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

May 2024

Project Reference Number

NIA_WWU_02_22

Project Registration

Project Title

Gas Separation within UK Gas Networks

Project Reference Number

NIA_WWU_02_22

Project Licensee(s)

Wales & West Utilities

Project Start

May 2024

Project Duration

0 years and 5 months

Nominated Project Contact(s)

Henry James

Project Budget

£126,503.00

Summary

By embedding gas separation solutions within the gas network, strategic gas separation could have the ability to provide customers with the type and quality of gas which they need whilst the energy system around them is transitioning. This not only builds flexibility into the gas networks and wider energy system, but also strengthens the case for large scale blending which, in turn, could accelerate the hydrogen economy and decarbonisation in a piecemeal fashion.

Third Party Collaborators

Environmental Resources Management (ERM)

Nominated Contact Email Address(es)

innovation@wwutilities.co.uk

Problem Being Solved

To deliver WWU's Regional Decarbonisation Pathways a more detailed assessment and planning is required on the opportunities and challenges in certain areas. One particular challenge in delivering the pathway is how the network will transition from natural gas to hydrogen, and what technologies and techniques should be deployed to facilitate the interim period where GDN's may be operating both natural gas and hydrogen assets. In this period, networks will likely be operating assets which are:

- Wholly or predominantly methane (natural gas)
- Wholly or predominantly hydrogen (>98% hydrogen by volume)
- A mixture of methane and hydrogen as a blend (≤20% hydrogen by volume)

The aim of this work is to demonstrate where gas separation technology can strengthen the case for large scale network blending, and how this can also provide flexibility to customers in early cluster projects.

Method(s)

Work to date, notably by National Gas Transmission and Cadent (see below), has focussed on the opportunities posed by deblending and purification technologies when applied to transport customers. By first incorporating an initial literature review and market assessment, this project will build on work to date by looking holistically at where different types of gas separation technology (e.g., electrochemical, membrane) can be applied to serve multiple customers on a blended network. This will explore industrial and commercial (I&C), power generation, and transport customers who are either:

- Sensitive to hydrogen and wish to continue using natural gas – Protective
- Wish to use an enriched blend, or wholly hydrogen - Progressive

By embedding gas separation solutions within the gas network, strategic gas separation could have the ability to provide customers with the type and quality of gas which they need whilst the energy system around them is transitioning. This not only builds flexibility into the gas networks and wider energy system, but also strengthens the case for large scale blending which, in turn, could accelerate the hydrogen economy and decarbonisation in a piecemeal fashion.

Previous Projects

HyNTS Deblending

HyNTS Deblending for Transport Applications

Hydrogen Grid to Vehicle (HG2V): Network purity for Transport.

Hy4Transport

HyNTS FutureGrid Deblending

Composite membranes for H2 purification

Measurement Quality Statement and Data Quality Statement

Data Quality

All sources of data used will be assessed for reliability of the data acquisition method used, and bias of the data source to the extent practical. Sources of data that do not meet high standards of reliability and impartiality will be excluded. All data used in the study will be referenced. Any concerns regarding the quality of the data or reliability of the sources will be recorded and communicated to and discussed with the client.

Measurement Quality

Data relating to the costs (CAPEX and OPEX) and performance of gas separation technologies will be used to estimate the overall levelized cost of separation (per unit of hydrogen delivered). The Excel model used for these calculations will be subject to a rigorous testing and quality assurance process. Steps include:

1) A thorough review of all input assumptions – assessing whether the proposed inputs assumptions are valid and representative of the technologies / scenarios under consideration. Confirmation that all units are correct and that the assumptions are unambiguous.

2) Review of all formulae – check that all formulae are correctly coded and follow best practice recommendations (e.g. avoiding any hard-coded values and ensuring all calculations use easy-to-review formulae).

3) Review of outputs – the results of the modelling tool will be reviewed and stress tested against a wide range of input assumptions. The stakeholder engagement and review exercise also provides a further opportunity to check and validate findings.

In addition to the steps described above, the project team will adopt a clear, consistent file naming convention to ensure version control of all documents, data sets, and tools associated with the project.

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 1: market assessment and technology review

1.1 Market assessment

To initiate the study, ERM will identify and characterise available gas separation technologies and solutions for both hydrogen purification and deblending that are at a Technology Readiness Level (TRL) of 6 or above. They will conduct a literature review to identify any additional technologies that should be included, for example as a result of further technological developments since the HyNTS study.

1.2 Technology review

In this task, ERM will conduct a more detailed assessment of each of the technologies identified in Task 1.1. This wil include determining representative technical and economic parameters including:

- CAPEX – up-front capital costs (distinguishing between factory gate and fully installed costs where possible);
- fixed OPEX – costs of maintenance, consumables, etc.;
- variable OPEX – running costs which vary with operation;
- other technical characteristics such as hydrogen feed-in content, throughput rate, input and output pressures, operating temperature, achievable purity, hydrogen recovery and tolerance to poisons; and
- maturity and expected development timescales.

1.3 Preferred technology shortlist

Based on the analysis in Task 1.2, ERM will compare the gas separation technologies and summarise the analysis in assessment matrices.

This exercise will be performed from the perspective of best-serving ‘protective’ customers, who wish to continue using natural gas, and from the perspective of serving ‘progressive’ customers who wish to use an enriched blend or 100% hydrogen.

Work package 2: embedded gas separation opportunities and risks

2.1 Technology assessment by application

In this task, the potential of the shortlisted technologies will be assessed in relation to the needs of the various applications within WWU’s customer base.

To conduct this assessment, ERM will first characterise the requirements for each application. This will include consideration of technical factors such as required pressure, purity requirements and typical scale of demand, as well as the timescales, willingness to pay and drivers for their potential transition to hydrogen or an enriched blend.

Based on the characterisation of the application requirements, ERM will then assess the ability of the technologies selected in Task 1.3 to meet these requirements, drawing on the assessment in Task 1.2.

2.2 Preferred technology selection

Based on the assessment in Task 2.1, ERM will propose preferred technologies for each application. The rationale behind the technology selection will include discussion regarding:

- any standout opportunities for low-cost deployment and integration;
- the associated risks and limitations of each technology (e.g. scale, timescales, wider value chain effects);
- drivers and dependences, i.e. the key developments needed to unlock the technology’s potential.

2.3 Billing methodology assessment

In this task, ERM will discuss the implications of the selected gas separation technologies on the billing methodology for customers.

Work package 3: application of preferred solutions and case studies

3.1 Case studies

In this task, ERM will define three case studies which consist of realistic combinations of end use applications based on current and expected hydrogen and natural gas demands.

3.2 Cost assessment

For each case study, ERM will estimate the CAPEX and OPEX of the gas separation solution. They will draw on data gathered in WP1, and will sense-check and refine the cost estimates through discussions with stakeholders and comparisons to existing literature. They will also consider the potential effects of economies of scale and future cost down associated with technology maturation.

3.3 Conclusions and recommendations

ERM will collate the findings of the study into a final report. They will prepare both a detailed internal report and a summary report without sensitive information which can be used for external engagement.

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 save £millions with minimal gas customer disruption verses alternative decarbonisation solutions

Objective(s)

To demonstrate where gas separation technology can strengthen the case for large scale network blending, and how this can also provide flexibility to customers in early cluster projects.

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

The project will be a success if WWU are able to demonstrate where gas separation technology can strengthen the case for large scale network blending, and how this can also provide flexibility to customers in early cluster projects.

Project Partners and External Funding

The project partners for this project are ERM. The project is wholly funded via NIA.

Potential for New Learning

The project will allow WWU to understand how the network can transition from natural gas to hydrogen, and what technologies and techniques should be deployed to facilitate the interim period where GDN's may be operating both natural gas and hydrogen assets

Scale of Project

This is a desktop study, which is the required scale at this time, this ensures that we are able to develop the initial valuable learning to assess feasibility and enable planning for later iterative project phases if needed.

Technology Readiness at Start

TRL3 Proof of Concept

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The outputs are not Geographically specific, as this is a desktop study the work will take place at ERM offices.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External Spend: £94,877

Internal Spend: £31,626

Total: £126,503

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:

To deliver WWU's Regional Decarbonisation Pathways a more detailed assessment and planning is required on the opportunities and challenges in certain areas. One particular challenge in delivering the pathway is how the network will transition from natural gas to hydrogen, and what technologies and techniques should be deployed to facilitate the interim period where GDN's may be operating both natural gas and hydrogen assets. In this period, networks will likely be operating assets.

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 which will assist in this area. Repurposing the UK gas networks with hydrogen to support the challenge of the climate change act has the potential to save millions of pounds with minimal gas customer disruption verses alternative decarbonisation solutions.

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

Any outputs of the project will be replicable across GB

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

There are no roll out costs at the current time.

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

The challenge of gas separation is the same for all network licenses, so outputs can be used by all 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)

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, there are proejcts that have covered off gs seperation that have are listed in the Method secion. This work builds on those proejcts and does not duplicate.

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

This project builds upon previous projects completed by WWU (Regional Decarbonisation Pathways), as well as work undertaken by Cadent (Hy4Transport) and National Gas Transmission (HyNTS FutureGrid Deblending). Blending in the natural gas grid with hydrogen has never happened and this project is a stepping stone to allow that to happen

Relevant Foreground IPR

The report published, will form the 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

Ofgem published its final determinations which included a variety of provisions to enable necessary development work on Net Zero projects but also to ensure vulnerable customers are thought about in any decision making. This project has the potential to facilitate the energy system transition and is therefore eligible to use the NIA funding mechanism.

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 be used in industry then this work is no longer valid.

This project has been approved by a senior member of staff

☑ Yes