

SIF Project Registration

Date of Submission

Mar 2022

Project Reference Number

10020609

Project Registration

Project Title

Ch4rge Emissions Reduction

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10020609

Project Licensee(s)

National Gas Transmission PLC

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

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Project Budget

£144,782.00

Project Summary

The proposed project meets the scope objectives of Innovation Challenge 4 (heat) as a successful programme will significantly reduce gas network constraints (namely loss of energy in transport through process gas emissions) facilitating cost effective, low carbon heating solutions via a Net Zero National Transmission System (NTS). The project will take a selected technology through project design and delivery, leading to a proof-of-concept trial installation on a live NTS site under future SIF Alpha and Beta phases. Through a trial period, we would seek to understand the benefits, risks and challenges of operating process capture technology, ahead of a full network-wide roll out as business as usual (BAU).

The proposed team has the required experience and capability to deliver the project, comprising at Discovery stage of:

- National Grid Gas (NGG) (partner / lead organisation). NGG is a heat network infrastructure provider and is the only licensed gas Transmission Network Operator (TNO) in the UK. NGG is challenged with solving the identified constraints to facilitate a network capable of providing cost effective low carbon heating solutions. NGGT is uniquely placed to trial and prove a technology solution in a UK context with its range of assets, sites and operating experience.
- PESL (Sub-contractor). PESL (lead delivery partner for CH4RGE NIA) has specialist experience in rolling out cost effective environmental improvements on the NTS, which align with the Best Available Techniques (BAT), as a cost-benefit based technology selection approach.
- Mott MacDonald (Subcontractor). Mott MacDonald is an approved design partner (service provider) with extensive experience of technology project delivery on live gas sites in a safe and sustainable manner.

After SIF Discovery phase, and following subsequent funding approval, we would involve at least one Original Equipment Manufacturer (OEM); a supplier with proven capability will be chosen to avoid any potential impact on network availability or security of supply. The primary user will be the gas transmission license holder; however, elements will also be widely applicable to gas distribution license holders. All potential users are faced with the same challenges of reducing process gas losses and preparing for a transitional hybrid network to facilitate the delivery of cost-effective low carbon heat. Secondary users include European and global gas TNOs, and related upstream and downstream sectors (including hydrogen producers, gas midstream partners, and interconnector operators).

Third Party Collaborators

Project Environmental Solutions Ltd

Mott MacDonald

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Problem Being Solved

The UK gas network is about to undergo the most significant change since the discovery of North Sea natural gas in the 1960s. UK Net Zero objectives will require the gas National Transmission System (NTS) and local distribution networks to transition from methane-based to hydrogen-based systems; in the interim they will operate in a hybrid condition transporting methane-hydrogen gas blends. Methane emissions contribute directly to anthropogenic global warming, methane and hydrogen emissions represent a significant loss of energy in transport and are a key network system constraint, impacting the delivery of cost-effective low carbon heat networks. Releases of these process gases, although well controlled, are an inevitable part of any transmission or distribution system and occur for normal operational and maintenance reasons. Regulatory policy and Net Zero drivers have brought these emissions (currently methane) to the forefront of scientific and political concern, and a technical solution is required to solve the problem. We have an opportunity to investigate and prove a technology solution if SIF Discovery Funding is allocated to CH4RGE (Methane (CH₄) Reduction from Gas Equipment).

Innovative technological solutions are becoming available for the first time which will allow these methane or hydrogen based process gas releases to be captured, dramatically reducing overall emissions and facilitating the first key step in a network transition that will take the NTS towards Net Zero. Early pilot, proof of concept and roll-out of these process gas capture technologies will deliver key reductions in methane losses for the current NTS, helping deliver progress to Net Zero ahead of the eventual transition to a wholly hydrogen-based system.

Under previous NIA projects*, National Grid Gas (NGG) has successfully delivered the initial feasibility phase of the CH4RGE project, demonstrating a clear environmental, financial, and political need case for process gas emission reduction technology in the UK. A pre-feasibility assessment has been conducted, identifying how these technologies play a key role in a future 'low loss' NTS. This is a fast-developing market with accelerating demand for technical solutions particularly from Europe and North American markets. Since the project inception, the political, corporate and regulatory direction now aligns even more closely to the CH4RGE objective of reducing methane emissions in the short term, particularly with the Net Zero Agenda and the RII0-2 settlement. The project is now well placed for a Discovery Phase application under SIF to enable the project to move towards its goals.

* NIA_NGGT0164 and NIA_NGGT0174

Project Approaches And Desired Outcomes

The Big Idea

New technology applications are in development which allow process gas emissions from certain gas transmission operations to be captured and returned to the network, increasing efficiency, reducing heat delivery costs and associated carbon emissions.

The CH4RGE NIA project confirmed that Original Equipment Manufacturer (OEMs) have several technologies in latter development stages that could provide viable and deployable solutions to process gas losses, specifically from rotating machinery seals and planned compressor venting. These sources account for significant, potentially avoidable process gas losses. These technology solutions, identified as Best Available Techniques, are potentially suitable for installation as new build or to be retrofitted to existing equipment, reducing the levels of investment needed. They are skid based and incorporate small electrically driven reciprocating compressors, which allow otherwise vented gas to be captured and recompressed into accumulator vessels from where it can be re-injected into the process gas pipework. Indirect carbon emissions associated with electricity usage are substantially outweighed by the net gain associated with process gas recovery. No such system is currently in use on the national transmission system (NTS).

In some cases, these technologies are undergoing pilot trials, although none on the UK NTS and none which fully implement integrated combined seal and compressor venting emissions mitigation on UK network infrastructure. This confirms the market is seeking viable solutions for compressor machinery train (CMT) emissions reduction for which real life utilisation and success could be demonstrated with a relatively modest investment of SIF funding.

Early work on CH4RGE NIA demonstrated that demand for solutions is accelerating (some pilots are at commissioning stage), making them more 'market ready' than anticipated when early development of the CH4RGE NIA concept took place. Despite the progress in this area there are a number of uncertainties related to the safe installation and integration of these systems onto live gas sites; these need to be resolved through a programme of engineering design, safe working design studies, financial validation, environmental assurance and site-based performance monitoring.

Intellectual Property (IP) from the design and assessment exercise is anticipated to reside with National Grid Gas (NGG) as the project lead partner. Certain existing IP rights will already be established by the OEM technology providers which would be relevant at a later SIF project stage. It is NGG's intention that the learnings from the project will be disseminated as widely as possible to maximise opportunities for broader uptake of these emission reduction solutions.

Innovation Justification

The proposals for the CH4RGE SIF application represent a genuine innovation opportunity. There are no direct equivalent operational applications of this technology class on the National Transmission System (NTS). The technologies and solutions identified remain innovative with a higher investment risk profile than normal asset replacement programmes on the NTS. There is no approved funding under RII0-2 or Net Zero Reopener or Net Zero Use It or Lose It (UIOLI) for any comparable emissions reduction technology installation. National Grid Gas has secured funding under the RII0-2 price control for additional investment in mobile recompression equipment (for gas pipeline intervention works) however, this is an established Business As Usual (BAU) technology and presents wholly different challenges and requires different technical solutions to the in-scope emissions under CH4RGE.

A previous Innovation study, 'Alternatives to Venting' (NIA_NGGT0001, 2013), identified several theoretical solutions to methane emissions on the NTS, but none were ready to transition to BAU on network critical sites with an acceptable risk profile. Northern Gas Networks undertook innovation work to identify areas and equipment resulting in gas venting and potential solutions to reduce emissions. Their findings were specific to the distribution network and thus have limited applicability to NTS compressor losses which CH4RGE focuses on.

The CH4RGE project commenced under NIA_NGGT0164 -- 2020 and NIA_NGGT0174 -- 2021; and has delivered the necessary initial feasibility works (need case, technology review and site selection) to provide a launch pad for a successful SIF application. Through the CH4RGE NIA feasibility phase, the innovative nature of the CH4RGE scheme has been reaffirmed through engagement with European Transmission Network Operators (TNOs) and technology providers to understand the technology readiness and learning from other similar initiatives. There are similar projects in various states of roll out in Europe (e.g. Enagas the Spanish TNO) and more widely, however, none are directly equivalent to the UK NTS. We are seeking to combine technologies and apply them to the UK's unique gas supply sector, to deliver the maximum benefit.

All of the technology providers approached are yet to offer a market ready solution, with their current efforts looking at packaging elements of the technology and working with prospective operators to resolve integration challenges. As such, even though progress has been made, the risk profile is too high for a CH4RGE pilot to be considered via any BAU funding route, making this proposal

initially ripe for SIF Discovery funding.

Project Plans And Milestones

Project Plan And Milestones

The SIF Discovery phase main work packages will comprise:

WP1 Technical / environmental and Best Available Techniques (BAT) review of Original Equipment Manufacturer (OEM) technology proposals (including scope, performance and integration). Outputs ('success criteria') to include Tender Query for issue to OEMs. Activity led by National Grid Gas (NGG), supported by PESL.

WP2 Technical / safety engineering evaluation and recommendation of OEM Request for Proposals (RFP). Output would be RFP tender evaluation forms (with supporting information). Activity led by NGG supported by Mott MacDonald.

WP3 Review and update of draft 'Functional Requirements' and definition of:

- Formal environmental performance requirements (net reduction in Global Warming Potential).
- Formal asset performance requirements.
- Cost and resource implications for maintenance of equipment through operational life.
- Activity led by NGG supported by Mott MacDonald and PESL.

WP4 Compliance review of proposals against NGG standards and other relevant national and international standards. Outputs will be a detailed compliance map and identification of scope and extent of any required deviations against standards. Activity led by Mott MacDonald.

WP5 Review and develop project stakeholder engagement schedule. Activity led by PESL.

WP6 Carbon footprint estimate (using predetermined National Grid Carbon Rate) and population of an initial Sustainability Action Plan. Activity led by NGG supported by Mott MacDonald.

WP7 Undertaking Formal Environmental Assessment activities (NGG's environmental project management and governance system) to support the ongoing programme delivery and assessment of BAT. Outputs will include updated BAT assessment and completion of relevant governance documents to demonstrate compliance. Activity led by PESL.

Prior to this SIF Discovery application, Pre-feasibility / Feasibility stage activities have been completed for CH4RGE, funded under NIA. When the SIF Discovery funding is given the go ahead, assuming a successful outcome for the CH4RGE application, the market call-off will already have been launched. This puts the CH4RGE SIF Discovery application in a favourable position to swiftly launch into the planned Discovery phase tasks, maximising the benefit realised from the short two-month delivery window. In addition, a detailed project plan has already been developed for future SIF Alpha and Beta funding applications; this will enable NGG to move rapidly forward to future stage applications if requested to do so.

A risk matrix has been provided, which outlines the primary risks and their mitigations measures.

No major regulatory, commercial or technical constraints have been identified; the NIA funded pre-work on CH4RGE has allowed the project to design out potential constraints.

Route To Market

The Discovery phase will select representative equipment and exemplar sites which will promote the ready rollout at other network locations as the long term programme progresses. The beta phase of the project will focus on the integration requirements and opportunities for design standardisation to aid the ready transition to Business-as-Usual (BAU). There are a number of planned projects across the national transmission system (NTS) (emissions reduction, asset life replacement) which will present opportunities to rapidly integrate the technology within planned projects. It is anticipated that there will be a net financial benefit to National Grid Gas (NGG) and any others who use this technology due to the reduced exposure to carbon cost and reverse incentives. This will help drive the rapid uptake of the technology.

NGG has already undertaken preliminary work to update corporate policies, procedures and specifications to prepare for a roll-out of CH4RGE technology if the Beta pilot is successful. A new specification on 'Sustainability and Net Zero for Gas Transmission Projects' (T/SP/ENV/30) has been approved; where, following a successful CH4RGE pilot at Beta phase, this specification will be updated to mandate the use of CH4RGE technology where appropriate. NGG's compressor engineering specifications (the 'COMP' suite of

documents) will also be updated with the technical requirements for implementation and integration of CH4RGE on compressor engineering projects. NGG already has in flight tools and assessment processes covering Best Available Techniques and carbon foot printing which will allow the rapid evaluation and confirmation of the suitability of including CH4RGE solutions within future investment decision making.

We have already shortlisted three Original Equipment Manufacturer technology providers who are at present developing CH4RGE compatible solutions; these suppliers are already qualified onto existing compressor engineering frameworks, so there is a ready vehicle to support BAU procurement. It is anticipated that an outcome of the Beta phase would be preparatory works to enable the launch of an NGG 'Net Zero Suppliers' framework onto which all relevant suppliers could be co-opted.

Finally, NGG propose to make their CH4RGE project specific learnings available for other Transmission Network Operators to benefit, via a programme of dissemination and sharing of lessons learnt, as part of the SIF Beta reporting phase. This will support others in the effective procurement of similar technologies in the future.

Costs

Total Project Costs

144782

SIF Funding

144782

This project has been approved by a senior member of staff

Yes