

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

Jul 2021

Project Reference Number

NIA_WWU_2_01

Project Registration

Project Title

SWIC Hydrogen Supply Pipeline Infrastructure

Project Reference Number

NIA_WWU_2_01

Project Licensee(s)

Wales & West Utilities

Project Start

July 2021

Project Duration

0 years and 7 months

Nominated Project Contact(s)

Henry James

Project Budget

£100,000.00

Summary

A project to develop a study to perform an early identification and evaluation of supply and demand scenario's for hydrogen in South Wales and the pipeline infrastructure required to meet potential demand.

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

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.

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 March 2021, the South Wales Industrial Cluster Phase 2 deployment project gained support from Innovate UK. It is a 36 month project, ending in March 2024 and will address the following:

- Blue/green H2 production
- Green ammonia production

- H2 distribution
- CO2 transmission via pipelines
- CO2 shipping to storage
- Low carbon aviation fuel

This project will identify the challenges imposed on network physical configuration and operation and identify potential solutions in the context of the South Wales region.

Method(s)

For RIIO-2 projects, apart from projects involving specific novel commercial arrangement(s), this section should also include a Measurement Quality Statement and Data Quality Statement.

The feasibility study is aimed to perform an early identification and evaluation at concept level of network configurations including all gas energy vectors (natural gas, biomethane, hydrogen and gas blends) in the context of supply and demand scenarios. Costain will work closely with the SWIC coordination team to ascertain future demand for hydrogen / hydrogen production locations, and the WWU Asset Integrity and Network Analysis teams to understand how islanded biomethane networks could develop. The outcomes of this evaluation will help determine the future network configuration including repurposing of network sections, new dedicated hydrogen pipelines and retained biomethane networks. The outcomes of the project should also provide an initial view on the operability of gas networks and process facilities (e.g. deblending) in the short, medium and long-term to operate with adequate flexibility.

It is recognised that based on information currently available, forecast of demand and mapping of this on a regional scale may have a large degree of uncertainty, and as such defining network configurations and operating and control philosophies can only be produced at a conceptual level. Scenarios will be based on current knowledge of proposed hydrogen production sites and location of major industrial users and regions of potential demand (domestic). These demand models and the associated configuration and operating philosophies will be validated or updated as more information on the development of demand becomes available in the future.

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.

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, 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 - South Wales
 - Sensitivity analysis for Bristol area and “hydrogen riviera”
 - Pressure tiers (>7 bar, 2-7 bar, <2 bar)
- Network operating data
 - Historic demand profile (gas flows), operating pressure, operating philosophy
 - Future demand profile

Definition of case study scenarios

1. Review and summarise the current understanding on how the transition to increasing hydrogen in the gas networks will take place. This includes review of UK and SWIC deployment roadmaps, with demand aligned with expected availability of hydrogen in the network. This will require determining at high level
 1. which geographical areas show an early potential for roll out,
 2. how hydrogen will be produced and supplied to the region,
 3. how the network will evolve to provide the required transportation and distribution capacity to meet projected demand across all demand sectors
 4. provide the intelligence to ensure that network modifications can be sized to meet the upper end of demand projections, therefore ensuring “no-regrets” investment decisions
2. Identification of likely ambitions for hydrogen rollout in the SWIC in terms of regional plans to develop demand including fuel switching (domestic, industrial) and new demand regions (e.g. transport hubs, new industrial sites, new housing developments); and plans for hydrogen production at scale in the region (SWIC) or imported (e.g. via blends in the National Transmission System (NTS) or ammonia ships) to support demand forecast
3. Review of existing work and tools (e.g. Pathfinder 2050, Net Zero South Wales future scenarios) and approaches (e.g. already developed in SWIC and other industrial clusters) to define method to be used for demand forecast
4. Define regional demand scenarios including criteria for proportion of gas energy vectors (LNG/NTS gas, hydrogen, gas blends and biomethane networks) over time. These scenarios will include a distribution of gas flows per region, evolution of these gas flows over time including introduction of hydrogen to replace energy content of natural gas. Current variability of demand (daily and seasonal) to be initially used to define shape of future demand profiles.

Evaluation of network configuration and operation

1. Map out of proposed hydrogen production or import / export locations in the South Wales region
2. Map out of existing gas networks to analyse current network configuration and operation (e.g. supply from offtakes, prevalent gas flow direction and operating pressure) and capacity constraints
3. Work with the WWU asset team to model the network capacity against the developed demand scenarios (using the WWU Synergi models) to ascertain the capacity of the existing network to transport hydrogen / hydrogen blends
4. Evaluation of network configuration and operation against the demand scenarios
5. Identification of likely network configuration in line with demand scenarios (e.g. offtakes interaction, need to sectionalise / isolate network for biomethane, repurpose of network sections, hydrogen injection points, new transmission and distribution pipelines, storage, deblending).
6. Map out of potential evolution to include hydrogen and gas blends on repurposed or new dedicated pipelines to provide the required network capacity to meet the developed demand scenario
7. Identification of integrated network / pressure management strategies (line-packing, storage, reactive deblending to protect hydrogen sensitive consumers) to handle the variable demand/supply for the range of products based on
 1. Network sections transporting a defined gas energy vector
 2. Network sections handling gas blends with different composition, with hydrogen content varying over time (hourly/daily) as a result of variability of flows from different sources/networks feeding into a distribution zone to meet demand, surplus products from deblending, etc.

Gas network modelling of potential network configurations

Costain will work with the WWU network modelling team to develop capacity models for each of the three demand scenarios, utilising WWU’s existing modelling tools.

Identification of impacts on the gas network

Potential impacts of hydrogen rollout in the gas network will be identified including technical considerations and challenges, safety and environmental impacts and cost implications

1. Major risks and mitigation measures will be identified and documented. This will also include opportunities for process optimisation and cost reductions.
2. 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 is widely seen as the least cost option to decarbonise space heating and industry. Although it is impossible at this point to fully assess the benefits to GB energy consumers, converting the gas networks to enable the transportation of hydrogen to support Net Zero has the potential to save £million's opposed to other decarbonisation options.

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 perform an early identification and evaluation of supply and demand scenario's for hydrogen in South Wales and the pipeline infrastructure required to meet potential demand.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This is a low impact project because it will identify supply and demand scenario's for hydrogen in South Wales and the pipeline infrastructure required to meet potential demand. 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 technical Report including:

- Basis of design
- Demand scenarios
- Network configuration diagrams
- Network capacity management strategies
- Network modelling output
- Risk and opportunity register
- High level network configuration plans for each developed scenario (including identification of optimum storage locations and modelled hydrogen production / import / export locations)
- Documentation for next phases of scheme development
- Timeline for any future phases of development e.g. FEED / Detailed Design / Investment Decision Points

Project Partners and External Funding

The project partner is Costain Limited. The total cost of this project is £150k. This project has external funding from Innovate UK, who will contribute 50% of the external costs (£75k). The remaining 50% contribution will come from NIA funding (£75k).

Potential for New Learning

This feasibility study, will provide a view of gas network configurations against the range of possible scenarios, identifying the implications of future energy scenarios on gas network configuration and operation to provide the required capacity and flexibility whilst ensuring security of supply.

Scale of Project

The scale of the project is directly linked to the industrial consumers that have potential to decarbonise through fuel switching to hydrogen within the South Wales Industrial Cluster (SWIC), and therefore the scale of the project has been designed to cover its entire SWIC geography.

The project is aligned to reflect the scope defined in the UKRI's Industrial Strategy Challenge Fund (ISCF) decarbonisation of industrial clusters phase two.

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: £75,000

WWU Internal Cost: £25,000

Total NIA: £100,000

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:

Blending hydrogen into the existing natural gas pipeline network has already been proposed as a means of decarbonising energy. However, previous studies and current physical demonstration projects have been focused on evaluating and providing the evidence for the suitability to handle increased levels of hydrogen of (1) the current gas network infrastructure (particularly in terms of materials and safety); and (2) the user's appliances (for thermal performance and safety).

Early work has been developed based on the assumption of entire network conversion to a given basis, e.g. gas blends with (up to) 20% hydrogen, and generic scenarios in with components in the hydrogen supply chain (production, transport and distribution, including blending) been treated in isolation without consideration of real network configuration and the dynamic operation to respond to varying demand.

This study will identify the challenges imposed on network physical configuration and operation and identify potential solutions in the context of the South Wales region

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 RIIO-2 Project

Please provide a calculation of the expected benefits the Solution

This is a research project

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 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 study can be considered as a first-of-a-kind, as no other work to date has approached the complex integration of gas energy vectors, for given demand forecast scenarios, departing from current network configuration and operating dynamics gradually adapting with demand developing over the years.

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 can be found [here](#) 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 total project cost is £150k 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 will deliver both societal and environmental benefits that extend beyond 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