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

Aug 2021

Project Reference Number

NIA_WWU_2_03

Project Registration

Project Title

SWIC Market-Accelerating Hydrogen Distribution and Storage

Project Reference Number

NIA_WWU_2_03

Project Licensee(s)

Wales & West Utilities

Project Start

August 2021

Project Duration

0 years and 6 months

Nominated Project Contact(s)

Henry James

Project Budget

£46,667.00

Summary

A project to evaluate market-accelerating hydrogen distribution and storage options to connect large scale production with demand as an alternative to gas network development

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 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.

Market-accelerating hydrogen distribution and storage options need to be developed and viability evaluated, (1) to connect large scale production with demand and (2) to co-locate small scale production and local demand.

Method(s)

Alternative forms of hydrogen storage and transport could be considered to support the phased conversion of the gas network to transport hydrogen blends, in advance of transition to a fully decarbonised 100% hydrogen network. These alternatives include storage and transport and distribution of hydrogen as:

- Compressed gaseous hydrogen – stored in high pressure tubes (300-500 barg for transport, up to 1000 barg for static storage)
- Liquefied hydrogen – stored at cryogenic temperatures and near atmospheric pressure in insulated containers
- Liquid Organic Hydrogen Carriers (LOHC) – stored via hydrogenation of organic liquids, stored and transported using standard infrastructure for oil products
- Ammonia – catalytic synthesis of ammonia, stored and transported as liquid using standard infrastructure for ammonia or LPG

Localised small-scale hydrogen generation and storage could accelerate deployment and availability of hydrogen supply, which will in turn support demand increase by new use in transport (Hydrogen Refuelling Stations, HRS) and fuel switching, mainly for heat generation. This could be either

- Small-scale Steam Methane Reforming (SMR), using either (a) natural gas from the grid or (b) biomethane as feedstock. CO2 utilisation would be necessary to consider decarbonisation benefits, including negative emissions from biomethane use.
- Electrolysis, using either (a) electricity from grid or (b) surplus renewable electricity.
- Dedicated renewable electricity supply

Cost reduction is critical, aiming to exploit benefits of economies of scale, installation of low-cost standardised modular skids (e.g. dehydrogenation or ammonia cracking plus purification, electrolysis/purification/compression/storage/dispenser HRS modules), heat integration with other processes, reusability of facilities (e.g. for relocation in the transitional period to other parts of the network), etc.

The technical and economic feasibility of these alternative forms of hydrogen supply will need to be evaluated in consideration of the particular regional circumstances, including the type, volume, profile and regional dispersion of demand.

- Compared to distribution of hydrogen via pipelines, these alternatives could be expected to have a lower CAPEX but a higher OPEX and potentially a higher cost of hydrogen delivered, but it would allow a faster deployment given the relatively lower capital and potentially financing requirement compared to pipeline infrastructure projects, plus the potential availability of commercial processing units and the possibility to use existing storage and transport infrastructure.

Data Quality Statement

Data used in the analysis will mainly consist of end consumer (residential, industrial, commercial and transport) energy demand (electricity, gas) using data and methods established in current best industry practice (such as Future Energy Scenarios), with demand developed from actual historical demand data and peer reviewed modelling methodologies plus input from stakeholders for forecasts. The latter represent the best view for demand and supply over the short-term and future scenarios (including potential energy supply forms and contribution) will reflect uncertainties around this view, projecting beyond the first years all the way out to 2050. Network modelling will be based on best industry practice using established modelling tools. In addition to the main deliverables in the form of technical reports providing the analysis and interpretation of results and recommendations, input and output data and models will be passed to Wales & West Utilities at project completion for custody, to support subsequent phases and for audit (as and if necessary).

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. This is particularly applicable given the expected level of detail of the study (high level / feasibility) and associated accuracy of results (moderate), which will be used to support early strategy planning, for which a degree of uncertainty is acceptable. For the purposes of comparability of results, the feasibility study will validate input data and output results against published reports and sources 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 ENIP document after assessing the total project value, the progression through the TRL levels, the number of project delivery partners and the low level of data assumptions. No additional peer review is required for this project.

Scope

Establishing Project Basis

During the Kick-off Meeting and early in the development of the work, the project design basis will be defined and agreed as either provided by WWU, assumptions advised by Costain or jointly defined and agreed.

Definition of project design basis include:

- Study objectives, stakeholder requirements
- Design and functional requirements
- Operating / design cases / scenarios
- Network scope / Geographical area
- Demand scenarios and demand predictions/assumptions, from NIA project "Assessment of Wales & West Utilities Pipeline Infrastructure to Support the Supply of Hydrogen Within the South Wales Industrial Cluster" to be developed in parallel to this study, as part of the WWU scope in SWIC, plus alignment with other strategic work (e.g. Net Zero South Wales, Regional Future Energy Scenarios, SWIC plans).

Review of Alternative Forms of Hydrogen Storage and Transport

- Review forms of hydrogen supply – transport and storage (alternatives to supply via pipelines) with potential for the South Wales region, including compressed and liquefied hydrogen, LOHC and ammonia.
- Evaluation to review and summarise for comparison purposes, general/typical performance, costs and identify challenges and implications (technical, economic, safety, environmental, planning, etc.) for the alternative supply chain including requirements at the point of production, transport and point of use

Work to include:

- Literature review of recent reviews and feasibility assessment, including gap analysis
- Costain's previous project experience on techno-economic evaluation of forms of hydrogen storage and transport, applied to the South Wales region
- Information from early engagement with Technology Providers (particularly on LOHC)
- Available outcomes from HySCALE NIA study on LOHC and applicability to the South Wales region

Review of Options for Localised Hydrogen Production

- Review forms of hydrogen supply – localised small-scale production (alternatives to supply via pipelines) with potential for the South Wales region, including electrolysis and SMR, plus any other emerging technology.
- Evaluation to review and summarise for comparison purposes, general/typical performance, costs and identify challenges and implications (technical, economic, safety, environmental, planning, etc.) for the alternative supply chain including requirements at the point of production, transport and point of use

Work to include:

- Literature review of recent reviews and feasibility assessment, including gap analysis
- Costain's previous project experience on techno-economic evaluation of forms of hydrogen storage and transport, applied to the South Wales region
- Information from previous or early engagement with Technology Providers, particularly electrolyser packages and SMR units (including purification)

Evaluation of Viability of Alternative Forms of Hydrogen Supply Against Demand

- Identify the range of capacities (hydrogen volumes) that could be viable for supply of alternative forms, including physical, economic and planning constraints.
- Evaluate feasibility of alternative forms of hydrogen supply to provide the volumes of hydrogen required by region and the implications in terms of capacity (size, footprint) and costs (implications of not exploiting economies of scale) – evaluation against regional energy demand scenarios for South Wales (ambition for hydrogen supply).
- Identify magnitude of potential demand that cannot be met by early hydrogen infrastructure (dedicated pipelines or as gas blends)

and in consideration of regional dispersion in South Wales for heat (including domestic, commercial, and industrial) and transport (refuelling stations) use and for off-grid users.

- Determine regional applicability of alternative forms of hydrogen supply and define representative case scenarios for which there appears to be potential. These cases will be considered in more detailed techno-economic evaluation

Techno-economic Evaluation of Alternative Forms of Hydrogen Supply Against Representative Cases

For representative case scenarios defined and agreed (based on viable demand):

- Develop representative concept designs for localised small scale hydrogen production and for conversion-transport-reconversion facilities.
  - Evaluate technical requirements (unit size, footprint, traffic movements, utility requirements).
  - Outline footprint and utilities requirements and identify safety and environmental implications impacting planning applications
- Develop outline cost estimates, calculate specific hydrogen supply costs

Technical Report Review

Deliverables

A Technical Report will be produced, incorporating the design elements described in the previous section.

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 to assess the potential for localised small scale hydrogen generation and the hydrogen transport, distribution and storage supply chain (excluding hydrogen production) for alternative forms of hydrogen transport and storage.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This is a low impact project because it will identify hydrogen infrastructure in South Wales. When looking at decarbonisation options it is important that this is done not only with a technical focus but also with a focus on the consumer and the potential impact of change upon them. However this work will concentrate on the technical aspects of supplying hydrogen, further projects would look to asses the impact of any decision on all customers, including vulnerable customers.

Success Criteria

A successful project will produce a report to evaluate market-accelerating hydrogen distribution and storage options to connect large scale production with demand.

Project Partners and External Funding

The project partner is Costain Limited. The total cost of this project is £70k. This project has external funding from Innovate UK, who will contribute 50% of the external costs (£35k). The remaining 50% contribution will come from NIA funding (£35k).

Potential for New Learning

The project will help Wales & West Utilities to understand the technical and economic feasibility implications of small co-located production, compared to the option of developing hydrogen distribution infrastructure

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 Ecternal Cost: £35k

NIA Internal Costs: £11,667

Total Cost: £46,667

The 10% minimum contribution will be met by the IUK funding.

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:

Hydrogen produced and distributed in alternative forms could be of particular benefit to regions not served by the natural gas network, displacing use of LPG or fuel oil, or users of off-grid natural gas currently served by LPG or small local networks.

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

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 report produced will be relevant to the South Wales region, however the recommendations made 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.

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” at nia-data-sharing-policy.pdf (wwutilities.co.uk)

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

The total project cost is £70k which will be funded equally from NIA and an IUK grant. In December 2020, Ofgem published its final determinations which included a variety of provisions to enable necessary development work on Net Zero projects. This project has the potential to facilitate the energy system transition and is 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 the commercial benefits and technical/operational risks associated with this type of hydrogen project are outside the traditional environment of any gas distribution network or its shareholders.

This project has been approved by a senior member of staff

☑ Yes