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

Apr 2022

Project Reference Number

NIA_WWU_2_08

Project Registration

Project Title

SWIC - Hydrogen Peaking Plant Feasibility Study

Project Reference Number

NIA_WWU_2_08

Project Licensee(s)

Wales & West Utilities

Project Start

April 2022

Project Duration

1 year and 0 months

Nominated Project Contact(s)

Henry James

Project Budget

£33,333.00

Summary

A project to develop a study to assess the interaction of gas-fired peaking plants connected to WWU network, when the plant is converted to Hydrogen

Preceding Projects

NIA_WWU_2_03 - SWIC Market-Accelerating Hydrogen Distribution and Storage

NIA_WWU_2_01 - SWIC Hydrogen Supply Pipeline Infrastructure

NIA_WWU_2_07 - SWIC: Assessment of potential hydrogen demand in 2030 - 2050

Third Party Collaborators

Costain

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. To support this, the UK Government has issued the “10 Point Plan to deliver a Green Industrial Revolution” by mobilising £12 billion of Government investment.

The South Wales Industrial Cluster (SWIC) is a consortium of some of Wales’ top industry, energy, infrastructure, law, academic and engineering organisations. SWIC is led by Costain alongside partners including WWU. In 2020 the project received an allocation of

grant funding from Innovate UK that supported the first phase of the SWIC Roadmap and Deployment projects

All future energy modelling identifies a key role for hydrogen (linked to Carbon Capture, Utilisation and Storage (CCUS)) in providing decarbonised energy for heat, transport, industry and power generation. To enable the transition from natural gas to hydrogen, the gas networks will be required to provide the transportation and distribution infrastructure to supply hydrogen to customers in the future low carbon economy.

Gas networks will transport and distribute hydrogen as gas blends in early years to contribute to partial network decarbonisation, together with increased injection of biomethane. In response to demand and decarbonisation ambitions, targets and plans, gas networks will gradually transition to distribution of 100% hydrogen via pipelines either in repurposed sections of the existing network or in newly built pipelines.

Transport and distribution of hydrogen in pipelines represents the optimum lowest cost option to transport the large volumes required to meet regional energy demand. However, network decarbonisation may be hindered due to the required large investment in network infrastructure. Challenges also arise in terms of network sectionalisation and operation to allow distribution (and billing) of gas with variable compositions during the transition period, impacting the network flexibility.

There are a number of gas-fired peaking plant connected to the electricity system in South Wales with further projects under development. Most are connected to Wales & West Utilities gas network, although the largest future projects may obtain their gas supply from the National Grid NTS. These peaking plants have a low load factor - reacting to electricity market signals indicating that there is a need for peaking power and it would be profitable to do so. There is a tendency for the local peaking plant installations to collectively react to the same electricity market signals and select to operate over the same time periods.

The characteristics and behaviour of the existing gas-fired units are relatively well understood and known. However, as the UK transitions to operating a low carbon energy system, it is anticipated that these units will transition to hydrogen combustion in future. The operational behaviour of existing and also future units is less well understood and will be the focus of the study. The study will provide a better understanding of how gas-fired peaking plants will interact with the gas network when it converts to hydrogen.

The project will also produce a report which is intended to be public facing, to publicise the work which has been carried out under the SWIC Deployment programme. Incorporating this project, as well as the three projects previously approved.

Method(s)

Phase One:

- Engage with existing peaking plant operators in South Wales to obtain their perspective on present day operations and view of the future.
- Peaking plant units tend to utilise either gas turbine and reciprocating engine equipment. Engage with the market leading OEMs (Original Equipment Manufacturers) to obtain the latest available information on hydrogen capability and performance information for their relevant product range.
- Compare the anticipate performance of peaking plant on hydrogen with existing natural gas performance. This will be limited to sites with an operational capacity of 10 – 100MW.
- Perform a quantitative assessment of the potential gas network impact of peaking plant switching from natural gas to hydrogen fuel.

Phase Two

- Develop graphics and diagrams which summarise key messages from the suite of NIA SWIC projects to date. This will feed into report for dissemination to industry and the wider public

Data Quality Statement

The input data utilised for this Project will adhere to several key attributes including:

Consistency: There is no contradictions or inconsistencies in the data. This will be measured by the number of inconsistencies

Accuracy: The information corresponds to reality. This will be achieved by identifying errors

Completeness: That there are no missing values

Auditability: Changes to data are auditable

Timeliness: The data represents reality within current timescales

Historical gas demand information for flexible power plant producers connected to WWU's network is a key study input. This information is held by WWU and is used as a basis for charging these power producers for the gas they consume so the data is considered to be both accurate and also a good indication of future gas consumption levels in the short term. In considering future hydrogen consumption, it is proposed that the study will be supported by both input from local power producers (based upon their existing relationship with WWU as gas customers) and gas turbine and engine Original Equipment Manufacturers (OEMs) perspective on equipment performance for hydrogen duty (where Costain has performed recent relevant engagement – e.g. in delivery of the Stanlow H2 CHP FEED study work as part of the HyNet programme in 2021). The combination of these factors provides confidence in the quality of the various aspects of data that will be considered by the study including:

- Historical (natural gas) gas demand;
- Future (hydrogen) gas demand; an
- Performance information for power production equipment operating on hydrogen.

The accuracy and reliability of the dataset underpinning the analyses in the report will undergo a rigorous validation procedure. In accordance with the Costain (ISO 9001) quality process

Measurement Quality Statement

For the purposes of traceability and reliability of results, data and methods employed will be based on established best practice regarding data sources and methodologies/tools, which are expected to meet the Data Quality objectives without the need for additional audits.

The historical natural gas demand information to be used in the study will be confirmed with both WWU's operational team and also those individual flexible power plant producers who choose to engage with the study. Future flexible power plant operations on hydrogen duty will be based upon historical performance information and subject to review with the existing power plant operators who are WWU's customers to confirm the extent that they anticipate future operations will follow a similar pattern to their recent historical operating profiles. Performance on hydrogen will be reviewed in conjunction with engagement with the relevant OEMs, supported by the fact that the focus of their R&D activity into hydrogen combustion has been on the smaller units within their portfolio which are most applicable to the present study scope. Lastly, review of the potential impact on WWU's network operations will be based upon the understanding already gained by Costain in delivery of the Hydrogen Pipeline Assessment study work (NIA_WWU_02_01) which has recently been completed and peer reviewed by WWU's technical and operational teams.

For the purposes of comparability of results, the feasibility study will validate input data and output results against published reports and manufacturers (OEM) data to demonstrate compatibility and validity of assumptions and results, clearly identifying the potential reasons for discrepancies or deviation from the assumptions or results, the conditions for which the results are valid and the sensitivity to assumptions.

The project is rated low in the common assessment framework detailed in the Energy Networks Innovation Process (ENIP) document after assessing the total project value, the progression through the TRL levels, the number of project delivery partners and the medium level of data assumptions.

No additional peer review is required for this project.

Scope

- In their Net Zero Carbon Budget 2 (2021 – 25) document, the Welsh Government has proposed a moratorium on new build unabated fossil fuel generation in Wales from 2021, with current unabated gas generation removed from the system by 2035. Therefore, the study scope will focus on existing flexible power plant site operators only and will not consider connection of new projects.
- The study will focus on existing peaking plant units in the region which are already WWU customers and consume gas supplied from WWU's network. Where possible, the study will also include consideration of existing diesel peak generation sites to convert to hydrogen, or natural gas (e.g. at Briton Ferry, Waunarlwydd, Swansea, Dowlais, and Hirwaun).
- The study scope will consider assessment of the ability of flexible gas generation to combust an intermediate system operations condition with up to a 20% hydrogen blend in the existing natural gas system, as well as the expected pathway to 100% hydrogen combustion.
- It is intended that the study will comprehensively cover the equipment installed at all the peaking plant sites in the region. However, this will only be achieved if all the site operators engage and support the study activities. If made possible by their engagement, case studies will be included considering operations at specific site locations.

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 develop a study comparing natural gas vs hydrogen operating characteristics and performance, as well as a quantitative assessment of the relative impact on the gas network, if the local peaking plant was to fuel switch to hydrogen.

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 produce a report to assess the interaction of gas-fired peaking plants connected to WWU network, when the plant is converted to Hydrogen.

Project Partners and External Funding

The project partner is Costain Limited. The total external cost of this project is £50k. This project has external funding from Innovate UK, who will contribute 50% of the external costs (£25k). The remaining 50% contribution will come from NIA funding (£25k).

Potential for New Learning

The study will engage with existing peaking plant operators in South Wales to obtain their perspective on present day operations and view of the future. The study will compare the anticipate performance of peaking plant on hydrogen with existing natural gas performance and perform a quantitative assessment of the potential gas network impact of peaking plant switching from natural gas to hydrogen fuel.

Scale of Project

The scale of the project is directly linked to the SWIC and will cover its entire geography, so is at the appropriate scale to deliver the benefits needed to decarbonise the South Wales network. This project is a suite of projects that will move networks forward in decarbonising heat

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project will undertake a feasibility study of the South Wales network

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

NIA External Cost: £25,000

NIA Internal Cost: £8,333

Total Cost: £33,333

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 review of the effects of hydrogen powered peaking plants across the South Wales region and the recommendations made will provide learning towards the energy systems transition,

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)

Please provide a calculation of the expected benefits the Solution

This is a research proejct

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

All networks in Great Britain are looking to decarbonise heat and the methodology from this project may be applicable to other networks.

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

Roll out costs are currently an unknown, these will be become clearer in future projects.

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 review of WWU's gas network configurations and the recommendations made from this project will provide learning and a methodology that may be applicable to other future conversion projects by other Network Licensees

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 over duplication has 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

This level of detailed analysis has never been carried out on the Wales & West Utilities network. By completing this work we move closer to being able to decarbonise the network by providing hydrogen to homes and businesses. There are many stages to decarbonising the network and this project is the next step in that journey.

The UK gas networks are working on a wide range of projects to understand the feasibility of hydrogen as an energy solution for the UK as part of the net zero targets for 2050.

Relevant Foreground IPR

No background or foreground is needed within the project, the foreground IPR that will be generated will be a report detailing the findings of the study.

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, while also keeping vulnerable customers front and centre of our thinking 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 heat homes in 2050 that this work is no longer valid.

This project has been approved by a senior member of staff

☑ Yes