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

Apr 2022

Project Reference Number

NIA_WPD_067

Project Registration

Project Title

Hydrogen Economy: Reassessing Approaches to Connecting Large Electrolyser Sites (HERACLES)

Project Reference Number

NIA_WPD_067

Project Licensee(s)

National Grid Electricity Distribution

Project Start

April 2022

Project Duration

1 year and 4 months

Nominated Project Contact(s)

Nick Devine

Project Budget

£108,702.00

Summary

The UK's Hydrogen Strategy sets a target for 5 GW of green hydrogen production capacity in the UK by 2030. It is anticipated that around half of this hydrogen will be produced via electrolysis, which means adding significant demand to electricity networks. Currently, there are knowledge gaps on the likely operating behaviour and demand characteristics of electrolysers, and how they will interact with electricity networks. The HERACLES project will take the first steps to solving this problem by developing an understanding of where electrolytic hydrogen plants can best be deployed in WPD's licence areas, and identify the type and level of data required to ensure the optimum operation of electrolysers on the network.

Problem Being Solved

The UK's Hydrogen Strategy sets a target for 5 GW of hydrogen production capacity in the UK by 2030. It is anticipated that the majority of hydrogen will be produced via electrolysis, which means adding a sizeable amount of demand to electricity networks. Innovation projects investigating hydrogen electrolyser connections have focused on the use case for hydrogen plants as enablers of storage solutions for renewable generation, or developments informed entirely by uptake of fuel cell electric vehicles. This is distinct from the growth of the hydrogen production economy in its own right, and there is a need to ensure electricity networks would not be a blocker to increased hydrogen production uptake. Furthermore, it is not well known what the likely operating behaviour and demand characteristics of electrolysers will be, and how they will interact with electricity networks.

Movement to grow capacity in the wake of the Hydrogen Strategy is already being seen in the UK. For example, the HyDEX project seeks to make the Midlands a world leading hub for the hydrogen economy. WPD must be in a position to meet the challenges of this growth and ensure that the electricity network is not an obstacle for the successful deployment of this technology.

Method(s)

The HERACLES project will pioneer the development of solutions to this problem by developing an understanding of how DNOs might strategically address connecting electrolytic hydrogen plants to their networks and ensure their optimum operation. The project will consist of the following work packages:

WP1: Discovery and criteria development
This work package will capture existing knowledge gaps on hydrogen electrolysers and the wider hydrogen economy, existing connection assessment processes and the tools currently used to optimise connections (e.g. capacity maps) and the requisite answers for developing a hydrogen strategy for electricity distribution. It will assess the current UK landscape for the development of the hydrogen economy to understand in detail the problem as described above and develop the criteria for identifying optimum location for hydrogen electrolyser connections.

WP2: Network investigation
This work package will carry out a network investigation to test implementation of the criteria developed in WP1 on a section of WPD's network and identify optimum deployment locations in this area based on the expected operating behaviour identified in the discovery phase. The selected network area will be around two BSPs in WPD's licence areas. If possible, selection of this network area will leverage knowledge of UK hydrogen economy growth gleaned through discovery activities in WP1. Otherwise, an area in WPD's South West region will be the default study location.

WP3: Hydrogen electrolyser connection considerations document
This work package will collate the find of the previous work packages to outline at high-level the considerations for assessing the impact of hydrogen electrolyser connections to the distribution network and discuss the factors most important for optimising connection locations. It will contextualise this discussion with recommendations and next steps for DNOs to develop an electricity distribution hydrogen strategy.

Scope

Hydrogen will likely play a prominent role in the decarbonisation of UK plc, due to the UK's extensive gas infrastructure. It will contribute to the decarbonisation of transport, through hydrogen fuel cells or hydrogen combustion, and heating, through hydrogen boilers or hybrid heat pumps. Taking a Whole System approach to decarbonisation means that electricity networks should ensure that they are not the barrier to the growth of green hydrogen.

The UK Hydrogen Strategy released in September 2021 has committed the UK government to a target of 5 GW of low carbon hydrogen production, around of half of which is expected to be produced via electrolysis. The UK gas industry, local authorities (especially those in rural locations), academia and innovators (including multiple UKRI and SIF funded projects) are working to grow the hydrogen economy in the UK to meet this strategic ambition Hydrogen electrolysers which will produce the hydrogen are electrically powered, and will require sizeable electrical demand connections in order to function effectively. Furthermore, it is anticipated that the burden for connection reinforcement will be shifted further towards networks in the ED2 period. It is important therefore to optimise the capacity available on electricity networks for the uptake of electrolysers and reduce reinforcement costs funded by network customers.

The growth of hydrogen production also presents new opportunities to provide benefits for customers. For example, new PEM (variously Proton Exchange Membrane or Polymer Electrolyte Membrane) electrolysers can be dynamically controlled with fast response times and high energy efficiency. There is significant potential for these electrolysers to offer new types of flexibility and interoperability and to embed these in connection agreements. Even conservatively estimating that if 1% of the new hydrogen capacity could be made available as flexibility, and 1% of that capacity aligned with constrain management zones could unlock over 600 MWh of flexibility capacity across WPD's licence areas.

WPD's procurement of flexibility in RIIO-1 has so far deferred more than £40m of reinforcement for more than 590 MWh of flexibility. Based on this ratio, the estimated value of the flexibility unlocked would be £42m.

Additional reinforcement deferment benefits may also be seen in the use of hydrogen for transport. Hydrogen may prove to be a more cost-effective low carbon transport option for rural and heavy industry applications than electric vehicles, and the growth in hydrogen transport would obviate the need to provide network infrastructure for EV charging in those areas.

Objective(s)

- Understand the current and future development of the hydrogen economy in the UK.
- Understand the technical and operational characteristics of hydrogen electrolysers.

- Develop an understanding of how electrolyser connections to distribution networks may be optimised.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A

Success Criteria

- The current and future landscape of development of the hydrogen economy, both commercially and technologically, will be captured.
- The operating profile of hydrogen electrolysers will be captured at a high level.
- A set of criteria will be developed and trialled for optimising large hydrogen electrolyser connections to the network.

Project Partners and External Funding

GHD are project partners.

Potential for New Learning

Parties are expected to learn from this project the potential growth and impact of hydrogen electrolysers on distribution networks. Furthermore, it will develop understanding of how best to strategically optimise those connections.

Learning from this project will be published within the WP3 considerations report. This report will contain a summary of the outcomes of all project work packages and a discussion of the approaches considered within the project. The learning will also be presented at WPD Innovation Showcase events. This knowledge and information will allow other LNOs to inform their own approach to electrolyser connections.

Scale of Project

This will be a desktop only exercise comprising producing report documentation and carrying out network analysis studies. No technical demonstrations will be carried out in this project.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

WP2 will include a desktop case study on a section of network within WPD's licence areas. As a default, this will be in the South West licence area, but the choice will be informed by WP1 and may be any of the four. The learning developed in the project will be applicable across all licence areas.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

Total Project Cost: £128,702
Agreed Partner Contributions: £20,000

Project Budget: £108,702
WPD DNO Contribution: £10,870

Funding from NIA: £97,832

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:

N/A

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)

It is anticipated that around half of the 5 GW of hydrogen capacity in the UK Hydrogen Strategy would be produced by electrolysers, likely requiring around 3 GW of electrical capacity UK wide, depending on electrolyser efficiency. There is significant potential for these electrolysers to offer new types of flexibility and interoperability and to embed these in connection agreements. Even conservatively estimating that if 1% of the new hydrogen capacity could be made available as flexibility, and 1% of that capacity aligned with constrain management zones could unlock over 600 MWh of flexibility capacity across WPD's licence areas. WPD's procurement of flexibility in RIIO-1 has so far deferred more than £40m of reinforcement for more than 590 MWh of flexibility. Based on this ratio, the estimated value of the flexibility unlocked would be £42m.

Furthermore, it is anticipated that the burden for connection reinforcement will be shifted further towards networks in the ED2 period. Optimising the capacity available on electricity networks for the uptake of electrolysers will reduce reinforcement costs funded by network customers. Additional reinforcement deferment benefits may also be seen in the use of hydrogen for transport. Hydrogen may prove to be a more cost-effective low carbon transport option for rural and heavy industry applications than electric vehicles, and allowing for the growth in hydrogen transport would obviate the need to provide network infrastructure for EV charging in those areas.

Please provide a calculation of the expected benefits the Solution

N/A

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

The approaches discussed in the considerations document will be considerate of variations such as geography and network assets and so will be adaptable to varying licence areas. Learning on the operational and commercial requirements for potential electrolyser flexibility or balancing services will be shared in the project outputs to be adapted by any other LNO/LSO.

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

N/A

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 outcomes of this project will generate learning on optimising hydrogen electrolyser connections that can be used by any Network Licensee. The approaches discussed in the considerations document will be considerate of variations such as geography and network assets and so will be adaptable to varying licence areas. Learning on the operational and commercial requirements for potential electrolyser flexibility or balancing services will be shared in the project outputs to be adapted by any other LNO/LSO.

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.

The methodology for HERACLES has been reviewed against other projects registered on the Smarter Networks Portal and circulated with other DNOs and TNOs ahead of registration to ensure no unnecessary duplications will occur.

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

There are three funded projects with similarities to HERACLES:

- NGESO "The Role for Hydrogen as an Electricity System Asset" will study the interaction of hydrogen markets with the energy system in FES, and how targeted investment can support the electricity system. HERACLES will take a more connections-oriented approach focused on electrolyser plants.

- NGET “Role and value of electrolysers in low-carbon GB energy system” will take a whole-system perspective on linking electricity and hydrogen vectors and optimising electrolyser portfolio and locations from a transmission network perspective. HERACLES will cover similar ground, but from DNO viewpoint.

- NGGT “Green Hydrogen Injection into the NTS” will include modelling electricity system constraints affecting hydrogen injection into the NTS, and investigation potential role of green hydrogen in flex markets.

Additional Governance And Document Upload

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

The project aims to develop an innovative approach to enabling hydrogen electrolyser connections, treating the growth of the hydrogen economy as an area of focus in its own right, rather than as a standard connection or as novel battery storage for renewables. Furthermore, it will consider the potential for electrolysers to offer innovative flexibility and/or balancing services to electricity networks.

Relevant Foreground IPR

The Relevant Foreground IPR is: All deliverable reports and documents.
The Relevant Background IPR required to produce this is: WPD network modelling data.

Data Access Details

Additional data will not be collected for the project.

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

We would not normally investigate optimising a particular type of connection as part of normal network design activities. The technical case for the optimisation approach is not proven and risky activity for BAU.

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

This project is investigating an area (namely large hydrogen electrolysers) where there are significant knowledge gaps within electricity networks. The optimisation approaches use an unproven methodology and require external knowledge of hydrogen electrolysers not inherent to WPD, and an innovation study with key specialist skills is the most sensible approach.

This project has been approved by a senior member of staff

☑ Yes