

NIA Project Registration and PEA Document

Date of Submission

Jun 2023

Project Reference Number

NIA_NGT0213

Project Registration

Project Title

Characteristics of hydrogen and natural gas blends in the NTS

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NIA_NGT0213

Project Licensee(s)

National Gas Transmission PLC

Project Start

June 2023

Project Duration

1 year and 0 months

Nominated Project Contact(s)

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

Project Budget

£445,845.00

Summary

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 technical effects that blended gases will have on the NTS and determine the “worst case” conditions for testing purposes and safety considerations.

Consideration should also be given to the effects different blend concentrations have on current recompression technologies and in-line inspection technologies.

This work will be a combination of desktop literature review, modelling and physical testing.

Third Party Collaborators

Wood PLC

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.

Significant amounts of work has been conducted into the effects of 100% hydrogen in the NTS, both within National Gas Transmission and globally. However, there is limited discussion about whether 100% hydrogen always represents the “worst case scenario” for asset reliability and health when considering the effect of blends.

Understanding the behaviour of hydrogen/natural gas blends is key to underpinning the testing assumptions made thus far, and determining future work required.

Method(s)

The project will begin by determining the key blending scenarios, assets and benchmarking the properties of interest against current and previous projects globally.

The project will utilize the most appropriate software and models to determine impact of blend and flow characteristics. E.g. use of advanced modelling tools which have been used in hydrogen blending studies. CFD might not necessarily be the best tool for thermophysical properties or wide scale network modelling, so the appropriate tool will be identified and utilised

The project will develop a list of fluid, performance, and material parameters, model their behaviour in 2%, 5% 10% and 10% intervals up to 100% hydrogen, before conducting a limited amount of physical verification testing

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 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.

Scope

In Scope

- Literature study and benchmarking

- Model development and scenario runs
- Blend concentrations greater than 0% and less than and including 100% H2
- Desktop study
- Flow modelling
- Limited physical testing (learning to be shared from prior/adjacent project work)

Out of Scope

- Extensive testing to validate the model

Objective(s)

The likely blending percentages “stepping” up to 100% hydrogen should be identified, along with any concentrations that may be expected to exhibit abnormal behaviours. Consideration should also be given to sensitive assets on the NTS network such as compression and metering systems.

The blend concentrations to be considered are each 10% from 0-100% and additionally 2% and 5%, the impact at each should be investigated, including (but not limited to):

- Thermophysical properties
- Thermohydraulic behaviours
- Equipment performance
- Asset integrity – Materials of construction

Consideration should also be given to the effects different blend concentrations have on current recompression technologies and in-line inspection technologies.

An additional possibility is that the blend concentrations could vary in and around any concentration due to fluctuations in supply and demand. Consideration to the impact of this should be incorporated into the determination of behaviour in the network.

This work will be a combination of desktop literature review, modelling and physical testing.

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

1. Show that demonstrating network capability with 100% hydrogen can provide evidence for network capability at hydrogen/natural gas blends

To gain a better understanding of how hydrogen / natural gas blends may affect the NTS and ensure the appropriate testing is conducted to demonstrate safety and resilience at “worst case” scenarios.

To determine if testing asset capability at 100% hydrogen is the “worst case” scenario for impact or if alternative blends have a greater negative impact on asset capability and lifetime.

Project Partners and External Funding

This project will be delivered by Wood Group, with National Gas Transmission as lead network.

Potential for New Learning

The project will produce new learning about the thermophysical properties, thermohydraulic behaviours, asset performance and effect on asset materials of hydrogen/natural gas blends at a range of concentrations from 2%-90% hydrogen.

The results will be disseminated in the form of a publicly available final report.

Scale of Project

The scale of the project is mainland UK, which is considered appropriate as the NTS covers the whole area. A smaller scale would generate insufficient information regarding the opportunities for NGT

Technology Readiness at Start

TRL1 Basic Principles

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The results of this project would be applicable across the UK.

Revenue Allowed for the RIIO Settlement

Not applicable to this project

Indicative Total NIA Project Expenditure

£445845

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:

Asset and materials testing is focussed towards 100% hydrogen being the worst case scenario for the network. Undertaking tests at all blends will be a lengthy and costly activity, if we can prove that 100% hydrogen demonstrates capability at blends or identify key blends to test at this will help accelerate the energy transition and reduce the cost to the consumer.

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)

N/A

Please provide a calculation of the expected benefits the Solution

Category

Description

Scoring

Maturity

TRL 0-1

0

Opportunity

>50% or multiple assets

3

Cost to Deploy

£0

10

Innovation Cost

£350,000

0

Financial Savings

£0

0

Safety

0% No change

0

Environmental

0.0 tonnes of CO2

0

Compliance
No change
0
Skills & Competencies
Individuals
1
Future Proof
Indicated on the business strategy
5

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

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

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

This is a research 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

Final report will be publicly available

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.

The results of this project are specific to NTS assets and operating conditions. To date, there has been no studies conducted into the effect different hydrogen/natural gas concentrations has on the gas properties, asset materials or asset health.

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

At present, hydrogen blending does not occur in the NTS. Asset and materials testing is focussed towards 100% hydrogen being the worst case scenario for the network. This assumption needs to be evaluated and proven, to ensure demonstrating network capability with 100% hydrogen can provide evidence for the networks capability at other hydrogen/natural gas blends

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).

Data Access Details

Data for this project, and all other projects funded under the Network Innovation Allowance (NIA) funding scheme, can be found or requested in a number of ways:

A request for information (RFI) via the Smarter Networks Portal at <https://smarter.energynetworks.org>. National Grid Gas Transmission regularly publishes much of the data arising from our innovation projects on the ENA portal, before submitting a RFI check this website.

Via our managed mailbox box.GT.Innovation@nationalgrid.com. Further data can be shared upon request through the innovation mailbox. Each request will be assessed by the GT Innovation Team for its merits and viability.

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

Hydrogen/natural gas blends are not currently applicable to the 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