

NIA Project Registration and PEA Document

Date of Submission

Nov 2022

Project Reference Number

NIA_NGGT0203

Project Registration

Project Title

Impact of Hydrogen & Hydrogen Blends on Linepack

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Project Licensee(s)

National Gas Transmission PLC

Project Start

January 2023

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Matthew Hammond, box.GT.innovation@nationalgrid.com

Project Budget

£195,280.00

Summary

Gas Transmission and Metering (GT&M) are committed to reducing emissions from the operation of the National Transmission System (NTS) and eliminating emissions by 2050. A key technology in this transition is hydrogen as an alternative for carbon fuels in heat, transport, and industrial uses. The NTS currently provides a resilient supply to homes, businesses and industry, and GT&M aim to provide the same capability for hydrogen and hydrogen blends. Natural gas is currently stored within the NTS as linepack which can be utilised during periods of peak energy demand. The energy content of hydrogen is a third of that of methane, which will impact the energy content of linepack. The project will aim to investigate the impact of hydrogen and hydrogen blends on linepack and assess potential solutions to manage linepack in the future.

Nominated Contact Email Address(es)

Box.GT.Innovation@nationalgrid.com

Problem Being Solved

Gas Transmission and Metering (GT&M) are committed to reducing emissions from the operation of the National Transmission System (NTS) and eliminating emissions by 2050. A key technology in this transition is hydrogen as an alternative for carbon fuels in heat, transport, and industrial uses. The NTS currently provides a resilient supply to homes, businesses and industry, and GT&M aim to provide the same capability for hydrogen and hydrogen blends. Natural gas is currently stored within the NTS as linepack which can be utilised during periods of peak energy demand.

As the energy content of hydrogen is a third of that of methane, the energy content of linepack will change when transporting hydrogen and hydrogen blends which will impact the ability of the NTS to meet intraday demand. The way in which linepack is currently measured

and calculated will also have to change in a more complex, blended network, where the concentration of hydrogen is likely to vary based on location.

Method(s)

A desktop study will be carried out to determine the impact hydrogen and hydrogen blends may have on the capacity and operation of linepack. ROSEN will arrange a workshop with the GT&M innovation team and GSO to gather data on the current operation of linepack.

Linepack calculations will be aided utilising SIMONE software, as this is currently used at GT&M. The analysis will evaluate the effect of hydrogen blends and variability of hydrogen concentration, with respect to operating limits and constraints. The outcome of this analysis will be used as the basis for the desktop study, considering the method and location of automated gas measurement, data capture and transfer to GNCC, and potential pipeline integrity issues. A report will be compiled detailing the likely impact of hydrogen and hydrogen blends on linepack.

The output from the analysis will be used to build the requirements for the management of linepack in the future. This will include considering the potential for additional storage on the NTS to provide the intraday storage required, gas measurement locations, gas properties to be measured and the calculation of linepack in the future.

Measurement Quality Statement

The measurement approach used to meet objectives will be through the identification of high calibre project partners who are experts in their given field. In this instance the project will be limited to a desktop analysis from TRL2 to TRL3 to understand the impact the transportation of hydrogen and hydrogen blends will have on linepack.

Data Quality Statement

The project will ensure that data used is of sufficient quality to deliver project objectives by engaging with GT&M colleagues from various areas of the business. The relevant data and background information will be stored for future access within the National Grid Innovation SharePoint site.

Scope

The project will be split into 3 work packages:

Work package 1 – Study Investigating the Impact of Hydrogen & Hydrogen Blend on Linepack)

ROSEN will organise a meeting with GT&M representatives from Innovation & GSO to develop of clear understanding of how linepack is currently managed and operated and gather / request data. The impact on linepack will be assessed considering:

- Hydrogen
- Hydrogen Blends
- Variability of hydrogen concentration within gas blend
- Capacity of linepack, including lower & upper limits

- Operational parameters, including potential changes to operational parameters to increase capacity
- Linepack balancing

The impact on the following parameters of linepack operation will be assessed in Work Package 1:

- Linepack calculation
- Method and location of automated gas measurements
- Data capture and transfer to GNCC
- Pipeline integrity

Work package 2 – Management of linepack in the future

The objective of Work Package 2 (WP2) is to investigate how linepack can be managed with hydrogen / hydrogen blends, considering:

- Potential to increase linepack capacity
 - o Practicalities of integrating storage into the NTS
 - o Regulatory considerations
 - o Potential storage options to provide intraday demand
- Linepack measurement
 - o Measurement locations
 - o Gas properties to be measured
- Linepack calculation
 - o Method of remote data transfer to GNCC
 - o Linepack calculation for hydrogen and hydrogen blends using captured data
 - o Linepack balancing

Work package 3 - Reporting

Creation of technical report, technical summary and ENA closure report.

Objective(s)

The objectives of the project are to:

- To determine the impact of transporting 100% hydrogen on linepack
- To determine the impact of transporting hydrogen blends on linepack
- Determine requirements for the measurement and calculation of linepack in the future

Investigate the potential for increasing linepack capacity in a hydrogen network

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

The following key criteria need to be met for the project to be considered successful:

- Objectives met to time and cost.
- Project findings inform the overall hydrogen strategy and the potential modifications required to enable the gas networks to meet future energy demand.

Project Partners and External Funding

ROSEN

Potential for New Learning

The project will be the first step in understanding the impact a hydrogen network will have on the capacity and operation of linepack in the future. The learning will develop an understanding of changes required to gas networks to meet future energy demand, with hydrogen and hydrogen blends. The findings from the project will be uploaded to the ENA Smarter Networks portal and will be shared via GT&M innovation social media.

Scale of Project

The project is a desktop study which will provide insight into the impact of hydrogen and hydrogen blends on linepack capacity and operation. This learning will help to inform the hydrogen strategy and develop required learning for the energy transition.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

United Kingdom – Newcastle Upon Tyne

Revenue Allowed for the RIIO Settlement

£195280

Indicative Total NIA Project Expenditure

External: £146,459.90

Internal: £48,820

Total: £195,279.90

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:

The project supports the decarbonisation of the network by investigating the impact of transporting hydrogen and hydrogen blends within the gas networks on the capacity and operation of linepack. The energy content of linepack will vary dependent on the gas composition within the network, and it is important to understand how this can be managed in the future to enable the gas networks to meet energy demands.

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

Although this project does not directly affect vulnerable consumers the energy transition may and as such, we must consider the effect of the work we are doing through the NIA funding. The National Transmission System (NTS) is a key UK infrastructure for the transport of Gas to consumers, including those considered vulnerable. In a scenario where hydrogen replaces methane as a household heat source, it is essential the vulnerable are not excluded by virtue of fuel inaccessibility. In cases where vulnerable consumers already utilise gas it is likely that in a net zero future the optimum option is to provide a consistent energy solution. The transition to hydrogen within the NTS provides continuity of access to the vulnerable of hydrogen as a replacement to methane, with ongoing benefits of efficiency and economy of scale within a closely regulated environment. Ensuring robust NTS assets and consistent hydrogen production options will support the transition of the NTS to hydrogen which in turn supports the availability of gas to the vulnerable.

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

As the benefits of this project will be environmental it is difficult to quantify the benefits. The project will inform the hydrogen strategy for the NTS and provide valuable learning to the whole of the UK gas industry.

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

The project is focussed on the impact of hydrogen and hydrogen blends on linepack and will therefore be applicable to gas networks within the UK.

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

N/A – The Project does not intend to rollout anything, but knowledge and information generated through the lifecycle of the project.

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 the gas networks currently utilise linepack to meet peak intraday energy demand, and the learning from this project will therefore be applicable to all gas networks.

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.

There will be no duplication of activities done as part of this program and the learning will be shared with the gas industry and wider energy industry to avoid future duplication.

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

Work has not yet been undertaken to understand the impact the transportation of hydrogen and hydrogen blends will have on the capacity and operation of linepack. This project will be the first step in understanding the impact and potential solutions to any challenges identified.

Relevant Foreground IPR

The results of the project will enable us to inform the hydrogen strategy and the impact the transportation of hydrogen and hydrogen blends will have on linepack. The project will not create any new systems.

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 is being directed as a future energy solution but RIIO-2 business funding does not allow the development of hydrogen ready solutions and therefore this project cannot be undertaken as part of BAU activities.

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

This investigation into the impact of hydrogen on linepack is early-stage research and therefore carries additional exposure to risk. The NIA funding reduces exposure to risk and enables feasibility assessment of hydrogen production technologies.

This project has been approved by a senior member of staff

Yes