

NIA Project Registration and PEA Document

Date of Submission

Jan 2022

Project Reference Number

NIA2_SGN0014

Project Registration

Project Title

Technical assessment and feasibility study into water requirements for hydrogen production

Project Reference Number

NIA2_SGN0014

Project Licensee(s)

SGN

Project Start

January 2022

Project Duration

0 years and 8 months

Nominated Project Contact(s)

Colin Thomson

Project Budget

£124,410.00

Summary

Low carbon hydrogen can be produced by a variety of processes, that require substantial quantities of water. Several major hydrogen projects are proposed in Scotland; as an energy storage medium, allowing new renewable power capacity to operate, and as a direct alternative to displace natural gas as a primary fuel source. The additional water consumption associated with these hydrogen projects presents an infrastructure challenge.

The aims of the study are to evaluate the water requirements of new hydrogen production facilities, and the associated implications for water infrastructure, and to develop a strategic framework for assessing these aspects of hydrogen projects throughout the UK. The initial focus of the study is on Scotland; however, the methodology developed in the project will be used throughout the UK

Nominated Contact Email Address(es)

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Problem Being Solved

The UK Government has committed to substantial reductions in greenhouse gas emissions. The Climate Change Act commits the country to reaching net zero by 2050. This commitment encompasses England and the devolved administrations. Decarbonising heat is a key strand of the policy which is required to meet these targets.

It is a well-accepted fact that the low carbon hydrogen will be critical for achieving the UK's 2050 net zero ambitions. The UK hydrogen strategy published in August 2021 has estimated that up to 250-470 TWh of hydrogen could be needed by 2050 contributing up to 35% of final energy consumption. Current hydrogen production in the UK is approximately 27 TWh, therefore hydrogen production capacity in the UK is predicted to increase tenfold over the next three decades.

Low carbon hydrogen can be produced by a variety of processes, all of which require substantial quantities of water. Several major hydrogen projects are proposed in Scotland; both as an energy storage medium, allowing new renewable power capacity (particularly wind) to operate, and as a direct alternative to displace natural gas as a primary fuel source. The additional water consumption associated with these hydrogen projects presents an infrastructure challenge e.g., the Scottish Environment Protection Agency (SEPA) recently highlighted Scotland's vulnerability to dry weather and climate-induced changes in the availability and functioning of water resources.

Method(s)

The project will follow a 6 Work Packages as follows:

1. **Hydrogen production** - A desktop research to identify the potential locations for new hydrogen production infrastructure will be carried out.
2. **Technology Review** - For each of the hydrogen project locations identified in Work Pack 1, undertake an estimate of water consumption for x10 shortlisted locations.
3. **Sources of Water** - An assessment and identification of potential sources of water at each shortlisted hydrogen project location will be undertaken.
4. **Resiliency Assessment** - Assessment of the resilience of the alternative water sources at different locations.
5. **Opportunities Assessment** - Carry out an assessment of area segments based on hydrological regions and identify innovative and resilient solutions to supply water for hydrogen production.
6. **Peer Review** - A comprehensive peer review of the outcomes and methodology/tool developed through Work Packs 1-5.

Scope

The project proposal is outlined below:

1 - Hydrogen production

- Key locations in the SGN network.
- Offshore wind farms.
- Onshore renewables infrastructure (where known).
- Energy projects in planning.
- Potential hydrogen project locations.

2 - Technology Review

- Type of hydrogen production (blue or green).
- Production capacity.
- Annual production.
- Water volume needed.

3 - Sources of Water

- Types of water sources available.
- Volume available from each source.
- Hydrogen production water consumption as a fraction of the total volume, for each source.
- Distance (most direct route, i.e., "as the crow flies") of each source to the related hydrogen production locations.
- A conceptual water balance for each watershed impacted by a hydrogen project location.
- Determine representative water quality for each source.
- Prepare flow diagrams of water (pre)treatment required to use each type of water source.

4 - Resiliency Assessment

- Update GIS maps with:
 - Water Volume Provided
 - Capital Cost
 - O&M Cost
- A technical memorandum on residuals generation in both blue and green hydrogen production, potential environmental impact, and recycle/reuse potential.

- A summary table of the impact on each applicable water source for each shortlisted hydrogen project location.
- Develop and provide an MS Excel-based tool to assess the suitability of different water sources for hydrogen production at different locations.

5 – Opportunities Assessment

- Water demand and source analysis for each segment.
- Overall Raw and Weight Score.
- Subcategory Scoring for:
 - Permitting Considerations.
 - Design Considerations.
 - Implement Considerations.
 - Operations Considerations.
 - Community Considerations.
 - Sustainability Considerations.
- Summary report aggregating the results and observations from the individual segments.
- Summary report on innovative solutions, circular economy and strategic view on water supply.

6 - Peer Review

A comprehensive peer review of the outcomes and methodology/tool developed through Work Packs 1-5.

Objective(s)

The aims of the study are to evaluate the water requirements of new hydrogen production facilities, and the associated implications for water infrastructure, and to develop a strategic framework for assessing these aspects of hydrogen projects throughout the UK. The project outputs include:

- An evaluation of the water requirements and associated implications for water systems due to increasing hydrogen production across Scotland.
- Identifying innovative solutions and opportunities for circular economy approaches to develop resilient and sustainable water supply systems to meet increasing hydrogen demand.
- A framework/methodology to conduct similar analysis in other areas of the UK.
- A long-term strategic view for water requirements associated with hydrogen production.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Not applicable

Success Criteria

Success criteria for the project will be as follows:

- An evaluation of the water requirements and associated implications for water systems due to increasing hydrogen production across Scotland.
- Identified innovative solutions and opportunities for circular economy approaches to develop resilient and sustainable water supply systems to meet increasing hydrogen demand.
- A framework/methodology to conduct similar analysis in other areas of the UK.
- A long-term strategic view for water requirements associated with hydrogen production.

Project Partners and External Funding

Project partners for the study will be Ramboll UK Ltd.

Potential for New Learning

Low carbon hydrogen can be produced by a variety of processes, all of which require substantial quantities of water. Several major hydrogen projects are proposed in Scotland; both as an energy storage medium, allowing new renewable power capacity (particularly wind) to operate, and as a direct alternative to displace natural gas as a primary fuel source. The additional water consumption associated with these hydrogen projects presents an infrastructure challenge e.g., the Scottish Environment Protection Agency (SEPA) recently highlighted Scotland's vulnerability to dry weather and climate-induced changes in the availability and functioning of water resources.

The project, in partnership with Ramboll, will look to deliver a technical assessment and feasibility study into water requirements for hydrogen production in Scotland. The aims of the study are to evaluate the water requirements of new hydrogen production facilities, and the associated implications for water infrastructure, and to develop a strategic framework for assessing these aspects of hydrogen projects throughout the UK. The initial focus of the study is on Scotland; however, the methodology developed in the project will be used throughout the UK.

Scale of Project

The project will be a combination of desktop study and stakeholder engagement.

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 Scotland.

Revenue Allowed for the RIIO Settlement

Not applicable

Indicative Total NIA Project Expenditure

£165,888

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 look to deliver a technical assessment and feasibility study into water requirements for hydrogen production in Scotland. The aims of the study are to evaluate the water requirements of new hydrogen production facilities, and the associated implications for water infrastructure, and to develop a strategic framework for assessing these aspects of hydrogen projects throughout the UK. The initial focus of the study is on Scotland; however, the methodology developed in the project will be used throughout the UK.

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

Not applicable

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

The initial focus of the study is on Scotland; however, the methodology developed in the project can be used throughout the UK.

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

RIO-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 project will allow an evaluation of the water requirements and associated implications for water systems due to increasing hydrogen production across Scotland, identifying innovative solutions and opportunities for circular economy approaches to develop resilient and sustainable water supply systems to meet increasing hydrogen demand. A framework/methodology to conduct similar analysis in other areas of the UK will be provided, along with a long-term strategic view for water requirements associated with hydrogen production.

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

Low carbon hydrogen can be produced by a variety of processes, all of which require substantial quantities of water. Several major hydrogen projects are proposed in Scotland; both as an energy storage medium, allowing new renewable power capacity (particularly wind) to operate, and as a direct alternative to displace natural gas as a primary fuel source. The additional water consumption associated with these hydrogen projects presents an infrastructure challenge e.g., the Scottish Environment Protection Agency (SEPA) recently highlighted Scotland's vulnerability to dry weather and climate-induced changes in the availability and functioning of water resources.

Relevant Foreground IPR

Not applicable

Data Access Details

The project will aim to develop a GIS based data illustrating the outputs from several the Work Packages detailed. Some sensitive data may be required to be de-sensitised with distribution of the GIS outputs when completed. Sensitive data will most likely be in the form of existing gas or water infrastructure.

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

The project will look to deliver a technical assessment and feasibility study into water requirements for hydrogen production in Scotland. The aims of the study are to evaluate the water requirements of new hydrogen production facilities, and the associated implications for water infrastructure, and to develop a strategic framework for assessing these aspects of hydrogen projects throughout the UK. The initial focus of the study is on Scotland; however, the methodology developed in the project will be used throughout the UK. 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 the outputs from this project if hydrogen is not accepted as a means 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