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

Jan 2024

Project Reference Number

NIA_WWU_02_49

Project Registration

Project Title

Hydrogen Blending in LPG Feasibility Study

Project Reference Number

NIA_WWU_02_49

Project Licensee(s)

Wales & West Utilities

Project Start

January 2024

Project Duration

0 years and 10 months

Nominated Project Contact(s)

Kerry Misljen

Project Budget

£293,033.00

Summary

Following on from the feasibility LPG to Hydrogen Village (NIA_WWU_2_11) study by WWU, one scenario that ranked highly regards the potential to lower carbon emissions was hydrogen blending with Liquid Petroleum Gas (LPG). This project would investigate the feasibility of creating a hydrogen-LPG blend and validating that homogenous mixing can occur without stratification occurring within the network, with the intention of the blend being used by consumers as a step forward to lowering carbon emissions. The project seeks to demonstrate hydrogen- LPG blending into a rural below 7Bar network using established processes. The solution would be applicable to a wide range of rural areas that are currently supplied by isolated networks operated by a range of GDNs.

Preceding Projects

NIA_WWU_2_11 - LPG to Hydrogen Village: Feasibility and concept design

Third Party Collaborators

Frontier Economics

Frazer-Nash Consultancy

Nominated Contact Email Address(es)

innovation@wwutilities.co.uk

Problem Being Solved

The UK government has committed to reducing greenhouse gas emissions to net zero by 2050 with the Scottish government targeting net zero by 2045. All future energy modelling identifies a key role for hydrogen in providing decarbonised energy for heat, transport, industry, and power generation. Significant decisions on the future of UK heat policy are expected from the UK government in 2026 so

the need for further evidence to influence these decisions is of critical importance.

Following on from the feasibility LPG to Hydrogen Village (NIA_WWU_2_11) study by WWU, one scenario that ranked highly regards the potential to lower carbon emissions was hydrogen-LPG blending. This project would investigate the feasibility of creating a hydrogen-LPG blend and validating that homogenous mixing can occur without stratification occurring within the network, with the intention of the blend being used by consumers as a step forward to lowering carbon emissions. The project seeks to demonstrate hydrogen-LPG blending into a rural below 7Bar network using established processes. The solution would be applicable to a wide range of rural areas that are currently supplied by isolated networks operated by a range of GDNs.

Method(s)

This project seeks investigate the feasibility of creating a hydrogen-LPG blend validating that homogenous mixing can occur without stratification occurring within the network, with the intention of the blend being used by consumers as a step forward to lowering carbon emissions.

This spend will fund the delivery of two work packages. Work package one will be delivered by Frazer-Nash Consultancy and will focus on a technical analysis of the feasibility of blending hydrogen with LPG. This work package will encompass a blend stability study, a materials suitability assessment and the development of a test plan, consolidated into a final report of Frazer-Nash's findings.

The second work package will be delivered by Frontier Economics and will focus on a regulatory analysis of the issues and barriers associated with blending different volumes of hydrogen into a below 7Bar LPG network, as well as identifying potential solutions. This work package will see Frontier Economics carry out scoping and stakeholder engagement exercises, the findings of which will be consolidated into a final report.

Frazer Nash's Data Measurement and Quality Statement

Frazer-Nash's ISO 9001:2015 accredited Quality Management System (QMS) assures that the products and services they provide to their clients fulfil their expectations and business objectives. As a consultancy they are adept at tailoring their approach to comply with the requirements of their clients' own specific quality standards and other sector schemes, as required by the markets in which they operate. Their system is designed to be effective, economical, scalable, and flexible, and to provide objective evidence that their delivery is fit for purpose. The QMS is an essential part of their ability to work in industries where the consequences of errors or non-conformances are serious.

Their QMS requires an individual quality plan to be completed for each project under contract. This plan is an internal document that is a single reference source for: the people, processes and tools which will be used in executing the work; the quality procedures to be followed; the project controls used and the deliverables that will be produced.

Their quality system also requires that each project has a nominated project auditor; providing an independent reviewer to deliver a balanced assessment of the project objectives, including satisfying the client's requirements, combined with a review of the technical and commercial risks across the complete project. Graham Hawkes will act as auditor. Graham is the engineering manager for Frazer-Nash's Energy Technology group, an IMechE fellow and a European Engineer with a specialty in unsteady flow, heat transfer and fluid mechanics. He has significant experience in leading research and innovation projects across a wide range of industries and a track record of successful management of complex projects. The project will receive formal project audits, with the project manager and auditor meeting to discuss the project and agree that the project risks are controlled.

The deliverables will be recorded in the project's Quality Plan, which will also appoint a suitably qualified and experienced independent verifier and an independent approver for both the model and report. Each deliverable will be subject to a "Deliverable Verification and Approval Record" (DVAR), which will record the agreement between author, verifier and approver that the deliverable is fit for purpose. These measures, in addition to a formal project audit, will ensure that an objective record of project quality is maintained throughout delivery.

Frazer-Nash have identified where they will require data from WWU in the methodology section of the proposal, this will be reiterated during the project kick off meeting with WWU and any risks associated with supply of this data will be discussed and mitigations agreed.

Frazer-Nash will employ their standard data management system for received data from WWU and keep a record of it within their electronic project folder. They can issue this list of received data as an appendix within the final report and re-issue that back collated in a zip file if required. All processed data will be clearly labelled and issued with the final report. All data processing will go through their verification processes, carried out by an independent member of staff. All assumptions will be made explicit in the final reports and data sources will be referenced.

In their Literature Reviews, they will undertake a Quality Assessment (QA) on the long-list of information sources, before they down-select to a short-list for detailed consideration.

The QA will consider if the:

- Research is clear and justified
- Document is appropriately referenced
- Methods employed by the research are appropriate
- Document has been peer reviewed or independently verified
- Conclusions are consistent with the results
- Author and publishing organisation have a track record in the technical area.

Frazer-Nash will restrict access to the project file within their systems so that data is only available to the project team. They do not expect to deal with any personally identifiable information within this project. If this becomes the case they will carry out a risk assessment and put relevant mitigations in place to manage the data properly.

Frontier Economics' Data Quality Statement

All data and information used in this project will be subject to Frontier Economics' standard quality assurance (QA) review process to ensure that project outputs are accurate to the best of their knowledge. At a high-level, their review process includes answering the following key questions:

- Validation – is the analysis a suitable representation of the world?;
- Verification: have all calculations included in the analysis been implemented correctly?;
- Data and assumptions: are the inputs to the analysis appropriate? We will ensure that sources of data and information are appropriately documented.

Data and information collected as part of this project will be stored on Frontier Economics' internal systems ensuring backup and future access.

Frontier Economic' Measurement Quality Statement

The project will be subject to Frontier Economics' internal Quality Management System. Their internal Quality Management System is consistent with best practice quality assurance principles. For this project, all outputs and draft reports would be read, discussed, tested and challenged internally before being delivered, to ensure the clarity, accuracy and relevance of the material presented. The team structure is such that there is clear accountability for the quality of the work which rests with the Project Manager in the first instance and ultimately with the Project Director. While this project will involve limited quantitative analysis, for all quantitative analysis undertaken on the project, Frontier Economics will follow their standard QA review process. All project outputs will be stored on their internal systems ensuring backup and version management.

The project is rated low in the common assessment framework detailed in the ENIP document after assessing the total project value, the progression through the TRL levels, the number of project delivery partners and the high level of data assumptions. No additional peer review is required for this project.

Scope

Work package one will see Frazer Nash deliver the following outputs:

- Blend Stability Study - a technical analysis to understand the mechanisms, consequences and likelihood of stratification of hydrogen when blended with LPG within existing LPG distribution networks (blend ratios of 5%, 10% and 20% hydrogen by volume).
- Materials Suitability Literature Review - development of a list of materials to be considered in collaboration with WWU and other stakeholders, followed by a literature review of the current understanding of chemically driven degradation mechanisms for the identified materials in hydrogen and LPG environments. A gap analysis will be conducted to identify relevant gaps in material performance data.
- Test Plan Development - Building on the literature review, Frazer Nash will develop appropriate testing protocols for the identified test programme.
- Final Reports - Frazer Nash will produce two final reports; one full report for WWU including details of the engineering analysis, and a public-facing version of this report.

Work package two will see Frontier Economics deliver the following outputs:

- Scoping - Confirmation of the relevant stakeholders to engage, including other gas transporters with responsibility for independent LPG networks, Shipper and Suppliers, Xoserve, Metering Equipment Managers, and Policymakers (OFGEM).
- Stakeholder Engagement - Conducting a series of in-depth 1:1 or small group meetings that will identify and discuss in detail the barriers and issues associated with blending different volumes of hydrogen into a below 7Bar LPG network. Frazer Nash will present to these stakeholders an initial set of potential solutions and identify where these are feasible and practical, considering additional solutions identified by the stakeholders.
- Consolidation - Review of the inputs received from stakeholders and noting areas where there is and is not consensus.

Objective(s)

To produce two reports; the first summarising the technical viability of blending hydrogen at different ratios with LPG to validate that homogenous mixing can occur without stratification occurring within the network, with the intention of the blend being used by consumers as a step forward to lowering carbon emissions. The objective of the second report is to understand and detail the regulatory barriers and issues with blending different volumes of hydrogen into a below 7Bar LPG network, as well as identifying potential solutions.

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.

Success Criteria

A successful project will see the production of two reports; the first summarising the technical viability of blending hydrogen at different ratios with LPG to validate that homogenous mixing can occur without stratification occurring within the network. The second report will enable GDNs to understand and detail the regulatory barriers and issues with blending different volumes of hydrogen into a below 7Bar LPG network, as well as identifying potential solutions.

Project Partners and External Funding

The partners for this project are Frazer-Nash Consultancy (WP1) and Frontier Economics (WP2), and the project is wholly funded via NIA. WWU are acting as lead network and NGN are partnering with a 50/50 external cost split.

Potential for New Learning

The project will enable networks to understand whether hydrogen can be blended with LPG, at what blend ratios, and whether homogenous mixing can occur without stratification occurring within the network. It will also enable networks to understand the regulatory barriers that they face toward using hydrogen-LPG blends, as well as what potential solutions can be implemented to overcome these barriers. The learning will be of particular benefit to rural areas and the organisations/networks that supply them in decarbonising their energy supply.

Scale of Project

This will be a desktop study.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project and its generated learnings will be applicable to a wide range of rural areas that are currently isolated networks operated by a range of GDNs.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External WWU = £109,887.50 NGN = £109,887.50 Internal WWU = £36,629 NGN = £36,629.16 Total WWU= £146,516.50 NGN= £146,516.66 Grand total = £293,033.16

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 seeks to investigate the technical and regulatory viability of blending hydrogen at different ratios with LPG to validate whether it will flow efficiently and without separating within the network, with the intention of the blend being used by consumers as a step forward to lowering carbon emissions.

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

There is a lot of ongoing work to identify the most effective route to meet net zero in the UK and this project is one of many projects to evidence the major or minor role hydrogen will have in different scenarios. Repurposing the UK gas networks with hydrogen to support the challenge of the climate change act has the potential to decarbonise heating with minimal gas customer disruption compared to alternative decarbonisation solutions.

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

The project and its generated learnings will be applicable to a wide range of rural areas that are currently isolated networks operated by a range of other organisations.

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

There are no roll out costs at present, as this is a research 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

GDNs are looking to decarbonise the network by switching to alternative fuel sources. This project will provide valuable learnings on the technical viability of blending hydrogen at different ratios with LPG to validate that homogenous mixing can occur without stratification occurring within the network, with the intention of the blend being used by consumers as a step forward to lowering carbon emissions. Likewise, the project will assist networks to identify the regulatory hurdles, as well as potential solutions to overcoming them, of using hydrogen-LPG blends.

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.

All networks have been made aware of this project and no concerns of duplication have been raised.

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

Following on from the feasibility LPG to Hydrogen Village (NIA_WWU_2_11) study by WWU, one scenario that ranked highly to lower carbon emissions was hydrogen-LPG blending. This project would investigate the feasibility of creating a hydrogen-LPG blend and validating that homogenous mixing can occur without stratification occurring within the network, with the intention of the blend being used by consumers as a step forward to lowering carbon emissions. The project seeks to demonstrate hydrogen- LPG blending into a rural below 7Bar network using established processes. The solution would be applicable to a wide range of rural areas that are currently isolated networks operated by a range of other organisations. Attempting to validating hydrogen-LPG blending at different blend ratios for this purpose has yet to be validated.

Relevant Foreground IPR

The project reports will form the relevant foreground IP.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. WWU already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website here
- Via our managed mailbox innovation@wwutilities.co.uk
- Details on the terms on which such data will be made available by Wales & West Utilities can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" here

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

The project would only be undertaken with support from NIA funding, it is in the interests of gas customers, the regulator and the UK government and the realisation of any benefits are outside the control of the gas networks. There is no allowance in BAU business plans for this type of work and there is a risk that if hydrogen is not accepted as a means to heat homes in 2050 that this work is no longer valid.

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 would only be undertaken with support from NIA funding, it is in the interests of gas customers, the regulator and the UK government and the realisation of any benefits are outside the control of the gas networks. There is no allowance in BAU business plans for this type of work and there is a risk that if hydrogen is not accepted as a means to heat homes in 2050 that this work is no longer valid.

This project has been approved by a senior member of staff

☑ Yes