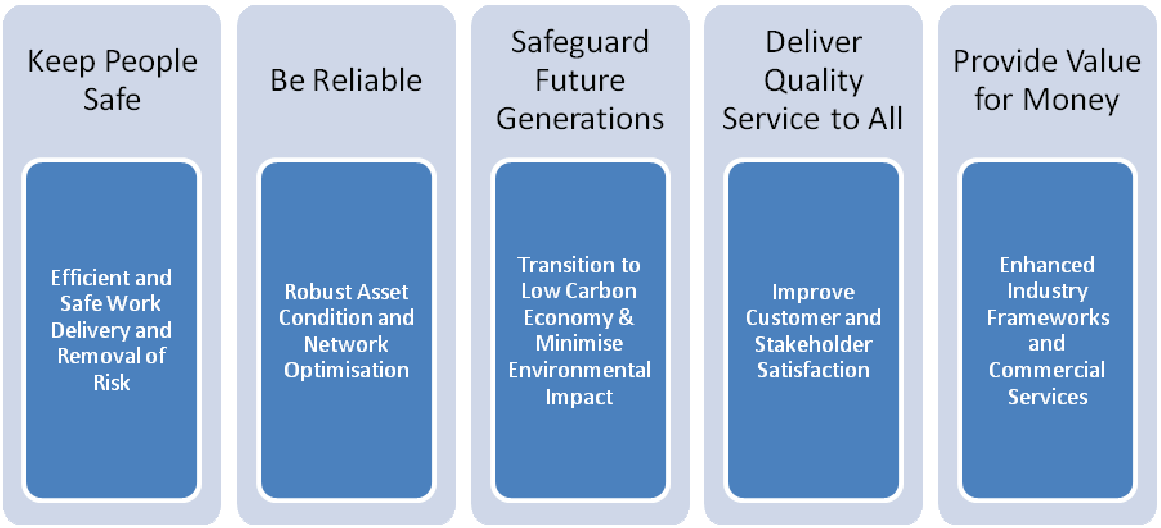
During the RIIO-GD1 period we will build on our current approach to innovation. The innovation team will manage a portfolio of projects, with each project being managed and delivered by a dedicated expert project manager in the relevant business area.

We will make a step change in efforts to generate innovative ideas and we will develop a new capability within Gas Distribution to construct bids associated with the Network Innovation Competition. For example, building on the feasibility and design work that we have completed under IFI79 – BioSNG Pilot Plant Design and Demonstration.

We will ensure that we develop a culture of innovation in all our activities. We will also ensure that we have a strong framework to ensure the value of our innovation programme is aligned to our business plan objectives, and that the potential benefits are tracked, monitored and risks mitigated.

Going forward we will continue to build on the benefits we have delivered under IFI, to ensure a safe, reliable network for future generations. In addition we aim to build on this by improving our understanding of customer behaviour and the impacts of new commercial arrangements. We will embrace innovative solutions to share information with our stakeholders and inform the consumer, and to deliver enhanced industry frameworks and commercial services.

Within our Innovation Strategy we have outlined our key priorities, incorporating 5 key innovation themes which illustrate the areas that we are seeking to explore. The following diagram outlines our 5 innovation themes, linked to our priority outputs:



The following describes each of our innovation themes in turn and the business challenges that we want to address:

- **Efficient and Safe Work Delivery and Removal of Risk** – To deliver our new mains replacement programme based on a risk removed approach, as opposed to length of iron main abandoned, and the need to progress the development of improved mains replacement technology and techniques, to minimise risk to be more efficient, safe and less disruption to the public.

- **Asset Condition and Network Optimisation** – We need to ensure that our assets are resilient and can adapt to the consequences of climate change. We have also identified a number of specific challenges associated with major cities, particularly London, in terms of consequences of incidents and congestion.

- **Transition to Low Carbon Economy & Minimise Environmental Impact** – The changing energy landscape and the need for us to transition to a low carbon economy means we need to continue to focus on reducing our impact on the environment and the minimisation of our Business Carbon Footprint emissions.

- **Improve Customer and Stakeholder Satisfaction** – During RIIO-GD1 we need to consider more innovative ways to improve the service we deliver to customers such as the challenge to minimise supply loses and getting customers' supply restored as quickly as possible.

- **Enhanced Industry Frameworks and Commercial Services** – We need to consider innovative commercial and regulatory frameworks to help us best manage future uncertanties such as volumes of biomethane connections to our networks. We will also look to develop innovative approaches to solving problems of theft of gas, encourage new capacity products, and utilise smart data and new charging methodologies.

  In order to address these future challenges we will need to invest in higher risk technologies. More specifically, we will look to technologies at the early development stages of the Technology Readiness Level (TRL) scale, which by their nature carry a higher risk of evolving into a project. We will explore these technologies to determine if we are able to adopt and drive real efficiencies across our organisation.

Innovation Project Reports Content Page

(IFI4) Optimise Own Energy Use (PRIs)

Year: 2012/13

Project Description

The project targets the energy used by National Grid in non-vehicular applications, aiming to reduce and optimise the energy used to establish company-wide best practice for operational Pressure Reducing Installations and Offtakes.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£104,135	£139,582	£18,427	
External	£697,363	£660,829	£104,697	£3,949,666
Materials	£223,335	£709,576	£0	
Total	£1,024,833	£1,509,987	£123,124	

Status	
Submitted	
Draft	13/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ 1 Low Carbon Economy	Good Alignment. Viable alternative forms of pre-heat with measured energy savings of lower carbon emissions.
☐ 2 Eradicating Fuel Poverty	
☑ 3 Promoting Energy Savings	Major Alignment. More effective and efficient use of energy will lead to energy savings and reduced emissions.
☑ 4 Safe, Reliable Network	Minor alignment. Moving away from traditional water bath heater solutions for pre-heating should lower the risk of supply failure as water bath heaters are essential assets in ensuring security of gas supply to consumers. Faults occurring due to corrosion that pose risks of fire / injury at the PRI and loss of gas supply downstream will be eradicated with these new technologies.
☑ 5 Protecting the Environment	Minor alignment. Moving away from traditional water bath heater solutions for pre-heating will improve environmental performance as there will be no need to use or dispose of large quantities of potentially hazardous glycol or non-glycol solutions.

Technological area / issue addressed by project

Viable alternative heating solutions that will reduce own energy use for pre-heat conditions that either:

- optimise the energy use only as and when required
- use another method of pre-heating that is sustainable and environmentally friendly

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Medium	21	1	20

Expected benefits of project

To reduce energy consumption at National Grid gas operational sites and offices. Improved environmental and performance of water bath heaters. Current Water Bath Heater replacement systems (modular boilers with heat exchangers) require contingency arrangements in the form of backup modular boilers and heat exchanger. These also need to be maintained and notably require an electricity supply.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	20 yrs	75%	-£153,347

Potential for achieving expected benefits

Potential to undertake pre heating more economically and reduced associated asset maintenance.

Project Progress

Four field trials on two different technologies are taking place and will continue through the 2013/14 winter. This will influence / inform National Grid's pre heater strategy and water bath heater replacement programme.

Collab' Partners

Provider(s) GL Noble Denton, CWT, Bruest

(IFI10) Easy Flow Stop Systems

Year: 2012/13

Project Description

The primary objectives are to verify and demonstrate the use of stoppling flow stop equipment on PE pipes.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£22,006	£8,256	£0	
External	£114,886	£29,428	£0	£474,189
Materials	£20,169	£0	£0	
Total	£157,061	£37,684	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Good Alignment. Will enable a flow stop solution that will be cost effective and avoid the need for expensive cut-out operations.
☑ 5 Protecting the Environment	Good alignment. Will reduce excavation sizes and thus materials to landfill. Output will enable the ability to reuse same location to carry out same type of flow stop operation in the future. Minimises disruption to members of the public through reduced excavation footprint.

Technological area / issue addressed by project

o Validation and verification that the Stopple equipment and launch platforms are fit for purpose for use within the UK.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Medium	18	-4	22

Expected benefits of project

Reduced excavation footprint reduces potential for interference damage to other buried apparatus. This will reduce materials to landfill and minimise the disruption to members of the public.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	5 yrs	75%	£13,212

Potential for achieving expected benefits

Reduced time required to prepare for a flowstop operation. Reduced costs associated with excavation and reinstatement materials. Footprint dimension length reduced by 4.4m for a 355mm diameter pipe and width can also be reduced from 0.8m to 0.6m. Different flow stop methodology which eliminates risks associated with induced stresses placed on PE pipes during traditional squeeze off technique.

Project Progress

The operations using the stopple equipment on PE pipes appears to be satisfactory with good seals being made and minimal let by during the flow stop operations. Although the Stopple operations were successful, one of the trials took 2 days to complete due to issues with materials and equipment, specifically the operation of the Stopple Tee completion plug. Therefore the provider will ensure that the completion plug assembly is fit for purpose.
The results of the PolyStopp Intermediate Pressure Stopple operation were in line with the performance recorded at the trials.

National Grid can approve flow stopping operational products for larger diameter pipelines

Collab' Partners Pipeline Maintenance Centre, National Grid Transmission

Provider(s) GL Noble Denton

(IFI19) Better Load Analysis & Demand Modelling (Feasibility)

Year: 2012/13

Project Description Develop a new and novel demand estimation model that can be practically utilised within <7bar analysis modelling.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£92,323	£42,143	£0	
External	£599,590	£366,106	£0	£2,490,840
Materials	£0	£1,946	£0	
Total	£691,913	£410,195	£0	

Status	
	Submitted
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	A better understanding of demand profiles will: o facilitate better pressure management of the system and consequent improvements in control of leakage o provide a baseline for the understanding of current demand patterns against which the impact of new gas technologies and energy uses may be assessed.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	A better understanding of demand profiles will allow the peak demand requirements to be better understood. This will lead to a more economic and efficient design of the system to meet those peak demands and better understanding of off-peak demand will facilitate greater security and flexibility in carrying out maintenance activities.
☑ **5 Protecting the Environment**	A better understanding of demand profiles will facilitate better pressure management of the system and a consequent improvement in the control of leakage.

Technological area / issue addressed by project

o Statistical techniques for the development of improved demand models have been specified.

o The proof of concept models developed based on these techniques using available data indicates an increase in accuracy of the demand models over those currently in use and a general reduction in demand being modelled.

o The requirements for the flow data required to develop working demand models have been specified.

o The new Network Analysis model will take into account new factors such as socioeconomic data, cunsumer behaviour and current thermal effeciencies including appliance effeciency.

o Provision of initial winter data for Customer demand profiles to be developed and understood at later stages in the project.

o Whole network data will also be collected to enable the testing of the theroretical flow against the actual demand conditions experienced across the winter.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Significant	Medium	19	5	14

Expected benefits of project The principle benefit from this work will be knowledge acquisition that may ultimately lead to the production and replacement of the current published demand algorithms. Better identification of demand requirements at the peak condition will lead to reduced risk of supply failures.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	10 yrs	50%	-£645,004

Potential for achieving expected benefits Results obtained from the use of the system did not support the business case and indicated significant development work will be required to resolve the issues that were identified and as such a decision has been taken to stop the project, however potential has been identified to utilise some of the learning gained from the project to improve elements of the existing process in the areas of

(IFI19) Better Load Analysis & Demand Modelling (Feasibility)

Year: 2012/13

	customer classification and demand allocation.
Project Progress	Stage 6 of IFI19 developed a prototype enhancement of the current network analysis system that is capable of dealing with variable diversity. This enhancement has been used with data from a number of network models to support the development of a business case for the implementation of the approach in a production environment. In addition to this, work has been undertaken to produce a design for flow metering to gather data to enable assurance of the system.
Collab' Partners	**Provider(s)** GL Noble Denton, Hyphen

(IFI21) Improvements to the MRPS Model

Year: 2012/13

Project Description

The key objective of the project is to develop improvements to the MRPS model to efficiently identify mains that are likely to leak and therefore reduce the risk of fire/explosion from any potential escape, to enhance safety to gas employees and the general public whilst also complying with HSE legislation.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£4,126	£9,327	£0	
External	£38,192	£81,016	£0	£776,499
Materials	£0	£0	£0	
Total	£42,318	£90,343	£0	

Status	
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Draft	02/05/2013
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Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	This project will investigate possible enhancements to the methodology including the consideration of age as a factor with the cast iron model , and the inclusion of corrosion information in the spun cast model to take account of fissure corrosion. The project will also examine the impact of any changes in terms of risk profile and the potential to increase the rate of reduction of risk and leakage from current levels. The work proposed within this proposal has been costed over a 5 year period.
☑ 5 Protecting the Environment	The ability of MRPS to identify mains before they leak will have a direct impact on the level of methane emissions from the UK distribution system. In addition, more efficient planning of mains replacement has a direct impact on road closures and traffic congestion

Technological area / issue addressed by project

- Research into the correlation or link between the age of pit cast mains and fracture rate
- Research into the correlation or link between corrosion and fracture rate
- Demonstration of cast iron and spun cast profile factors in live MRPS model.
- Feasibility of profile factors for multi-occupancy buildings
- Development & testing of profile factor for the update of the >12" model
- Continued update of all profile factors within the MRPS model to accurate profile risk and prioritise remediation

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	20	-4	24

Expected benefits of project

- The knowledge used to analyse the data and produce improvements to MRPS will be communicated in detail to the industry participants. This understanding will assist GDN's in defending the model robustly when challenged by the HSE.
- Any improvement in the way in which mains are prioritised for replacement will affect the UK incident level. This has a direct impact on improving safety but is very difficult to quantify.
- The ability of MRPS to identify mains before they leak will have a direct impact on the level of methane emissions from the UK distribution system. In addition, more efficient planning of mains replacement has a direct impact on road closures and traffic congestion.
- The MRPS is model is used to effectively replace those pipes with a higher degree of risk. By doing so, the GDN can allocate expenditure accordingly and avoid significant cost if a minor or major incident occurs.
- The application of a credible methodology for identifying mains at risk will contribute to mitigation measure for any potential litigation arising from fatalities linked to incidents.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	5 yrs	25%	-£621,489

Potential for achieving expected benefits

•□MRPS has been endorsed by HSE as a method to allow for prioritisation of mains replacement that effectively reduces the risk of incident. However MRPS must be continuously developed using the most recently available data to ensure that the models reflect recent leakage activity. This project enables each Gas Distribution Network to demonstrate compliance with safety legislation in this respect.

(IFI21) Improvements to the MRPS Model

Year: 2012/13

	• Stage 5 of this project has successfully provided an updated trend analysis, both in terms of overall trends and in significantly more detail by month, leak type and GDN. This has provided the GDNs with a wealth of information relating to their own data and has highlighted clearly where changes in data collection or definition have impacted upon their own figures and the scale of the changes. • The results of carrying out the impact analysis on an alternative methodology for assessing services has indicted that a significant number of services will be affected by the alternative approach and hence the priority for replacement is likely to change. This should improve the correct identification of ferrous services for replacement. • The GDNs remain committed to the ongoing development and improvements to the MRPS model.
Project Progress	The more detailed analysis carried out this year identified some anomalies in the trends in failures and GiBs, which were attributed to particular GDNs over particular time periods. The impact analysis of applying an alternative methodology for calculating the risk from services has shown that the risk from the first 30m of a long service (100m for example) is diluted by the current methodology and would be captured more accurately by the alternative methodology. The results of applying this known change to the real population of services has indicted that a significant number of services will be affected by the alternative approach and hence the priority for replacement is likely to change. This should improve the correct identification of ferrous services for replacement.
Collab' Partners	NGN, SGN, WWU
Provider(s)	GL Noble Denton

(IFI24) European Pipeline Research Group (EPRG)

Year: 2012/13

Project Description

EPRG is a cooperation of European pipe manufacturers and gas transmission companies. EPRG undertakes a wide range of research directed to increase integrity and safety of gas transmission pipelines.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£5,244	£34,489	£0	
External	£28,283	£45,359	£0	£785,384
Materials	£0	£0	£0	
Total	£33,527	£79,848	£0	

Status	
Submitted	
Draft	02/05/2013
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Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Jointly funded pipeline research to mitigate issue and risks associated with the high pressure network. The group also provides opportunities for sharing information on best practice and incidents with other pipeline operators.
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

o (EPRG 124) DWTT Round Robin
o (EPRG 127) Reliability Based Analysis
o (EPRG 129) Hostile environmental effects on residual mechanical resistance of damaged pipes
o (EPRG 130) DWTT Testing philosophy
o (EPRG 134b) Development of tests for assessment of long term resistance to adhesion loss in 3-layer polyolefin external pipeline coatings
o (EPRG 137) Assessment of delayed failure under constant pressure
o (EPRG 138) Clarification of European view towards inline pipe standards ISO3183/2007 and EN 10208-2
o (EPRG 139) Hostile environmental effects on residual mechanical resistance of damaged pipes supplementary tests
o (EPRG 141) Discrimination for mill features using MLF pigs for baseline inspections- Phase 1
o (EPRG 142) Model of ultimate limit state design to predict combined loading capacity of line pipes
o (EPRG 143) Extension of FFP and puncture resistance criteria to X80
o (EPRG 144) Revision of EPRG guidelines on weld defect acceptance criteria
o (EPRG 145) Assessment of bending wrinkles
o (EPRG 146) Development of a reliable model for evaluating the ductile fracture propagation resistance for high grade steel pipelines
o (EPRG 147a) Development of an improved model for the burst strength of dent-gouge damage under sustained internal pressure loading Phase 2 part 1 Modelling
o (EPRG 147b) Development of an improved model for the burst strength of dent-gouge damage under sustained internal pressure loading – Phase 2 part 2 Experimental
o (EPRG 148) Investigation of automated ultrasonic testing concept for longitudinally SAW pipe and coupling control
o (EPRG 149) HIC Assessment of low alloy steel line pipe for sour service application Phase 2
o (EPRG 150) HIC Assessment of low alloy steel line pipe for sour service application Phase 3
o (EPRG 151) Assessment of sensitivity to hostile environments of damaged pipe, under cathodic protection and internal pressure
o (EPRG 152) The effect of toughness on the integrity of HFI pipe seam welds.
EPRG 153 - The Definition of a Rich Gas with respect to the Arrest Toughness for Line Pipe Steel
EPRG 154 – Survey of sulphide stress cracking methodologies
EPRG 155 – Assessment of delayed failure under constant pressure
EPRG 156 – Guidance for mechanised gas metal arc welding of pipelines
EPRG 157 – DWTT for small diameter thick walled pipe seamless
EPRG 158 – Influence of inverse fracture on BDWTT assessment
EPRG 159 – CO2 pipelines, fracture control
EPRG 160 – CO2 pipelines, main project

(IFI24) European Pipeline Research Group (EPRG)

Year: 2012/13

EPRG 161 – CO2 pipelines, shock tube testing
EPRG 162 – Revision of EPRG weld defect guidelines
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Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	11	-5	16

Expected benefits of project

- Improved system integrity knowledge, Improved corrosion protection, reduced 3rd party incidents leading to less supply disruptions. Networking opportunity with other pipeline operators, sharing information and best practice. It is very difficult to articulate the proposed benefits of these high level benefits until the output of each individual project is known.
- Prevention of incidents will also mean the prevention of the loss of gas to atmosphere. It is extremely difficult to quantify a value of the amount of gas saved from the proposed EPRG projects if all were implemented.
- The primary benefit from this programme is collaboration on projects that will help to maintain the integrity of the high pressure pipelines, via developed assessment, risk and prevention tools and techniques that mitigate the integrity threats on the high pressure pipeline network and thus reduce the overall risk.

Assuming the probability of a high pressure pipeline failure is approx 1 in 20 years. If the cost of the incident is assumed to be £10m, then the annual avoided cost year is £500k.

If the work from EPRG reduces this risk by 10%, then the annual avoided cost is £455k, giving a reduction of avoided cost of £45k per year. The current formula period has two years to run therefore the total avoided cost will equate to £90k.
- Significant research leverage benefits. The total value of projects being undertaken is 445,000 Euros in 2009 and about 300,000 Euros in 2010, which provides National Grid with a leverage ratio of 15:1, based on the total National Grid membership cost of 19,684 euros in 2009.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	2 yrs	25%	-£88,185

Potential for achieving expected benefits

o New knowledge via the delivery of research and development projects from the EPRG programmes of work
o Networking with technical representatives from other companies that leads to the understanding of new techniques and best practice across Europe
o Networking/sharing knowledge with technical representatives from other companies concerning incidents or failures that occurred i.e. Fluxys incident
o Understanding and awareness of developing research and development projects proposed from European participants. This include other pipeline operators but also pipe manufacturers.

The importance of the knowledge is that assists National Grid in mitigating and pro-actively responding to current and potential future integrity issues and threats. Such awareness helps to demonstrate (for example to the HSE) that National Grid is fully informed of emerging techniques, best practice, and learning from incidents.

Participation in EPRG still provides National Grid will a significant leverage benefit, and therefore demonstrates value for money invested. If National Grid were to withdraw from the group this may impact upon our reputation negatively given that we are one of the largest gas transmission pipeline operators in Europe.

National Grid Gas (NGG) is a member of the EPRG, which manages a programme of R&D projects, the results of which NGG obtains through its membership. This project is required to ensure that:
o NGG is kept informed of progress and the benefits realised in ongoing sponsored projects of the EPRG Materials and Corrosion committees;
o Relevant, or potentially relevant, projects are assessed to identify best practice, emerging technologies etc. that may have an impact NGG's operations.

Key areas of particular interest to National Grid are:
Materials
o Fracture propagation for high strength steels, high toughness levels and rich gas mixtures
o DWTT requirements for seamless pipe and generally increased understanding
o CO2 pipeline requirements relating to fracture propagation
o HFI pipe bond line Charpy toughness testing

Corrosion
o Sensitivity of damaged pipe to cathodic over-protection

(IFI24) European Pipeline Research Group (EPRG)

Year: 2012/13

	o Long term behaviour of 3 layer polyethylene coatings Design o Fitness for Purpose of X80 pipelines o Dent and gouge damage testing o Wrinkles due to bending o State of the art review of seismic assessment methods o Ground movement o EPRG weld defect guidelines
Project Progress	The funding of the EPRG requirements comprises of two elements: 1. National Grid membership of EPRG provides information on all the projects undertaken by EPRG. The relationship to this group is managed jointly by Tx and GDx and the costs of the membership is shared to ensure that a consistent approach is adopted between the lines of business and primarily a safety perspective. The projects during 2011 and 2012 have included: EPRG 124 - DWTT Round Robin EPRG 127 - Reliability Based Analysis EPRG 129 - Hostile environmental effects on residual mechanical resistance of damaged pipes EPRG 130 - DWTT Testing philosophy EPRG 134b - Development of tests for assessment of long term resistance to adhesion loss in 3-layer polyolefin external pipeline coatings EPRG 137 - Assessment of delayed failure under constant pressure EPRG 138 - Clarification of European view towards inline pipe standards ISO3183/2007 and EN 10208-2 EPRG 139 - Hostile environmental effects on residual mechanical resistance of damaged pipes - supplementary tests EPRG 141 - Discrimination for mill features using MLF pigs for baseline inspections- Phase 1 EPRG 142 - Model of ultimate limit state design to predict combined loading capacity of line pipes EPRG 143 - Extension of FFP and puncture resistance criteria to X80 EPRG 144 - Revision of EPRG guidelines on weld defect acceptance criteria EPRG 145 - Assessment of bending wrinkles EPRG 146 - Development of a reliable model for evaluating the ductile fracture propagation resistance for high grade steel pipelines EPRG 147a - Development of an improved model for the burst strength of dent-gouge damage under sustained internal pressure loading - Phase 2 part 1 - Modelling EPRG 147b - Development of an improved model for the burst strength of dent-gouge damage under sustained internal pressure loading - Phase 2 part 2 - Experimental EPRG 148 - Investigation of automated ultrasonic testing concept for longitudinally SAW pipe and coupling control EPRG 149 - HIC Assessment of low alloy steel line pipe for sour service application Phase 2 EPRG 150 - HIC Assessment of low alloy steel line pipe for sour service application Phase 3 EPRG 151 - Assessment of sensitivity to hostile environments of damaged pipe, under cathodic protection and internal pressure EPRG 152 - The effect of toughness on the integrity of HFI pipe seam welds EPRG 153 - The Definition of a Rich Gas with respect to the Arrest Toughness for Line Pipe Steel EPRG 154 - Survey of sulphide stress cracking methodologies EPRG 155 - Assessment of delayed failure under constant pressure EPRG 156 - Guidance for mechanised gas metal arc welding of pipelines EPRG 157 - DWTT for small diameter thick walled pipe seamless EPRG 158 - Influence of inverse fracture on BDWTT assessment EPRG 159 - CO2 pipelines, fracture control EPRG 160 - CO2 pipelines, main project EPRG 161 - CO2 pipelines, shock tube testing EPRG 162 - Revision of EPRG weld defect guidelines Completed projects of particular interest to National Grid include the project on X80 fitness for purpose, the update of the EPRG girth weld defect acceptance criteria and the definition of rich gas when considering fracture propagation behaviour. Ongoing work on 3 layer PE coatings, although not used by National Grid, helps National Grid keep a watching brief on their use. 2. Support from GL Noble Denton covering a range of expert technical activity in the year up to 31.03.13, including: o Representation of NGG (by MACAW consultant, Bob Andrews) at up to 3 meetings of the EPRG Materials Committee.

(IFI24) European Pipeline Research Group (EPRG)

Year: 2012/13

o Representation of NGG (by GL Noble Denton consultant, Ian Thompson) at up to 3 meetings of the EPRG Corrosion Committee.
o Workshop to disseminate the results of Project 162 “Revision of the EPRG Weld Defect Guidelines” (Design Committee) (by MACAW consultant, Bob Andrews).
o Year-end review presentation and stage gate meeting

Key highlights during the year were:
o X80 fitness for purpose report - provides additional data for X80 damage assessment to support National Grid’s T/PM/P/11 procedure.
o Workshop briefing given to National Grid on mechanised pipeline welding
o Review of strain based design
o Work being taken on rich gas definition for fracture propagation to provide a better understanding of the risk - gas supplies from LNG means more rich gas coming into the network
o Review meetings with GL Noble Denton
o Joint Technical Meeting (JTM) held between PRCI, EPRG and APIA to present significant pipeline research between the groups and to consider priority areas for future direction of research programmes for collaborative funding.
o Joint workshop held between Tx and GDx to share awareness of the EPRG/PRCI programmes of work.

Collab' Partners

BP Exploration Operating Co. Ltd. (United Kingdom
Corinth Pipeworks S.A. (Greece)
Corus Tubes - Energy (United Kingdom)
ENI G& P (Italy)
E.ON Ruhrgas AG (Germany)
Europipe GmbH (Germany)
Fluxys n.v. (Belgium)
Gaz de France (France)
N.V. Nederlandse Gasunie (The Netherlands)
Salzgitter Mannesmann Großrohr GmbH (Germany)
Salzgitter Mannesmann Line Pipe GmbH (Germany)
Shell Global Solutions International B.V. (The Netherlands)
SNAM Rete Gas S.p.A.n (Italy)
TENARIS DALMINE SPA (Italy)
Total E & P (France)
RAUTARUUKKI OYJ (Finland)
Vallourec & Mannesmann France (France)

Provider(s) GL Noble Denton, EPRG

(IFI25) PRCI Research Collaboration

Year: 2012/13

Project Description	The main focus for National Grid is assessment, prevention and migration of integrity threats, such as mechanical damage and external corrosion.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£19,264	£15,162	£0	
External	£44,077	£46,755	£0	£6,000,000
Materials	£0	£0	£0	
Total	£63,341	£61,917	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Main focus for National Grid Distribution is assessment, prevention and migration of integrity threats such as mechanical damage and external corrosion. Jointly funded pipeline research/ sharing information on best practice / incidents.
☐ **5 Protecting the Environment**	

Technological area / issue addressed by project

The 2008 PRCI research program consisted of Member contributions of $7 million. The 2008 program included:

o Mechanical damage - detection, characterization, and management to address third party damage and geo-technical events.
o Design and construction (pipelines)
o Integrity management - research into corrosion and environmental cracking to enhance safety and reduce the potential for incident.
o Compressor and pump stations - air emissions and fuel requirements.
o Measurement - metering accuracy, reliability and cost-effectiveness.
o Underground storage - storage facility integrity and operational flexibility.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Minor	11	-4	15

Expected benefits of project

- Improved system integrity knowledge, Improved corrosion protection, reduced 3rd party incidents leading to less supply disruptions. Networking opportunity with other pipeline operators, sharing information and best practice. It is very difficult to articulate the proposed benefits of these high level benefits until the output of each individual project is known….
- Prevention of incidents will also mean the prevention of the loss of gas to atmosphere. It is extremely difficult to quantify a value of the amount of gas saved from the proposed EPRG projects if all were implemented.
- The primary benefit from this programme is collaboration on projects that will help to maintain the integrity of the high pressure pipelines, via developed assessment, risk and prevention tools and techniques that mitigate the integrity threats on the high pressure pipeline network and thus reduce the overall risk.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	2 yrs	25%	-£60,976

Potential for achieving expected benefits

The importance of the knowledge is that assists National Grid in mitigating and pro-actively responding to current and potential future integrity issues and threats. Such awareness helps to demonstrate that National Grid is fully informed of emerging techniques, best practice, and learning from incidents.

Participation in PRCI still provides National Grid will a significant leverage benefit, and therefore

(IFI25) PRCI Research Collaboration

Year: 2012/13

	demonstrates value for money invested.
Project Progress	PRCI membership is collaborative with Gas Transmission to ensure consistency of approach with National Grid Gas. During the last year, areas of particular interest to National Grid have included the continuing work on the dent/gouge mechanical damage model and also of interest is work on monitoring of third party interference threats and the performance of composite repair techniques. The PRCI work on Extended Low Flow Range Metering has been used in the scoping further National Grid test work at the flow centre at Bishop Auckland, UK. Testing is still ongoing but initial results are encouraging. The tests on CO2 Shock Tube Testing complimented work undertaken by National Grid and has helped with considering the design requirements for anthropogenic CO2 pipeline systems.
Collab' Partners	National Grid Transmission, and 34 other member companies with energy pipeline interests via PRCI (23 based in the USA; 5 European; 5 Canadian; 1 South American; 1 Middle-Eastern)
Provider(s)	PRCI

(IFI26) The Effect of Thermal Lagging on Fiscal Metering Temperature Measurement

Year: 2012/13

Project Description

To determine if existing non lagged high pressure metering installations provide a representative temperature measurement for the purposes of fiscal flow measurement, including impact on thermowell installation performance.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£10,890	£4,121	£3,520	
External	£71,969	£40,326	£20,000	£489,630
Materials	£26,352	£0	£0	
Total	£109,211	£44,447	£23,520	

Status	
Submitted	
Draft	02/05/2013
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Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Mitigation against the pass on costs to customers if the lagging of high pressure metering tubes work has to proceed.
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

o Validate and demonstrate the need for not having thermal lagging on meter tubes and its impact upon accurate tempeture measurement
o dentify any alternative techniques for accurate temperature measurement & methods of installation with subsequent tests
o Challenge the established engineering rationale regarding thermal lagging on meter tubes
o Challenge the established engineering rationale regarding thermowell design and configuration.
o Challenge the established engineering rationale regarding surface mounted measurement technqiues.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Significant	Minor	10	2	8

Expected benefits of project

Knowledge on thermal lagging future option requirements. The project could provide an efficiency for annual maintenance activities and Gas Industry reputation enhanced through improved metering accuracy.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	2 yrs	50%	£529,093

Potential for achieving expected benefits

The output of this project has increased the understanding of the issues associated with thermowell installations and provides assurance that the existing deployment of thermowell measurement can be shown as fit for purpose.

Project Progress

Testing was undertaken to determine whether the current National Grid Distribution method of measurement continues to be fit for purpose and whether an alternative method of temperature measurement for fiscal metering purposes using surface mounted sensors may be acceptable. The testing was successfully completed and concluded that for the representative operating studied:-
o There was no real firm evidence to support the lagging of measurement installations which deploy intrusive techniques, centre third requirement, cited by some standards as being a necessary prerequisite for measurement sensor tip location was not considered to be necessary
o Viable alternative intrusive temperature measurement thermowell pockets considered by the project are considered to be viable and these in turn provide a suitable solution for smaller bore pipes and can address any integrity issues that might otherwise be present for deeper penetrated pockets.

Findings will be shared at the North Sea FM Workshop.

(IFI26) The Effect of Thermal Lagging on Fiscal Metering Temperature Measurement

Year: 2012/13

Collab' Partners		**Provider(s)**	GL Noble Denton

(IFI28) Hazard & Risk Assessment Tools for Major Gas Installations

Year: 2012/13

Project Description Research and development of two Software tools for hazard and risk assessment of Major Hazard, Gas Installations

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£6,219	£5,512	£0	
External	£42,450	£54,450	£0	£500,000
Materials	£0	£0	£0	
Total	£48,669	£59,962	£0	

Status	
Submitted	
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Supports National Grid in assessing the risks from its above 7 bar pipeline system and ensuring that expenditure is appropriately allocated.
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

o Ensure National Grid Gas Distribution is using appropriate and up to date risk assessment methodologies that can be justified to HSE when assessing the risks from its high pressure pipeline assets.
o Enhanced Software tools for hazard and risk assessment of Major Hazard Gas Installations

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	20	-3	23

Expected benefits of project

- Improves National Grid's understanding of pipeline risks
- Safety management through application of the models developed through this project
- The full cost of this project will collaborative partners is approximately £500k. National Grid's commitment to this is £135k. This provides a National Grid leverage ratio of 3.7:1 and individually GD's ratio will be 7.4:1.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2011	20 yrs	50%	-£36,050

Potential for achieving expected benefits

Supports the management of risk required under the Pipeline Safety Regulations and Process Safety.

Leverage and collaboration benefits.

Project Progress

1. An updated version of the PIPESAFE package (for hazard and risk assessments of gas transmission pipelines) was prepared for implementation in 2013/14, delivered through the PIPESAFE collaboration and including improved consequence models for pipeline fires and rupture crater dimensions based on new research.
2. A revised version of the National Grid specification for protective slabs was developed to enable the use of PE slabs as an alternative to reinforced concrete slabs
3. Annual submissions were prepared on behalf of National Grid to industry databases collating the incident experience of pipeline companies in connection with both buried high pressure pipelines and associated installations. The databases are a valuable resource for deriving historical statistics for incident frequencies and ignition probabilities for use in risk assessments.
4. A review of gas release incidents on National Grid's high pressure pipelines and related installations was carried out, to examine trends and to highlight issues. The two reports build on the foundations laid in previous years to provide a valuable key performance indicator to monitor safety performance.
5. A new version of the ORDER package (for hazard and risk assessments of high pressure gas

(IFI28) Hazard & Risk Assessment Tools for Major Gas Installations

Year: 2012/13

	installations) was delivered in 2012/13 delivered through the ORDER collaboration, including improved functionality and an updated explosion methodology, as well as software modifications for the use of the package under Windows.		
Collab' Partners	Collaborative partners for the "ORDER" group include (but are not limited to) GDF SUEZ (France) Gasunie (Netherlands) Enagas (Spain) Energinet.dk (Denmark) & Fluxys (Belgium). "PIPESAFE" group include (but not limited to) National Grid (UK) Energinet.dk (Denmark) Enagas (Spain) Fluxys (Belgium) Gasunie (Netherlands) StatoilHydro (Norway) & TransCanada PipeLines (Canada).	**Provider(s)**	GL Noble Denton

(IFI40) AGI Condition Monitoring

Year: 2012/13

Project Description	To review and test condition monitoring techniques for above ground installations (AGIs)

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£892	£792	£0	
External	£8,598	£8,598	£0	£73,778
Materials	£0	£0	£0	
Total	£9,490	£9,390	£0	

Status	
	Submitted
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Reduction in maintenance taks and deferring of replacement of PRIs or their components
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	The system has the potential to allow targeted maintenance to be performed by detecting moisture under insulation to identify areas of potential significant corrosion. This will enable corrective measures to be taken prior to any leakage occurign thus ensuring no loss of supply.
☐ **5 Protecting the Environment**	
Technological area / issue addressed by project	o Detecting conditions that would support corrosion under insulation. o Identify areas of insulation that require removal to inspect pipework. o Identify and rectify areas of pipe corrosion prior to failure.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Medium	7	-2	9

Expected benefits of project	A system to allow targeted maintenance to be performed by detecting moisture under insulation on AGIs. Improved integrity of the pipelines and vessels mitigating against the potential loss of supply.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	75%	-£70,652

Potential for achieving expected benefits	The business benefits of the project are solely knowledge acquisition.
Project Progress	The project was stopped following the completion of field trial, whilst the demonstration concluded that the technology could detect moisture in insulation, there were a number of limitations identified The limitations include: o The need for frequent visual monitoring on site (likely to be weekly) due to battery life and the need to visually check for water in the detector. o No cost effective solution for remote monitoring.
Collab' Partners	**Provider(s)** GL Noble Denton

(IFI43) High Pressure Temporary Repairs

Year: 2012/13

Project Description	To select, test and approve composite temporary repair solutions for use on National Grid's high pressure gas pipeline network.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£15,921	£19,961	£0	
External	£89,976	£89,404	£0	£381,606
Materials	£26,991	£107,964	£0	
Total	£132,888	£217,329	£0	

Status	
	Submitted
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☑ **2 Eradicating Fuel Poverty**	Minimising the loss of supply will limit the potential impact upon vulnerable and needy consumers.
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	This type of solution could prevent a severe loss of supply scenario where long lead times are required fot the production of traditional repair fittings.
☐ **5 Protecting the Environment**	
Technological area / issue addressed by project	Composite repair systems are currently unapproved. Selection, test and approve a composite repair system that could be used on pipeline geometries, such as bends and tees, where existing techniques are unsuitable.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Medium	15	2	13

Expected benefits of project	Identification and appraisal of a temporary high pressure pipeline repair techniques, sufficient to allow an optimum selection for a given repair scenario. Successful qualification test of solution(s) that can be used for emergency repair use or development of bespoke solution.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	1 yrs	25%	£398,398

Potential for achieving expected benefits	Preparation of a specification for a tender event is now required under NIA to realise benefit.
Project Progress	The aim of stage 3 was to test and verify suitability of two potential composite temporary wrap repair solutions for use on National Grid's high pressure gas pipeline network using finite element analysis (FEA) to model the parameters of the repair solutions which could then be subsequently tested in the second phase of the stage. From the FEA it was concluded that crack-like defects in circumferential (girth) welds that have been repaired using the repair system will not lead to failure provided that the pipeline is operated within its original design. During the full scale testing, the pressure was raised to predetermined levels. None of the repaired bends failed during these tests, each exceeding the high level test requirements of IGE/TD/1 Edition 5 with no apparent breakdown of the repair system. Overall the analysis and testing was successful and it was concluded that the composite repair systems can both be used to temporarily repair defects in bends in high pressure pipelines up to 84bar. The FEA did accurately predict the outcome however some necessary adjustments will need to be made to ensure that it remains a robust prediction tool going forward. As tests proved more than favourable, further work under NIA to certify the approach as a permanent rather than just a temporary repair will be considered.
Collab' Partners	
Provider(s)	GL Noble Denton

(IFI46) Internal Joint Profiling System for PE Pipes

Year: 2012/13

Project Description

To demonstrate if the internal weld profile of in-service PE joints (both butt and electrofusion joints) meet gas industry engineering standards; this will be completed by a combination of:
- visual inspection
- reproducing the internal profile to enable comparison against acceptable parameters.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£4,916	£3,921	£0	
External	£20,090	£33,180	£0	£455,912
Materials	£0	£0	£0	
Total	£25,006	£37,101	£0	

Status	
Submitted	
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Good alignment as this will provide a methodology of determining the integrity of PE joints (both butt and electrofusion) to be undertaken without the need to undertake multiple excavations
☑ 5 Protecting the Environment	Minor alignment as the use of the new tool will result less excavations compared with current practice.

Technological area / issue addressed by project

To design a profile measurement device linked with a camera within PE pipe systems for measuring internal joints covering:
- LP/MP/IP pressure tiers, initially up to 4bar, but with the potential to increase to 10bar
- All PE pipe diameters from 125mm up to and including 630mm
- The following existing SDR ranges, 11, 17.6 & 21, plus the potential to modify the instrumentation for other SDRs which are currently under development, e.g, 26 & 33 - subject to acceptable entry systems being designed and developed.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Significant	Medium	13	1	12

Expected benefits of project

This device could enable more accurate identification of PE plant to other 3rd party excavators to minimise the potential of interference damage. Reduced operational cost and environmental issues for a single excavation and improved decision making on the condition joints by internal visual appearance and accurate measurement of both butt and electrofusion joints.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	11 yrs	75%	£621,914

Potential for achieving expected benefits

The benefits will only be realised once the decision on which activities and specialist business unit will implemented has been made which is expected in 2013.

Project Progress

The laser profile measurement device linked with a camera for measuring internal joint profiles and bores of PE pipes was trialled this year. The system can operate inside a pipeline, weld beads and obstacles can generally be overcome with no problems, during the field trial only steep inclines have prevented further progress:

o The system has been tested in an explosive and non explosive atmosphere with no adverse effects.
o With the scissor lift mechanism using electrical power to move the laser system up and down, the biggest risk to the profiler is a power failure. Analysis of the risk has been undertaken and a suggested simple recovery plan has been drawn to enable the device to be removed.

Collab' Partners Synthotech Ltd **Provider(s)** Synthotech

(IFI47) Alternative Sources/Scenarios for Bio-methane Injection

Year: 2012/13

Project Description

To demonstrate the safe injection of biomethane into the UK gas grid from biogas sources other than sewage to demonstrate the overall feasibility of small scale "renewable" additions to the National Grid Gas Distribution network for LTS and IP systems.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£15,970	£15,356	£0	
External	£19,725	£160,000	£0	£1,538,943
Materials	£70,059	-£17,000	£0	
Total	£105,754	£158,356	£0	

Status	
Submitted	
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Strong Alignment Injection of bio-methane into the gas network provides the only large scale, non-disruptive & economic solution for decarbonising heat in the UK.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Minor Alignment. National Grid have established that up to 50% of residential gas demand can be met with renewable gas and therefore this represents a potentially significant source of fuel that will enhance energy/security of supply within the UK.
☑ **5 Protecting the Environment**	Strong Alignment. Biogas promises to deliver substantial environmental benefits. This project should demonstrate the injection of this gas into the gas distribution network enabling it to be used in the most efficient way and thus delivering the greatest environmental benefit.

Technological area / issue addressed by project

Conceptual Design for the IP system to inject bio-methane from Foodstocks and waste
- o Conceptual Design for the LTS system to inject bio-methane from pig slurry
- o Identify the specific gas quality monitoring equipment for each pressure tier compliant with GS(M)R requirements
- o Identify lower cost, fit for purpose, equipment for each pressure tier and the regulatory changes that would be required to implement them

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Significant	14	4	10

Expected benefits of project

Develop knowledge of best industry practice on the injection of biomethane into the grid in the UK for the pressure tiers identified. This project should also identify any on-going barriers that may prevent biogas being injected and reaching its full potential. This information combined with data from the trial is anticipated to enable effective solutions to those barriers, especially economic ones, to be identified.

This project should demonstrate the injection of this gas into the gas distribution network enabling it to be used in the most efficient way and thus delivering the greatest environmental benefit.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	0 yrs	50%	£1,451,681

Potential for achieving expected benefits

The knowledge gained during the course of this project has informed the direction of IFI: 70, the business now has a commercial offering for customers who can inject approximately 300m³ per hour of bio methane that will provide a viable return on their investment. As the site is anticipated to go live during 2013 the documented environmental benefits have not yet been realised but are still expected.

Project Progress

The project was carried out over 2 stages, the first being a feasibility study and the second was to complete the detailed design and then subsequently build and commission a bio methane injection connection point into the intermediate pressure network at the Adnams Brewery in Suffolk
Stage two enabled NG to identify costs associated with an installation that followed established Natural Gas Site configurations and site lay outs. From this point sufficient experience was established to generate a scope of works for NG Procurement to progress a framework contract for a Bio methane Packaged Solution and bring some economies of scale to the required equipment to enable future unconventional Gas Sources connections with a view to reducing barriers to entry

(IFI47) Alternative Sources/Scenarios for Bio-methane Injection

Year: 2012/13

	associated with cost. Whilst the majority of the work was completed in February 2012 the site is still yet to be commissioned primarily due to the proposed clean up technology had to be changed by the third party to enable efficient injection into the gas network, it is anticipated that the site will go live in later in 2013 and the required commissioning will enable demonstration of safe injection of bio methane in to the Network.
Collab' Partners	**Provider(s)** Mouchel, Willows, Oribital

(IFI50) Proximity Effects of Squeeze Off upon PE Pipe Joints

Year: 2012/13

Project Description

To understand the loads imposed upon PE Pipes when they are squeezed off and to use this information to better understand the requirements for separation distances between squeeze off equipment and joints.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£2,000	£517	£3,520	
External	£17,689	£5,614	£20,000	£250,345
Materials	£0	£0	£0	
Total	£19,689	£6,131	£23,520	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Good Alignment. Project will mitigate against the risk of joint/fittings failures during squeeze-off operations and this maintaining supplies to customers.
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

o Using validated finite element analysis of PE pipes to explore sensitivity of joint/fitting proximity to squeeze-off equipment
o Explore Proximity issues when soil restraints is present
o Explore Proximity issues when joints contain defects
o To undertake basic testing of samples of PE material that have been subjected to Squeeze-Off to verify the Post Squeeze-Off Yield Strength

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	19	1	18

Expected benefits of project

This project will provide essential knowledge and understanding via validated FEA regarding the loads imposed during PE squeeze-off operations. This informed position will then determine whether any modifications are required to its working practices to ensure that their PE pipes are safe and also maintain supplies during flowstop operations.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	5 yrs	75%	£941,371

Potential for achieving expected benefits

Benefits will be realised following implementation of the new Policy documentation.

Project Progress

The scope of this stage was to record the background stress levels on PE pipes during squeeze off operations. Six tests were originally planned and from these five were successfully completed within the revised delivery timescales. The main conclusion from the trials undertaken revealed that the stress levels were higher than expected.

The output from the trials has been reviewed and separation distances can not be reduced but increased for PE100 and PE80 pipes and not below. Policy documentation will be revised.

Collab' Partners | **Provider(s)** GL Noble Denton

(IFI51) New Materials for Gas Distribution

Year: 2012/13

Project Description	Determine the feasibility of applying specific novel materials to gas distribution that will overcome the construction difficulties associated with reinforcement and replacement of mains in and around London, so that National Grid can design and construct the mains replacement programme from 2013.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£19,342	£9,493	£0	
External	£185,756	£121,138	£0	£786,729
Materials	£21,139	£0	£0	
Total	£226,237	£130,631	£0	

Status	
Submitted	
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Strong alignment. Currently there is no practical pipe material to meet the requirements of the London Strategy replacement programme for future years.
☑ **5 Protecting the Environment**	Strong alignment. In the absence of any innovative material and faced with no alternative, steel would have to be used typically by non trenchless techniques. This would cause major traffic congestion, additional excavation and waste materials
Technological area / issue addressed by project	Large diameter pipes other than PE/ST that meet Gas Industry standards and procedures of up to 7bar operation o Risk assessments for laying such pipes in close proximity to buildings o Ability to connect to existing gas distribution systems o Ability to connect new offtakes in PE/ST o simplified table or matrix specifying building proximity distances associated with PE material by SDRs and PE pipe generation, pressure range host pipe material and jointing method.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Significant	Significant	25	1	24

Expected benefits of project	Develop an alternative to steel and provide environmental benefits by reducing excavations and waste materials in urban areas. This supports our London strategy.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	18 yrs	75%	£847,953

Potential for achieving expected benefits	As a result of the physical testing and risk model rerun a revised proximity table has been produced. Case study quantative risk assessments have been undertaken to enable the impact of societal risk to be taken into account.
Project Progress	The key technical challenge during the year was to obtain information on the resilience of large diameter PE to damage incurred by typical plant as there was little or no actual damages to PE pipe >315mm PE from records. Detailed tests were carried out with JCB on 500/630mm PE pipe and have been used to update the PE proximity risk model. The effect of societal risk compared to individual risk has also been addressed on large diameter pipes laid in urban areas.
Collab' Partners	**Provider(s)** PB Rune, GL Noble Denton, Radius

(IFI52) European Gas Research Group (GERG)

Year: 2012/13

Project Description

GERG is a cooperation of European Gas Utilities. Its members undertake a wide range of research directed to increase integrity and safety of gas distribution systems. National Grid is an active partner within the Distributions stream of GERG and seeks to gain significant leverage by collaborating in joint research projects.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£7,046	£9,677	£0	
External	£38,780	£85,247	£0	£750,000
Materials	£0	£0	£0	
Total	£45,826	£94,924	£0	

Status	
	Submitted
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ 1 Low Carbon Economy	Minor alignment. Development of best of breed methane emission methodologies.
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Good Alignment,. Jointly funded research/ sharing information on best practice NDT of joints and Gas in Soils.
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

- Non destructive testing using field made joints
  - o The dynamics of gas tracking in soils
  - o Bench marking of methane emission methodologies
  - o Evaluation of nano technologies in gas distribution systems
  - o Reducing gas losses as a result of operation of the system
  - o Innovative testing of PE to define the tendency for slow crack growth

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	7	-2	9

Expected benefits of project

- Improved knowledge in all project areas. The Gas in Soils project will inform the business concernimg the dynamics of gas tracking when dispersed in soils

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	25%	-£94,924

Potential for achieving expected benefits

Gas in Soils:
Benefits remain on track.

Admissable Hydrogen:
Significant advances have been made to understand the impacts of hydrogen but there remains uncertainty and hence benefits are likely to be deferred.

Project Progress

Soils:
Laboratory controlled tests have been completed at GDF Suez offices to validate mathematical models.
Further tests in a open field environment have been planned and preparations made to undertake these test in Germany during 2013.

Admissable Hydrogen:
Better understanding of the impact of hydrogen mixtures particularly on CNG vehicles, compressors, gas turbines and residential appliances.

Collab' Partners

Alliander N.V.
Danish Gas Technology Centre,
DVGW e.V.

Provider(s) GDF Suez, GERG

(IFI52) European Gas Research Group (GERG)

Year: 2012/13

Enagas
Energinet
Eni S.p.A
E.ON Ruhrgas
E.ON Gas Storage GmbH
Euromot
EUTurbines
Fluxys
Gas Natural
Gasum Oy
GdF SUEZ
Italgas
DNV Kema
Kiwa Gas Technology
Naturgas Energla Group
Open Grid Europe
Shell Global Solutions International
Siemens Energy Sector
Snam Rete Gas S.p.A
SVGW
Statoil ASA
Wintershall

(IFI62) Development of DANINT FWAVC software for New Gas Chromatograph

Year: 2012/13

Project Description	Develop and trial engineering software for data management of Gas Composition, CV and volume data in compliance with 'The Gas Calculation of Thermal Energy Regulations'.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£5,783	£0	£0	
External	£6,550	£0	£0	£305,054
Materials	£13,640	£0	£0	
Total	£25,973	£0	£0	

Status	Submitted
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Minor alignment. Lower installation and maintenance costs for directed CV measurement resulting in fewer visits to sites.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Good Alignment. Accurate and reliable monitoring of throughput in accordance with Ofgem regulatory requirements.
☑ **5 Protecting the Environment**	Lower consumption of bottle gases.

Technological area / issue addressed by project

o Site Acceptance Testing of output from stage 1 installed at Holford, a FWACV configured and non-directed site.
o To develop and maintain a laboratory system that replicates the installed facilities such that long term resilience testing of the developed software and approved hardware can be carried out.
o Development of a standard Ofgem compliant Application configuration for the 2350A (new Processor card) and the Model 500 & 700 Danalyzer.
o Specialist Investigations to improve hardware/software performance:

~ DANGO collects zero composition with no Danalyzer alarm. DANGO could be changed to trap this, or OC_gdata could sense check data sent to the flow computer.
~ Invalid composition values should not be sent to the flow computer (see above point) – A System 1 alarm to be generated if component concentrations are outside specified alarm range
~ Alternatives to OC_gdata
~ omni alarms not tied to flow streams (Danalyzer streams) so difficult to know where they have come from, consider the generation of separate alarm files whilst preserving backward compatibility
~ Provide Ethernet capability for Omni(s) as well as chromatograph controller etc (whilst retaining backward compatibility). - change to OC_gdata to able enable ethernet modbus/TCP or serial modbus to communicate with omni.
~ Development version of GasVLe (currently not generally released) has AGA8 calculations for '92, '94 Gross and Detailed versions. These need to be enabled in the various spreadsheet tools, which are included with the DANINT suite.
~ Consider Windows approach to replace the Notepad-style configuration files or check option for application to identify clearly incorrect configurations.
~ Consider different 'cycle times' between chromatograph data and that collected from the flow computer as regards RBD?
~ Provision of P&T from all streams in use on chromatograph.
~ Some way of trapping illegal entries would be useful. Config.exe and GEtest.exe are Ok as input via DANview screen
~ Would like onscreen indication that calibration is in progress and pop up window that gives the results if the cal fails. Could the cal fail (RF deviation alarm in the 2350A controller) be interpreted as a Cal Fail in the DANINT window (this is a change to DANview)

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	27	-6	33

(IFI62) Development of DANINT FWAVC software for New Gas Chromatograph

Year: 2012/13

Expected benefits of project

- Environmental benefits via less visits to site by operational staff will obviously contribute to less pollution from vehicles however, it is very difficult to quantify the benefit.
If this solution is approved by Ofgem there will be two solutions available for Operators to use. This Model 700 solution will be more cost effective that the Model 500, and will also enhance the viability of injecting other gas sources.

- This project is being funded equally between the Gas Distribution operators and National Grid Transmission. This provides a good leverage ratio of 1:5 for each funding participant.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2016	5 yrs	50%	-£89,622

Potential for achieving expected benefits

The anticipated output will be environmental improvements and network performance.

Project Progress

Stage 2 commenced in January 2013. The output of which will be: Resilience Testing of the new DANINT 12C and 12D software and additional configuration requirements.

Collab' Partners

NGN, SGN, WWU, National Grid Transmission

Provider(s)

Energy Innovation Centre, GL Noble Denton

(IFI63) PE Asset Life Reseach

Year: 2012/13

Project Description	To develop methodologies, techniques and decision support tools that establish the current condition of the existing PE network, identifies potential threats to the integrity of PE pipes and joints, assesses the residual life of the PE network and identifies possible strategies and policies for targeted replacement.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£36,395	£26,566	£53,129	
External	£300,312	£217,766	£295,598	£1,340,948
Materials	£1,270	£12,987	£0	
Total	£337,977	£257,319	£348,727	

Status	
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Draft	02/05/2013
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Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Strong alignment. The avoidance of wholesale PE replacement in future years based on design life of 50years. The work is expected to allow asset life to be extended for many decades thereby avoiding major construction activity.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Strong alignment. The principal objectives of this work are to provide tools and methodologies to allow condition assessment and risk management of PE mains and service assets to be undertaken. This may lead to targeted replacement where risk dictates.
☐ **5 Protecting the Environment**	
Technological area / issue addressed by project	o Introduction and development of novel retrieval methods for small PE samples (slivers & coupons). o Development of chemical and physical characterisation methods of determining condition assessment and residual life prediction from small samples. o Introducing new test methods to qualify the long term service performance of recovered sections of pipes and joints. o Developing a PE materials database and software tools for predicting the residual life of PE systems.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Significant	Significant	25	2	23

Expected benefits of project	- New test methods for PE integrity and life that may be used to provide improved tests to specify new PE products. Understanding the risks posed by the PE asset to at least the same level of confidence as is currently the case for metallic mains.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	10 yrs	50%	£131,204

Potential for achieving expected benefits	Benefits remain on track. General confidence has grown that in general the early Aldyl A PE material has a long life and the focus of the project shifts towards joints and/or specific material types.
Project Progress	Conducted a review of available tests and the development of novel tests: - Statistical analysis of failures, leak data - Definition of sample extraction programme - Impact of squeeze off on early PE materials - Compatibility of early and modern materials - Accelerated deterioration testing Obtaining opportunistic samples as and when PE pipes are cut out has been a challenge.
Collab' Partners	SGN
Provider(s)	MACAW, Radius

(IFI67) Pipeline Industry Research Club [PIRC]

Year: 2012/13

Project Description	Assessment, prevention and investigation of PE threats and opportunities via collaborative research.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£1,593	£4,548	£0	
External	£10,000	£10,000	£4,167	£170,000
Materials	£0	£0	£0	
Total	£11,593	£14,548	£4,167	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	PIRC undertakes jointly funded pipeline research to mitigate issues and risks associated with PE pipes. The group also provides opportunities for sharing information on best practice and incidents with other 8 other Water Companies
☐ **5 Protecting the Environment**	

Technological area / issue addressed by project

Year 1:
o Butt Fusion Welding using forced-cooling to reduce welding cycles by up to one third without sacrificing quality, in collaboration with equipment manufacturers, thereby providing very real cost savings to the Industry.
o Coil Straightener a modular unit which can be attached to a coil trailer straightening and re-rounding coiled pipe in the process. The major benefits would be significant improvement in both joint quality and safety for relatively low cost.
o Rehabilitation Guidance a critical assessment of various rehabilitation techniques, including Rolldown, Swagelining and Polyflex, with practical guidance and advice to minimize avoidable risks.
o NDT of fusion joints - establishment of specific pass/failure criteria for the welds by correlation of NDT results obtained from the field with mechanical testing where appropriate, ultimately providing reliable reassurance.
5) Large Diameter EF Couplers (>630mm) Various jointing issues (including Reversion of pipe ends) are exaggerated in larger diameter fittings. Exova conduct approval testing and analysis to prevent problems occurring in the field.

Year 2:
In Year 2 the following projects will progress/continue:
o Harnessing Standards to Optimise Procurement
o Microwave NDT of PE BF and EF Joints
o Butt Fusion Welding of PE
o Lifetime of Electrofusion Fittings
o Coil Straightener
o Condition Assessment of Large Diameter Iron Trunk Mains
o New Technology Awareness

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	13	-7	20

Expected benefits of project

Improved system integrity.

The primary benefit from this programme is collaboration on projects that will help to maintain the integrity of PE pipes and demonstrate to the HSE and other stakeholders that National Grid is actively engaged at an Industry level.

Significant research leverage benefits.

(IFI67) Pipeline Industry Research Club [PIRC]

Year: 2012/13

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	8 yrs	25%	£36,405

Potential for achieving expected benefits

Benefits as stated. This remains high based on the successful work delivered to date.

Project Progress

NDT of fusion joints:
Further field trials and site audits have taken place within the Water Industry. This has further refined the specific pass/failure criteria following destructive testing of welds. The main focus of the work now is look at making the equipment intrinsically safe for deployment in the Gas Industry.

Core & Vac
Evaluation of the Core & Vac technique to fit a repair clamp using long handle tooling in conjunction with a laser pipe profiler. This could result in significant benefits mainly due to reduced excavation size.

New Product Development
Development of a new type of shear mixing clamp to promote better molecular mixing of molten PE during electrofusion of a PE joint. The aim of this work is to enhance joint quality.

From the work programme for Year 2, the coil straightener site trial and second issue of pressure test IGN items have been completed pending the final output. All other items are in progress and are expected to deliver in line with their anticipated timelines.

Collab' Partners

United Utilities, Thames Water, Severn Trent Water, Yorkshire Water, Veolia Water, Northern Ireland Water, South West Water, Bristol Water, Sutton and East Surrey Water & Northumbrian Water.
The current membership for 10/11 is to be confirmed but is likely to exceed 8.

Provider(s) EXOVA Polymer

(IFI68) Model Maintenance Improvements

Year: 2012/13

Project Description	To develop enhancements and efficiency improvements to the model maintenance applications that are used to model and analyse gas distribution systems with the aim to enable better integration with the business systems proposed under the GDFO programme.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£10,678	£6,515	£0	
External	£43,479	£54,621	£0	£151,508
Materials	£0	£0	£0	
Total	£54,157	£61,136	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☑ **2 Eradicating Fuel Poverty**	Good Alignment. The network analysis models are used to make operational and strategic decisions for the business, the swifter updates will remove the potential disparity between the models and reality removing the probability of loss of supply and thus protecting venerable customers.
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Good Alignment. The network analysis models are used to make operational and strategic decisions for the business, the swifter updates will remove the potential disparity between the models and reality removing the probability of loss of supply and ensuring that these models align to reality.
☐ **5 Protecting the Environment**	

Technological area / issue addressed by project

- o New GBNA/LINAS Compare & Update functionality
- o Develop a prototype that provides the ability to independently process pipe attribute changes
- o Develop a prototype that provide the ability to 'drag and drop' node numbers
- o New Pipe Attributes Supplied From GIS
- o New update functionality for the underlying GBNA network files to hold the PON/Asset ID.
- o New Update the underlying GBNA network files to hold the unique GIS Node IDs.
- o Prototype Export to ArcFM Designer

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	12	2	10

Expected benefits of project

The proposed enhancements will greatly reduce the manual effort required to maintain and update models, which in turn will reduce the potential for errors occurring in the network models. Therefore there will be an expected increase in both efficient working and quality of the network models.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	3 yrs	75%	£1,341,533

Potential for achieving expected benefits

- o Vital changes presented to the user for quick decision making
- o Avoidance of unnecessary wasted effort in cross checking data within the maintenance model.
- o Reduction in time spent updating models.

Project Progress

Software was successfully deployed during 2012 which provided user process and performance improvements such as an improved approach to handling negative/positive node number changes and source change information and the ability to automatically associate nodes with an LFZ.

Collab' Partners | **Provider(s)** GL Noble Denton

(IFI69) Capacity Enhancements Using Compression

Year: 2012/13

Project Description

To demonstrate the feasibility of the use of compression to pump gas into higher pressure tiers at times of low demand, and hence to maximise the capacity for biomethane injection into the gas networks

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£7,793	£23,238	£0	
External	£67,756	£87,500	£0	£401,529
Materials	£2,714	£0	£0	
Total	£78,263	£110,738	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ 1 Low Carbon Economy	Successful integration of compression into the gas network at strategic locations will enable GDNs to accept biomethane into their networks at many more locations than at present, as capacity is often constrained by the lack of year-round local demand
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	The introduction of biomethane at a multiplicity of locations will provide additional resilience for gas networks, and also facilitate the long-term continued use of all gas networks
☑ 5 Protecting the Environment	The additional quantities of biomethane injection that will be facilitated by the development of intra-network compression will reduce the proportion of fossil gas in the gas network and hence reduce greenhouse gas emissions from gas utilisation

Technological area / issue addressed by project

- Confirm, by means of simulation model, the steady-state and transient operating characteristics of a compressor installed at a PRS to pump gas from one pressure tier to a higher tier.
- Quantify operational constraints, gas flow metrics, site and equipment pressure settings, safe operating envelopes, consequences of breaching limits
- Review and quantify plant performance characteristics, reaction times, and start-up/shut-down reliabilities
- Derive site or network-specific sensitivities to clarify key considerations when designing explicit site requirements
- Define the technical, commercial and regulatory requirements for a field trial project.
- Injection biomethane into a higher pressure tier using compression

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Significant	13	-4	17

Expected benefits of project

- The output will provide significant knowledge benefits for the funding parties via firstly the development and testing of the Simulation Model (to be owned by National Grid and NGN) and then subsequently via the design and testing from the field trial installation.
- It is estimated that compression could be required in relation to around 40% of potential biomethane injection sites, which would otherwise not connect to the gas network. Additional biomethane injection should enhance the resilience of the gas network, and secure its long-term future in an environment when there will be increasing pressure to reduce the use of fossil gas. It is difficult to quantify the environment benefit here given that installation and injections rates may vary from site to site and it is also difficult to predict the number of connections that may be requested in the future.
- By ensuring that the output is codified and adopted into existing connection processes it will allow the funding to parties to respond accordingly within the appropriate standards of service.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	8 yrs	75%	-£360,191

Potential for achieving expected benefits

Knowledge benefits have been realised.

Project Progress

The project is a collaboration between NGN, NGG and CNG Services. Progress this year:

(IFI69) Capacity Enhancements Using Compression

Year: 2012/13

	o Completion of site installation of all components specified in the design o Completion of network trials to test the safety and security of supply functions of the equipment, with results confirming there is no additional risk to the network or connected consumers. o Completion of a simulated biomethane grid injection pilot trial to successfully prove the operational functionality of the equipment o Validation of the computer model in respect of steady state conditions and transient flows The output from this project will influence how we provide a bio-methane connection service to end user and with full adoption of the knowledge will be incorporated into our business during the next 12 months.
Collab' Partners	NGN
Provider(s)	CNG Services, NGN

(IFI70) Development of Packaged Solution for Bio-methane Injection

Year: 2012/13

Project Description	To develop an integrated packaged solution to allow bio-methane producers to connect to the network in the intermediate, medium and high pressure tiers.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£52,287	£9,301	£54,386	
External	£153,148	£77,074	£164,823	£799,143
Materials	£237,924	£0	£50,200	
Total	£443,359	£86,375	£269,409	

Status	
Submitted	
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Good Alignment. Bio-methane is a renewable energy that cuts the dependency on fossil fuels helping to ensure security of supply for the future whilst using and thus sustaining the existing energy infrastructure.
☑ **5 Protecting the Environment**	Strong Alignment. The project forms a fundamental part of National Grid's target to integrate sources of renewable gas into the network, which will thus contribute towards the UK government target of 15% of the UK's energy to be from renewable sources by 2020
Technological area / issue addressed by project	o Greater process integration leading to a more streamlined approach. o It is possible that new equipment may be incorporated into the packaged solution providing that it meets existing standards, GS(M)R, and National Grid engineering policies.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	9	-1	10

Expected benefits of project	Essential knowledge to modularise the connection and installation process for a bio-methane connection.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	50%	-£753,505

Potential for achieving expected benefits	The continued progression of establishing a framework for Bio Methane Injection facility contracts demonstrates National Grid's support of renewable gas connections and the focus on removing barriers to entry for customers. The Stockport project will offer opportunities to demonstrate the efficiencies in delivering the innovation of packaged skid designs to customers. Those companies that have had there designs appraised by National Grid for use on the Framework have maintained the Intellectual Property rites to such designs and this has enabled the market to develop towards a 3rd party ownership model where National Grid will be afforded the opportunity to review such designs for assurance.
Project Progress	The project has seen completion of stage 1 and move into Stage 2 during this year. The developed framework agreement has been used and the first company has been issued such contract agreement in conjunction with the framework contract process The packaged Solution has progressed to the point of all long lead items have been received at factory and the factory build process has started with some design clarifications still being required surrounding control philosophies. The civils designs and telemetry designs have been completed. It is expected that the solution will be completed in the Summer 2014.
Collab' Partners	**Provider(s)** GL Noble Denton, Technica

(IFI71) Cured-in-Place and Polyurethane Spray Linings >12"

Year: 2012/13

Project Description

The overall aim is to demonstrate that CIP and PU spray linings are 'fit for purpose' as a permanent repair/rehabilitation technique for gas distribution mains, so supporting future Health and Safety Executive approval for the techniques as an alternative to pipeline replacement. This will include conducting mechanical testing on linings, laboratory and site trials and auditing of installation practicalities, quality assurance and quality control procedures.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£10,917	£2,829	£0	
External	£89,565	£36,098	£0	£261,559
Materials	£0	£0	£0	
Total	£100,482	£38,927	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ 1 Low Carbon Economy	Strong alignment. Utilisation of thinner wall solutions over PE, that are easier to transport and install
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Strong alignment. Leads to a significant improvement in large diameter replacement
☑ 5 Protecting the Environment	Strong alignment. Reduction in excavation due to reduced pipe entries and ability to replace longer lengths.

Technological area / issue addressed by project

o Development of lining technologies that are able to withstand pipe fracture and provide a system that enables the carrier pipe to be deemed 'permanently replaced'
o Development of liner thickness measurement devices
o Development of technologies to transport and/or deliver product in long lengths of buried pipe

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Significant	7	0	7

Expected benefits of project

- This initial stage of this project is to validate the proof of concept which will also will inform the business of the potential benefits.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	25%	-£261,559

Potential for achieving expected benefits

During Stage 1 of this project it is anticipated that in order to achieve the expected benefits, the following work elements would be required:

•□Set up a steering group that will provide clear guidance of project progress.
•□Review and assessment of available and/or emerging CIP and PU lining technologies.
•□Write a performance specification and best practice guide for both CIP and PU linings in the Gas Industry.
•□Ensure that a thorough evaluation and framework method for assessing the relative risk of deployed systems.
•□Develop CIP and PU products as required.
•□Undertake trials and testing of products.
•□Auditing

Project Progress

The project outputs are:

•□Performance Specification for Renovation of Gas Mains with a Cured-in-Place Liner, UC9191.04, February 2013;
•□Performance Specification for Renovation of Gas Mains with an In Situ Spray Lining, UC9240.03, February 2013;
•□Best practice guide for renovation of gas mains using cured-in-place liners and spray lining,

(IFI71) Cured-in-Place and Polyurethane Spray Linings >12"

Year: 2012/13

	UC9239.02, February 2013, and; • Use of Cured-in-Place and Polyurethane Spray Linings for Permanent Repair of Large Diameter Gas Mains, Final Report, UC8972.03, February 2013. The duration of the Stage 1 project was extended by two months to allow lining manufacturers to review and comment on the CIP liner and PU spray lining performance specifications. The outputs from Stage 1 provide a solid platform on which to progress to Stage 2, allowing manufacturers and material suppliers to start the development of lining solutions that will be 'fit for purpose' for use within the UK gas industry. Therefore, the lead GDN has proposed that this project is progressed forward to Stage 2, which would test and validate against these Stage 1 documents, under controlled conditions, a range of available CIP lining solutions with the goal of establishing the generic approach as 'fit for purpose' as a rehabilitation technique for iron gas mains up to 2 bar. It is anticipated that the CIP performance specification and best practice guide will be refined during this stage, and that the tests may identify a development gap for certain technologies ahead of their acceptance. Furthermore, the test programme will look to embrace the lining materials, the installed liner, and installation practice together with the evaluation of a range of routine maintenance activities (e.g. flow stopping, connections, jointing and repair).
Collab' Partners	NGN, SGN, WWU
Provider(s)	WRc

(IFI75) Improved Diurnal Storage Requirements Modelling

Year: 2012/13

Project Description

Identify and consider the application of new modelling techniques and methodologies for predicting diurnal storage needs for the Gas Distribution Networks to support both investment and operational planning activities.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£3,944	£3,466	£0	
External	£10,833	£10,833	£0	£65,000
Materials	£0	£0	£0	
Total	£14,777	£14,299	£0	

Status	
Submitted	
Draft	02/05/2013
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Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	The key benefit of this research is in improved diurnal storage requirement modelling capability to ensure GDNs are able to make efficient investments or flex bookings to demonstrate regulatory compliance
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

o Validate whether improved diurnal storage requirement modelling capability will ensure GDNs are able to make efficient investments or flex bookings to demonstrate regulatory compliance.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium			

Expected benefits of project

- The main benefit from the study undertaken in the first stage will be to look at all the drivers for storage requirement and would investigate the most appropriate method for delivering a tool which satisfies agreed requirements:
  - o Whether through development of SSM, or
  - o Through the development of a new tool perhaps linked into 'Forecaster1' technology.

- The main benefit of this proposal is in improved diurnal storage requirement modelling capability to ensure GDNs are able make efficient investments or flex bookings in demonstrating regulatory compliance, i.e. each network has to demonstrate its ability to identify and meet the 1 in 20 storage requirement.
Identification of diurnal storage requirement factors in this feasibility study and the consequent identification and review of possible solutions for development of new tools/techniques in a future IFI project has the potential to deliver better network planning performance, and by improving the information available to System Operation, enable more efficient use of diurnal storage.

A full benefit analysis will be undertaken should the project proceed to further stages beyond the Feasibility Stage proposed.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2012	0 yrs	25%	-£65,000

Potential for achieving expected benefits

The key benefit of this research is an improvement to a GDN's diurnal storage requirement modelling capability over a range of input scenarios.

Project Progress

In 2011 a collaborative commissioned by WWU, Scotia and National Grid Gas to assess whether SSM is still using appropriate methodologies, is able to take into account changes in the LDZ/NTS operating regime and provides sufficient information to inform both long term planning requirements and system operation requirements for day/week-ahead diurnal storage planning. The feasibility

(IFI75) Improved Diurnal Storage Requirements Modelling

Year: 2012/13

	capturing the joint development to the modelling of diurnal storage was and any new work will commence under NIA.
Collab' Partners	SGN, WWU
Provider(s)	GL Noble Denton

(IFI76) Mobile Data Capture Project

Year: 2012/13

Project Description	This project aims to leverage the low cost and flexible platform afforded Smart Phones and bespoke applications to re-engineer the Gas Alliance Field force business processes associated with data collection, communication, compliance and customer service

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£20,285	£12,032	£0	
External	£39,087	£38,184	£0	£243,725
Materials	£0	£0	£0	
Total	£59,372	£50,216	£0	

Status	
Submitted	
Draft	02/05/2013
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Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Strong Alignment. Improvement to process safety via an efficient technological solution to capture data whilst out in the field.
☑ **5 Protecting the Environment**	Minor Alignment. Reduce the amount paper and avoidance of re-visits to site.
Technological area / issue addressed by project	o Development and testing of smartphone application for use in the Gas Distribution industry o Future proofing system cosing to ensure potential integration with bespoke GDFO/SAP systems

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Significant	17	-6	23

Expected benefits of project	Improvements in process safety, data quality and timeliness by removing hand-offs and delays. The use of the smartphone app technology will reduce significantly the paper used in the back office. As data will be captured on site this will also avoid unnecssary revisits to site.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2012	2 yrs	75%	£459,021

Potential for achieving expected benefits	Efficiencies, improved compliance and environmental benefits.
Project Progress	The project successfully proved the concept of introducing mobile applications into the business and within the project 10 apps were developed with 5 now incorporated into the business as usual. As a result of this project the development of additional apps continue and therefore this project can be closed.
Collab' Partners	Amec, BBUS, Morgan Sindell, Skanska, Morrisons, Enterprise
Provider(s)	Hyphen

(IFI77) Asset Health Modelling

Year: 2012/13

Project Description	Development of a Condition Based Risk Model that will determine the future health index of NGGD's key assets so that these can be assessed to prioritise investment decisions.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£29,969	£12,805	£15,488	
External	£250,000	£142,334	£88,000	£564,873
Materials	£0	£0	£0	
Total	£279,969	£155,139	£103,488	

Status	
	Submitted
Draft	03/05/2013
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Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Good alignment. Understanding of asset condition and criticality, identifying and modelling different interventions to mitigate risk, and prioritise / select optimal expenditure via a condition based risk approach.
☐ **5 Protecting the Environment**	
Technological area / issue addressed by project	o Asset management investment decision making, based on actual individual asset condition data. o Simplification of regulatory submission data that is fully auditable and repeatable. o An automated methodical approach to asset management that supplements existing engineering knowledge.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	19	3	16

Expected benefits of project	The tool will review and update data sets for each asset category thus providing understanding as to the condition and deterioration factors that impact upon the performance of key assets and how the risk is determined from these inputs.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2012	8 yrs	50%	-£529,273

Potential for achieving expected benefits	Potential to inform our risk model and inform Asset Management Strategy.		
Project Progress	Undertake Asset management risk profiling and modelling on tier 2 pipes that are not subject to replacement.		
Collab' Partners		**Provider(s)**	EA Technology

(IFI79) Bio-SNG Pilot Plant Design and Demonstration

Year: 2012/13

Project Description

To design and build a pilot plant that demonstrates the production of bio-SNG from biogenic waste.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£43,045	£18,250	£0	
External	£230,241	£74,907	£0	£554,147
Materials	£0	£0	£0	
Total	£273,286	£93,157	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	The project forms an essential building block in National Grid's 'heat story', by demonstrating that large quantities of renewable gas could be produced from zero / low carbon sources, thereby providing justification for continued retention of the existing gas distribution network into the long term future if/when heating using fossil gas becomes more problematic.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	As bio-SNG would be produced from indigenous waste resources, this would enhance supply security by providing an alternative to fossil gas imports as UKCS gas production declines.
☑ **5 Protecting the Environment**	Thermal gasification is environmentally preferable to the alternatives of incineration or landfill of waste. Production of bio-SNG maximises the efficiency of energy from waste compared with electricity generation and can be applied at relatively small scale, thereby obviating the need for long distance transport of waste. Thermal gasification plants are more acceptable to the public than incineration plant in view of their lower environmental impact on their surroundings (e.g. air quality and visual impact).
Technological area / issue addressed by project	o high-level process design of a pilot bio-SNG plant based on the existing APP Gasplasma® gasification facility, including selection of the catalyst provider for the methanation stage and integration of this process into the overall design. o High level assessment of waste availability and composition.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Medium	10	4	6

Expected benefits of project

Demonstration of SNG production from biogenic waste would establish the UK as a leader in the production of renewable pipeline quality SNG, with possible future benefits in terms of exports of commercial plants and enhanced employment.

National Grid's participation should enhance our reputation as a leading proponent of the low carbon economy.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	0 yrs	25%	-£540,359

Potential for achieving expected benefits

The knowledge benefits have been realised during the course of the project. National Grid and its partners in this work can now be seen as the UK leaders in the production of renewable SNG. The report provide a full understanding of the process but also highlighted the potential hurdles that will need to be addressed such as the potential hydrogen content that the syngas may produce.

The environment benefits can still be on course to be achieved. To realise these benefits, the full commercialisation of syngas installations will have to be developed and deployed first but only once the demonstration plant is constructed and proven to physically work. The output from this project has also been shared with other industry parties as part of the wider renewable agenda. Good, positive responses have been received thus enhancing National Grid's reputation in this arena.

Project Progress

A report was produced containing the detailed design and costing of the pilot plant that confirmed syngas clean up to GSMR could be achieved at reasonable cost and, that a commercial BioSNG

(IFI79) Bio-SNG Pilot Plant Design and Demonstration

Year: 2012/13

	could be competitive compared to other renewable technologies assuming RHI and ROC funding. Additional work was also undertaken by the project to test the proposed catalytic conversion. This additional requirement proved successful and added robustness to the overall proposed design. The reports content has now been used to prepare a NIC (Network Innovation Competition) bid proposal to support the demonstration phase of the project when bidding commences in April 2014. If the subsequent demonstration of the pilot plant proves successful the technology can then be potentially scaled up into a full scale sized plant where it estimated that 100,000 tonnes pa of waste could be gasified. The gasification of waste on this scale would serve an average sized town in the UK for a calendar year, thus avoid sending waste to landfill. Full roll out could be as early as 2017.
Collab' Partners	Advanced Plasma Power Progressive Energy Limited
Provider(s)	Advanced Plasma Power

(IFI80) Demonstration of Air Driven Water Extraction Unit

Year: 2012/13

Project Description

Complete a robust wide scale demonstration trial to prove the long term sustainability of an air drive powered design to extract water from gas mains.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£60	£5,290	£0	
External	£0	£0	£0	£80,048
Materials	£645	£67,500	£0	
Total	£705	£72,790	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ 1 Low Carbon Economy	Minor. Reduction in carbon emissions as the utilisation of the vehicle engine to power the unit as opposed to the current need to run both the vehicle and units.
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Minor. Increasing the availability of units during the winter period enabling restoration of gas networks in the event of a water ingress incident
☑ 5 Protecting the Environment	Good. The use of an air drive motor will reduce noise levels from its current 104dB to a more acceptable 75dB. The system will also reduce carbon emissions

Technological area / issue addressed by project

- Evidence of robust testing of the product in different geographical and operational conditions
- Demonstration of the systems robust design
- Acceptance by the user that the design meets current operating requirements when used during normal works or as part of an incident.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	13	-4	17

Expected benefits of project

- Improved confidence tha the design meets the requirements of operations with regards to compliant noise levels and safe use for field operatives.
- Improved reputation by delivering a system that reduces the impact our works have on the public at times of water ingress.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2012	10 yrs	75%	£18,664

Potential for achieving expected benefits

Benefits can be realised until the decision for implementation has occurred.

Project Progress

A system has been developed that utilises an air drive motor as the power house. The system developed has reduced noise levels from an average 104dB(A) to 74dB(A) which is now lover than the HSE intervention limits. The balance of the unit even when full has reduced the risk to operatives required to move it on site.

It is not possible at this time to clearly state that this unit should become the National Grid preferred design. Whilst successful the robustness of the modifications need further monitoring.

Collab' Partners

Provider(s) D Shuttleworth, SK Plant Ltd

(IFI81) Heat Economics Project

Year: 2012/13

Project Description Identify whether gas ought to be more or less prominent, from an economic point of view, as part of a low Carbon economy than currently envisaged by government

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£19,963	£26,059	£0	
External	£24,437	£75,000	£0	£184,991
Materials	£1,669	£43,131	£0	
Total	£46,069	£144,190	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Identifies the scale of biomethane economically viable for gas to gas grid injection by decade and identifies the economic merits of retaining gas in a low Carbon economy. Proposes pathways and key policy milestones to enable a low Carbon UK vision to become a reality.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Identifies the timescales and milestones required to enable a low Carbon pathway to become a reality concerning specifically bio-methane and the assumptions previous made.
☐ **5 Protecting the Environment**	

Technological area / issue addressed by project

o determine the level of heat economically attractive to electrify or deliver from heat networks and the level and implications for gas networks.
o determine the level of bio-methane to aim to deliver by decade.
o outline the costs for energy in each decade and policies / technologies commercially required

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Significant	12	3	9

Expected benefits of project

Transfer of key knowledge from modelling related to the longevity of network assets - identification of business requirements / needs of 2050 which will support asset depreciation, regulatory submissions and reputation.

The output will inform the dialogue with DECC regarding long term views concerning the delivery of heat in a low carbon economy.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	50%	-£182,822

Potential for achieving expected benefits

Redpoint developed a holistic energy model satisfying all objectives of the project.

Project Progress

National Grid appointed Redpoint Baringa to develop a least cost optimised energy model to investigate the role of natural gas, gas networks and customer heating technologies to a low carbon 2050 horizon. The study was designed to objectively identify the specific markets to which gas is a key fuel source whilst satisfying the UK Climate Change Act 2008 obligations in the most economic method. The model was designed to incorporate key information that has to date remained absent from similarly developed models. In particular, the seasonal demand and variation in heating load by various household / building types was explored. In addition, a range of emerging technologies was included alongside the options to make use of alternative fuels such as Hydrogen and district heating. The model identified a range of new gas appliances that would be vital to the transition to a low carbon society and indicated the long term utilisation of gas for building heat demand in 2050. The study concludes with a compelling case for the long term utilisation of existing gas grid infrastructure as part of the most economic scenario for achieving an 80% reduction in green house gas levels. Gas remains critical to security of energy supplies and vital to serving seasonal variations in heat demand. The project produced a technical report that supported National Grid's response to the Governments Heat Strategy consultation in 2012. The model was later used as the

(IFI81) Heat Economics Project

Year: 2012/13

	primary model by the Department of Energy and Climate Change in their March 2013 "Heat - Meeting the Challenge" publication which summarised the conclusions to their 2012 strategy paper.
Collab' Partners	
Provider(s)	Redpoint, AIMMS

(IFI86) Domestic Heating Project

Year: 2012/13

Project Description	To provide a bottom up study on the optimal appliance technology pathways, by property type, based on known and emerging heating technology, required to meet carbon and renewable targets, highlighting the impact on consumers (cost to change and behavioural) and the impact on the gas and electricity distribution networks out to 2050.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£5,389	£0	£0	
External	£29,281	£0	£0	£82,908
Materials	£0	£0	£0	
Total	£34,670	£0	£0	

Status	
	Submitted
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Research to better understand future the uptake of various residential appliances that may develop in a low carbon economy.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☐ **4 Safe, Reliable Network**	
☐ **5 Protecting the Environment**	

Technological area / issue addressed by project

1. Provide a bottom up study on the optimal appliance choices based on known and emerging heating technology, highlighting the impact on the consumer (cost to change and behavioural) and the impact of that on energy demand and gas and electric distribution networks taking into account the various types of property.

2. Map out a range of realistic heating solutions base around long term scenarios, in particular, referencing the types of appliances suitable for different housing types out to 2050

3. Providing a more detailed scenario analysis with focus on domestic heating supply, demand and heating method up to 2050 achieving the 80% national CO2 reduction target.

4. Review the implications of how existing Government policies could influence the scenarios i.e. the Carbon Neutral Homes, Renewable Heat Incentive or any other relevant assumptions or sensitivities that should be considered.

5. Consider the current UK housing stock split and new build “zero carbon homes” definitions from the Zero Carbon Hub.

6. Consider the within day and within year seasonal swing in heat demand and demand reductions over time by segmented housing analysis and how that could be met from alternative sources e.g. hybrid/peak heating, electrification, storage etc.

7. Consider the existing assumptions and projections regarding energy efficiency rollout rates and examine how various levels of energy efficiency can impact on overall costs.

8. Consider injection of biomethane, quantity realistically available and alternative uses for heat, transport and power.

9. Evaluate the average annual cost for the provision of heat taking into account technology, efficiency and variations in house types and compare this to costs for conventional heating systems.

10. Map out other impacts on customers e.g. behavioural change/demand side response e.g. changes in appliance usage and system interaction such as those outlined in the EST research into heat pumps

11. Identify any issues associated with suitability of technologies i.e. retrofitting heat pumps, solid wall insulation issues, biomass boiler fuels availability and emissions.

(IFI86) Domestic Heating Project

Year: 2012/13

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	8	-5	13

Expected benefits of project

- Transfer of key information from modelling related to the longevity of network assets - identification of business requirements / need by 2050 which will support asset depreciation, regulatory submissions and reputation.

Identifies the market segments for gas into the future and indicate market intervention risks to such markets so business impacts can be assessed and strategies formulated.

- Reputational benefits for all participants as the output will input inform the DECC Heat Strategy.

The project also provides good leverage benefits for all funding participants.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2012	1 yrs	25%	-£82,908

Potential for achieving expected benefits

The production of the report provides essential knowledge concerning the suitable technologies and processes the energy industry could adopt that will assist the UK in meeting its 2050 renewable targets. This output will inform the DECC Heating Strategy.

Project Progress

The report can be accessed via the ENA website. In order to review the options within the report a model was produced in order to analyse the scenarios. This was warmly received by the wider energy industry and the funding participants will be able to use the model going forward as a tool in deciding what technologies it should pursue in meeting their own renewable targets. This model will be used by Strategy & Policy department within the Market Operations team with Transmission.

Collab' Partners		Provider(s)	
	National Grid Transmission, NGN, SGN, WWU, Inexus, GTC		Energy Networks Association, Redpoint

(IFI87) Pipe Condition Assessment System

Year: 2012/13

Project Description

To develop a technology that satisfies obligations under the Pipeline Safety Regulations to enable Tier 2/3 pipes to be safely maintained for continued use, or be categorised in such a way to prioritise for remediation. In this context remediation could involve internal repair, or semi structural linings.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£17,559	£0	£0	
External	£110,000	£0	£75,000	£450,000
Materials	£40,000	£0	£0	
Total	£167,559	£0	£75,000	

Status	
Submitted	
Draft	07/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ 1 Low Carbon Economy	Identification of possible failures in iron tier 2 and 3 mains prior to the event occurring thus allowing for better prioritisation and justification of mains replacement and allowing for preventative action to be taken to minimise leakage whilst also minimising the amount of iron mains replacement required.
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	The ability to identify by quantitative data analysis of the structural capability of individual pipes will enable targeted and efficient action to be taken.
☑ 5 Protecting the Environment	Identification of possible failures in iron tier 2 and 3 mains prior to the event occurring thus allowing for better prioritisation and justification of mains replacement and allowing for preventative action to be taken to minimise leakage whilst also minimising the amount of iron mains replacement required.

Technological area / issue addressed by project

o Provide a working set of pipe condition assessment equipment capable of detecting internal and external pipe wall defects to 25% or less of pipewall thickness, measurement of induced strain to circa 100 microstrain limit of detection and the location of associated stress raisers acting on Tier 2 pipeline diameters

o Prove capability at large diameter mains sizes with full circumferential coverage with 2no or 3no pass throughs dependant on diameter

o Development of an "intelligent" data collection system capable of producing usable management information pertaining to pipewall defects, induced strain and stress raiser locations within pipeline lengths.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	20	-3	23

Expected benefits of project

Of the population of some 6400KM of Tier 2/3 pipes the following lengths have been 'allowed' under Ofgem's final proposal, 140KM of Tier 2 above the risk action threshold (£89M), 300KM of non mandatory condition and 382KM of non mandatory Tier 3 (£600M).

The use of this systerm is initially targeted at Tier 2 >risk action threshold whereby the technology could be used to defer replacement or remediation.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	1 yrs	50%	£366,967

Potential for achieving expected benefits

Benefits are on track to be delivered during the future stages of the project.

Project Progress

Tests on an extracted section of CI main have confirmed that the prototype tool can detect hairline cracks, wall thickness loss and infer strain and hence stresses. Knowledge has been gained such that the number and sensitivity of the sensors necessary to desired outputs.

Collab' Partners WWU **Provider(s)** DVS Technologies

(IFI88) Energy Innovation Centre

Year: 2012/13

Project Description

A new method to engage with small medium enterprises (SMEs) with Gas Distribution Networks with a route to table and manage collaborative projects in a consistent efficient manner.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£13,602	£0	£0	
External	£73,512	£0	£0	£661,608
Materials	£0	£0	£0	
Total	£87,114	£0	£0	

Status	
	Submitted
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

- ☐ **1 Low Carbon Economy**
- ☐ **2 Eradicating Fuel Poverty**
- ☐ **3 Promoting Energy Savings**
- ☐ **4 Safe, Reliable Network**
- ☐ **5 Protecting the Environment**

Technological area / issue addressed by project

Covered by projects IFI:62; IL104; IL110; IL117; IL141 and IL143

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental				

Expected benefits of project

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	25%	£0

Potential for achieving expected benefits

New ideas feedstock. One consistent way to collaborate with SME and GDNs.

Project Progress

Following stakeholder feedback and building on the experiences of the Electricity network operators, the collaboration with the Energy Network Centre was established in 2012. The EIC provide SME's with a route to table new ideas to the GDN's and support them commercially to manage risk in working with new innovations with large organisations.

Targets were set at the start of 2012 to have 3 collaborative projects live during the year. A total of six projects commenced with NG participating in all of them alongside SGN and NGN. W&W participated in 3. 40 new innovative leads were collected by the EIC, 14 synopsis where evaluated which lead to 6 projects starting in 2013.

Collab' Partners

Electricity North West
Northern Gas Networks
Northern Power Grid
Scotia Gas Networks
Scottish Power
Southern & Scottish Electric
UK Power Networks
Wales&West Utilities

Provider(s) Energy Innovation Centre

(IFI89) 2050 Infrastructure Outlook

Year: 2012/13

Project Description	Deliver economic data to enable the evaluation of various energy infrastructure options and identify research opportunities on different types of fixed energy infrastructure from now until 2050.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£11,732	£0	£0	
External	£40,000	£0	£0	£51,732
Materials	£0	£0	£0	
Total	£51,732	£0	£0	

Status	
Submitted	
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	The UK is to potentially start a transition to new and changing supply capacity from different technologies. The demand patterns and profile are also likely to vary with a change in end user technology use. Hence, there is a need to identify key areas of energy infrastructure research and development that are needed to ensure this transition to a low Carbon Economy can occur successfully, with minimal capital and operational cost, and maximum efficiency.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☐ **4 Safe, Reliable Network**	
☐ **5 Protecting the Environment**	

Technological area / issue addressed by project

The intention is to allow the comparisons to be made between the different types of infrastructure. As such, the cost and performance data for each should account for all aspects of that element of the particular type of infrastructure.

The required breakdown for infrastructure is as follows:

o Transmission - data is required on a per km basis, for different ranges of voltage level for electricity transmission (specifically the AC and onshore and offshore HVDC voltage ranges shown in Table 1) and different pipe sizes for gas and hydrogen transmission (i.e. 16", 20", 24", 26", 28", 30", 32", 34" and 36" piping). It is not expected that heat will be transmitted over significant distances, so heat is excluded from the transmission requirements.

o Distribution - as with transmission, data is required on a per km basis, for different ranges of voltage level for electricity distribution (i.e. 33-6.6kV and 400-230V), different pressures for gas and hydrogen distribution (i.e. Intermediate, Medium and Low Pressure piping) and different temperatures of heat distribution (i.e. using hot water at 120oC, 70oC and 50oC). For heat this should also include data for the return piping and associated infrastructure.

o Storage - data is required for all four aforementioned types of energy vector. For electricity, pumped hydro or Compressed Air Energy Storage (CAES) should be used as the reference for transmission scale storage and flow batteries or utility scale batteries for distribution level storage. Data should refer to typical onshore storage for gas and the equivalent storage for hydrogen as well. In addition data for underground salt cavern offshore storage should be included for both gas and hydrogen. For heat only large scale underground thermal storage is relevant. The data should not reference any energy storage below distribution scale, e.g. end user storage.

o Conversions - this refers to conversion from one type of an energy vector to another type of the same energy vector, for example, from one voltage to another (in the case of electricity) or from one temperature to another (in the case of heat). It should be quoted on a per conversion basis. For electricity this should include conversions between the different transmission and distribution voltage ranges described above and in Table 1. For gas and hydrogen this should include conversions between transmission, intermediate, medium and low pressure piping. Whilst for heat this should include conversions between hot water at 120C, 70C and 50C.

o Connections - data is required for connections to, for example, residential and commercial office

(IFI89) 2050 Infrastructure Outlook

Year: 2012/13

buildings on a per connection basis and an average should be assumed for each type. For electricity the types would be residential, commercial office, industrial and vehicle recharging. For gas and hydrogen it would be residential, commercial office, industrial, vehicle refuelling stations and power generation. Whilst for heat only commercial office and residential are required.

In terms of the data, parameters are required that will allow evaluation of cost and performance. All costs are required to be in GBP (pounds sterling) in real terms relative to 2010.

The data parameters of interest are:
- Capital costs
- Fixed operating and maintenance costs
- Variable operating and maintenance costs
- Abandonment costs - this would include the cost of decommissioning the infrastructure
- Repurposing costs
- Efficiency - this data would be a measure of the energy in versus energy out: on a per km basis for transmission and distribution; on a per conversion basis for all conversion types; and on a per connection basis for the different connection types.
- Capacity - data is required for the different infrastructure types on the same basis as described above (i.e. per km conversion and connection) The degree to which the above parameters can change due to the impact of certain variations will also be captured by this Project.

The variations in question are:
o Time - this will provide the variation in the above parameters and research opportunities every 5 years from 2010 - 2050, i.e. 2010 (historic), 2015, 2020, 2025, 2030, 2035, 2040, 2045 and 2050. As noted above, all cost data will be in real terms relative to 2010.

o Distance or scale - will provide a measure of the variation in the parameters as a result of distance or scale. A variation in terms of distance is relevant only for transmission and distribution infrastructure, whilst a variation in terms of scale is only relevant for storage. If appropriate, scaling factors are sufficient to represent these variations. Variations to conversions and connections are excluded from this.

o Overall volume of deployment - the variation in the parameters in relation to the level of overall deployment of the infrastructure, e.g. the variation in cost through economies of scale.

o UK region - how the parameters would vary within different parts of the UK. Twelve onshore regions are specified (East, East Midlands, London, North East, North West, Northern Ireland, Scotland, South East, South West, Wales, West Midlands and Yorkshire & Humber) as well as nine offshore regions for transmission (Channel Islands, Dogger Bank, East Scotland, Hebrides, Irish Sea, Lundy, Norfolk, Pentland, Shetlands) and two regions for offshore storage (North Sea and Humber).

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Significant	7	-2	9

Expected benefits of project

- The project aims to provide cost information concerning Electric Distribution, Transmission, District heat and hydrogen networks. The information will be applied to internal scenario based modelling currently under development through IFI81 so that further strategic reviews of alternative opportunities or threats can be better evaluated.
Good leverage ratio i.e. 4:1 in total 5:1 for external spend only.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	25%	-£100,000

Potential for achieving expected benefits

The project has completed its primary objective to develop an infrastructure costing model. The model is be validated by the Energy Technology Institute and will be released to National Grid during the summer of 2013. The model is intended to assist National Grid, and Energy Technology Institute partners, in assessing the economic implications of satisfying energy demands from varying energy vectors. Accordingly, the project serves as a support mechanism for further "in house" energy policy and strategy developments. The project has provided a view on areas of future research that has the potential of producing significant value to the ongoing operation of network infrastructure and a useful reference for future innovation studies.

Project Progress

National Grid joined the Energy Technology Institute project to develop a robust energy infrastructure cost model. The study reviews gas, electric, district heat and hydrogen networks, including transmission and distribution networks in order to develop a network cost calculator. The purpose of the study was in part to develop more robust cost information to inform long term energy

(IFI89) 2050 Infrastructure Outlook

Year: 2012/13

	strategy models, to gain a better understanding to the practicalities of developing new or reinforcing existing infrastructure, and to identify research opportunities in respective value merit order.		
Collab' Partners	National Grid Transmission, E.ON, EDF, BP, Shell, Rolls Royce, Catepillatr, DECC, Defra etc	**Provider(s)**	Energy Technology Institute

(IFI91) Emergency Optimisation

Year: 2012/13

Project Description	To improve the overall efficiency of the emergency process by trialling a new software solution package to optimise resources and provide knowledge to define business requirements for the strategic software emergency solution of the future.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£81,275	£0	£0	
External	£384,020	£0	£0	£465,295
Materials	£0	£0	£0	
Total	£465,295	£0	£0	

Status	
	Submitted
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Good alignment. Reduction in travel times for field force - less unutilised vehicles at certain times of day'
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Minor alignment. Improved data capture and accuracy. Utilisation of historical leakage data to plan resources and predict future trends in leakage patterns. Streamlined, consistent processes. Improved management information. Through more resilient technology we can reduce the risk of business continuity failures
☑ **5 Protecting the Environment**	Good alignment. Reduction in travel times for field force - less unutilised vehicles at certain times of day'
Technological area / issue addressed by project	o Use of historical leakage patterns, seasonal, weekend/working day to generate resource requirements o To have the optimum resources to respond to the Network leaks and Emergencies. o Reduction in the number of vehicles unutilised at certain times of the day, therefore reducing the number of vehicles within the Operational shift pattern. o Visual representation of the data – the ability to quickly see the impact of changes to supply and demand, WTS offers a easy and clear graphical representation o The WTS tool produces multiple shift patterns quickly which all meet the optimisation criteria o The WTS tool allows for large volumes of what if scenarios (changing shift lengths, demand scenarios etc) o Outputs from this project will be fed into the start locations work also being undertaken by the ER&R process team to match team location with work location

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	17	-1	18

Expected benefits of project	- Enhanced knowledge to configure systems to build optimum patterns in the future within multiple complex processes. Informed position concerning integration into existing systems at a later date. - Enhanced methodology in using leakage data to optimise the deployment of resources that will reduce travel time for operatives.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	1 yrs	50%	£2,534,705

Potential for achieving expected benefits	Efficiencies in the deployment of emergency resources are expected in Winter 2013/2014.
Project Progress	The trialling of a new innovative software solution has improved the overall efficiency of the emergency process by optimising resources, and providing knowledge to define business requirements for the strategic software emergency solution of the future.
Collab' Partners	**Provider(s)** WTS, Leadant Solutions

(IL100) Supaspray

Year: 2012/13

Project Description	Increase the utilisation of internal Mainspray repair technique to reduce leakage and resolve public reported gas escapes in the most cost effective manner.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£4,922	£0	£0	
External	£17,500	£0	£0	£39,922
Materials	£17,500	£0	£0	
Total	£39,922	£0	£0	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	The wider goal is that the system will become a preventative maintenance technique rather than its current reactive use. By improving the performance of the equipment and removal of perceived and actual blockers it will be possible to deploy mainspray during periods of low leakage. This will then treat targeted areas of known risk.
☑ **5 Protecting the Environment**	The increased use in application of the internal mainspray system will see a reduction in the excavation requirements necessary to resolve public reported escapes. It will allow teams to request the use of a system to minimise the impact our works have on the travelling public.
Technological area / issue addressed by project	o Combine the Internal Spray head with an Internal Inspection Camera to enable a full survey to be carried out to identify and locate the potential source of leakage and ensure accurate spraying of the joint o Increase the length which can be inserted by 25%, this is especially important in the larger diameter mains o A review of the development and benefits obtained to determine if the perceived blockers identified during the leakage workshop exist or if further financial gains from developing the system further can be leveraged.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Significant	13	-1	14

Expected benefits of project	- Improvements in internal spraying should see increased targeted use that will allow the system to be deployed easily and with more confidence that current levels have achieved. - The increased use in application of the internal mainspray system will see a reduction in the excavation requirements necessary to resolve public reported escapes. It will allow teams to request the use of a system to minimise the impact our works have on the travelling public.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	2 yrs	50%	£62,814

Potential for achieving expected benefits	Benefits remain on track.
Project Progress	The Internal Spray head has been successfully integrated with an Internal Inspection Camera to enable a full survey to be carried out to identify and locate the potential source of leakage and ensure accurate spraying of the joint.
Collab' Partners	**Provider(s)** ALH Ltd

(IL102) MEG Improvement

Year: 2012/13

Project Description	To assess the practical and financial feasibility of the technology offered by TTP to significantly improve the effectiveness of the current Gas Conditioning process

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£4,861	£0	£8,403	
External	£52,000	£0	£30,000	£98,784
Materials	£0	£0	£0	
Total	£56,861	£0	£38,403	

Status	
	Submitted
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☑ **3 Promoting Energy Savings**	Savings in resources with not having to undertake unnecessary work.
☑ **4 Safe, Reliable Network**	Some minor improvement in reducing MEG drop out, ie the tendency for current MEG fogging to create localised concentrations of condensed fluid thereby creating restriction to gas flow and in the worst case mains blockages
☑ **5 Protecting the Environment**	The technology, if proven, could significantly improve MEG saturation levels and hence reduce leakage from lead yarn joints and thereby reducing emissions
Technological area / issue addressed by project	o Controllable MEG saturation levels o Linking the volume of MEG input at any point in time to downstream demand

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Significant	16	-1	17

Expected benefits of project	- The current average MEG saturation level is 22%. The technology provides a means to have a more controllable, efficient system.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	7 yrs	50%	£8,245,502

Potential for achieving expected benefits	Benefits will be established during the stage 2 trial which is planned to take place during 2013-14.
Project Progress	A feasibility study has been carried out on the potential use of an alternative to existing MEG technologies. The feasibility has confirmed that it may be possible to scale the technology to provide a more consistent MEG saturation level. Work is progressing to identify 2 sites for potential trial.
Collab' Partners	
Provider(s)	The Technology Partnership

(IL103) Unpiggable Pipelines

Year: 2012/13

Project Description	To develop a strategy for the management of GDUK high pressure pipelines not currently internally inspected.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£20,609	£0	£0	
External	£89,767	£0	£0	£111,416
Materials	£1,040	£0	£0	
Total	£111,416	£0	£0	

Status	
	Submitted
Draft	07/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Early detection of pipeline defects and interference damage will facilitate prompt intervention to divert and reconfigure the network, undertake repair work and minimize risk to security of supply.
☐ **5 Protecting the Environment**	
Technological area / issue addressed by project	o Trial and Demonstration of a piggable 6" pipeline o Development and testing of a risk based management approach to support the selection of non piggable 6" pipelines

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	11	3	8

Expected benefits of project	- Improved knowledge of current in-line inspection capability and alternative above ground assessment techniques. Improved pipeline inspection prioritisation methodology and strategy.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	50%	-£111,416

Potential for achieving expected benefits	Potential to inform our risk model and inform Asset Management Strategy.		
Project Progress	Undertake a number of field trials to determine appropriateness /suitability of two technologies to help pigg 6 inch pipeline population.		
Collab' Partners		**Provider(s)**	Corrosion Services, GL Noble Denton, BBUS

(IL104) E-pipes

Year: 2012/13

Project Description	Access the ePIPE technology to establish its suitability for the application of riser repair. The project will ascertain what resin developments are needed, what equipment designs need to be altered and what procedural processes need to be implemented.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£4,140	£0	£7,795	
External	£44,290	£0	£44,290	£177,161
Materials	£0	£0	£0	
Total	£48,430	£0	£52,085	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	This technology will prevent leaks and thus help to reduce gas usage.
☑ **2 Eradicating Fuel Poverty**	Many vulnerable customers are housed in buildings that contain gas risers. This system will help to make these environments safer.
☑ **3 Promoting Energy Savings**	Substantial reduction and avoidance of gas leaks, following implementation of the outcome of this study.
☑ **4 Safe, Reliable Network**	After a gas riser has been treated the supply of gas should not be interrupted.
☑ **5 Protecting the Environment**	Reduced carbon footprint for gas risers, following implementation of the outcome of this study. Preventing gas leaks is beneficial to the environment as methane is a potent greenhouse gas. Benefits to a high population of affected sites (eg 40%-60% locations)
Technological area / issue addressed by project	o A technology assessment to include some critical tests necessary to confirm suitability.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Medium	27	-5	32

Expected benefits of project

- Ascertain what resin developments are needed, what equipment designs need to be altered and what procedural processes need to be implemented.
- Using ePIPE may provide a more cost effective solution to full replacement.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	10 yrs	25%	£1,616,718

Potential for achieving expected benefits	This project started in January 2013 and is expected to deliver benefits to safety and network performance.
Project Progress	The output from Stage 1 will be validation of the technology.
Collab' Partners	NGN, SGN
Provider(s)	Energy Innovation Centre, Pipe Restoration Services

(IL105) Tier One Replacement System (TORS)

Year: 2012/13

Project Description	To prove the concept of a remote connection between a replacement PE main (inserted within a de-commissioned metallic carrier pipe) and a PE service (inserted within a de-commissioned metallic carrier pipe) within the context of it's potential application to the 'TORS' objective.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£5,339	£0	£0	
External	£56,045	£0	£0	£61,384
Materials	£0	£0	£0	
Total	£61,384	£0	£0	

Status	
	Submitted
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Eliminating service connection traffic management, noticing and council interaction.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Eliminating service connection excavation, operation and reinstatement logistics costs and effort and reduced potential for LTI's. Reducing customer and third party disruption, increasing customer satisfaction.
☑ **5 Protecting the Environment**	Reduce environmental impact by minimizing all associated works as above including the requirement for landfill of excavated spoil.
Technological area / issue addressed by project	o Produce a proof of concept of a remote connection between a replacement PE main inserted within a de-commissioned metallic carrier pipe and a PE service inserted within a de-commissioned metallic carrier pipe within the context of it's potential application within the 'TORS' objective.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	5	-3	8

Expected benefits of project	Knowledge to inform if the proof of concept is achievable.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	25%	-£61,384

Potential for achieving expected benefits	The output of this project has increased the understanding of the issues associated with remote connection of PE mains and services in the replacement context.
Project Progress	This project commenced with a proof of concept to see if replacement mains and services could be renewed with minimum streetworks intervention. The POC report has now been completed and internal evaluation to taking place for future work under NIA

Collab' Partners		**Provider(s)**	Synthotech, Hyphen

(IL110) Internal Stress Corrosion Cracking

Year: 2012/13

Project Description

To understand and develop a method to assess the threat of internal stress corrosion cracking (ISCC) in pipelines previously used to transport manufactured gas.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£1,035	£0	£1,716	
External	£9,500	£0	£9,500	£22,932
Materials	£250	£0	£250	
Total	£10,785	£0	£11,466	

Status	
	Submitted
Draft	03/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Security of supply through improved knowledge of the threat of ISCC
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

o Undertake internal inspection (MPI) of six pipe samples retrieved from Lamesley to confirm the presence of ISCC (depending on the outcome of the inspection a more detailed inspection of each sample may be required during a subsequent stage).

o Develop a threat assessment algorithm to enable identification of those pipelines that are most likely to contain ISCC and develop guidelines to identify where along the pipeline route that the ISCC would most likely be located.

o Identify and attempt to map the different gas manufacturing processes in the UK by area and/or pipeline supplied.

o Identify the gas manufacturing process associated with Lamesley since its construction.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	9	0	9

Expected benefits of project

- Understanding the extent of the threat of ISCC to the integrity of the gas pipeline networks.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	25%	-£89,569

Potential for achieving expected benefits

Expected to deliver outputs of financial, knowledge and network performance benefits

Project Progress

Stage 1 commenced in February 2013 and comprises of feasibility and preliminary assessments.

Collab' Partners NGN, SGN, WWU

Provider(s) Energy Innovation Centre, GL Noble Denton

(IL117) Optical Methane Sensing System - OptiSci

Year: 2012/13

Project Description

Development of a mobile, optical methane sensing system for gas escape teams to use in urban areas for detection and location of gas leaks into and within cable or similar ducting.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£1,333	£0	£8,342	
External	£14,256	£0	£47,399	£226,846
Materials	£0	£0	£0	
Total	£15,589	£0	£55,741	

Status	
Submitted	
Draft	21/05/2013
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Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Rapid leak location and reduced repair time minimises gas losses from the distribution network.
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Using this technology could: o Substantially improve the gas leak identification process and hence the integrity, safety and reliability of the gas network. o Significantly reduce the gas leak identification and repair time. o Decrease the overall cost of leak identification and repair cost for gas distributors
☑ **5 Protecting the Environment**	o Faster gas leak location reduces fugitive methane (a potent greenhouse gas) emissions to the atmosphere o Reduced fugitive gas emissions and all optical sensing technique with no spark risk makes it inherently safer for the workforce and public o Reduced excavation work required prior to locating the gas leak, hence minimising transport disruption and third party risk

Technological area / issue addressed by project

Using Tuneable Diode Laser Spectroscopy (TDLS) and fibre optic technology confers other technical benefits to this solution beyond the operational ones above when compared to other sensing techniques:
o Self-referencing TDLS technology means no calibration drift and no requirement for re-calibration
o Zero gas cross-sensitivity as laser tuned to only detect methane
o No high concentration gas level measurement saturation, as system can reliably detect up to 100%v/v methane
o Sensor are intrinsically safe with no spark risk or possibility of electrical interference
o Methane measurement made in the service duct, so no data update delays caused by the need to extract gas and hence disrupt the local concentration at the measurement point in the duct
o Actual gas concentration distribution along duct measured at several points and displayed in real-time on the remote instrument, assisting rapid identification of the gas leak location.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	7	-2	9

Expected benefits of project

- Rapid leak location and reduced repair time minimises gas losses from the distribution network.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2015	0 yrs	25%	-£213,064

Potential for achieving expected benefits

The anticipated output will be improvements to the environment, network performance and financial.

Project Progress

Project commenced in February 2013. Stage 1 is Proof of Concept.

Collab' Partners NGN, SGN

Provider(s) Energy Innovation Centre. OptoSci

(IL120) Venting Controllers

Year: 2012/13

Project Description	To provide a robust measurement and evaluation of the emission rates from selected venting controllers.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£20,742	£0	£24,304	
External	£109,077	£0	£138,088	£357,034
Materials	£56,435	£0	£0	
Total	£186,254	£0	£162,392	

Status	
Submitted	
Draft	21/05/2013
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Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Reduced carbon footprint for AGI site operations related to valve positioners and controllers, following implementation of the outcome of this study.
☐ **2 Eradicating Fuel Poverty**	
☑ **3 Promoting Energy Savings**	Reduced losses of natural gas at AGIs, following implementation of the outcome of this study.
☐ **4 Safe, Reliable Network**	
☑ **5 Protecting the Environment**	Reduced carbon footprint for AGI site operations related to valve positioners and controllers, following implementation of the outcome of this study.

Technological area / issue addressed by project

o Development of a test method to measure the vent rates using standard flow metering approaches
o Laboratory tests on a Bristol Babcock and Becker controller will be included, with tests to establish: that the manufacturers quoted release rates can be validated ; the correlation between control pressure and vent rate and the validation of the off-site measurement method.
o Initial site tests on up to ten sites covering all the controller vents at each site. This work will focus on individual controllers, investigating the impacts of actuation pressure, controller type and other installation specific parameters.
o Site test work at four selected sites to cover a continuous 24-hour period at three times over the year proposed mid-summer, 'shoulder' month and mid-winter, to establish the impact of flows and network demand.
o Correlation of the measured emission rates/controller types with data from DNCC to establish if current DNCC data can be used to estimate the overall leakage for a wider regional study.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	12	1	11

Expected benefits of project

- Currently, AGI Venting at 84GWh represents approximately 5% of overall emissions. However, this estimate is based on a National figure reported in a 1994 Watt Committee report and is fixed value for each of the five National Grid LDZs. In order to reduce the calculated level of emissions for AGI Venting, a new model is required that is 'activity' based, i.e. one that is based on the number and type of venting equipment on site. With this type of model in place, any reduction in emissions associated with asset replacement can be captured within the leakage model and be rewarded through the incentive. The new model needs to be demonstrated to Ofgem and Shippers to show that the revised methodology results in a robust assessment of AGI Venting.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	8 yrs	50%	£2,485,137

Potential for achieving expected benefits	Significant reduction in gas emissions.
Project Progress	Undertake analysis and supporting field trials to determine opportunity to replace gas venting controllers with non gas venting controllers.
Collab' Partners	**Provider(s)** GL Noble Denton

(IL141) Orifice Plate Deformation

Year: 2012/13

Project Description	The objective is to recommend a reliable and accurate method for calculating orifice plate deformation at typical Gas Distribution operating conditions.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£644	£0	£2,690	
External	£4,006	£0	£0	£95,873
Materials	£0	£0	£0	
Total	£4,650	£0	£2,690	

Status	
	Submitted
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Good alignment. This work will validate whether the current concepts built on 1947 data, assumptions and mathematics are robust and fit for purpose leading to accurate and reliable assessment of both plastic and permanent deformation, conformance to ISO standards and suitable billing for gas transport revenue.
☐ **5 Protecting the Environment**	
Technological area / issue addressed by project	o Use computational fluid dynamics (CFD) to calculate the actual load distribution on the orifice plate for a worst possible case (stage 2). o Use finite element analysis (FEA) to calculate the behaviour of the orifice plate under the load distribution calculated from the CFD for a worst possible case .

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Significant	Medium	17	1	16

Expected benefits of project	- Modern computational techniques now provide a means for developing existing knowledge. Improves the traceability for measurement errors Makes known any problems associated with existing calculation tools. Provides a robust, definitive and traceable assessment acceptable to all and alignment of all calculation tools Provides auditable conformance to the ISO5167 and ISO12767 standards. - Reduces difficult removal of deformed orifice plates or more frequent removal to facilitate manual assessment checks. - Reduction in costs and effort for re-machining orifice plates and removing/replacing deformed orifice plates.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	7 yrs	25%	£80,199

Potential for achieving expected benefits	This project is expected to deliver environmental, network performance, financial, safety and knowledge benefits.
Project Progress	Stage 2 has recently been commissioned which entails Computation Fluid Dynamics and Finite Element Analysis reviews.
Collab' Partners	National Grid Gas Transmission, NGN, SGN
Provider(s)	Energy Innovation Centre

(IL142) Sealback II

Year: 2012/13

Project Description

To develop and successfully trial an improved method to replace short lengths of metallic main in specific locations of engineering difficulty (short lengths of main that connects onto its parent main in a major road junction) in a safe, efficient and practical manner and to agree an efficient implementation strategy for the technique.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£12,566	£0	£14,886	
External	£121,772	£0	£84,577	£243,801
Materials	£10,000	£0	£0	
Total	£144,338	£0	£99,463	

Status	
Submitted	
Draft	02/05/2013
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Approved	

Alignment with IFI/SD

☐ 1 Low Carbon Economy	
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	With the new RIIO Tier 1 replacement policies from April 2013, Sealback II would allow the mains located in areas of engineering difficulty to be replaced via live transfer leading to a reduction in operational expenditure and risk.
☑ 5 Protecting the Environment	Reduce environmental impact by minimizing all associated works as above including the requirement for landfill of excavated spoil.

Technological area / issue addressed by project

o Development of a revised nose cone, incorporation of camera technology advances and developing and recommending an appropriate sealant and delivery method.
o Technique will be for Low Pressure mains use only with minimum insertion distance of at least 20m of replacement pipe with a stretch target of 30m, up to 8" metallic 'child' main leading on to any size parent main.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	5	-3	8

Expected benefits of project

- Reduce environmental impact by minimizing all associated works as above including the requirement for imported backfill and landfill of excavated spoil.
- Significant reduction in operational expenditure and risk. With the new RIIO Tier 1 replacement policies from April 2013, Sealback II would allow the mains located in areas of engineering difficulty to be replaced. In particular this technique will delivers a solution to the requirement to replacement short length stub pipes under Appendix F of T/PM/REP2.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	50%	-£239,119

Potential for achieving expected benefits

Reduction in operational expenditure and risk. Sealback may allow the mains located in areas of engineering difficulty to be replaced.

Project Progress

The project began in 2012 and commenced with a feasibility study which sought to address the limitations of the Sealback I technique. This feasibility study saw the identification of an innovative solution and has now progressed to Stage 2, which will look at the development and field trial of the identified 'Sealback II' solution. This will incorporate camera technology advances, development and recommendation of an appropriate sealant, and agreement of a suitable implementation strategy and delivery method. If successful Sealback II will allow mains located in areas of engineering difficulty to be replaced via live transfer leading to a reduction in operational expenditure and risk. Also reduced environmental impact, including the requirement for landfill disposal of excavated spoil.

Collab' Partners | **Provider(s)** Synthotech, Hyphen

(IL143) Application of Fracture Alert Monitoring

Year: 2012/13

Project Description	To maintain the safety and risk profile associated with cast-iron gas distribution mains via a cost effective innovative monitoring/ detection services as an alternative to full mains replacement.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£3,415	£0	£16,637	
External	£20,000	£0	£101,305	£340,452
Materials	£0	£0	£0	
Total	£23,415	£0	£117,942	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ **1 Low Carbon Economy**	Reduced excavation as there is a reduced need to replace Gas Mains that have historically caused no Operational problems. Removing the requirement of the 30/30 rule on monitored pipe lines.
☐ **2 Eradicating Fuel Poverty**	
☑ **3 Promoting Energy Savings**	Savings in resources with not having to undertake unnecessary work.
☑ **4 Safe, Reliable Network**	Using this technology could deliver: o An immediate notification of a fracture event to the pipe line operator enabling a much improved response time. o The ability to locate the fracture event (assuming it falls between monitor stations) and, o Potentially the opportunity to detect the onset of a fracture event if pre-failure signals are generated (this is unknown at this time).
☑ **5 Protecting the Environment**	Reduced excavation so reducing reinstatement, landfill and natural resources
Technological area / issue addressed by project	o To provide an alternative to replacement in certain high profile, urban areas o The potential to have an early warning of pipe fracture that can warn of impending fracture (unknown at this time) o To be able to pinpoint the location of any fracture and hence enable the source of leak to be excavated and safely managed sooner that would be the case without the system o To have the potential to reduce the pipe risk score for those pipes being monitored and hence be a cost effective option to full replacement

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Substitution	Medium	19	0	19

Expected benefits of project	The use of fracture alert is targeted primarily at Tier 2 >risk action threshold whereby the technology could be used to deem the pipe remediated ie to remove the risk.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	5 yrs	50%	£461,923

Potential for achieving expected benefits	This project is expected to deliver environmental, network performance, financial, safety and knowledge benefits.
Project Progress	Project commenced in February 2013. Stage 1 is Proof of Concept.
Collab' Partners	SGN, NGN
Provider(s)	Energy Innovation Centre

(IL178) Improved Diurnal Storage Requirement Modelling

Year: 2012/13

Project Description

To build, test and support implementation of a system that applies new modelling techniques and methodologies for predicting diurnal storage needs for a GDN to support improvements to both investment decisions and operational planning activities.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£3,068	£0	£6,160	
External	£27,500	£0	£57,500	£294,000
Materials	£0	£0	£0	
Total	£30,568	£0	£63,660	

Status	
Submitted	
Draft	02/05/2013
Final	21/05/2013
Approved	

Alignment with IFI/SD

☑ 1 Low Carbon Economy	Potential to model the impact of bio-methane supplies on required diurnal storage. Potential to model the impact of embedded electricity generation, or other energy generation which affect Network gas demand.
☐ 2 Eradicating Fuel Poverty	
☐ 3 Promoting Energy Savings	
☑ 4 Safe, Reliable Network	Accurate diurnal storage requirement modelling is essential for reliability and security of supply to customers.
☐ 5 Protecting the Environment	

Technological area / issue addressed by project

Develop a new modular and flexible software solution with improved speed performance and usability that will be used primarily to inform network investment decisions and National Transmission System offtake capacity bookings. This will include consideration of the following areas:

o Better modelling of diurnal volume to reflect changes in demand behaviour.
o Development of new demand models to model particular significant customer behaviours which are overlooked within the current approach, such as:
- the effect of large loads on a system
- bio-methane supply
- Improvements of the modelling of both the information provided to the operations room and the constraints used to simulate/define operator behaviour2.
- Better presentation of results.
- Additional statistical analysis of results.

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Significant	Medium	13	-2	15

Expected benefits of project

New Model to predict diurnal storage needs for GDN compliance with regulatory regimes

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2014	7 yrs	50%	£108,464

Potential for achieving expected benefits

Project has recently commenced in February 2013 and at this stage all benefits are expected.

Project Progress

This collaborative project between all 4 GDN's will support the development of a software application reflecting the required functionality in a configurable and flexible modelling platform.

Collab' Partners NGN, SGN, WWU

Provider(s) GL Noble Denton

(IL) Operational & Integrity Challenges (Small Projects) 2012/13

Year: 2012/13

Project Description	To facilitate utilisation of innovative tools, techniques and processes across Operations, Coalitions and Alliance work activities that result in supporting RIIO objectives in terms of efficiency,outperformance of other incentive measures and outputs.

	Expenditure for Current FY	Expenditure for Prev' FY	Expenditure for Next FY	Total Project Costs
Internal	£55,996	£0	£0	
External	£185,230	£0	£0	£262,119
Materials	£20,894	£0	£0	
Total	£262,120	£0	£0	

Status	
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Draft	03/05/2013
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Approved	

Alignment with IFI/SD

☐ **1 Low Carbon Economy**	
☐ **2 Eradicating Fuel Poverty**	
☐ **3 Promoting Energy Savings**	
☑ **4 Safe, Reliable Network**	Improvement in operator safety. Efficient utilisation of tools, techniques and equipment that enhance the operation, replacement and maintenance of the gas network
☑ **5 Protecting the Environment**	Minimising leakage and waste
Technological area / issue addressed by project	o Technical safety & risk assessments for innovative products o Development of new performance specifications that will deliver new innovative products from the market

Innovation Type	SD Rating	Benefits Rating	Residual Risk	Overall Score
Incremental	Medium	5	1	4

Expected benefits of project

- Adoption of knowledge via an indepentent appraisal that will determine whether an innovation opportunity can be quickly developed and thus implemented into the business as efficiently as possible.

The knowledge gained will also enable the efficient development of project scopes should any one of the small projects need to be developed into a more substantial project.
- A number of projects will investigate how to reduce safety risks as part of the day-to-day operations. These cannot be articulated at this stage due to the early stage in the respective project life cycle.
- A number of projects are supporting little dig technologies to minimise the amount of excavation/waste and imported excavtaion materials.
- A number of the projects are specifically aligned to RIIO themes and outperformnace including sealback (Tier 1 effefiency), internal repairs (enabler to allow insert of PE in Tier 2/3 pipes with eg weco seals), towbar drill to extend the utilisation of keyhole technologies, CIPP analysis for Tier 1/2/3 alternative liners,.

Adoption (Year)	Duration of Benefits	Prob' of Success	Project NPV
2013	0 yrs	25%	-£235,000

Potential for achieving expected benefits

Dual heating. The feasibility has identified a number of manufacturers who are developing these systems.
Drilling techniques. Benefits have been delivered
Joint repairs. Benefits have been delivered and further projects have been started as a result.
Sealback 2. Benefits have been realised and the project continues as a larger development project
Numerical modelling. Implementation of the recommendations is under internal review. Benefits will be realised but it will be necessary to develop a clear and simple guidance document
Bar code. Whilst the benefits have been demonstrated the application within NGG is subject to internal evaluation and impact assessment on existing Contracts
Impact on PE of Biomethane at elevated temperature. Benefits have been realised

(IL) Operational & Integrity Challenges (Small Projects) 2012/13

Year: 2012/13

	Power 2 gas platform. Benefits are on track High risers. Benefits have been realised MP pressure management. Benefits have been realised although at this time no further development of profile systems is being progressed Nitrogen sleeve. Benefits have been delivered Gas adsorption heat pump. Project is on track. Alternative jointing for PE. Benefits have been delivered Thinner wall PE. Benefits have been delivered
Project Progress	72.6 Dual heating. Feasibility study has indicated that the innovative gas and electric technologies can be successfully integrated. 72.8 Drilling techniques. Enhanced capability drill bits have been successfully trialled 72.15 Joint repairs. Report delivered to confirm 2 viable technologies based on internal joint sealing can be progressed. 122 Sealback 2. Feasibility study has confirmed that there are no technological barriers to re introducing and extending the range and capability of the kit into mains sized 8-18” 123 Numerical modelling. Detailed analysis as to the structural safety of deep excavations has been carried out under a number of different scenarios and recommendations to avoid the use of trench support under some situations have been demonstrated. 136 Bar code. Feasibility delivered. The ability to track significant value items of kit has been demonstrated 159 Impact on PE of Biomethane at elevated temperature. Impact on temperature has provided re-assurance that the integrity of pipe is retained. 162 Power 2 gas platform. The membership has enabled knowledge sharing and a research platform for stakeholders. 170 High risers. Internal inspection technologies are suitable for further investigation. 171 MP pressure management. Feasibility completed on the profile control of MP systems and work has confirmed linkage between pressure and leakage. The study has provided assurance that investment decisions about these systame are soundly based. 172 Nitrogen sleeve. Proved that existing of the shelf camera and existing kit and sealants work but further work is required to confirm full end seal capability 173 Gas adsorption heat pump. Pump has been purchased but no substantive work has been undertaken as yet 174 Alternative jointing for PE. An analysis suggests that mechanical fittings may offer an alternative to PE electrofusion for services 175 Thinner wall PE. A report on the structural capability of thin wall PEs has been delivered
Collab' Partners	
Provider(s)	GL Noble Denton, ALH, KEMA, KIWA, MACAW, MBW, Synthotech

nationalgrid

National Grid plc
1-3 Strand,
London
WC2N 5EH,
United Kingdom

Registered in England and Wales 4031152