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

Feb 2019

Project Reference Number

NIA_NGGT0143

Project Registration

Project Title

Project Cavendish

Project Reference Number

NIA_NGGT0143

Project Licensee(s)

National Gas Transmission PLC

Project Start

March 2019

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Susannah Ferris

Project Budget

£425,000.00

Summary

To undertake a feasibility study to help support the potential of the Isle of Grain as a location for hydrogen production and storage.

Third Party Collaborators

Arup

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Heating currently accounts for almost one quarter of all UK carbon emissions. This has historically been a difficult sector to decarbonise due to the high relative cost of other heating methods with electricity typically having a unit cost 3-4x that of gas. One potential method of economically decarbonising heat involves repurposing gas infrastructure to transport low carbon hydrogen. Many areas in the north of England have been assessed for the suitability of this method, however the south has remained relatively un-touched.

National Grid will lead a feasibility study to examine the potential of utilising existing gas infrastructure in the Isle of Grain (IoG) region to decarbonise heat in London and the South East of England. The Isle of Grain region has many existing facilities including LNG importation, gas and electricity transmission infrastructure, an anticline, offshore wind power, a power station and potential offshore storage; all of which could provide significant value in developing a decarbonised network.

Method(s)

To undertake a feasibility study that will examine the financial and economic impacts of repurposing infrastructure for hydrogen, the technical considerations that will need to be addressed as well as a deployment route to its implementation.

The deliverables from this commission will take the form of a report and a supporting digital asset based upon geospatial data and Geographical Information System (GIS) files. This provides an interoperable platform to support future project stages including detailed design and planning, through to operation.

The report will include a set of recommendations for next steps in the development process.

Aspects considered are:

- Business case
- Identification of carbon saving
- Benefit cost assessment
- Outline 'reference' design / technical concept
- Indicative costs
- Stakeholder views
- Road map
- Next Steps

Scope

The feasibility study will be examined over four phases.
1. Discovery Phase: This stage would be used to gather 'As is' data, and to inform vested stakeholders of the project's goals. We would undertake the following tasks during this phase:

- A review of the gas network to meet heating demand (this includes distribution and transmission gas networks)
- Technology for separating hydrogen from a hydrogen / methane blend
- Geological review of IoG
- An assessment of potential hydrogen users in the area, including TfL
- Stakeholder Engagement including identifying Initial stakeholders and ecosystem mapping
- Examine commercial arrangements required for investment purposes and how this would develop over time to a wider use of hydrogen for transport and heating in the London area.

2. Design & Modelling Phase: Our study will provide an outline 'reference' design of a hydrogen gas network linking into London from the IoG, and present this in diagram format, indicating the major component parts and sequencing. We will also outline the indicative costs associated with the options examined. We would undertake the following tasks during this phase.

- Technical concept development
- Production, CCSU (if needed), Pipeline, Storage, identifying modifications that would be required to the network and how much might this might cost.
- CO2 reduction - its implications on health costs, contribution to Clean Growth Strategy
- Business Model / Business case -Our modelling will assess a number of development scenarios, considering the volume of hydrogen production over time, TfL's capacity as an end user, the ability to distribute and use hydrogen locally
- End state – future vision of hydrogen in South London (aligning with BEIS & element energy vision work on the future of London's energy landscape).

3. Analysis Phase: This phase will analyse the options and costings developed during the Design and Modelling Phase in greater detail, in order to provide the parties with a preferred solution. This would include the following tasks:

- Refinement of cost estimates
- Wider economic benefits:
- Examine commercial/funding - the provision of subsidies – equivalent to green electricity
- What regulatory arrangements would be needed?
- Road map & modular design
- Stakeholder and communications

4. Completion Phase: During this phase the study will be concluded, developed and the final report presented. This phase will also include:

- Report on Lessons learnt
- Final report with recommendations
- Outlining Next Steps that may include
- Reinforcing the transmission network for hydrogen

- Reinforcing the existing distribution network for hydrogen

Objective(s)

- Determine the viability of utilising existing infrastructure to enable the Isle of Grain region to supply decarbonised hydrogen to London and the South East.
- Ascertain what additional infrastructure would be required if the Isle of Grain was to supply all of London's hydrogen, including the identification of critical environmental issues and ecosystem mapping of stakeholders.
- Generate a reference design showing the outline of a hydrogen system linking the Isle of Grain to London and the South East
- Generate a business case showing the economic and environmental benefits to consumers and UK PLC
- Develop a roadmap with next steps for hydrogen development in the region

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria are as follows:

- Produce an investment road map and report that verifies:
- The commercial arrangements needed to facilitate the development from inception.
- Outlines the requirement needed to supply all of London's hydrogen
- Suitability of existing gas transportation infrastructure
- Validation of the suitable assets required to carry out the production and storage of hydrogen
- Clarification of any environmental issues and ecosystem mapping that may impact stakeholders

Project Partners and External Funding

Project Partners – Arup, Cadent, SGN
External Funding – (nil)

Potential for New Learning

- Investigate possible technologies for separating hydrogen from methane in pipelines (building upon work completed in this field), in order to allow existing pipelines to carry blends of gases
- Interaction with SGN Realtime innovation programme to review how hydrogen may travel in a blended gas network
- Validation of the suitable assets required to transport hydrogen
- Exploring the use of an anticline geological formation as a repository for hydrogen storage

Scale of Project

This will primarily be a desktop study which will examine how the utilisation of existing gas infrastructure for hydrogen in the Isle of Grain region could become the catalyst for decarbonisation in London and the South East, and the part that innovative new technologies could play in facilitating this.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

Isle of Grain, London and South East

Revenue Allowed for the RIIO Settlement

n/a

Indicative Total NIA Project Expenditure

£424,998
NGGT - £141,666, SGN - £141,666 and Cadent - £141,666

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:

n/a

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

n/a

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)

The UK Government should meet demanding targets to reduce CO2 emissions by 80% of 1990 levels by 2050.

An initial estimate of the benefit has been generated:

- Assuming the population impacted is around 3 million, the annual emissions from domestic heating in this region is approximately 3.2 million tonnes CO2eq. Using the standard carbon abatement value of £60 per tonne, the financial value of removing these emissions is approximately £192,000,000.
- Additionally, TfL account for 5% of London energy requirements, much of which is generated by diesel leading to reduced air quality. Hydrogen produces no carbon at the point of use and can make use of the UK's extensive existing gas distribution and transmission infrastructure potentially providing a more economical solution to decarbonising heat and transport than other options.

Please provide a calculation of the expected benefits the Solution

This will be examined as part of this feasibility study .

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

The context and development approach outlined in the feasibility study will be applicable to other areas of the UK.

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

This is a feasibility study and it is not possible to provide indicative implementation costs before this work has concluded .

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

All evidence associated with the development of a hydrogen hub, including the use of distribution and transmission networks is applicable to all network licensees within the UK.

The re-use of existing gas infrastructure to transport hydrogen will be considered at all levels of the natural gas value chain. Specific information generated around separation technologies, geological storage, importation, environmental concerns, skills requirements, blended transport, economic and environmental benefits, and reinforcement could all benefit the ambitions to utilise hydrogen in other areas of the country.

There would be significant potential for collaboration with existing regional projects developed by the gas distribution networks including H100 (SGN), HyNet (Cadent) and H21 (NGN) as well the Hydrogen in the NTS NIA study.

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

Future of gas

☑ Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

The set of conditions applicable for the development of a South East hydrogen hub are unique, and have not been examined in the past.

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

Hydrogen gas is now seen as a viable alternative to methane gas, however technical and financial considerations need to be examined before hydrogen gas can be used. This review of existing assets, ground conditions and new technologies in combination with the project partners and wider stakeholders is seeking to establish if a sustainable solution for a hydrogen hub located in the

South East is viable. In particular, hydrogen separation from a blended gas mix has not been studied in any detail within the UK but could prove to be a valuable tool in the UK's decarbonisation strategy.

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

The benefits of the project to the Network Licensees is uncertain and would not accrue within the current price control, therefore this activity would not be undertaken as BAU.

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 project is highly collaborative and involves multiple regulated gas transporters which makes it particularly suitable for the NIA framework. Through utilising NIA funding the outputs of the project will also be made available to all interested parties in the decarbonising heat challenge.

This project has been approved by a senior member of staff

☑ Yes