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

Nov 2024

Project Reference Number

NIA_WWU_02_65

Project Registration

Project Title

Lined Rock Caverns for Flexible Hydrogen Storage

Project Reference Number

NIA_WWU_02_65

Project Licensee(s)

Wales & West Utilities

Project Start

October 2024

Project Duration

0 years and 9 months

Nominated Project Contact(s)

James Pugh

Project Budget

£166,667.00

Summary

This project will identify locations within WWU's network for hydrogen storage in lined rock caverns that are feasible to support the early hydrogen sector and enable hydrogen producers to provide electricity network services.

Highlight services that lined rock caverns can cost effectively provide to the hydrogen sector, and compare these costs to alternative available storage options, identifying the timelines that these services are likely to be required.

Highlight the network planning implications for the need to connect hydrogen producers and demand to lined rock caverns.

Preceding Projects

NIA_WWU_2_10 - Potential for Salt cavern storage of hydrogen in and near South Wales

Third Party Collaborators

ERM

Nominated Contact Email Address(es)

innovation@wwutilities.co.uk

Problem Being Solved

Salt caverns are currently the default technology for large-scale hydrogen storage considered in literature and by government, however, their capabilities are restricted by the limited locations in which they can be deployed. In addition, availability of capacity may be limited, as salt cavern operators will likely prioritise demand from local users.

Lined rock caverns, on the other hand, can be flexibly located as they are not tied to a geographically restricted rock type as with salt caverns, and can be hosted in a range of different rock types.

Method(s)

This project will identify locations within WWU's network for hydrogen storage in lined rock caverns that are feasible to support the early hydrogen sector and enable hydrogen producers to provide electricity network services (i.e. operating at times of high renewables, supporting dispatchable power generation). Although the case studies will be based in the WWU networks, learnings can be taken for all networks.

The project will highlight services that lined rock caverns can cost effectively provide to the hydrogen sector, and compare these costs to alternative available storage options, identifying the timelines that these services are likely to be required. It will also highlight the network planning implications for the need to connect hydrogen producers and demand to lined rock caverns.

The project will be comprised of 5 work packages producing a final summary report. The final report will also highlight hydrogen producer/users who may benefit from LRC storage, the timelines for this storage need and locations of LRC that can provide this storage, along with promising locations within the WWU network and the implications of lined rock caverns for network planning.

Scope

WP1: Hydrogen sector, gas network and electricity network context

Gather information on the hydrogen sector, gas network and electricity networks within the WWU license area and identify regions of interest to focus the search for suitable lined rock cavern locations.
WP2: Identification and characterisation of locations suitable for lined rock caverns

Review lithology and borehole data within regions of interest in the WWU license area, to identify locations for lined rock caverns. The suitability of the locations will be ranked based on their geological characteristics and proximity to potential hydrogen supply, demand and energy infrastructure. Technical specifications will then be developed for the most suitable archetypal lined rock cavern, based on existing LRC specifications and different host lithologies.
WP3: Costs of Lined Rock Cavern development

Conduct a pre-feasibility study to develop estimates for the capital cost of developing, and the costs to operate, the chosen lined rock cavern archetype.
WP4: Use cases for lined rock caverns to support electricity and hydrogen networks cost effectively

Develop example storage use profiles for hydrogen users and demands that may arise in the WWU license area. The costs of using LRC to meet these storage needs will be modelled, to determine which services LRC can provide at a viable cost and how this compares to alternative storage options.

WP5: Implications for network planning and identification of demonstration locations

Consider the implications that the availability of LRC and the potential users will have on hydrogen routes that WWU would like to consider developing.

Objective(s)

To investigate the suitability of lined rock caverns to support hydrogen storage and provide a comparison to alternative storage options.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has been assessed as having a neutral impact on customers in vulnerable situations.

Success Criteria

Success will provide fundamental evidence informing networks on the feasibility of lined rock caverns, to enable the storage of hydrogen and support the energy system transition.

Project Partners and External Funding

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

Potential for New Learning

The business case for this storage type and costs associated with its use to support UK hydrogen and electricity sector needs, compared to alternative technologies, have not yet been studied. This piece of work will provide learning required to identify if there is a case for developing lined rock caverns as a complement to alternative storage options in the UK.

Scale of Project

This is a desktop study, which is the appropriate level of scale for this project. The project will inform future work, the scope of which is unknown until this project is complete.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

As this is a desktop study the work will take place at ERM's offices

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External Cost: £125,000

Internal Cost: £41,667

Total: £166,667

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 will facilitate strategic planning of the gas network to make flexible, large-scale geological hydrogen storage in Lined Rock Caverns (LRC) available in WWU's license area. Other large-scale storage options for the WWU area are uncertain in their potential availability and the timelines for availability, and so LRC could enable large scale H2 storage ahead of alternative options.

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

The outputs will be relevant to al networks where storage for H2 is an issue.

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

This is unknown at this stage

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 outputs outlining the costs of lined rock caverns, including which types of rock are most appropriate, providing hydrogen and electricity sector services compared to alternative options, will be useful for all Gas Network Licenses to consider the role that lined caverns could play in their own license areas. In addition, all electricity network licensees will benefit from an understanding of the electricity network services that electrolysers with lined rock caverns could provide to their network.

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

The technology for storing natural gas in a lined rock cavern is well-proven and has been used for about 20 years for storing natural gas. Advancements are now being made to store hydrogen in lined rock caverns, with feasibility studies being carried out to verify the viability of using this technology. However, the business case for this technology and costs associated with its use to support UK and WWU hydrogen and electricity sector needs, compared to alternative technologies, have not yet been studied.

Relevant Foreground IPR

The report published as part of the project will generate 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 methodology undertaken in this project is deemed a beneficial part of the network conversion to 100% hydrogen. This is not yet BAU activity for the GDNs.

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 for transport in 2050 that this work is no longer valid.

This project has been approved by a senior member of staff

☑ Yes