Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Nov 2021

Project Reference Number

NIA_NGGT0177

Project Registration

Project Title

Hydrogen Deblending Feasibility Phase 2

Project Reference Number

NIA_NGGT0177

Project Licensee(s)

National Gas Transmission PLC

Project Start

November 2021

Project Duration

1 year and 0 months

Nominated Project Contact(s)

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Project Budget

£666,038.66

Summary

Further the understanding and research relating to gas separation on a gas network level by looking into the customers that are likely to be affected, the assets required to perform deblending, future and innovative solutions and an in-depth analysis of how the market frameworks currently in place are likely to change. Additionally, further the design of a demonstration deblending facility at FutureGrid.

Nominated Contact Email Address(es)

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Problem Being Solved

Preceding research has been carried out into the techno-economic feasibility of gas separation or deblending technology, the research concluded that it could be technically possible to use the inherent pressure drop between gas transmission and distribution to power gas separation technology. The project also summarised the costs for this technology and started to develop a demonstration of the technology.

This research now needs to be taken to the next phase as not enough is known about the customers that will require this technology, where they are located on the gas network and what specific gas separation technology could work for their individual needs. There is also a gap in understanding on how 'mobile' the separation equipment could be used to prevent stranded assets in the transition and what new, innovative and emerging technology is available currently at small or lab scale that could disrupt future separation technology.

Additionally, not enough is understood on how the market framework which currently operates today for natural gas will need to adapt to a gas network that has a blend of natural gas and hydrogen and how deblending specifically could be accommodated.

Method(s)

The project will be split up into 4 workstreams (1-3 on the Engineering side and 1 workstream looking at the Market Frameworks).

1. Engineering Workstream – UK gas network mapping and mobility

· Based on the current UK gas network, summarise the most likely locations for this technology based on the feedback from the stakeholder engagement, previous studies and operational constraints.

· Fully understand the challenges of installing gas separation technology at gas offtake sites across the network, considering cost, available space, operation and the 'mobility' of de-blending technology to prevent stranded assets.

2. Engineering Workstream – Demonstration high level design and scope

· Develop the high-level design and cost of a demonstration scale de-blending facility on the National Grid FutureGrid facility. Working with original equipment manufacturers (OEMs) and installation companies (if different) to fully understand the cost, scale and design of a mobile de-blending facility.

3. Future Technology Workstream

· Carry out a technology watch into future and emerging concepts that could disrupt the existing gas separation marketplace. Research new materials, designs and processes that may require scaling but show promise for the future.

Engineering Peer Review

· Peer review the Engineering workstreams to ensure all aspects had been covered fully and fairly.

1. Markets Framework workstream

· Work through key unresolved market questions concerning the use of de-blending technology on the gas networks, including cost, connections, capacity, balancing, charging, gas quality and system operation.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document NGGT / NGET internal policies. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal sharepoint platform ensuring backup and version management. Relevant project documentation and reports will also be made available on the ENA Smarter Networks Portal and dissemination material will be shared with the relevant stakeholders.

Measurement Quality Statement (MQS):

The methodology used in this project will be subject to our supplier's own ISO 9001 certified quality assurance regime and the source of data, measurement process and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and made available for review.

Scope

A possible solution identified to address transportation of low-cost hydrogen to accommodate the development of hydrogen economies across the UK demographic is the ability to utilise the gas transmission and distribution networks to transport hydrogen /

methane blends within the existing UK gas system and “deblend” the mixed gas streams at scale on a regional basis. If proved to be technically and economically feasible the concept could provide a credible pathway to achieving the transition n from <20% hydrogen / methane blends to a fully decarbonised gas network, whilst providing the added optionality for sensitive customers requiring a 100% methane during the transitional phase to a fully decarbonised gas network.

Critically, this method of distributing low carbon hydrogen would allow certain sensitive consumers, such as a CCGT power stations, to continue to receive a steady supply of natural gas without disruption to the transition of the gas network. Other consumers, such as early adopters of low carbon hydrogen, will conversely be able to receive a hydrogen gas stream. Therefore, this technology maintains optionality for consumers during the transition to a low carbon gas network.

Objective(s)

The objective of this project is to take the understanding and concept of de-blending on the gas network to the next level with the project being split between an engineering and market framework focus. For engineering the objectives will be to understand the potential locations for gas separation on the network, what ancillary equipment will be needed and how mobile this could be. Within the engineering part of the project an overview of the future emerging technology will be completed alongside development of a demonstration plant linked to the FutureGrid test facility.

For the market framework focus, the objective will be to explore how commercial frameworks may need to evolve to accommodate de-blending technology considering and potential changes to the existing regime including to connection agreements, capacity allocation, balancing, charging, gas quality and system operation. As series of stakeholder engagement sessions on the topic of de-blending will be organised to gather industry opinions and feedback.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Financial impact – as the UK gas network companies focus on decarbonisation and removing natural gas from the network there is a potential that the transition period will have an impact on our customers who are not ready to receive higher levels of hydrogen and green gases. This project is looking at gas separation technologies which could protect these sensitive or vulnerable customers until they are ready for the transition.

Success Criteria

Engineering – completed reports covering workstream 1, 2 and 3, including design drawings for the demonstration gas separation plant at FutureGrid Spadeadam.

Peer review of the Engineering workstreams

Market Framework - final report outlining the above unresolved market questions related to de-blending technology and potential solution options to accommodate de-blending technology within commercial frameworks.

Project Partners and External Funding

DNV have been selected to lead on the Engineering side (workstreams 1-3) with support from the National Physics Laboratory (NPL) for workstream 3 and Imperial College London for the Engineering Peer Review.

Frontier Economics have been selected for workstream 4 focusing on the Market Framework changes, support will be provided by Dentons on the legal aspect of market code changes through Frontier Economics.

Potential for New Learning

Workstream 1 – this workstream is looking to develop scenarios for gas separation and match these with likely customers on the gas network, this work will be carried out in conjunction with the workstream 4 supplier and with the proposed wider working group. Once the customers are mapped a summary of the technology will be carried out looking at the OEMs for gas separation and how this could be facilitated. The two will then be mapped together to see what an actual installation of gas separation will look like on

an example site for a customer. In doing this we will also assess the ‘mobility’ of the assets and understand whether there is a risk for stranded assets as customers’ demands change.

Workstream 2 – Develop what a demonstration gas separation set up would look like and operate at the FutureGrid test facility at

Spadeadam.

Workstream 3 – Explore which new, innovative and potentially disruptive technology is being developed currently that is at lab scale or with start-up businesses that has the potential to change the gas separation market. Explore whether these can be scaled to operate at transmission levels on a gas network.

Workstream 4 - work through key unresolved market questions concerning the use of de-blending technology on the gas networks, including cost, connections, capacity, balancing, charging, gas quality and system operation.

Learning from workstream 4 will be disseminated during the project at facilitated work shops held by Frontier Economics for a focused stakeholder group, there will also be a wider stakeholder webinar and presentation at the end of the project. This is additional to the standard methods of dissemination via report at the end of the project and conferences held by National Grid Gas Transmission e.g. Energy Networks Innovation Conference (ENIC 2021).

Scale of Project

This project builds on the work carried out in Phase 1 and covers both the engineering and market framework aspects of the topic of gas separation. The scale of the project is significantly more than Phase 1 as it will combine a mapping exercise, OEM discussions, mobility assessments, high level designs for a demonstration site at FutureGrid, a future tech watch into emerging technology and an in-depth review of the market framework changes needed with regular interactions from a focused working group. The engineering aspects will also be peer reviewed to ensure it is complete as part of this project.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

The scale of the projects the entire gas transmission system of the UK with learning applicable to the gas distribution networks as well.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£666,038.66

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

It is viewed that the concept of gas separation and deblending will be very important in the energy system transition. This technology could allow customers to still receive the gas composition they need even if they are not able to accept higher concentrations of hydrogen in the short term. This will allow National Grid to introduce higher levels of hydrogen into the national transmission system (NTS) as we transition to green gases and still provide 100% natural gas to a customer if required. De-blending technology could also allow further customers to extract 100% hydrogen from a blended gas network to meet the needs of customers who require 100% hydrogen.

How the Project has potential to benefit consumer in vulnerable situations:

A vulnerable customer for gas transmission will be a company that will be financially affected by the introduction of greater levels of hydrogen in their supply. Therefore, gas separation will significantly benefit those customers as they can continue to receive natural gas as they do today with the separated hydrogen being used in other processes or diverted back into the NTS downstream.

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

The concept of utilising deblending to transition from blends of <20% hydrogen to 100% hydrogen could negate / reduce the need for new hydrogen pipelines, dramatically reducing the impact on customers.

Research project therefore expected benefits not defined.

Please provide an estimate of how replicable the Method is across GB

The exact gas separation technology that will be deployed at each site it is required at will be different for the given scenario and company involved. This project will aim to map out what these scenarios and locations are and present some indication of what a gas separation plant could look like at a site. The learnings gained will be transferable across the gas system in the UK, for customers connected to both the Transmission and Distribution networks.

Please provide an outline of the costs of rolling out the Method across GB.

This will be focused as part of the project as it is not clear what a gas separation plant would look like and cost at a site level.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☑ A specific piece of new equipment (including monitoring, control and communications systems and software)

☑ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☑ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☑ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

The concept of gas separation will likely happen at the transmission / distribution boundaries as the drop in pressure between the two tiers can be used to 'power' the separation processes, therefore the learning from this project will be of interest to the other network licenses. Additionally, in the future gas separation may be required at the distribution offtakes if percentage blends in the NTS exceed those that can be accepted by the distribution companies.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

This project is a direct follow on from the Deblending Feasibility Phase 1 project and will build on that learning. Specifically, aspects within that project such as technology summaries will not be duplicated and the work completed in defining scenarios and demonstration designs will be built on and developed further here. The market framework aspect to this project has not been attempted prior to this study and so duplication is not an issue.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

Gas separation is not currently carried out on a gas network scale (only at industrial scale to date) therefore innovation is required to

ensure the technology can be used in this scenario. This project is looking at the current technology and applying it, for the first time to a gas transmission site. Workstream 3 is also solely focusing on new and innovate materials and technology in gas separation that could be scaled up for transmission use in the future.

Workstream 4 considers, for the first time, the market framework changes necessary to implement de-blending technology. Workstream 4 will provide new learnings including: Identifying the commercial and regulatory issues and challenges which would be associated with use of deblending equipment on the gas networks, identifying and evaluating what changes to the commercial framework might be needed to provide solutions to the issues and challenges and will set out what actions are required to overcome these challenges and enable deblending, with indications on timelines for this.

Relevant Foreground IPR

N/A

Data Access Details

N/A

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

Gas separation could potentially play a significant part in the transition to net zero but it is not carried out today and therefore funding is not available to research this topic, develop the understand and design demonstration scale projects as part of business as usual activities. With regards to the market framework aspect to this project, again business activities are focus on the current frameworks around natural gas and not one with increased levels of hydrogen in.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The low TRL of this project favours the use of NIA funding as gas separation is not currently carried out on the gas transmission network today. The technical, commercial and operational risks within the project mean that NIA is the best option to support this project.

This project has been approved by a senior member of staff

☑ Yes