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

Jul 2023

Project Reference Number

NIA_NGT0218

Project Registration

Project Title

Blending Infrastructure for the NTS

Project Reference Number

NIA_NGT0218

Project Licensee(s)

National Gas Transmission PLC

Project Start

July 2023

Project Duration

1 year and 9 months

Nominated Project Contact(s)

Helen Dugdale, box.GT.innovation@nationalgas.com

Project Budget

£442,089.00

Summary

It is important to understand the design of the infrastructure required to allow blending into the NTS. There are multiple scenarios where hydrogen may be blended into the NTS which need to be considered:

1. High flow industrial blue hydrogen injection
2. Medium flow injection, such as from a large electrolyser site
3. Low flow injection, such as from a wind farm

Each of these connection scenarios should be considered as direct green field feeder connections, along with injecting at existing NTS sites.

The effect that the different flow rates have on the design of the infrastructure should be considered, along with the location of injection.

The findings of the project should also be applied to a specific test case: the design of a temporary hydrogen connection acting as a pilot for hydrogen blending into the NTS.

Third Party Collaborators

DNV

Premtech Ltd

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

The conversion of the NTS into a hydrogen transmission network has been widely discussed and extensive work is underway to prove the technical capability and commercial viability of a 100% hydrogen network. However, it is recognised that blending of hydrogen and natural gas in the network is an important intermediary step towards that goal.

It is therefore important to understand the design of the infrastructure required to allow blending into the NTS. There are multiple scenarios where hydrogen may be blended into the NTS which need to be considered:

1. High flow industrial blue hydrogen injection
2. Medium flow injection, such as from a large electrolyser site
3. Low flow injection, such as from a wind farm

Each of these connection scenarios should be considered as direct green field feeder connections, along with injecting at existing NTS sites.

The effect that the different flow rates have on the design of the infrastructure should be considered, along with the location of injection. Consideration should also be made of the scenario where multiple injections are occurring on a single feeder, such as the requirement to monitor hydrogen concentrations before and after an injection site.

The findings of the project should also be applied to a specific test case: the design of a temporary hydrogen connection acting as a pilot for hydrogen blending into the NTS.

Method(s)

This project will comprise of multiple work packages to understand the process and infrastructure requirements for hydrogen blending into the NTS:

1. Review literature around hydrogen blending at transmission pressures
2. Understand and summarise how the end-to-end connections point would be different for a hydrogen connection, opposed to a natural gas connection.
3. Conduct simulation models of hydrogen at a hydrogen connection point.
4. Produce engineering drawings for an example connection facility in a number of scenarios:
5. Carry out a bespoke design for a pilot temporary hydrogen connection

Measurement Quality Statement

The measurement approach used to meet Data Quality objectives will be through the identification of high calibre project partners who are experts in their given field. 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.

Data Quality Statement (DQS)

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document and NGT 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.

Scope

In Scope:

- Blend concentrations between 0 and 20%
- Desktop study
- Metering requirements
- Modelling of gas behaviour for
- Direct injection & pre-blending

Out of Scope:

Asset testing

Objective(s)

- Determine the infrastructure required to allow blending into the NTS
- Understand the impact location and hydrogen injection flow rate has on the blending infrastructure requirements
- Determine whether direct hydrogen injection is possible, or whether pre-blending is required

Understand the impact multiple injection sites has on downstream injection sites

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact on customers in vulnerable situations. This is because it is a transmission project.

Success Criteria

Phase 1: Connections Process

Requirements: Desktop research report

Phase Acceptance Criteria: Report detailing technical & commercial deliverables, along with workshops with Gas Customer Hub

Phase 2: Modelling of Blending Scenarios

Requirements: Desktop research report

Phase Acceptance Criteria: Report detailing previous work and lessons learnt from simulation modelling

Phase 3: Example Engineering Drawings for Connection Facilities

Requirements: Desktop Study Report

Phase Acceptance Criteria: NGT to receive, review and sign off engineering drawings for six scenarios with estimated CAPEX and OPEX

Phase 4: Design of Pilot Temporary Connection

Requirements: Desktop research report

Phase Acceptance Criteria: Engineering design for temporary hydrogen connection for pilot

Phase 5: Standards & Reporting

Requirements:

- Technical report is delivered from supplier.
- NGT review and accept technical report.
- ENA Project Closure form is also populated by supplier. As required an ENA Project Progress Report is due end of each Financial Year.
- Project is then registered as complete.

Phase Acceptance Criteria: NGT to receive, review and sign off a final technical report.

Project Partners and External Funding

This project will be delivered by Premzero, who are subcontracting the support of nZero, with National Gas Transmission as lead network.

Cost: £417,026.88

Potential for New Learning

The learning from this project will increase the understanding of how to enable blending into the NTS. It will develop what the connections process needs to be, increase knowledge of the infrastructure and assets required, including costs.

Scale of Project

The scale of the project is mainland UK, as the NTS covers the whole area. A smaller scale would restrict the scenarios considered in the project and provide an incomplete picture of process, infrastructure requirements and cost.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The results of this project will be applicable across GB.

Revenue Allowed for the RIIO Settlement

Not applicable to this project

Indicative Total NIA Project Expenditure

External Cost: £333,622

Internal Cost: £83,405

Total Cost: £417,026.88

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:

Blending is an important step towards the energy transition, allowing customers that are hydrogen ready to decarbonise, whilst still allowing those that aren't the opportunity to get natural gas. It also allows customers to take blended gas. If the entire gas network was blending with 20% hydrogen, 6Mt of carbon will be saved

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)

RIIO-1 Question N/A

Please provide a calculation of the expected benefits the Solution

Value tracking

	Data Point	Data Point Definition
Maturity	TRL 2-3	Production of concept drawings & pilot
Opportunity locations	>50%/multiple asset classes	Conceptual drawings & modelling of multiple connection types in different
Deployment costs	500,000	Will change with location. Temporary connection cost £200,000
Innovation cost	£417,026	Sanction value
Financial Saving	£0	No savings, but realisation of business opportunity. Supports business strategy
Safety	0%	No increase in safety
Environment	6Million T	Amount saved of 20% hydrogen blended into gas network across GB.
Compliance	No change	No change
Skills & Competencies	Group	Project will integrate learning into Connections Team & Gas Customer Hub
Future proof	Must have for strategy	Blending is key to energy transition & future business strategy

The net benefits to be delivered so far are the ability to understand the requirements of a hydrogen connection in a blended network, and the ability to inform potential customers of the process. Forecast benefits to be delivered in the late 2020s-2030s.

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

Method is replicable in different types of connection sites across GB

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

Costs will be generated as part of the project, but a green field connection is expected to be considerably more expensive than at an existing AGI.

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

Understanding the process of connection to the NTS will add greater understanding to the blending outlook across GB and the general concept drawings and models will showcase opportunities for infrastructure to enable blending across gas networks, as well as increasing understanding of blended gas behaviour at high pressures

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

RIIO-1 Question 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.

Hydrogen blending in the NTS has not previously been considered, nor undertaking to gain an understanding of the gases behaviours around a connection point in different injection conditions.

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

Considerations of how hydrogen can be blended into the NTS has not been investigated before, nor has the behaviour of hydrogen in a high pressure network

Relevant Foreground IPR

This project and the resultant outcomes/deliverables will conform to the default treatment of IPR as set out under the agreed NIA Governance (where the default requirements address two types of IPR: Background IPR and Foreground IPR).

The foreground IP created in this project are identifying the infrastructure and process required to enable hydrogen blending

Data Access Details

Details on how network or consumption data arising in the course of an NIA funded project can be requested by interested parties, and the terms on which such data will be made available by National Gas can be found in our publicly available “Data sharing policy relating to NIA projects” at www.nationalgas.com/gasinnovation. National Gas data access is managed IAW provisions under 2.15-2.18 for the current NIA Governance Document.

National Gas already publishes much of the data arising from our NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published.

Data Quality Statement (DQS):

The project will be delivered under the NIA framework in line with the agreed Energy Networks Innovation Process document NGT 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.

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

Blended hydrogen is not applicable to the management of a natural gas network

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

There is a risk that if the conversion of the NTS to hydrogen is not accepted, then this work is no longer valid. The technical, operational, and regulatory risks around hydrogen are elements being explored across the Hydrogen Grid R&D programme.

This project has been approved by a senior member of staff

☑ Yes