Innovation in networks – Ofgem's Gas Network Innovation Competition

Decision on first year competition

Publication date: 29/11/2013

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Overview:

We run an annual Gas Network Innovation Competition (NIC) to help stimulate innovation in gas transmission and distribution networks. Through the Gas NIC, Network Licensees can apply for up to £18m to fund innovative projects that could deliver low carbon and environmental benefits to customers. This document explains which projects we have selected for funding this year.

This was the first year of the Gas NIC and there were six applications. We have selected four projects for funding. This decision is consistent with the recommendations of our independent expert panel. We propose to award £15.12m of the available £18m to these projects. In addition, the Network Licensees and a range of partners will invest £4.72m of additional funding and in kind contributions in the projects.

The winning projects trial innovative practices and new technologies. They have been selected because they will help Network Licensees understand how to meet customers' changing requirements as Great Britain moves toward a low carbon economy.

Context

The Network Licensees will face a number of challenges over the coming years. These include -

- Playing a role in delivering the low carbon economy and the objectives of the Carbon Plan.
- Reducing the overall carbon footprint of the gas transportation businesses.
- Enabling alternative and/or renewable sources of gas to connect to the network.
- Adapting the networks to cope with the impact of climate change.

These challenges will affect the gas distribution and transmission networks and the way the Network Licensees plan and manage their businesses. Network Licensees will need to innovate in the way they design, plan, build and operate their networks.

The Gas NIC is designed to help stimulate this innovation. It provides up to £18m of funding each year to encourage Network Licensees to undertake trials to address these challenges in the most cost-effective way. Network Licensees will gain understanding from these trials, which they will then be able to apply to the specific challenges they face. This could potentially bring benefits and cost savings to consumers in the future.

Associated documents

Gas NIC Governance Document

RIIO-T1 Strategy Decision

GD1 Strategy Decision

Decision on funding the cost of preparing submissions for the Network Innovation Competition and the Governance of the Network Innovation Allowance

Decisions on the Network Innovation Competition and timing and next steps for implementing the Innovation Stimulus

Decision and further consultation on the design of the Network Innovation Competition

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Executive Summary

The Gas NIC is an annual competition which helps to encourage Network Licensees to innovate in the design, build, development and operation of their networks.

It provides funding to a small number of large-scale innovation projects. Network Licensees compete against each other for an allocation of up to £18m of available funding. Trials financed through the NIC will generate learning for all Network Licensees and will be made available to all interested parties. This learning brings potential benefits and cost savings for current and future consumers.

The competition was run for the first time this year. This document announces our decisions.

The six submissions we received requested funding for a total of £26.31m. From these, we have selected four projects for funding. We will approve £15.12m, of the available £18m. The project proposals were assessed against published criteria which we have summarised in the introduction.

Successful Projects

In reaching the decision to select four projects for funding, we were advised by our independent expert panel, which reviewed the project submissions and recommended which projects should be awarded funding.

Following consideration, we have accepted the expert panel's recommendations. We have summarised the successful projects in the table below. We plan to place additional requirements on two projects, in order to ensure they deliver good value to customers.

Project (Location)	**Funding requested**
BioSNG Demonstration Plant (Swindon) A project to construct a demonstration plant investigating the techno-economic feasibility of the thermal gasification of waste to produce pipeline quality renewable gas. *Submitted by National Grid Gas Distribution*	£1.88m
Low Carbon Gas Preheating (North East) A project to test new and emerging pre-heating technologies and associated operating systems. *Submitted by Northern Gas Networks*	£4.84m
Opening up the Gas Market (Oban) A project to establish whether gas which sits outside the British standards could be used safely and efficiently. *Submitted by Scotland Gas Networks (SGN)*	£1.87m
Robotics (South East) A project to develop new robotic technologies that operate inside live gas networks, in order to repair leaking joints, manage risk of pipe fracture in larger diameter pipes and repair and replace pipeline assets. *Submitted by Southern Gas Networks*	£6.53m

Unsuccessful Projects

We received applications for two projects which we do not intend to fund.

Wales and West Utilities' **Clean Energy Balance (CEB) – Hydrogen Injection for Carbon Displacement** was a somewhat innovative project which would have trialled the storage, mixing and injection of zero carbon hydrogen into the gas network, at a higher volume than the currently allowed limit. The project did not provide good value for money as the costs would not have justified the limited learning. The proposed solution was likely to have yielded limited low carbon and environmental benefits to gas customers.

National Grid Gas Transmission's **Variable Envelope Compressors: Trial, Optimisation and Review (VECTOR)** project was to a certain degree innovative and would have sought to prove a technical solution to providing operational flexibility to the gas National Transmission System (NTS). However, we felt that the low carbon, environmental and financial benefits would have been small and uncertain in comparison to the cost of the project. Furthermore, we were concerned that the Intellectual Property Rights (IPR) arrangements would have limited the potential of the VECTOR solution to be rolled out across Great Britain, further limiting the delivery of potential benefits.

1. Introduction

Chapter Summary

This chapter describes the purpose of this document and the background to, and structure of, the Gas Network Innovation Competition (NIC). It explains how we and the expert panel have evaluated the submissions made to the competition.

Purpose

1.1. The purpose of this document is to explain our decisions on the applications that were made to the first Gas NIC. We evaluated the projects against the evaluation criteria set out in the Gas Network Innovation Competition Governance Document.[1] The criteria are summarised below.

1.2. We have published a number of other documents alongside this decision. These are -

- The full submission for each project. These include the information on each project that we used to evaluate the project against the evaluation criteria.
- The independent expert panel's recommendation on which projects should receive funding.
- Reports by our consultant, Rune Associates, on each project. These scrutinise the information provided by the Network Licensees and provide the consultant's detailed assessment of each project to aid the expert panel's recommendation and our decision.
- The Network Licensees' answers to questions that Rune Associates, the expert panel and Ofgem raised on aspects of each project.

1.3. We use a number of terms in this document that are defined in the Gas NIC Governance Document.

1.4. This decision document constitutes both notice of and reasons for our decision as required under section 38A of the Gas Act (1986).

[1] Gas Network Innovation Competition Governance Document

The Gas NIC

1.5. Network Licensees need to consider how they can play a full role in tackling climate change while maintaining security of supply and providing value for money to customers. Significant investment in Great Britain's energy market is needed to ensure security of supply.[2] Of this, around £32 billion will need to be spent on network infrastructure.

1.6. The Gas NIC helps to encourage Network Licensees to innovate in the way they design, build, develop and operate their networks. It is an annual competition which provides funding to a small number of large-scale innovation projects. Network Licensees compete against each other for an allocation of up to £18 million of available funding.

1.7. Customers of the gas network fund the Gas NIC projects. Therefore, a key feature of the NIC is the requirement that learning gained through projects is disseminated. This is to ensure that customers gain significant return on their funding through the broad rollout of the funded projects. This return includes the delivery of network savings and/or carbon and environmental benefits. Even where the funded projects are deemed unsuccessful at the end of the project life, Network Licensees will gain valuable knowledge that could result in future savings.

Structure of the Network Innovation Competition

1.8. The Gas NIC Governance Document prescribes the governance and administration of the Gas NIC.

1.9. The annual competition starts with Network Licensees submitting outline project proposals in the Initial Screening Process (ISP). During the ISP, we consider whether these proposals are eligible for funding. Only eligible projects are allowed to progress to the full submission stage.

1.10. After the ISP, Network Licensees are invited to develop the eligible projects into full submissions. An independent panel of experts advises us, but we make the final decision.[3] The panel consists of individuals with specific knowledge and expertise in energy networks, environmental policy, technical and engineering issues, economics and finance, and consumer issues. The expert panel assesses each project against a set of evaluation criteria.

1.11. Table 1.1 summarises the current full submission evaluation criteria. The full detail of the evaluation criteria is contained in the governance document.

Table 1.1: Summary of evaluation criteria

Degree to which the solution being trialled -	**Degree to which the Project -**
• Accelerates the development of a low carbon energy sector and/or delivers	• Is innovative (ie not business as usual) and has an unproven

[2] Project Discovery - Energy Market Scenarios
[3] The biographies of the expert panel can be found here

environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers. • Provides value for money to gas network customers. • Generates knowledge that can be shared amongst all Network Licensees.	business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness. • Demonstrates a robust methodology and readiness of the Project. • Involves other partners and external funding. • Is relevant and timely.

The 2013 Competition

1.12. This year's competition began with the ISP in April 2013. We received seven submissions and were satisfied that they all met the ISP eligibility requirements of the Gas Governance Document. Network Licensees submitted Full Submissions for six projects by the deadline of 9 August 2013. A brief summary of each project is in Chapter 2 and all the ISPs and full submissions are available on our website.[4]

1.13. This year, the combined funding requested was £26.31m (excluding bid preparation costs). So the fund was oversubscribed.

1.14. The expert panel conducted a thorough evaluation. It reviewed the Network Licensees' submissions and Rune Associates' reports and met all the Network Licensees and their project partners twice. It then evaluated the projects against the criteria set out in the Gas NIC Governance Document. It was assisted in its review by our external consultants, Rune Associates, who assessed the feasibility of the projects, validated the information supplied and presented this information on a comparative basis. Rune Associates' reports are published on our website.[5]

1.15. Rune Associates, the expert panel and Ofgem asked questions of the companies throughout the process. Where answers to questions clarified aspects of the Licensees' submissions, the Licensees made necessary changes to their Full Submissions. All of the questions and non-confidential answers that were raised during the written Q&A process have been published on our website. In addition, Network Licensees had an opportunity to respond to feedback they received throughout the process. Rune Associates have also provided addenda to their reports that reflect the resubmissions. The panel made its recommendations based on the final submissions. The expert panel submitted its recommendation report to us in October 2013.

1.16. We assessed the projects taking the expert panel's recommendations into account, in order to decide which projects should receive funding based on their performance against the evaluation criteria. This assessment is included in Appendix 1.

[4] Full submissions can be found on our website

[5] The consultants' reports and questions and answers are available as sub documents to each project submission.

2. Decision

Chapter Summary

This chapter explains which projects we intend to approve for Gas NIC funding and provides an overview of the reasons behind our decision.

Overview of Full Submissions

2.1. This was the first year of the Gas NIC and we are pleased that each of the Network Licensees submitted at least one project proposal to the competition. We note that a number of the projects built on learning from the Innovation Funding Incentive (IFI).[6] We are pleased by the general level of innovation demonstrated in the majority of the full submissions.

2.2. This was the first time that the Gas and Electricity NICs have been run in parallel with the Low Carbon Networks (LCN) Fund competition.[7] When developing the NICs we were keen to ensure that there were no barriers to a cross industry venture seeking funding from multiple competitions. We note that a cross industry venture involving separate bids to the Gas NIC and LCN Fund was submitted this year. These two projects were evaluated individually against the evaluation criteria for their respective competition. Only the Gas NIC portion of the overall cross industry venture is considered in this document.

2.3. Overall, the expert panel expressed satisfaction with the quality and breadth of the projects submitted to the Gas NIC this year. We hope that the experience of this year's competition will aid all parties in developing future project bids.

2.4. Table 2.1 provides a summary of the six full submissions.

Table 2.1: Summary of project submissions

Project (location)	Funding request
BioSNG Demonstration Plant (Swindon) A project to build a demonstration plant testing the techno-economic feasibility of the thermal gasification of waste to produce pipeline quality renewable gas. *Submitted by National Grid Gas Distribution (NGGD)*	£1.88m
Clean Energy Balance (CEB) – Hydrogen Injection for Carbon Displacement (Wadebridge) A project to test storage and injection technologies allowing the hydrogen generated by an electrolyser to be injected into the natural gas network. Joint LCN Fund bid. *Submitted by Wales and West Utilities (WWU)*	£3.57m
Low Carbon Gas Preheating (North East) A project to test new and emerging pre-heating technologies and associated operating systems. *Submitted by Northern Gas Networks (NGN)*	£4.84m

[6] The Innovation Funding Incentive (IFI) is a mechanism for funding small scale innovation projects which have the potential to deliver net benefits.
[7] Developed as part of DPCR5, the LCN Fund is an innovation competition open to electricity Distribution Network Operators (DNOs).

Opening up the Gas Market (Oban) A project to establish whether gas which sits outside the British standards could be used safely and efficiently. *Submitted by Scotland Gas Networks (SGN)*	£1.87m
Robotics (South East) A project to develop new robotic technologies that operate inside live gas networks, in order to repair leaking joints, manage risk of pipe fracture in larger diameter pipes and repair and replace pipeline assets. *Submitted by Southern Gas Networks (SGN)*	£6.53m
Variable Envelope Compressors: Trial, Optimisation and Review (a selected site on the NTS) A project to develop and demonstrate the technology and process for retrofitting new turbo engine technology to make the operating envelope on existing compressors larger. *Submitted by National Grid Gas Transmission (NGGT)*	£7.63m

Our decision

2.5. Following consideration of the project submissions, the expert panel's recommendations and the consultant's reports, we have selected four of the six projects for funding. We will place specific conditions on two of these successful projects to ensure that customers' money is being spent efficiently and that customers are receiving best value for money from these projects.

2.6. Therefore, we have -

- Selected two projects that can be funded as they were submitted (listed in Table 2.2).
- Identified two projects that will require additional conditions to be agreed by the Funding Licensee(s) before funding can be provided (listed in Table 2.3). We explain the additional conditions for these projects below in the "Reasons for our decision" section.
- Decided that two projects will not be selected for funding (listed in Table 2.4).

Table 2.2: Projects selected for funding as submitted

Project (location)	Funding Licensee	Funding requested
BioSNG Demonstration Plant (Swindon)	NGGD	£1.88m
Low Carbon Gas Preheating (North East)	NGN	£4.84m

Table 2.3: Projects selected for funding with additional conditions

Project (location)	Funding Licensee	Funding requested
Opening up the Gas Market (Oban)	SGN	£1.87m
Robotics (South East)	SGN	£6.53m

Table 2.4: Projects not selected for funding

Project (location)	Funding Licensee	Funding requested
CEB (Wadebridge)	WWU	£3.57m
VECTOR (a selected site on the NTS)	NGGT	£7.63m

Reasons for our decision

2.7. We reviewed each project submission against each of the evaluation criteria in the Governance Document. These assessments are in Appendix 1 of this decision. Below we provide a summary of the reasons for our decision.

2.8. The total funding we have approved this year is below the £18m annual funding limit. It would not have been possible for us to fund all six projects because of the amounts requested by each project. We note, however, that we would have not funded more than the four projects even if more funding had been available.

Projects selected for funding as submitted

BioSNG Demonstration Plant (NGGD)

Overview

2.9. The BioSNG project aims to test the technical and commercial viability of using municipal waste to produce pipeline quality gas. Developing this low carbon source of gas could make an important contribution to the development of the low carbon energy sector.

Summary of assessment

2.10. If the potential of the BioSNG process is realised, Gas Distribution Networks (GDNs) across Great Britain could save up to £4.4m a year in NTS exit capacity costs. NGGD states that gas customers could also save up to £25bn in comparison to switching to electrified heating technology.

2.11. The learning from this project will be relevant to all GDNs. It would enable them to better engage in the potential rollout of BioSNG plants across Great Britain realising the maximum possible benefits.

2.12. While the overall potential financial benefits to the network are modest, the potential annual saving of £4.4m is twice the level of NIC funding requested and the NIC funding request represents less than half of the total project cost. Furthermore, the benefits to customers in avoided costs related to the electrification of heat are potentially significant. The remaining funding for the project will be provided by the project partners and NGGD, with additional funding from the EU BESTF ERANET[8] competition and from a commercial partner yet to be confirmed. We consider that

[8] More information on this competition can be found here.

the cost of the project represents good value for money on the basis that this other funding is secured.

2.13. BioSNG performed well across all of the evaluation criteria and we plan to fund the project as submitted. For the avoidance of doubt, we would require NGGD to still deliver the learning proposed in the full submission should the EU funding or commercial partner contribution ultimately not be committed.

Low Carbon Gas Preheating (NGN)

Overview

2.14. NGN proposes to undertake a comprehensive field trial of existing and alternative preheating technologies. It will monitor and record energy performance, including overall efficiency, carbon emissions and thermal losses data, under a range of operating conditions.

Summary of assessment

2.15. We note the number of low carbon and environmental benefits stemming from the potential optimisation of the operation of preheating assets. By trialling alternative preheating technologies, the project could introduce increased competition in the preheating technology market, driving prices for these technologies down. It could also inform Network Licensees' investment decisions of preheating assets. With rollout to preheating sites across Great Britain, cost savings could be between £1.5m and £5m per site per year and CO2 emission savings of up to 7.6m tonnes over 40 years.

2.16. The project's cost is relatively low compared to the substantial and valuable learning which would be derived from it. We agree with the expert panel that NGN has put forward a very good approach to capture and disseminate results. Overall, we consider the project to be good value for money.

2.17. We also note that the project partners bring substantial knowledge and experience in manufacturing preheating equipment.

2.18. The Low Carbon Gas Preheating project performed particularly well across all of the evaluation criteria and put forward a robust methodology. We plan to fund the project as submitted.

Projects selected for funding with additional conditions

Opening up the Gas Market (SGN)

Overview

2.19. This project aims to demonstrate that a European Association for the Streamlining of Energy Exchange (EASEE) Gas specification could be safely applied in Great Britain. If successful, this project could open up the gas market to a wider

range of gas sources which are currently prohibited by the Gas Safety (Management) Regulations (GS(M)R).

2.20. To test the feasibility of applying the wider gas specification to Great Britain, SGN proposed to inject non-GS(M)R gas into the Oban Statutory Independent Undertaking (SIU) – a physically separate gas network. To prove the safety of doing so, SGN will test appliances in Oban against the upper and lower Wobbe Index (WI) limits of the EASEE gas specifications. SGN stated that it will replace any non-compliant appliances.[9]

Summary of assessment

2.21. The proposed solution has the potential to reduce the cost to all gas customers of cross-subsidising the supply of gas to the SIUs and to reduce the price of gas in the markets by creating more competition. It could also reduce the need for (and cost of) nitrogen ballasting for localised (embedded) entry of gas into the distribution network, as well as accelerate the development of the low carbon energy sector by reducing the barriers to bio-methane and hydrogen-natural gas mixes.

2.22. Our consultant noted that the project will need to establish a suitable data gathering methodology to ensure that the learning from the project will be statistically relevant to support a potential wider application of the EASEE gas standard. We are generally satisfied that the technical experts engaged in this project will add considerable value in this area.

2.23. We note that putting a higher WI gas from Zebrugge into the Oban network will affect the billing methodology and that SGN will seek to agree an appropriate approach with us.

2.24. This project will require significant customer engagement to ensure that SGN gains access to enough, potentially all, homes in Oban to test the appliances. The expert panel noted that this could prove to be a major obstacle, especially in the case of unoccupied properties, such as holiday homes.

2.25. SGN indicated that if more than 40 per cent of appliances needed to be replaced, the project would not proceed. We note that SGN will need to monitor the rate of appliance replacement closely throughout the project to ensure that customers' money is not wasted if the overall rate is likely to exceed 40 per cent.

2.26. The panel recommended that this project be funded with additional conditions to ensure customers' money is spent efficiently.

2.27. We agree and as such, we have decided to require SGN to agree with the Health and Safety Executive (HSE) the requirements for obtaining an exemption from the GS(M)R and also establish its rights of access to properties before the full funding of the project is committed. SGN will be able to access some funding to carry out the initial appliance survey. The results of this survey will inform SGN's application for an exemption to the HSE.

[9] The Wobbe Index (of Number) is a means of evaluating and comparing the performance of one gas against another, when burned in a gas appliance.

2.28. We urge SGN, as far as it is practicable and does not impact on overall delivery timeframes, to backload spending on infrastructure for stage three of the project. This is to minimise any risk that funds are spent before the appliance testing has fully established that the project is viable and will progress to the gas injection stage.

2.29. Finally, during the appliance testing we will require SGN to monitor and update projections of the appliance replacement rate on the basis of actual rolling appliance replacement. If this rate crosses an agreed threshold SGN will be required to cease expenditure and notify us. If this should happen, SGN will have the opportunity to make a strong case to us that the rate is not representative and therefore the project should continue.

2.30. With these additional conditions, Opening up the Gas Market performed well across all of the evaluation criteria, and we therefore plan to fund this project with additional conditions.

Robotics (SGN)

Overview

2.31. This project proposes to develop robotic equipment that will be inserted into live gas mains and operated remotely. There are four Modules. Module one will provide the propulsion and the control system for the robotic equipment. Module two will perform maintenance operations on Tier two and Tier three mains. Module three will inspect larger diameter pipes. Module four will test a different robot which will remotely reconnect a customer's service pipe once a new Tier one main is inserted inside the old one.

Summary of assessment

2.32. The robotic equipment would deliver modest carbon dioxide emission savings from a more accurate and efficient risk assessment of the pipes and potential remediation of fractures before they occur. This would reduce gas leakage. It would also reduce disruption and expenditure resulting from current maintenance practices, which often involve excavation on the highways.

2.33. A phased rollout of the robotic equipment across Great Britain could deliver approximately 12,500 tonnes of CO2e savings.[10] Rollout of Module four across all GDNs could deliver an additional saving of around 5,000 tonnes of CO2e per year. We note that SGN has stated that it is not possible to quantify the environmental and low carbon benefits of avoiding highway excavation at this time. However, SGN has committed to looking at this as part of the project.

2.34. We consider that this project will provide value for money to gas customers as the costs are modest compared with the potential benefits and savings. However, we share the expert panel's concern with Module four being developed in parallel with the three other Modules, as there is greater uncertainty around its success. The

[10] CO2e, or CO2 equivalent, states the amount of carbon dioxide that would cause the same greenhouse effect as an amount of a different greenhouse gas, such as methane.

panel recommended that this project is funded with the condition that the development of Module four is delayed until after the completion of the first three Modules. We have decided that SGN will not access funding related to Module four before learning from Module one to three can inform its development.

2.35. SGN will be required to consult with other Network Licensees to ensure that developing Module four will provide learning as outlined in the full submission proforma.

2.36. With these conditions, Robotics performed well across all of the evaluation criteria. Therefore, we plan to fund this project with additional conditions.

Projects not selected for funding

2.37. The remaining two projects, while containing interesting aspects, did not perform sufficiently strongly against the evaluation criteria. We have therefore decided not to fund them. We did not consider that we would be able to resolve the issues with these projects by placing further conditions on funding.

Clean Energy Balance (CEB) – Hydrogen Injection for Carbon Displacement (WWU)

Overview

2.38. The project intended to trial the storage and subsequent mixing of hydrogen with natural gas at two per cent volume so it could be injected into the gas network.

Summary of assessment

2.39. The injection of hydrogen could support DECC's Future of Heating strategy as it could be one of the potential means of decarbonising heat and extending the use of established assets. However, the panel felt that at two per cent hydrogen[11], the low carbon and financial benefits of this project would have been minimal.

2.40. This project would have delivered limited learning. We think this would not have significantly assisted in the development of a low carbon energy sector. The scale and cost of the project were disproportionately greater than the limited learning likely to be gained.

2.41. We have serious reservations about the robustness of the proposed methodology, especially for customer engagement. The assumptions are unclear in relation to ensuring access to all premises and contingency arrangements should this not be possible. Additionally, a number of important assumptions were not well justified. The funding allocated to this aspect of the project, specifically to the replacement of appliances, was far below what we would expect. Therefore, forecast costs for this appear to be understated.

[11] Mixing hydrogen (2 per cent) with natural gas (98 per cent).

2.42. We note the lack of information around the potential risk if HSE does not grant an exemption from the GS(M)R to allow higher levels of hydrogen (than currently allowed) to be injected into the Wadebridge gas distribution network.[12] The Project partners did not give us confidence about their mitigations for this risk.

2.43. For these reasons, we and the expert panel were concerned that this project would not have delivered value for money to gas customers.

2.44. We had serious concerns about the performance of this project against a number of the evaluation criteria. We will therefore not fund this project.

Variable Envelope Compressor: Trial, Optimisation and Review (NGGT)

Overview

2.45. This project would have attempted to retrofit Variable Inlet Guide Vanes (VIGVs) in combination with variable speed control technology as a means of widening the optimal operating 'envelope' of the compressors used to transport gas through the NTS. The proposed method involved the development, demonstration, and optimisation of variable envelope technology designed specifically for the network in Great Britain. NGGT suggested that this project, if successful, could have potentially improved the operational flexibility of the NTS.

Summary of assessment

2.46. While we considered the proposed solution to be an elegant technical response to the problem of extending the operational envelope of compressor stations, we were not convinced that the project would have delivered value for money or significant new learning.

2.47. The expert panel considered that because the key benefit of flexibility was not adequately quantified, the cost-benefit case presented was weak and unproven. The expert panel also noted that the potential carbon savings of the project were small and that the capital savings were modest and not clearly demonstrated. Criterion (a) requires projects to demonstrate that they will deliver carbon and/or environmental savings while delivering net financial benefits. Because NGGT did not convincingly support the underlying assumptions of the base case, it was not clear how many sites the new technology would have been applied to or over what period the cost savings would have been delivered. As such, we were not confident that this project would have delivered net financial benefits. While a reduction in emissions resulting from more efficient use of fuel was cited as an environmental benefit, NGGT offered no quantification of this benefit. The expert panel also felt that this saving would be limited.

2.48. Criterion (c) requires that projects demonstrate that they will develop new learning which is applicable to other relevant Network Licensees. We acknowledge that the learning from this project would not have been relevant to any other Licensees because NGGT is the sole gas transmission network owner in Great Britain

[12] The project proposed injecting a gas mixture of two per cent hydrogen and 98 per cent natural gas. The current allowed limit is 0.1 per cent hydrogen.

and is the sole user of compressors for the purposes of gas transportation. However, we considered that the foreground IPR arrangements of the project would have restricted the potential to replicate the solution more widely on the NTS compressor fleet. Because the contracted Original Equipment Manufacturer (OEM) would have retained possession of the IPR generated through the project, we were not confident that the solution could have been applied to NTS compressors manufactured by other OEMs.

2.49. As a result, the panel was concerned that this project would not have delivered value for money to gas customers. The panel considered the cost of the project to be large in relation to the potential benefits and learning of the project.

2.50. We, therefore, had serious concerns about the performance of the project against a number of the evaluation criteria. As such, we will not fund this project.

Customer issues

2.51. One of the projects selected for funding will have a direct impact on customers. We are satisfied that this project has appropriate mitigation in place to prevent an adverse impact on customers.

2.52. The Opening up the Gas Market project will involve considerable interaction with customers. The project will involve changing the specification of gas being supplied to 1104 homes in Oban. SGN will be likely to require access to each house to test appliances connected to the gas network – to ensure their safety as a result of the trial. The testing will take approximately two hours, with a return visit if necessary. If an appliance is found to be non-compliant, SGN will replace it with a new compliant one free of charge to the customer. The project would cover this cost. SGN has set out possible contingencies should access to a house not be possible and will develop these further as part of the initial stages of the project. SGN considers the chance of unplanned interruptions during the trial to be very low, but standard emergency procedures would be followed should this happen.

2.53. We do not expect the BioSNG, Low Carbon Gas Preheating or Robotics projects to have any significant direct customer impact and no direct customer interaction was stated in the submissions. The BioSNG demonstration plant will not be connected to the live grid and therefore carries no risk of an adverse customer impact. The Low Carbon Gas Preheating project carries a very low risk of loss of supply should the technology being tested fail. However, we are satisfied that the risk is low and will be well managed. The Robotics project will be trialled where replacement of a gas pipe is already scheduled. As such, there will be very limited additional impact on customers and the road users. If the technology being trialled fails, SGN would revert to business as usual techniques, including guaranteed standards requirements.

3. Next Steps

Funding selected projects

3.1. Before projects are funded, we will issue a direction ('the Project Direction') setting out the project specific terms that the Funding Licensee has to abide by as a condition of the funding.[13] We are currently preparing Project Directions for the successful projects and we will issue draft versions of these to Funding Licensees shortly. The Project Directions for Robotics and Opening up the Gas Market will include additional conditions which will have to be agreed to by SGN in order to access funding.

3.2. Following the acceptance of the Project Direction by the relevant Funding Licensee, we will issue a separate direction (the 'Funding Direction'). This will specify the amount of money which the NTS System Operator will be allowed to recover from its customers over the course of the next Regulatory Year to fund the successful NIC projects.[14] The Funding Direction will require those funds to be transferred to the relevant Funding Licensees in order to fund the selected projects. We will issue the Funding Direction in time for the NTS System Operator to prepare its indicative use of system tariffs at the end of December 2013.

3.3. Although funding will not be raised until the next Regulatory Year (starting on 1 April 2014) we expect the Funding Licensees to start their projects as quickly as possible, according to the terms set out in their Project Direction and the Governance Document.

3.4. We will monitor projects to ensure they are being implemented in line with the full submissions. Each Funding Licensee will be required to provide a detailed report, at least every six months, to allow us to evaluate the project's progress. We will publish these on our website to make project learning available to all interested parties. All Funding Licensees should also be sharing their project's learning according to the plan set out in their project submissions. In addition, Funding Licensees are also required to hold an annual conference, open to all interested parties, where Funding Licensees will be able to present the learning from their projects. Finally, the Energy Networks Association (ENA) has developed a portal which holds learning from innovation projects, including LCN Fund and, from this year onward, NIC.[15]

3.5. Funding Licensees are incentivised to deliver the projects to a high standard. They will be eligible to apply for a delivery reward if they meet the delivery criteria set out in the Project Direction.[16]

[13] Requirements for the Project Direction can be found in 5.66 of the Governance Document
[14] Requirements for the Funding Direction can be found in 7.1 of the Governance Document
[15] Please see ENA portal here: http://www.ena-eng.org/smarter-networks/index.aspx
[16] The Successful Delivery Reward is designed to reward those projects which are well managed and completed at least to the standard that could be expected given the full submission. The project must achieve all the SDRC and must not have requested cost overruns.

Future competitions

3.6. As explained in Chapter 2, we had some concerns about certain areas of this year's submissions. We expect Licensees to consider these concerns when developing proposal for future competitions.

3.7. The expert panel has also provided its views in Section 4.4 of this year's recommendation report. We ask potential bidders in future competitions to take these points into account when developing their submissions.

3.8. We may also change the Governance Document to incorporate lessons learnt from this year's process and to make a number of "housekeeping" changes. The Gas NIC Governance Document (v2) would then govern the second year of the Gas NIC. This would be in place prior to the ISP deadline in 2014.

3.9. We will confirm the ISP and Full Submission deadlines in early 2014. We expect that they will be similar to the deadlines in 2013.

Appendices

Appendix 1 – Project Evaluations

This appendix contains our detailed evaluation of each project against the Gas NIC evaluation criteria. The Governance Document explains the evaluation criteria and our evaluation process in full, but we have summarised the process in the introduction and the criteria in the table below.

Degree to which the solution being trialled –	**Degree to which the Project -**
• Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers. • Provides value for money to gas network customers. • Generates knowledge that can be shared amongst all Network Licensees.	• Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness. • Demonstrates a robust methodology and readiness of the Project. • Involves other partners and external funding. • Is relevant and timely.

The detailed evaluation criteria in the Governance Document use the defined terms ‘Project’, ‘Method’ and ‘Solution’. A project is the specific trial being proposed or undertaken. A solution is the outcome which the project is seeking to establish, prove or demonstrate. A method is the proposed way of reaching the outcome. We use the same terminology in this appendix.

BioSNG Demonstration Plant (NGGD)

Project overview

The aim of this National Grid Gas Distribution (NGGD) project is to prove the technical and commercial viability of using municipal waste to produce pipeline quality gas. The project aims to generate technical and operational data regarding gas quality, and flow and pressure characteristics relevant to gas transporters and their role in facilitating the connection of future BioSNG plants to the gas network.

The project will address the need to reduce carbon emissions and develop renewable heat sources to help deliver the Carbon Plan. It will test the polishing and methanation of waste-derived syngas to produce pipeline quality gas. NGGD stated that the proposed solution could meet up to 30 per cent of current annual domestic gas demand (12 per cent of total gas demand) while delivering potential net financial benefits to Network Licensees and their customers across Great Britain of approximately £4.4m annually. Gas customers would benefit from the successful outcome of this project through a reduction in the carbon intensity of the gas sector and the significant potential financial savings from the avoided costs of electrifying heat, one of the main potential alternatives for delivering renewable heat.

NGGD proposes to build a scaled down demonstration plant which will seek to prove the end-to-end concept and allow testing to enable the Network Licensees to better understand the conditions under which the optimum outputs can be achieved while meeting the strict specifications for injecting gas into the network.

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers

This project has significant potential to facilitate the development of a low carbon economy. This project would also deliver net financial benefits for gas customers.

Low carbon and/or environmental benefits

If successful, this project could contribute to the delivery of the Carbon Plan. NGGD stated that this project will develop a renewable source of gas which could provide up to 100TWh – roughly equivalent to 30 per cent of Great Britain's domestic demand. The BioSNG process would provide a low carbon gas source, delivering a reduction of between 21 and 42 per cent to current domestic emissions.

NGGD stated that this solution could deliver carbon reductions more quickly than the alternative, electrification of heat using heat pumps. The electrification of heat would require grid reinforcement, customer appliance replacement, and potentially the implementation of Demand Side Response arrangements. Each of these steps would require time to develop and implement. This solution would make use of existing gas network infrastructure, meaning potential carbon savings could be achieved sooner.

NGGD noted that NTS capacity could also be released by BioSNG plants connected to the distribution network. GDNs would be able to offset the volume of exit capacity

booked from the NTS with gas from BioSNG plants connected to the distribution network, thus releasing that capacity back to the NTS.

Net financial benefits

The potential financial benefits delivered by this project could be significant. By delivering a low-carbon source of gas, the project partners asserted that Great Britain would be able to meet its 2050 carbon reduction commitments with less need for the electrification of heat. NGGD stated that 100TWh of renewable gas from the BioSNG process could supply 6.25m homes. Taking the cost of a current gas boiler and the expected costs of heat pumps to 2040, NGGD calculated that customers could be saved £25bn in total. This calculation was based on data available from the ENA DELTA report. We note that NGGD's analysis of this saving does not include assumptions about the cost (or subsidies) of BioSNG gas, although the electrification of heat counterfactual would also likely include subsidised renewable electricity generation.

NGGD estimated that a single 100MWth plant connected to the distribution network could also save a Network Licensee £0.1m in avoided NTS Exit Capacity charges. Network Licensees could collectively save £4.4m annually if the number of BioSNG plants rises to 40, which is only half the number of bio-methane plants predicted to be established during RIIO-GD1.

(b) Provides value for money to gas customers

We consider that this project will deliver value for money to gas customers. The rollout of BioSNG plants would likely increase the number of system entry points on the distribution network, potentially reducing payments to NTS for exit capacity. Because the demonstration plant will not be connected to the live network, the potential Direct Impact of this project will only be realised if BioSNG plants are deployed in the future.

The scale and cost of this project compared with the expected learning for the GDNs are well justified. The scale of the demonstration plant will be sufficient to provide learning about the commercial metering and contractual requirements, technical flow and pressure specification, ramp up/ramp down parameters and regulatory requirements around gas quality. This will be valuable to GDNs in facilitating the rollout of BioSNG plants and realising the associated network benefits. A scaled-down demonstration plant will be used to allow proof of concept and operational testing at a lower cost than a full-scale plant. The project cost will be further reduced by using the existing APP gasification plant at Swindon.[17] This will not only avoid the cost of acquiring syngas commercially but will also avoid the need for planning permission to build the demonstration plant.

We are satisfied that this project will be delivered at a competitive cost. The project partners will acquire equipment and materials through a commercial tendering process. There is no cost to this project associated with protection from reliability and availability incentives.

[17] Advanced Plasma Power (APP) specialise in producing synthetic natural gas through thermal gasification processes. APP is a project partner to the BioSNG Demonstration Plant project.

Gas customers will benefit in the long term, if the project is successful in establishing the commercial viability of BioSNG as a source of gas. NGGD stated that up to 100TWh of BioSNG could be released into the system. The Submission indicated that around £25bn of benefits may accrue to gas customers, £4.4m annually to GDNs, and the whole gas sector could benefit from lower CO2e emissions.

The project partners worked together on an IFI project. They investigated the feasibility of the BioSNG process and developed the demonstration plant design. As such, the rationale for continuing the collaboration is clear. All of the project partners have committed funding. APP committed up to £817,000 and Progressive Energy committed £20,000. A commercial partner is in negotiations to contribute up to £1m, subject to a successful NIC application. NGGD is also seeking £2.1m EU BESTF ERANET funding. If the partners obtain all of the additional funding, they have committed to reduce the level of funding required from the NIC.

(c) Generates knowledge that can be shared amongst all relevant Network Licensees

We consider that this project will generate knowledge which could be shared amongst relevant Network Licensees.

As noted under criterion (b), this project builds on concept design work undertaken through the IFI. This project will go further, potentially proving the viability of the design and delivering detailed data regarding output gas specifications, ramp rates, and potential commercial arrangements for GDNs. This data will enable Network Licensees to understand how BioSNG plants might impact on their networks and enable them to engage effectively with future developers of BioSNG plants to ensure that network safety and operational requirements are met.

The dissemination plan is credible. The plan shows that the project learning will be disseminated to a range of stakeholders. Learning will be shared with the other Network Licensees through the ENA Research and Development working group and the annual innovation conference. The project partners have a proven track record in projects requiring technical testing and knowledge capture. The project's staged test programme describes the data to be gathered and how the learning will inform the potential viability of a full-scale commercial plant in future.

NGGD indicated that the project will conform to the default IPR arrangements. NGGD does not consider the APP's Gasplasma IPR to be within the scope of the project. NGGD stated that the process which would be proven through this project would be compatible with a range of input syngas. The Relevant Foreground IPR and all other knowledge from this project will be made available to other Network Licensees royalty free. Non-Network Licensees requiring access to the Relevant Foreground IPR would enter into commercial arrangements, potentially including royalties.

(d) Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration project to demonstrate its effectiveness

We are satisfied that this is an innovative project which would be unlikely to go ahead without NIC funding.

The production of waste derived syngas is a proven process. However, syngas produced from waste is currently unsuitable for injecting into the gas network. The process which this project aims to demonstrate is the additional 'polishing' and 'methanation' needed to create pipeline quality gas. Methanation techniques have been used elsewhere for the production fertilizers (pure methane), not for use in gas networks. This project adapts techniques in use in other fields to create a unique end-to-end process to generate GS(M)R specification gas from municipal waste.

We are satisfied that this project could only proceed with NIC funding. NGGD would not be able to commercially benefit directly from the project. As such, it would not pursue this project as business as usual. Furthermore, this project will seek to demonstrate a relatively unproven process with an uncertain business case. For example, the project may prove that syngas cannot be sufficiently cleaned to satisfy the HSE that it is GS(M)R compliant. Similarly, the process may prove to be more expensive than anticipated if, for example, catalytic contamination occurs at a higher rate than predicted. The financial risk inherent in the project makes it unlikely that NGGD would be able to secure commercial funding at the level needed. This project is needed to prove the business case of the process and promote investment confidence, a necessary first step in unlocking the potential network benefits.

(e) Involvement of other project partners and External Funding

In our view, the project partners, APP and Progressive Energy, are appropriate and capable. We welcome the value added by access to APP's existing gasification site.

The project partners, NGGD, APP and Progressive Energy previously collaborated on IFI79, which developed the concept and design of the BioSNG plant. In our view, this project and the IFI project are sufficiently interlinked that continuing with the established partners is a justified approach to selecting project partners. We are satisfied that the existing research and development collaboration agreements are sufficient to ensure project delivery in compliance with the Gas NIC Governance Document. However, the future commercialisation of the BioSNG plant concept would rely heavily on gas shippers' interest. As such, we would have welcomed shipper involvement in preparing the bid for this project to the NIC.

We are pleased to see that all of the partners have committed funding to the project. The total project cost is substantially offset by their contributions and other sources of external funding. The project partners have stated that they hope to secure funding from an additional commercial partner and we understand that negotiations are at an advanced stage. The project partners have also submitted an application for EU funding from BESTF ERANET which has been progressed to the final round.

It is evident that the Network Licensee has taken a proactive approach to securing funding from project partners and that the process for selecting potential NIC projects is well conceived. The submission does not elaborate on the role of APP or Progressive Energy in identifying additional partners.

(f) Relevance and timing

This project is highly relevant in light of the low-carbon challenges faced by Great Britain. Meeting Great Britain's long term carbon emissions targets will require the

development of renewable heating sources to help decarbonise the gas sector. If successful, this project could deliver a solution which is renewable and low-carbon.

The project is relevant to Network Licensees' future price controls. They will need to consider the rollout of BioSNG plants in their network planning and will also need to engage with the parties developing BioSNG plants (such as suppliers) to ensure the safety and operational requirements of the network are met and that the benefits are realised.

(g) Demonstration of a robust methodology and that the project is ready to implement

The methodology of this project appears to be robust and well justified. We are confident that the project will be ready to implement in a timely way.

The project plan allocates adequate time and resource for delivering the outputs of this project. We are satisfied that the project will be implemented on time. NGGD identified potential risks and suitable mitigations. This project will have no customer impact because the demonstration plant will not be connected to the network.

We are pleased to see the involvement of external expertise in developing the technical and statistical methodology. The cost benefit analysis presented is detailed and robust with assumptions clearly identified and justified. The Successful Delivery Reward Criteria (SDRC) are broadly adequate.

Contingency Funding will only be accessible if the project Steering Committee gives approval. It is not explicit under what circumstances Contingency Funding would be requested, though NGGD provided good detail of how cost risk will be mitigated. The conditions under which the partners would request to halt the project are set out in the partners' existing research and collaboration agreement. We consider that the governance will ensure decisions regarding contingency funding or halting the project will be properly managed.

Clean Energy Balance – Hydrogen Injection for Carbon Displacement (WWU)

Introductory Note

Clean Energy Balance (CEB) was a cross industry venture, the funding for which was requested from a proposed LCN Fund project, a Gas NIC project and the Network Innovation Allowance (NIA). Each project was assessed separately against the relevant Governance Document. The assessment in this section relates to the submission made to the Gas NIC.

Where there is a local constraint on the electricity network, part of the LCN Fund project would have used an electrolyser to absorb excess electricity generated from a wind farm to create hydrogen. The Gas NIC project would then have tested hydrogen storage and the impact of the injection of a mixture made up of hydrogen and natural gas into the gas distribution system. The percentage of hydrogen would have been higher than currently allowed.

Project overview

Wales and West Utilities (WWU) submitted CEB to trial the storage of hydrogen, produced by an electrolyser. It would have then mixed the hydrogen with natural gas and injected it into the medium pressure gas network.

The NIA strand would have sought to obtain an exemption from the GS(M)R to allow higher levels of hydrogen than currently allowed, to be injected into the Wadebridge gas distribution network. The project proposed injecting a mixture composed of two per cent hydrogen and 98 per cent natural gas.[18]

Injecting low carbon hydrogen into the gas network has the potential to decarbonise the gas network and extend the use of established assets. For clarity, the exact source of hydrogen was irrelevant to our assessment. The project could have provided some learning associated with the practical issues of the management of hydrogen injection into the gas network.

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers

The injection of hydrogen could support DECC's Future of Heating Strategy as it could be one of the potential means of decarbonising heat. However, the panel felt that at two per cent hydrogen, the benefits of this project would have been minimal.

Low carbon and/or environmental benefits

The main low carbon benefit of the method would have been derived from the injection of hydrogen into the gas network as this could have decreased the carbon content of the gas. The method could have also reduced the carbon impact of leakage from the network by replacing CO2e intensive methane with hydrogen. However, this project's potential to accelerate the development of a low carbon

[18] The current allowed limit is 0.1 per cent hydrogen.

energy sector was relatively small based on the percentage of hydrogen which WWU aimed to inject into the gas distribution system.

WWU stated that the project could have supported the decarbonisation of heat. However, as discussed by the expert panel, this project's learning would not have put Great Britain on a route to allowing a higher percentage of hydrogen to be mixed with natural gas. This is a significant concern as WWU acknowledged that the benefits which stem from decarbonising gas would only be realised with levels of hydrogen injection significantly higher than two per cent. Additionally, WWU did not quantify the CO2e savings at two per cent hydrogen injection.

Net financial benefits

WWU stated that the project could have led to avoided costs of electricity system reinforcement as the need to electrify heat would be reduced. It could also have lowered costs for customers by avoiding the future decommissioning of the gas network. However, we were concerned that, as stated by WWU, at two per cent injection no significant benefits to customers would be realised. Additionally, we note that the project would not have released gas distribution network capacity.

The financial benefits calculated in the resubmission were based on hydrogen injection at 10 per cent. We note that this is not what the project would have trialled. Based on the evidence provided, we do not believe that this project would have materially informed a change to 10 per cent hydrogen injection in the gas network. The project therefore did not meet the requirements of this sub criterion.

We note WWU's assertion that new sources of low carbon gas could extend the life of the gas network, which could be less costly than switching customers to new electrical heating systems.[19] However, the evidence provided by WWU did not justify the assumption that the method could have played a significant part in lowering costs by avoiding future decommissioning of the gas network.

The project's financial benefits relied heavily on assumptions, which WWU did not fully justify. If significant volumes of spilled electricity are available for conversion into hydrogen (such that the price of hydrogen is competitive with natural gas), the resultant extension of the life of the gas network could provide value for money to customers. However, based on the evidence provided, we believe the likelihood of this to be low.

(b) Provides value for money to gas customers

Based on the information provided, this project would not have provided good value for money to gas customers. We were concerned that there was a substantial risk that WWU would not have gained an exemption to the GS(M)R. Without an exemption, WWU would have only been able to inject hydrogen to the current limit. This would have realised no additional low carbon or financial benefits compared with business as usual. Further, we agree with the expert panel that even at two per cent hydrogen, there would have been no substantial new learning.

[19] Dependent on the cost of the alternatives.

WWU stated that the Direct Impact on its network would have resulted from the new source of distributed gas. A Direct Impact would also have stemmed from the extension of the use of the network.

We consider it unlikely that this project would have provided sufficient benefits that are attributable to the gas network at the proposed hydrogen/gas mix. As discussed more fully under criterion (c), injecting hydrogen at two per cent would not have created substantial new learning. Therefore, the project's scale and high cost were not appropriate. Overall, we are concerned that the learning from the project would not have been enough to result in a change to the gas system in Great Britain.

Benefits from the project could have accrued to hydrogen suppliers or shippers. WWU acknowledged this. No quantification of these benefits was provided.

Partners would have been paid on completion of outputs to incentivise them to deliver on time. WWU provided high-level information on procurement procedures for subcontractors and other partners. However, given the limited information provided in this area, it was difficult for us to be confident that these processes would have ensured customers receive best value for money.

(c) Generates knowledge that can be shared amongst all relevant Network Licensees

We consider that the project would have provided limited new learning, mainly coming from the trial of the mixing and injecting technologies and from the running of a cross industry venture between the Gas NIC and the LCN Fund. However, we were concerned that the project may not have received a GS(M)R exemption and, therefore, that no new learning would have been produced, as injection at the current limit of 0.1 per cent would be considered business as usual.

The key technical learning would have been derived from the trial of the mixing process and the hydrogen injection technologies. As this would have involved engineering and safety challenges, it would have been relevant to all GDNs. However, we doubt the level of learning would have been enough to provide value for money to gas customers, if the percentage of hydrogen injection was at two per cent. Additionally, should an exemption not have been granted, WWU did demonstrate that new knowledge would have been gained at 0.1 per cent injection.

We consider that the project had effective learning dissemination plans, which included reports, workshops and the use of social media. WWU identified the key interested parties.

WWU indicated that the project would have conformed to the default IPR conditions.

(d) Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration project to demonstrate its effectiveness

Injecting gas with two per cent hydrogen into the gas network has not been tested before in Great Britain. Therefore this project would have been somewhat innovative. However, we note that hydrogen injection at a higher level would have been more innovative and the learning would have been greater (as noted in criterion c).

WWU would have needed to get an exemption from GS(M)R to inject hydrogen at two per cent, which is above the currently allowed limit.

WWU stated that the risks to customers' appliances and the cost of the method would not have allowed this project to be undertaken under business usual. Additionally, due to the health and safety regulations, the project would have been too risky for commercial funding. The project's business case was unproven therefore WWU would not have been able to undertake this project without NIC support.

Similar technologies are being demonstrated in Germany and we note that the project team would have utilised the learning to inform this project.

(e) Involvement of other project partners and External Funding

We are pleased to see that in the first year of the NICs, there was a cross industry venture between the Gas NIC and the LCN Fund. We also note the panel's comments on the diverse range of partners.

It was not always clear that all the partners and third parties involved have worked together to submit an integrated project. The expert panel expressed a concern that there was a general lack of coherence in the presentations and the project's methodology.

We were pleased to see contributions from the project partners. However, based on our concerns outlined under criterion (a), the proportion of funding by the gas customers was still too high given the limited learning and financial benefits that could have accrued to them.

WWU explained the process for identifying project partners at a high level. We were pleased to see the community energy group WREN involved. However, we were concerned that the customer engagement aspects of the project relied too heavily on WREN while its membership comprises only a third of the properties in Wadebridge. As stated under criterion (g), we would have preferred to see a more thorough customer engagement strategy.

There was no evidence that WWU actively sought out ideas for projects. We note that ITM Power, the proponent of this project, approached WWU with the idea for a Gas NIC project. We were unclear as to what process WWU has gone through to decide which other possible ideas it could have taken forward as NIC projects.

(f) Relevance and timing

Given the two per cent hydrogen injection, we did not consider this to be a very relevant project. We also also questioned its timeliness.

DECC's Future of Heat Strategy suggested that there is increased interest in the use of hydrogen as a means of decarbonising the gas network. With two per cent hydrogen injection, the project would have delivered little learning. We think this would not have been enough to assist in the development of a low carbon energy sector.

We note the expert panel's concern that WWU did not provide convincing evidence that the use of hydrogen, as proposed, would have proven a viable and widespread technique within the next decade.

(g) Demonstration of a robust methodology and that the project is ready to Implement

We are concerned about the robustness of the methodology for customer engagement and its associated cost estimates. We are also concerned at the lack of information and analysis around the risk of the HSE not granting an exemption to the GS(M)R.

The project has been planned in accordance with an accepted project management methodology. WWU included a project plan with task owners and interdependencies.

In response to the questions during the assessment, WWU outlined its approach to obtaining an exemption to the GS(M)R from HSE. However, with the limited information provided and the lack of clear mitigations in place, we considered the risk of not gaining an exemption to be too high. It would have been helpful for WWU to have engaged with the HSE at an earlier stage. This would have given us more confidence that the methodology for gaining the exemption was well thought through.

We were also concerned with the customer engagement aspects of the proposed methodology. Should HSE have granted an exemption, it might have been necessary to test all customer appliances in Wadebridge. However, the project's customer engagement methodology lacked detail and needed further consideration of the assumptions which were unclear. Specifically, the risk of not gaining access to all premises should have been adequately addressed and mitigated.

We were concerned that WWU may have underestimated the effect of issuing an Unsafe Situation notice to the customer. The funding allocated to the appliance replacement was far below what we would have expected. Forecast costs for this appear to have been understated.

The SDRC were clear and tied to project milestones. The majority of the criteria referred to deliverables that covered both the Gas NIC project and the LCN Fund project.

Low Carbon Gas Preheating (NGN)

Project overview

GDNs are required, in certain circumstances, to preheat gas to avoid freezing the outlet pipes, due to the reduction in temperature that occurs when the pressure is reduced. Preheating helps to ensure continuity of supply.

Current preheating technologies in Great Britain have seen little technological development. There has been no comparative study of their efficiency and environmental performance. In this project, Northern Gas Networks (NGN) will monitor and record energy performance information, including overall efficiency, carbon emissions and thermal losses data, of existing and alternative preheating technologies under a range of operating conditions.

NGN will select a range of sites with Water Bath preHeaters (WBH) or Boiler House (BH) preheating systems. It will install alternative technologies, Thermo Catalytic Systems and Low Pressure Steam Systems. Additionally, it will also install monitoring equipment.

The proposed solution could provide significant benefits, such as increased competition in the preheating technology market which could drive the price of these technologies down. The learning from the project will be applicable to all Network Licensees as it will allow them to optimise investment decisions on preheating technologies. It will also optimise the operation of the preheating assets thereby reducing the carbon footprint and whole life costs of preheating technologies.

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers

The project will have clear financial and low carbon benefits, including because Network Licensees would be better informed in their investments in preheating technologies. The project would optimise operations and could reduce carbon emissions due to the more efficient working of these technologies.

Low carbon and/or environmental benefits

NGN has clearly outlined the low carbon benefits of this project which facilitate the Carbon Plan.

Preheating currently constitutes a significant portion of GDNs' operational carbon footprint. We note that the project would reduce CO2e. The potential annual carbon savings if the method is applied to all of NGN's preheating assets is estimated at up to 13,400 tonnes of CO2e/year. Extrapolated to the whole of Great Britain, there would be an estimated overall reduction in business carbon footprint of up to 7.6m tonnes of CO2e over a 40 year period. We consider NGN's assumptions for these calculations were clearly set out and substantiated in the submission.

Currently, preheating technologies do not contribute to the achievement of the Carbon Plan, while the rollout of the project across Great Britain would. Therefore, we consider that it would deliver the solution more quickly than the current method.

Net financial benefits

The data collected and the learning derived from this project will allow Network Licensees to optimise their investment decisions on preheating technologies. The financial benefits will stem from the reduction of the whole life costs of preheating assets from more efficient use of the technologies.

We note that rollout to Network Licensees' preheating sites across Great Britain could deliver cost savings per site of between £1.5m and £5m per year. NGN provided detailed quantitative analysis to evaluate the whole-of-life costs over a 40 year period.

The preheating technologies market is currently dependant on BH and WBH. As NGN will also look at two alternative technologies, the project's learning has the potential to increase competition in preheating technologies. This has the potential to drive down the costs of existing technologies.

Customers would benefit, via reductions in their gas distribution charges, due to reductions in overall investment and operating costs within RIIO-GD1. These benefits will be delivered through a sharing factor in the price control and would continue during RIIO-GD2.

(b) Provides value for money to gas customers

We consider that this project will deliver value for money to gas customers. The project's learning will have a direct impact on GDNs.

Over a 40 year period, gas customers in Great Britain could see cost savings of between £585m and £2,700m with an overall reduction in business carbon footprint of between 0.7m and 7.6m tonnes CO_2e. Even at the lower end of the scale, these represent good potential savings. The benefits could be realised due to the project's potential Direct Impact on GDN's operation of preheating technologies. As noted under criterion (a), data gathered through the project will optimise investment decisions on preheating assets.

We feel that the project's cost is relatively low compared to the substantial and valuable learning which will be derived from it. The inclusion of existing technologies provides additional value to the project for a small cost. We also note that NGN has minimised costs where possible, including through the number of sites it would monitor.

NGN has confirmed that the project will be managed and delivered via its existing Major projects Team. NGN's approved framework partners for design and delivery have been identified and selected through a competitive tender process.

NGN clearly set out its approach to selecting ideas. The Preheating Technology Feasibility Study is a well thought-through and substantive piece of analysis. This study allowed the thorough development of the project proposal.

The project partners Proheat Systems Ltd and Bruest Catalytic Heaters are alternative preheating technology suppliers are were selected through the analysis in the Feasibility Study. Should the project's learning show that these two technologies are more efficient than the ones currently used, Bruest and Proheat could stand to profit commercially. We note that both suppliers will be paid a lump sum for the equipment supplied but will provide access to their engineering, technical and administrative capabilities as a benefit in kind to the project.

(c) Generates knowledge that can be shared amongst all relevant Network Licensees

The project will create new knowledge that would be shared amongst all Network Licensees. The findings of the project would be shared in real time via a website.

We note that there is no reliable data on the efficiency of existing WBH or BH, especially not in the operating environment of Great Britain. The project could therefore deliver substantial new learning on the operation and efficiency of these technologies. Learning will include technical and operational data as well as carbon emissions data.

Additionally, thermo catalytic and low pressure steam technologies have not been developed for gas preheating in Great Britain previously. Learning from the project will be new and relevant to the gas network as it could allow these technologies to enter the market in Great Britain.

We consider that NGN has put forward an excellent approach to capture and disseminate results. The Preheating Technology Feasibility Study developed a formula to assess efficiency, and the process to measure overall operating efficiency and energy balance is specified in the submission.

We are pleased to see that NGN has provided a comprehensive dissemination approach for the learning, which includes a real time data capture website. NGN will also host site visits and conferences. The processes described are robust and will enable all interested parties to access the information.

We note that the project indicated that it will conform to the default IPR arrangements.

(d) Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration project to demonstrate its effectiveness

This project is innovative as there has been little to no technological development of alternative sources of gas preheating. Specifically, Proheat and Bruest technologies have not been tested on the gas network in Great Britain. We note a number of interrelated risks which would prevent this project from being funded under business as usual by NGN.

Compared to BHs and WBH, which are established in business as usual (although we note there is little understanding of their performance), the two alternative technologies have an unproven business case in terms of their carbon benefits and overall efficiency. Additionally, they currently cost more than the established technologies. The project's learning will enable the assessment of these risks and uncertainties.

We note that the two alternative technologies have not been tested on the system in Great Britain or under varying scenarios. Therefore, this project is untested at the scale and circumstance proposed. The new learning on existing and alternative technologies will inform investments in preheating.

NGN has stated that the project's risks would not allow it to conduct the project under business as usual as there is no guarantee it would meet RIIO-GD1 outputs. Although NGN anticipates fewer faults with the alternative technologies, this is not proven and costly retrospective work may be needed if the alternatives prove to be unreliable. As these technologies have not been used on the gas network in Great Britain before, NGN does not know whether they would pose a risk to its required Asset Health outputs and associated expenditure allowances under GD1.

(e) Involvement of other project partners and External Funding

The project partners Proheat Systems Ltd. and Bruest Catalytic Heaters bring substantial knowledge and experience in manufacturing preheating equipment. Both will supply equipment, although the scale of this contribution is not detailed.

These suppliers were identified through the Preheating Technology Feasibility Study. They were selected based on their experience in manufacturing alternative heating equipment. Based on the information provided, we were concerned that this process was not competitive. However, based on the quality of the Preheating Technology Feasibility Study, we are satisfied that this aspect was well researched and the involvement of the two partners is thus justified.

Bruest manufactures boilers which use low pressure steam to heat the gas stream. Proheat produces the 'HotCat', which is a unit containing gas catalytic heaters mounted adjacent to the gas stream to heat the pipe gas through radiant heat. Both bring essential expertise to the project. We w note that both are committed to the project. Both suppliers provided letters of support in which they state they would contribute to development costs by providing access to their engineering, technical and administrative capabilities. Given that both suppliers could stand to profit commercially following the project, we would have preferred to see a more detailed quantification of contributions at this stage.

NGN's project team identified the problem. We note that the detailed method and solution were developed through the Preheating Technology Feasibility Study.

(f) Relevance and timing

This project is relevant and timely. The learning will inform investment decisions in preheating assets during RIIO-GD1 and subsequent price controls.

The current lack of data on the efficiency of existing preheating technologies has impeded the making of proper cost benefit based decisions on investment in these

technologies. Additionally, data on alternative technologies is also unavailable. Therefore, current investment decisions are suboptimal due to this lack of data. The project will address this and its learning would be applicable to all Network Licensees.

The project is timely as it will inform investment decisions during RIIO-GD1. We note that NGN will look to upgrade circa 45 sites currently operating WBH or BH technologies. We share the expert panel's view that the recovery of data on the efficiency of preheating technologies is long overdue. We expect that this project's learning will also inform GDNs' business plans in future price controls.

(g) Demonstration of a robust methodology and that the project is ready to Implement

The project has a robust methodology, with a clear project plan and a detailed risk register. We share the panel's view that this project has a strong project team and we are confident that this project could be started in a timely manner.

We note that the Preheating Technology Feasibility Study informed the project plan. NGN submitted a detailed project plan with responsibilities and inter-dependencies clearly identified. We were pleased to see a well-resourced project Team with an experienced project manager who is clearly committed to the project. We also note the support from NGN's senior management.

Costs are clearly assessed, external support is set out and financial resources are adequate. We believe the project will be started in a timely manner.

NGN put forward a robust methodology which includes details of project delivery. We note that the calculation of energy efficiency was well defined and based on the Preheating Technology Feasibility Study conducted by AquaSweett, part of the Sweett Group infrastructure consultancy. This project builds on knowledge gathered through the Study.

The risk register submitted by NGN is detailed and includes appropriate mitigation measures. We agree with the panel's view that the submission was well drafted and thorough. The project will have no direct customer impact.

The SDRC submitted are SMART and linked to the key outputs of the project which include building and installing the technology as well as the dissemination of the learning.

Opening up the Gas Market (SGN)

Project overview

The GS(M)R specifications are narrower than those in Europe and around the world. Gas which sits outside the GS(M)R either cannot be brought into the market in Great Britain or must undergo expensive processing. SGN reasons that these strict specifications constrain the market, causing higher prices for customers and limiting the use of lower carbon gases. This project aims to demonstrate that the wider EASEE Gas specification could be safely applied to the gas network in Great Britain.

To prove that EASEE specifications can be applied safely in Great Britain, SGN must establish that existing appliances in Great Britain could operate safely with different gas mixes or that the number of appliances requiring replacement would not be a barrier to change. Some older appliances would be unlikely to operate safely with a wider specification and would need to be replaced. This project aims to establish statistical data to forecast the proportion of appliances that would need to be replaced.

SGN proposed using the Oban SIU, a network separate from the main gas grid, as a controllable environment with a limited, but statistically representative, number of appliances to prove that the EASEE Gas specification could be safely and economically applied to Great Britain. The project will be undertaken over 3 stages:

- Stage one will establish what appliances are in use in Oban and what their theoretical safe WI limits are.

- Stage two will involve preliminary appliance testing to establish how age and wear and tear, and the conditions found in properties (such as the deterioration of appliance caused by dust and fibres). affect the safe WI limits of appliances. SGN will replace appliances which could not operate safely.

- In stage three, SGN will inject a higher WI gas into the Oban network. SGN plans to transport Liquefied Natural Gas (LNG) sourced from Zeebrugge at a lower cost than the current source of LNG to Oban, which is Avonmouth.

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers

We consider that this project could be a significant step towards accelerating the development of a low carbon energy sector and deliver net financial benefits.

Low carbon and/or environmental benefits

This project could accelerate the development of the low carbon energy sector by proving the safe and efficient use of a wider range of gases and thus facilitating the injection of renewable and low carbon gases into the network. The Carbon Plan stipulates that bio-methane and hydrogen technologies will play a role in the decarbonisation of the energy sector.

SGN stated the project could lower energy sector emissions by reducing the need for gas processing saving about 1.3 MtCO2e across Great Britain over 15 years. Similarly, SGN stated that a wider WI specification would allow gas by-products from onshore oil production to be captured and injected into the grid, reducing carbon emissions from otherwise necessary 'flaring'. While we acknowledge the potential emissions saving from reduced flaring, SGN has not demonstrated that this would be economically viable (for the oil producers) in enough cases to have a significant impact.

Injecting higher WI gas into the network would increase the energy capacity of the existing network. This could reduce methane leakage by allowing the network to be operated at lower pressure. The reverse applies to lower WI gases; network capacity would potentially be reduced but cheaper sources of gas may become available.

Net financial benefits

SGN presented a coherent financial benefits case for both Oban and Great Britain. SGN stated that bringing higher WI LNG from Zeebrugge could reduce the cost of supplying Oban by £1m per annum. SGN also stated that approximately £200,000 could be saved through avoided reinforcement as a result of the capacity released by using higher WI gases and lower operating costs resulting from using lower network pressures. This will benefit all gas customers in Great Britain through a reduction in NTS charges paid by gas customers in cross-subsidising the cost of supplying gas to Oban.

SGN stated that a single nitrogen ballasting site costs up to £1m to build and £0.1m annually to operate. SGN estimated that this would equate to Great Britain-wide savings of £60m per annum. This assumed rollout across Great Britain with no appliance replacement needed. SGN will test gases at both the upper and lower WI limits of the EASEE Gas range. This could open the market to a greater number of gas sources, creating additional competitive pressure on wholesale prices. This would benefit the entire supply chain, including shippers, suppliers, and consumers. SGN stated that this benefit cannot be quantified because it is dependent on uncertain commercial factors. We consider the potential financial benefits to be significant.

(b) Provides value for money to gas customers

We believe the cost of this project, compared with the potential learning and benefits, represents good value for money to gas customers.

The Direct Impact of this project will be to open the market to a wider range of gases. This could increase the capacity of the network, enabling GDNs to reduce methane leakage by operating the network at lower pressures, and/or to avoid reinforcement. Furthermore, the project could lessen the financial barriers to local embedded entry by reducing the need for gas processing.

The potential learning from this project is significant. SGN aims to generate data about the type, age, and state of appliances in use in Oban. It also aims to develop 'real world' performance data for those appliances against a range of high and low WI gases. Subject to appropriate statistical methodology, this data could be extrapolated to support the business case for applying EASEE gas specification to the

whole of Great Britain. Proving that the rate of appliance replacement would be low is essential to demonstrating this business case.

We were satisfied that this project would be delivered at a competitive cost. Procurement for the appliance replacement programme will be competitive and will consider whole-of-life costs, ensuring that the appliances will be procured at efficient cost. There are no project partners for this project. However, we consider the technical consultants to have appropriate expertise to support the project.

This project could lower the cost of supplying gas to Oban. This saving would flow through to all gas customers, because the higher costs of supplying Oban are offset by a cross-subsidy paid by gas customers across Great Britain. There will be no costs to the project associated with protection from reliability and availability incentives.

(c) Generates knowledge that can be shared amongst all relevant Network Licensees

We consider that this project could generate significant new knowledge. This project will demonstrate, based on real data, the proportion of gas appliances constraining the gas specification in Great Britain. The application to Great Britain of data gathered in Oban will depend on an appropriate statistical methodology. The project will demonstrate which appliance types and models cannot be safely operated using gases outside of the current GS(M)R specification. The project will also provide information about the safe conveyance of EASEE standard gas in the network.

The dissemination plan is credible. A range of stakeholders and of routes for broadcasting the learning of the project was considered in the plan. SGN proposed forming a Technical Stakeholder Group to share the learning of this project. SGN has already received positive feedback on this proposal through the Collaboration Portal.

We note that the method of data capture must maximise the project's applicability to the Great Britain-wide rollout case. SGN stated that it has started to engage with the HSE on this issue. The expertise of SGN's technical consultants will add to the robustness of the test programme. A significant challenge to SGN will be to ensure the statistical relevance of the Oban test sample to the rollout case. SGN demonstrated that some consideration was given to this. However, this remains a challenge. At a minimum, the raw data will provide a valuable starting point for further studies of the appliance population across Great Britain. We would expect SGN to manage data collection appropriately to ensure maximum learning regardless of the applicability to Great Britain as a whole.

SGN indicated that the project will conform to the default IPR arrangements.

(d) Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration project to demonstrate its effectiveness

This is an innovative project which would be unlikely to proceed without NIC funding.

There have been no similar projects elsewhere in Great Britain. The size and interconnected nature of the gas network give rise to a series of specific risks. In particular, the safety implications of using non-GS(M)R gas. This project will take

advantage of the relatively small size and isolated nature of the Oban SIU to mitigate this risk through an appliance testing and replacement programme. However, this causes significant additional costs, which creates an added financial risk (if the level of appliance failure is greater than expected). In our view, these risks are such that the project would not go ahead without NIC funding. We note that an HSE exemption will be needed to inject non-GS(M)R gas into the Oban network. We will place an additional condition on the project to obtain the exemption before the full funding is committed (see paragraph 2.26 above).

SGN stated that this project would not be funded by shareholders because the direct financial benefits of the project do not accrue to SGN. While some benefits will accrue to SGN, such as the reduced operating costs of using a lower network pressure, we acknowledge that the benefits to SGN are unlikely to be such that this project would go ahead under the normal course of business.

(e) Involvement of other project partners and External Funding

As also noted by the expert panel, we consider that this project would have been strengthened by greater involvement of gas suppliers and gas appliance installers.

Collaboration is a central objective of the Gas NIC. As such, we do not feel that SGN sufficiently explained why it does not have any partners for this project. In particular, we note that gas suppliers and appliance manufacturers would have significant expertise to offer. In addition, as noted under criterion (a), shippers and suppliers would stand to gain from the success of this project. We would, therefore, have welcomed their involvement, particularly if additional funding were secured.

However, we note that SGN engaged with industry stakeholders, including the Heating and Hotwater Industry Council, in preparing the bid. Some stakeholders have indicated that they may contribute technically where appropriate. We are satisfied with the competence of the technical expertise that SGN has engaged.[20] The commercial arrangements in place with the technical experts appear to be appropriate.

SGN's stated approach to identifying project ideas and potential project partners and which potential projects to bring forward to the NIC appears to be satisfactory.

(f) Relevance and timing

This project is relevant to the development of a low carbon energy sector, insofar as it has the potential to facilitate the wider use of bio-methane and hydrogen. The solution could reduce greenhouse gas emissions by limiting the need for nitrogen ballasting.

The avoided gas processing cost could facilitate local embedded entry and inform the Network Licensees' future business plans. The project would also provide a means of lowering the cost of supplying the SIUs.

[20] Namely Dave Lander Consulting, GL Nobel Denton and Kiwa Gastec.

(g) Demonstration of a robust methodology and that the project is ready to implement

We are satisfied that SGN has a robust methodology for planning and risk management. We have some concerns with the customer engagement and appliance replacement aspects of the project.

The project plan is detailed and appears to allocate adequate resources. SGN noted that the timescales are based on learning from LCN Fund projects on customer engagement. We consider that the project could be implemented in a timely manner.

The customer impact of this project will be significant. This was an area of concern to us and the panel. However, SGN demonstrated that the engagement would be well managed. We were particularly pleased by SGN's commitment to replace gas appliances free of charge to customers. Nevertheless, we note the project will need to address at a more detailed level and at an early stage, the issue of gaining access to unoccupied premises (eg holiday homes) for appliance testing. We will place an additional condition in this area (see paragraph 2.26 above).

There is financial risk to SGN's proposed appliance replacement programme. SGN stated that the project will become unviable if the appliance replacement rate exceeds 40 per cent. We note that the appliance replacement rate will need to be monitored closely by SGN. The rate will need to be projected forward to give an early warning if the replacement rate for the whole project is likely to exceed 40 per cent. We will also place an additional condition in this area (see paragraph 2.26 above).

We are satisfied that the costs and benefits of this project have been estimated well. SGN quantified the benefits for Oban. SGN's narrative supported the rollout benefits claimed.

We note that no contingency was included in the plan and SGN stated that it has confidence that none will be needed. The risks of the project are clearly identified and the mitigations appear to be appropriate.

Our consultants noted that the SDRC for this project are process based rather than focussed on outputs. We are broadly satisfied that the SDRC are specific and relevant enough to incentivise delivery of the project on time, on budget, and with appropriate learning dissemination.

Robotics (SGN)

Project overview

SGN proposes to develop robotic equipment that could be inserted into live gas distribution mains and operated remotely. The equipment will aim to assess the presence of fractures in the mains and to repair any fractures identified.

There will be four elements ("modules") to the project. Module one will provide the propulsion and management of the control system. Module two will perform maintenance operations on Tier two and Tier three mains, such as repairing leaking joints. Module three will introduce sensors to inspect larger diameter pipes providing new data and information about the pipes' condition. Module four will introduce and test a different robot which would remotely reconnect a customer's service pipe once a new Tier one main has been inserted inside the old one.

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers

If proven successful by the trial, the robotic equipment could deliver modest CO2e savings as well as other environmental benefits. It could also deliver substantial financial benefits. These benefits would stem from reduced leakage, reduced 'reactive' gas mains repairs and reduced gas main replacements.

It will also avoid disruption and reduce expenditure resulting from current maintenance practices. These usually involve excavation on the highways and obstructing traffic.

Low carbon and/or environmental benefits

The robotic equipment has the potential to deliver low carbon and environmental benefits.

The robotic equipment could reduce leakage and CO2e emissions. It could more efficiently repair the pipes that may otherwise require replacement with new polyethylene (PE) ones. In addition, the inspection capability would provide pipe condition assessment data that could improve the risk management process of the GDNs. It would enable the proactive detection of leaking joints and improve the assessment of the probability of fractures.

Based on certain assumptions,[21] SGN states that modules two and three could deliver about 12500 tonnes of CO2e savings. This would be through a phased rollout to all GDNs. Additionally, the reduction in the use of replacement PE pipe could save approximately 500 tonnes of CO2e per year across all GDNs.

[21] That a method comprising all four elements would be 20% faster than the current method and the target of 55% remediation is met.

The project could also deliver environmental benefits through avoided highway excavation (which currently produces significant landfill waste). We note that SGN has not quantified some aspects of the expected environmental benefits. However, where it has not quantified benefits, it has provided clear justification of why quantification could not be given. We accept that it is difficult to value the full benefit of avoided excavation and note SGN will consider this as part of the project.

Net financial benefits

If successful, the project's four modules have the potential to create substantial financial benefits through reduced operational costs.

Enhanced risk assessment and remediation of joints reduces operational costs. Additionally, reducing the need for excavation not only minimises disruption to road users, but also substantially reduces the GDN's costs. We note that total savings for customers in Great Britain over the RIIO period could be up to £74m.[22]

We were pleased to see a year by year scenario detailing the financial benefits (of a full rollout) to customers. The financial benefits claimed are dependent on the success of the robotic equipment. We note that there are different levels of risk associated with each Module.

(b) Provides value for money to gas customers

This project would provide value for money to gas customers. However, we have a concern about module four of the project, which was also identified by the expert panel. We are concerned that Module four is being developed in parallel with the other three modules. We consider that there is greater uncertainty around its success compared to the other modules. Learning from the first three modules would reduce the risk of Module four failing. As such, we are requiring the project to accept additional conditions in this area (see paragraph 2.35 above).

Financial benefits from this project are directly attributable to gas network customers. Efficiency savings made against expected expenditure in the RIIO-GD1 price control period would be shared with customers and the benefits of this technology would be factored into future price controls.

We consider that the project's costs are modest relative to the potential savings to Network Licensees' operations. The learning from the successful trialling of the project is clearly applicable to all GDNs. The project has the potential to start the move away from external management of the infrastructure to a less expensive, less disruptive, more accurate and quicker approach.

However, we note that the benefits are closely linked to the successful trialling of the robotic equipment. The risk of failure is especially high for Module four as the technological challenges are much more substantial than in the other three modules. As explained under criterion (g), we are concerned that parallel development of all the modules would not allow for the learning from the first three to be applied to module four and may increase risk of failure. Without this learning, it may be difficult

[22] Based on the following assumptions: 55% remediation and service replacement targets are met, there is a 3 month lag at the end of the project with full rollout in SGN within 12 months and remainder of Great Britain within 24 months.

to ensure the success of Module four and thereby put at risk the value for money to customers.

We are pleased to see that ULC Robotics and SGN would agree on a target price for the robotic equipment during the trial. To ensure value for money, it is important that SNG manages the relationship with ULC Robotics efficiently. We note SGN has set a number of bilaterally agreed payment trigger stage gates to allow ULC Robotics to conduct its work but also ensure efficient project management and delivery.

(c) Generates knowledge that can be shared amongst all relevant Network Licensees

The project will generate new knowledge that can be shared amongst all relevant Network Licensees. We are also pleased to see that the project team will build on learning from previous IFI projects, specifically the CISBOT project. We note that learning will be disseminated at every stage of the project.

The new learning arises from the building of a prototype robot, which would be field ready at the end of the project. Learning from the trial, including data from the sensors on module three, is directly relevant to all Network Licensees and could be key to changing their current asset management and risk assessment activities.

We note that SGN has put forward a good approach to knowledge capture and dissemination for each module. We are particularly interested in ensuring that the learning from the preliminary testing, be it successful or not, and from the building of the prototype is captured. SGN has identified the key areas of knowledge and has proposed a number of routes for dissemination, including the use of social media and formal written reports.

SGN has indicated that it would conform to the default IPR arrangements. If any IPR is registered, it would be done by ULC Robotics, following transfer of any foreground IPR created by SGN. We note that if the project is successful, ULC Robotics would be in a strong commercial position to market the robotic technology and associated services to the GDNs both in Great Britain and abroad. However, in addition to conforming to default IPR, SGN's and ULC Robotics' commercial arrangements would facilitate access to the technology by all GN Network Licensees.

(d) Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration project to demonstrate its effectiveness

The robotic solution proposed by SGN would operate unproven and complex electronics in a live gas environment – which is novel and untested in Great Britain at the scale and in the circumstance proposed.[23] Due to the particular technical challenges, the project could not be expected to be funded under business as usual. We consider it to be innovative due to the significant technical risks associated with the engineering and operational aspects.

The technical risks and challenges are clearly set out and justify why this project would only proceed with NIC funding. However, the written submission would have

[23] We note previous testing of the CISBOT robot, but also note that Robotics would be substantially different. For example, it would operate in smaller pipes and would be able to navigate around bends in the pipe.

benefitted from more detailed information on the associated commercial and/or operational risks at this stage.

The project partner, ULC Robotics, has previous experience of developing robotic capability to perform iron pipe joint remediation inside live gas mains. We note however that the technology requires further development to deal with the characteristics of gas distribution systems in Great Britain, specifically with the large number of bends in British network compared with the USA's.

In addition to the technical innovation, the data collected from the robotic equipment could also contribute additional knowledge. In particular, the inspection capability developed through Module three could provide pipe condition assessment data that would support the development of alternative risk management for gas pipes.

(e) Involvement of other project partners and External Funding

We agree with the expert panel that the choice of partner for this project is sound. ULC Robotics has demonstrable experience of robotic solutions for pipelines.

We are pleased to see ULC Robotics' current involvement in an IFI project, sponsored by SGN (CISBOT). We consider the continuation of the partnership between SGN and ULC Robotics as reasonable. It would contribute to the effective delivery of the project. However, we note that the selection process for the project partner has not been competitive or open as a result.

We are pleased to see SGN working with an SME. ULC Robotics provides a benefit in kind, but only should the trial be successful. As part of the rollout across all GDNs, ULC Robotics would perform a free demonstration of the robotic equipment on 300m section of the network for each of the GDNs. We note that if the project is successful, ULC Robotics would be in a strong commercial position to market the robotic technology and associated services to the GDNs both in Great Britain and abroad. However, as mentioned under criterion (c), SGN's and ULC Robotics' commercial arrangements would facilitate access to the technology by all Network Licensees, should the trial be successful, and they would conform to the default IPR arrangements.

The project participant was identified through a feasibility study to assess a range of solutions to a specific problem. Based on the information provided, we note that this process was not competitive. However, we note that SGN runs a suggestions scheme, Ignite, which we hope will lead to NIC project proposals in the future.

(f) Relevance and timing

We consider that this project is timely and relevant as it aims to address current and ongoing problems associated with maintenance and risk driven replacement of gas distribution mains. If successful, learning from the project could be the catalyst for changing the GDNs' operations in these areas.

SGN stated that potential financial benefits would commence within the RIIO-GD1 period. Learning would inform future business plans and would influence the future forecast of operational activities and costs. Additionally, Network Licensees now have

the option to consider alternative risk mitigation measures rather than simply replacing iron gas pipes. This project could contribute to delivering that output.

(g) Demonstration of a robust methodology and that the project is ready to Implement

The project plan identifies the key phases of the Modules' development, including go/no-go stages. SGN has provided a detailed breakdown of costs and the interdependencies between the Modules are clearly identified. It has also explained project risks and mitigations, which are directly linked to the benefits.

However, as noted above, we are concerned with Module four. This concern was shared by the expert panel. Module four would be developed in parallel with the other three modules. We consider that there is greater uncertainty around its success compared to the other Modules and that learning gained from the first three modules would reduce the risk of Module four failing. As such, we will place additional conditions on the project in this area (see paragraph 2.35 above).

Ensuring an appropriate supplier for the sensor technology is key to this project. We would have therefore preferred to see a project partner or supplier of the sensor technology already selected at this stage.

SGN will employ its standard programme management processes. Although SGN still needs to develop a detailed approach to bringing about a change to the current GDNs' risk management process, we note that it has approached the HSE on this.

The team and project partner are committed to the project and the financial resources are adequate. As noted above, the customer impact will be limited. Failure of the method would require SGN to revert to business as usual and would be subject to the guaranteed standards of service obligations.

We are pleased to see that SGN has included stage gates in its project plan following resubmission, which are also linked to the SDRC.

Variable Envelope Compressor: Trial, Optimisation and Review (NGGT)

Project overview

This project would have sought to develop a means of widening the optimal operating 'envelope' of the compressors used by National Grid Gas Transmission (NGGT) in the transportation of gas, potentially improving the operational flexibility of the gas NTS. Traditionally, gas flow on the NTS has been from north to south. Because of changes to sources of supply and demand patterns, this is no longer the case. The direction, pressure and flow of gas through the network will likely be increasingly variable because of the role envisaged for Combined Cycle Gas Turbines (CCGTs) in balancing intermittent renewable electricity generation. NGGT suggested that this will present a challenge.

68 compressors push gas through the NTS. Due to the variable gas flows, some of these compressors now operate outside their optimal range - the 'envelope'. This causes the compressors to use more fuel and produce higher levels of emissions.

The proposed solution was to retrofit Variable Inlet Guide Vanes (VIGVs) in combination with variable speed control technology to widen the optimal operating envelope of the compressors. This could have allowed the compressors to be operated more efficiently, particularly where pressure and flow conditions vary rapidly.

The project aimed to develop and demonstrate a new variable envelope technology. The demonstration would have measured the benefits and practical implication of retrofitting the solution onto existing compressors. NGGT explained that a successful outcome of the project would have given it investment-level confidence in the technology, as well as the operational data to specify the functional requirements of the VECTOR technology to manufacturers of the compressors.

(a) Accelerates the development of a low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing customers

This project may have helped facilitate the Carbon Plan. However, we consider that the potential carbon and financial savings of this project are uncertain and potentially limited. This view is supported by the expert panel's recommendation report.

Low carbon and/or environmental benefits

To achieve the Carbon Plan, CCGTs will need to provide flexible electricity supply to help manage intermittent renewable electricity generation. According to NGGT, the NTS will need to cope with the rapid ramp-up and ramp-down of gas supply to CCGTs as they respond to the requirements of the electricity grid. The rollout of the VECTOR solution could have played a role in enabling the NTS to meet this need.

If successful, the project could have delivered operational flexibility more quickly than other existing solutions. According to NGGT, delivering greater operational

flexibility to the NTS would currently require replacement of the compressor train which would take 5-7 years to implement and cause compressors to be offline for significant periods of time. If successful, VECTOR might have been implemented in 12-18 months.

The Full Submission stated that a reduction in carbon emissions would have resulted from the more efficient operation of NTS compressors. However, NGGT did not provide a quantified estimate of the carbon savings associated with this or a justification of why they cannot be estimated. Furthermore, the panel noted that these carbon savings would have likely been small in comparison to the cost of the project.

Net financial benefits

NGGT highlighted that a key benefit of the solution would have been the provision of operational flexibility on the NTS. However, as noted by the expert panel, this benefit was not adequately quantified.

NGGT stated that VECTOR could have provided both one-off capital cost savings and annual operating cost savings. NGGT indicated that the figures involved are commercially sensitive, so they have not been published. We analysed these costs and the financial savings stated by NGGT and explain our findings below.

NGGT's estimated costs savings were based on the assumption that the avoided rewheel costs on each compressor fitted with the solution would offset the one off cost of installing the solution.

Having reviewed the information provided, we do not consider that NGGT has sufficiently demonstrated this benefits case. In particular –

- It stated that in the past 20 years there have been 17 rewheels on the NTS fleet of 68 compressors. Two were undertaken in the last 10 years and 15 in the proceeding decade.

- The net financial benefit claimed assumed three rewheels on each of the compressor to which VECTOR is applied, in their remaining lifetime.[24]

In light of the historic evidence, we consider the counterfactual's assumed costs to be high and are therefore concerned that the benefits of the technique may be overstated. We share the panel's concern that the potential net financial benefits claimed by NGGT are modest and not fully substantiated.

[24] While we note there may be ongoing changes in gas flows which increase the need for re-wheels going forward, we also note there has been an evolution in the location of supply and demand in the past 20 years. For instance, the increase in supply from LNG terminals in the south east and south west.

(b) Provides value for money to gas customers

We consider that this project could have been delivered at a competitive cost. NGGT invited a number of OEMs to participate and the project plan includes a competitive process for identifying a project partner.[25] However, we had two key concerns on value for money -

1. The structure of the project would likely have limited the benefits which may have accrued to gas customers. We consider that NGGT's approach to IPR arrangements may have hindered the replication of the solution by other manufacturers. The compressors on the NTS fleet were built by a small number of manufacturers. One of these manufacturers would have been selected to develop the VECTOR technology. As much of the IPR would have sat with one manufacturer, we consider there was a significant risk that the solution developed through the project may not have been easily rolled out across the NGGT fleet.

2. If the VECTOR prototype had not succeeded, an existing back-up compressor would have been in place to ensure that the network would not have been adversely affected. The project cost included funding to overhaul the back-up compressor. However, NGGT already receives funding through RIIO-T1 for compressor overhauls. We were therefore concerned that this part of the requested funding does not represent value for money to customers.

We consider the cost of this project to be high relative to the potential learning.

(c) Generates knowledge that can be shared amongst all relevant Network Licensees

We had major concerns that the learning produced and disseminated by the project would not have been sufficient to support the rollout of VECTOR across the NTS.

Because NGGT is the only gas transmission operator in Great Britain, we would not expect this project to deliver learning applicable to other Network Licensees as the problem is unique to the NTS. Nevertheless, it was appropriate for us to assess how the knowledge generated could be applied across the NTS and also to assess the potential to replicate the solution on the rest of the NTS compressor fleet.

As noted under criterion (b), we had significant concerns regarding the Foreground IPR arrangements of this project. We considered the risk that the solution could only have been applied to compressors from one manufacturer to be considerable. We are concerned that this project could not have been applied across the NTS. Therefore, while we note the potential learning from the project, we consider that the knowledge generated by it would potentially have had limited application.

This project would have built on an IFI study into methods of widening the operating envelope of existing compressors. We note that examples of VIGV technology in Canada and Slovakia could have provided relevant data but also that this project could have added to a proven technology.

[25] We note that Rolls Royce has already expressed an interest in participating in the process.

NGGT's dissemination plan included an appropriate range of stakeholders and suitable avenues of dissemination were proposed. However, NGGT did not demonstrate how the knowledge generated through this project would have supported the adoption of the VECTOR solution as business as usual.

(d) Is innovative (i.e. not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration project to demonstrate its effectiveness

This project had some innovative elements in the context of gas transmission in Great Britain. However, we have concerns about NGGT's justification of why this project would only have been undertaken with the support of NIC funding.

There are examples of VIGV technology in use elsewhere (cited in a Frazer-Nash report which was provided to us during the assessment). However, NGGT stated that the proposed solution would have offered functionality not available elsewhere. It claimed that the solution would have offered a wider envelope than previously achieved. The solution would have allowed the VIGVs to be positioned at -15°, 0° and +30°, whereas previous examples only allowed the VIGVs to be set to 0° and +30°. The project would also have sought to develop the first remote-control system for changing the position of the VIGVs. We note that the previous examples have demonstrated that VIGVs can be retrofitted to a compressor and that VIGVs can be used in combination with a variable speed drive.

NGGT stated that it may have needed to replace a compressor at considerable cost if the retrofit had not worked. To mitigate this risk the back-up compressor at the test site would have undergone an extensive pre-emptive overhaul to ensure that it could have provided cover if the test compressor failed. However, NGGT receives funding through RIIO-T1 to overhaul its compressors. Furthermore, some of the higher risk elements of the project have already been proven elsewhere. For example, Rolls Royce has already retrofitted VIGVs to a gas transmission compressor in Canada.

(e) Involvement of other project partners and External Funding

We were satisfied with the potential project partners approached by NGGT. However, we were concerned by the low level of funding from the potential partners.

We considered Rolls Royce to be an appropriate project partner, given its position as a leading global equipment manufacturer. However, we felt that Rolls Royce would have gained considerable commercial benefit if the project had been successful; not solely from retrofitting the remainder of the affected Rolls Royce compressors on the NTS fleet, but also by applying any Foreground IPR generated through this project elsewhere. As such, and in light of the level of financial risk that would have been borne by customers, a larger contribution (either in kind or in cash), to more evenly distribute this risk, would have been desirable.

Because of the nature of the project, potential project partners were limited to those OEMs with existing compressors on the NTS. We were satisfied that any of them could have provided the requisite technical expertise and competence to deliver the project. The OEMs were approached through NGGT's consultants, Frazer-Nash, who conducted the initial study into the potential of VIGV technology. We were pleased

with NGGT's engagement with the Carbon Trust to verify carbon data generated during the trial. However, we note the absence of quantified estimates of carbon savings to be delivered. The Carbon Trust could have added value in this area.

(f) Relevance and timing

We considered this project to be relevant to the Carbon Plan insofar as it sought to provide a means of facilitating the growing role of CCGTs in balancing the intermittency of renewable electricity. However, we do not consider that NGGT fully demonstrated the need for the VECTOR solution in delivering operational flexibility.

The timing of this project was potentially appropriate. A successful demonstration of the VECTOR solution could have informed NGGT's investment decisions in the second half of the RIIO-T1 period. However, NGGT did not explain how the project outcomes would have informed its investment.

(g) Demonstration of a robust methodology and that the project is ready to implement

NGGT demonstrated a robust methodology in aspects of this proposal. However, we were concerned about the cost benefit analysis and how the project would have ensured the business case for rollout.

The project plan was comprehensive, providing appropriate resource to the project. Technical partners would have provided additional support where necessary. We are confident that this project could have been ready to implement. The project would have had limited potential for adversely impacting customers. A back-up compressor would have been in place should the test compressor have failed, ensuring that supply would not have been interrupted. We were satisfied that the SDRC were detailed and linked to project outputs.

We were concerned that the Submission did not fully address how the learning from this project would be captured and used. As noted under criterion (c), we felt that NGGT provided insufficient detail to give us confidence that the project learning would have supported the business case for rollout.

Suitable risk mitigations were built into the project plan. Contingency funding would be used if the test compressor is irreparably damaged and must be replaced. The submission also outlined when NGGT would have requested to halt the project.

As noted under criterion (a), we were not convinced by the base-case used for the cost benefit analysis with regards to avoided rewheeling costs.

Appendix 2 - Glossary

A

Authority

The Gas and Electricity Markets Authority is the governing body for Ofgem, consisting of non-executive and executive members.

D

Department of Energy and Climate Change (DECC)

UK Government department responsible for setting energy and climate change policy.

E

Energy Networks Association (ENA)

ENA is the industry body funded by UK gas and electricity transmission and distribution licence holders. It lobbies on common issues in the operating environment, both at domestic and European levels, and provides technical services for the benefit of members.

I

Innovation Funding Incentive (IFI)

Scheme established under previous price control settlements. The IFI is intended to encourage Licensees to invest in appropriate research and development activities that are designed to enhance the technical development of their networks (and to deliver value (ie financial, supply quality, environmental, safety) to end customers.

Initial Screening Process (ISP)

The Initial Screening Process is a pass/fail evaluation of Gas NIC bids that takes place before the full submission process. The purpose of the ISP is to prevent Network Licensees spending money to fund project bids which do not meet the Gas NIC criteria.

Intellectual Property Rights (IPR)

Comprises copyright, designs, patents, confidential information and trademarks.

L

Low Carbon Networks (LCN) Fund

Funding to encourage the DNOs to innovate to deliver the networks we will need for a low carbon economy.

N

Network Innovation Competition (NIC)

The Network Innovation Competition will apply the LCN Fund concept to electricity and gas transmission and gas distribution network companies. The competition will also be open to independent network operators.

R

RIIO

Revenue=Incentives+Innovation+Outputs. New framework for network regulation which was developed as part of the RPI-X@20 review.

S

Successful delivery reward criteria (SDRC)

Successful delivery reward criteria are project specific objectives. The Network Licensee will be eligible to claim a successful delivery reward, equal to their compulsory contribution, if all SDRCs are met.

T

Technology readiness level (TRL)

Technology readiness level is a measure used to assess the maturity of evolving technologies. It is graded on a scale from 1 to 9. TRL 1 occurs when scientific research begins to be translated into applied R&D with TRL 9 describing a proven technology.