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

Dec 2021

Project Reference Number

NIA2_SGN0013

Project Registration

Project Title

Long Term, Large Scale Hydrogen Storage Database

Project Reference Number

NIA2_SGN0013

Project Licensee(s)

SGN

Project Start

November 2021

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Colin Thomson

Project Budget

£168,000.00

Summary

The UK government has committed to reducing greenhouse gas emissions to Net Zero by 2050. All future energy modelling identifies a role for hydrogen in providing decarbonised energy for heat, transport, industry and power generation. A key element of transition to hydrogen is to ensure security of supply for customers through hydrogen storage. Our future decarbonised networks will require large scale, long term seasonal storage of hydrogen to ensure a resilient and efficient network. Storage provides the ability to maximise the use of installed renewable capacity for production and subsequent storage of green hydrogen, providing maximum economic recovery of energy. This project will provide a GIS database illustrating optimal sites for development of geological hydrogen storage.

Nominated Contact Email Address(es)

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Problem Being Solved

The UK government has committed to reducing greenhouse gas emissions to Net Zero by 2050, with Scotland committing to 2045. The hydrogen economy is forecasted to play a critical role in the UK's future Net Zero energy system providing decarbonisation to several end uses including domestic heating, transportation, industry and agriculture. A sustainable solution to delivering Net Zero energy is through utilisation of green hydrogen production from an increasing supply of renewable power capacity, supported by blue hydrogen production through the reformation of natural gas. A fundamental requirement for transition to hydrogen is to ensure network resilience and security of supply for our customers.

Current UK energy security is ensured through the delivery of LNG imports over winter months to supply an increase in demand. Available subsurface gas storage in the UK only provides the UK with security of supply for 6 days based on average gas consumption and is used to respond to short term price signals rather than an interseasonal store of gas for customers. For transition to low carbon, 100% hydrogen, It is imperative that we identify large scale, long term hydrogen storage sites to provide assurance to regulators and consumers that a hydrogen network is compatible with our obligations for energy security

Method(s)

The project will follow a 5-phase approach as follows:

Phase 1 - Phase 1 of the project will gather geological data on storage potential in salt formations located in the UKCS. GIS layers will be developed to illustrate salt thickness, depth, temperature, pressure and heterogeneity to establish confidence in regions for development of hydrogen storage solutions.

Phase 2 - Phase 2 of the project will gather geological data on storage potential in porous rock formation located in the UKCS. GIS layers will be developed to illustrate rock thickness, depth, temperature, pressure, heterogeneity and net to gross ratio to establish confidence in regions for development of hydrogen storage solutions.

Phase 3 - Phase 3 of the project will assess surface infrastructure to identify developments that may support production of green hydrogen through renewable technologies and use of electrical energy for electrolysis.

Phase 4 - Phase 4 will develop a RAG assessment to evaluate data confidence and quality from previous project phases.

Phase 5 - Phase 5 of the project will deliver all project findings and develop a GIS hydrogen storage database tool. The phase will also inform stakeholders of the resource to allow potential locations to feature in transition plans to 100% hydrogen.

Scope

The project proposal is outlined below:

Work Package 1-Hydrogen Storage Potential in Salts

- Gather geological data (e.g. borehole records, seismic surveys, scientific literature)
- Develop geological GIS layers of salt thickness, depth, temperature, pressure, heterogeneity
- Incorporate geomechanically layers of major fault lines and stress fields
- Calculate layers of estimated hydrogen storage potential (in terms of energy density and energy capacity).

Work Package 2-Hydrogen Storage Potential in Porous Rocks

- Gather geological data (e.g. borehole records, seismic surveys, scientific literature)
- Develop geological GIS layers of porous rock thickness, depth, temperature, pressure, heterogeneity, net-to-gross ratio
- Geomechanical layers of major fault lines and overpressure
- Chemical layers for formation salinity and geochemical reactivity potential
- Calculate layers of estimated hydrogen storage potential (in terms of energy density and energy capacity).

Work Package 3-Surface Infrastructure Assessment

- Obtain rights to use renewable sources data and gas network infrastructure GIS compatible files.
- Obtain rights to GUS compatible files of main land use areas (e.g. urban vs rural, roads, etc.)
- Build a layer identifying land ownership/exploitation rights

Work Package 4-Risk Identification, Data Confidence and Quality Assessment

- Develop a GIS layer for caprock sealing potential and well abandonment and its impact on seal quality.
- Using expert elicitation, add a traffic light ranking to evaluate data confidence and quality

Work Package 5-Project Delivery

- Development of the GIS hydrogen storage database
- A final report presenting all project findings
- A campaign to inform stakeholder of the resource
- Peer-reviewed publications to illustrate the science behind the dataset developed
- A summary for policy makers document to highlight the key recommendations and findings

Objective(s)

Project objectives include the development of a GIS hydrogen storage database tool that can play a key role in highlighting potential areas for hydrogen storage, feeding into decarbonisation plans of the network to 100% hydrogen. Project outputs will be invaluable to

SGN and other gas network operators to understand the location and capacity of storage sites in relation to transition plans to 100% hydrogen. The project will offer a database of storage options that will ensure confidence in the scale up of hydrogen systems whilst ensuring we keep our current 1:20 and 1:50 energy security obligations. This feeds into the wider national hydrogen conversion programme and illustrates to policy makers, the viability and resilience of a 100% hydrogen energy system with available storage sites.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Not applicable

Success Criteria

Success criteria for the project will be as follows:

- Development of the GIS hydrogen storage database
- A final report presenting all project findings
- A campaign to inform stakeholder of the resource
- Peer-reviewed publications to illustrate the science behind the dataset developed
- A summary for policy makers

Project Partners and External Funding

Project partners for the study will be Edinburgh University.

Potential for New Learning

With plans for the system transformation of the network to 100% hydrogen from existing natural gas dependency, initial studies have illustrated the importance of hydrogen storage sites to ensure we continue to fulfil our obligations as gas network operators for security of supply in a hydrogen end state. It is apparent from recent academic publications that hydrogen storage in subsurface salt caverns and depleted gas reservoirs offer significant capacity, how analysis has been high level and specific to fields being assessed. The production of a hydrogen storage database offers a centralised GIS data source for potential hydrogen storage locations and allows GDN's to assess which locations hold the most value to factor into decarbonisation plans. Project outputs will reduce current uncertainties in storage capacity and location with this understanding helping to support new potential markets for hydrogen e.g. export.

Scale of Project

The project will be a combination of desktop study and stakeholder engagement to develop the hydrogen storage database.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The geographical area for the project will be the UKCS.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

£168,000

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 gather geological data on potential locations for the development of subsurface storage in the UKCS. This data can be compiled into a centralised GIS data source. Identifying suitable hydrogen storage will be essential to developing a world leading hydrogen economy in the UK. Project outputs will be invaluable to SGN and other gas network operators, with the ability to highlight potential storage sites that can support each individual network end state plans to 100% hydrogen and a Net Zero economy. Development of an online storage database aligns with UK Government ambition for growth of a hydrogen economy, providing viable geological storage options to ensure security for the seasonal fluctuations in heat load experienced on the network and open future potential hydrogen markets.

How the Project has potential to benefit consumer in vulnerable situations:

Not applicable

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)

Not applicable

Please provide a calculation of the expected benefits the Solution

Conversion of the gas network to hydrogen has shown to be considerably less costly than conversion to alternative energy sources. The development of hydrogen storage ensures that we capture the maximum economic recovery of energy. In the context of offshore wind, this means we require fewer turbines generating all of the time with availability of hydrogen storage in comparison to considerably more turbines generating intermittently and curtailed in periods of low demand for an electrification pathway. The identification of potential subsurface locations for hydrogen storage in addition to surface infrastructure developments that would support production of green hydrogen is a critical area of work to produce a centralised data source that can be used by gas networks and wider industry to develop storage locations that are the most optimal with decarbonisation plans and potential future markets.

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

The production of a hydrogen storage database is critical to the industry as a whole, pulling together resources into a centralised data source. This GIS tool provides understanding to the location and capacity of potential hydrogen storage locations. As the database will provide data for all areas of the UKCS, the tool can be utilised by other gas network operators with the ability to incorporate potential hydrogen storage locations into decarbonisation plans for 100% hydrogen, ensuring security of supply. Recent academic publications by Edinburgh University have illustrated that the UK has potential for hydrogen storage that is between 3 to 7 times the capacity of UK annual consumption through development of subsurface depleted gas fields (Mouli-Castillo et al., 2021). Identifying the location of sites and detailed understanding of capacity into a single data source will be invaluable.

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

This is a research study and it is not possible to provide indicative implementation costs before this work has concluded.

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 hydrogen storage database project will provide an understanding of the location and capacity offered through subsurface locations in the UKCS. As the database will collect information from all of the UKCS, outputs can be used by other gas network operators to support end state hydrogen plans through security of supply and new hydrogen markets such as export.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

Not applicable

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.

The project scope has been reviewed against all existing projects and no areas of duplication have been identified.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

not applicable

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

Hydrogen is being considered as a viable alternative to natural gas however there are still technical aspects to be investigated. A critical component of the transition to 100% hydrogen is to evidence viable storage solutions to ensure security of supply. Subsurface storage in porous media can offer large scale and long-term storage of hydrogen to ensure that we fulfil obligations for energy security. There is still uncertainty around which subsurface sites provide the most optimal solution for hydrogen storage. The UK hydrogen storage database will identify viable locations and potential capacity and through a RAG assessment, illustrate the confidence and quality of data for a potential hydrogen storage location.

Relevant Foreground IPR

Not applicable

Data Access Details

The project will aim to develop a GIS database illustrating viable locations for geological storage of hydrogen in porous rock and salt whilst also identifying potential future renewable power developments and existing infrastructure tie ins. Some sensitive data may be required to be de-sensitised with distribution of the GIS database when completed. Sensitive data will most likely be in the form of existing gas pipeline routes.

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

The project aims to develop a GIS database to identify potential locations for the subsurface storage of hydrogen. This work forms a key part of SGN's pathway to decarbonisation to Net Zero ensuring security of supply for our customers with transition from natural gas to 100% hydrogen. As such, the project is not part of the usual activities of the business.

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 NIA framework offers a robust, open framework to support this work and ensures the results are disseminated to all licenses. There are risks associated with development of a hydrogen storage database if hydrogen is not accepted as a mean to heat homes in 2050. The technical, operational and regulatory risks around hydrogen are elements currently being explore across the networks providing mitigation to this potential risk.

This project has been approved by a senior member of staff

☑ Yes