

## NIA Project Registration and PEA Document

### Date of Submission

Jan 2022

### Project Reference Number

NIA2\_NGESO010

## Project Registration

### Project Title

The Role for Hydrogen as an Electricity System Asset

### Project Reference Number

NIA2\_NGESO010

### Project Licensee(s)

National Energy System Operator

### Project Start

January 2022

### Project Duration

1 year and 3 months

### Nominated Project Contact(s)

Mark Perry

### Project Budget

£300,000.00

## Summary

The need to cost effectively decarbonise heat and the challenge this poses for electricity networks has led to a resurgence in innovation around low carbon gases, including hydrogen, and the conversion of our natural gas system into a low carbon gas system.

Alongside the heating sector, there is also an increased interest in the use of Hydrogen for other purposes, such as industry and transportation. The generation and use of hydrogen has clear impacts on the electricity system and whilst it provides many opportunities to the broader energy system such as cross vector storage, it may also pose a number of challenges.

NGESO need to understand how the development of hydrogen markets will interact with the electricity system, and how targeted hydrogen investment can more effectively support the electricity system.

## Third Party Collaborators

Delta-EE

## Nominated Contact Email Address(es)

box.so.innovation@nationalgrid.com

## Problem Being Solved

The need to cost effectively decarbonise heat and the challenge this poses for electricity networks has led to a resurgence in

innovation around low carbon gases, including hydrogen, and the conversion of our natural gas system into a low carbon gas system.

Alongside the heating sector, there is also an increased interest in the use of Hydrogen for other purposes, such as industry and transportation. The generation and use of hydrogen has clear impacts on the electricity system and whilst it provides many opportunities to the broader energy system such as cross vector storage, it may also pose a number of challenges.

NGESO need to understand how the development of hydrogen markets will interact with the electricity system, and how targeted hydrogen investment can more effectively support the electricity system.

More specifically:

- What may the future low carbon hydrogen landscape look like under a range of scenarios?
- What are the possible interactions between the hydrogen vector and the electricity system operations and markets?
- What role could hydrogen take in supporting and optimising the electricity system and more broadly the energy system?
- What are the opportunities for National Grid ESO to best engage with the hydrogen sector across both the system and transmission parts of the business, and what models are appropriate?
- How can National Grid ESO best include the impacts of hydrogen in their forecasting and scenario planning including FES development and the supporting economic modelling?

## Method(s)

### Stage 1: Strategic review of hydrogen pathways and scenarios

(Work package 1 – 4)

Stage 1 will provide an overview of how the hydrogen sector is likely to evolve under a range of scenarios and provide the next level of detail for the FES analysis describing possible hydrogen transitions and system impacts. The stage will include:

- Research into long-term future hydrogen pathways and scenarios drawing on current projects and FES scenarios assumptions, and emerging thinking and ideas around hydrogen use, and extensive stakeholder engagement (NGESO and external).
- Considerations will include all elements of the hydrogen value chain (supply / generation, distribution, and end users), the role of storage, changing customer demands, and locational factors.
- A comprehensive list of hydrogen value chains will be produced and mapped to the electricity and gas system to identify the range of potential interactions, both physical and market based.
- Flexibility – in depth understanding of the interaction of hydrogen on whole system operation and how it can provide flex
- Reviewing and challenging FES scenarios based on the value chain analysis.
- A range of impacts will be identified and through working with National Grid a shortlist will be agreed for further in-depth analysis.

### Stage 2: Analysis of short-listed impacts

(Work package 5,6)

During the second stage of work, several topics will be explored in more detail, based around the shortlisting of impacts in Stage 1. This analysis will provide evidence to inform the FES scenario development for 2022, and inform the assumptions and datasets used within the BID3 modelling to further develop the Hydrogen modelling capability.

The nature and type of analysis conducted during stage 2 will vary depending on the topics explored but we anticipate a range of quantitative and qualitative research and analysis will be deployed.

### Stage 3: Support of Redispatch Power2X module development and data

(Work package 8)

WP8 will draw on the analysis in WPs 2 – 6, and supplementing this with further analysis provide additional research to support the development of the Redispatch module and the datasets and assumptions which drive it. Given the uncertainty around how this module will operate and the assumptions needed, it is difficult to be specific around tasks at this stage, and a more detailed specification would be developed at commencement of the work package.

In line with the ENA's ENIP document, the risk rating is scored Low.

TRL Steps = 1 (2 TRL steps)

Cost = 1 (£300k)

Suppliers = 1 (1 supplier)

Data Assumptions = 1

Total = 4 (Low)

## Scope

This project will provide National Grid ESO with:

- A more in depth understanding within / supplementing FES on the range of possible outcomes from a hydrogen transition.
- Identification of interactions of hydrogen with the electricity system and assessment of possible impacts, further work required to address these impacts, and gaps in current understanding.
- Evidence to support and refine the assumptions to allow modelling of hydrogen impacts (in particular electrolyser operation) into the existing NGENSO market modelling environment (BID3) to understand their likely performance and contribution in the market.

## Objective(s)

This project will follow a staged approach, based around an initial exploration stage followed by a more in-depth analysis stage. This will provide the opportunity to capture both the breadth of potential hydrogen interactions, and then focus more in-depth analysis on a sub-set of the impacts which are most pertinent to National Grid ESO in developing FES22 and supporting the modelling work going forward.

The final outputs will include:

- A list of Hydrogen value chains representing a broad range of potential future market uses of hydrogen
- Insight and feedback for the Future Energy Scenarios team to inform FES22 development and a short list of value chains mapped to the FES scenarios for subsequent analysis
- Report summarising the analysis, with recommendations on priority areas for stage 2 analysis
- Final summary report outlining the findings from each work package and the associated datasets
- Research report to support the development of the Redispatch module and the datasets and assumptions which drive it for the Network Options Assessment team

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The ESO does not have a direct connection to consumers, and therefore is unable to differentiate the impact on consumers and those in vulnerable situations. Benefits to all consumers are detailed below.

## Success Criteria

The following will be considered when assessing whether the project is successful:

- Findings from the project can be used to increase the accuracy of the FES22 and NOA reports
- The project delivers against objectives, timescale and budgets as defined in the proposal
- ESO's in-house capability is improved for modelling and representing the impact of hydrogen on the future electricity system
- A greater understanding of how hydrogen can be most effectively deployed, taking into account the needs of National Grid ESO, alongside the competing use cases and demands on hydrogen across the electricity and heating sectors
- Implementable recommendations
- Knowledge and tools developed in this project can be replicated across network partners

## Project Partners and External Funding

Delta-EE will be carrying out the work, no external funding required.

## Potential for New Learning

Hydrogen as an energy vector has the potential to be highly disruptive to the existing electricity and gas systems. Whilst a large amount of innovation work has been conducted technically on the gas networks to understand future H2 distribution pathways, there is very little understanding of how H2 will impact on the existing energy markets, and how it will impact on the electricity system. The latter

is particularly pertinent since green hydrogen will be a major cross-vector player using renewable electricity to generate storable gas.

This project will help National Grid ESO understand the answers to some fundamental questions:

- What does the future low carbon H2 landscape may look like under a range of scenarios?
- What are the possible interactions between the H2 vector and the electricity system operations and markets and how can these be best modelled?
- What role could H2 take in supporting and optimising the electricity system and more broadly the energy system.
- What are the opportunities for National Grid ESO to best engage with the H2 sector across both the system and transmission parts of the business, and what models are appropriate?

### Scale of Project

The project spans 18 month. The project consists of desk-based research and workshops with the relevant NGESO and wider network teams.

### Technology Readiness at Start

TRL3 Proof of Concept

### Technology Readiness at End

TRL5 Pilot Scale

### Geographical Area

We will be based upon the GB ESO area of operations.

### Revenue Allowed for the RIIO Settlement

None

### Indicative Total NIA Project Expenditure

£300,000

## 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:

There is currently a resurgence in innovation around low carbon gases, particularly hydrogen, driven by the need for low carbon heating. Hydrogen can be a highly disruptive energy vector. Still, there are significant uncertainties over what the transition looks like, how and where hydrogen will be generated, and the various use cases. Sustainable generation and storage of green hydrogen using electrolysis is a central long-term solution for hydrogen, requiring significant electricity input. This project seeks to identify the possible interactions of hydrogen with the electricity system and provide a more in-depth understanding of the range of possible outcomes and impacts from a hydrogen transition.

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

Not required.

### 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 required.

#### Please provide a calculation of the expected benefits the Solution

Not required as research project.

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

The initial outputs from the project will feed into National Grid ESO's Future Energy Scenarios 22 report, which provides a range of different, credible ways to decarbonise our energy system as we strive towards to the 2050 target. The increased accuracy of modelling hydrogen and forecasting potential interactions will help other network partners with future investment decisions.

Furthermore:

- Dissemination events will be held upon completion of the project to share the outcomes and gain feedback from wider GB stakeholders
- Based on the feedback and the outcomes of the reports we hope to then develop further projects with network partners to address potential gaps
- The project will also help to improve the modelling for the Network Options Assessment which is our recommendation for which reinforcement projects should receive investment during the coming year

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

As this is a research project, the final outputs of the project will aim to give an outline of the potential changes and costs to mitigate these risks.

### 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 need to cost effectively decarbonise heat and the challenge this poses for electricity networks has led to a resurgence in innovation around low carbon gases, including hydrogen, and the conversion of our natural gas system into a low carbon gas system.

Alongside the heating sector, there is also an increased interest in the use of Hydrogen for other purposes, such as industry and transportation. The generation and use of Hydrogen has clear impacts on the electricity system and whilst it provides many opportunities to the entire energy system such as cross vector storage it may also pose a number of challenges. This project will give insights and recommendations to National Grid ESO and wider stakeholders to help understand how the development of hydrogen markets will interact with the electricity system, and how targeted hydrogen investment can more effectively support the electricity system and wider energy system.

### 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 required.

### 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 proposed project will be the first to provide an in-depth analysis of how future hydrogen markets could interact with the electricity system.

### 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

Although National Grid ESO has started to include hydrogen electrolysis in its modelling and forecasting scenarios, it lacks accuracy and there is a lack of high-quality input data for Hydrogen. The full extent of the impact that hydrogen will have on the future energy system is still relatively unknown, therefore this research project aims to address the current gaps in understanding and provide NGENSO with a more in-depth breakdown of possible outcomes from a hydrogen transition, whilst also identifying future interactions of hydrogen with the electricity system.

### Relevant Foreground IPR

The following Foreground IPR will be generated from the project:

- Analysis of Hydrogen value chains and pathways
- Stage 1 Interactions analysis
- Stage 2 Impact analysis

### 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:

1. A request for information via the Smarter Networks Portal at <https://smarter.energynetworks.org>, to contact select a project and click 'Contact Lead Network'. National Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
2. Via our Innovation website at <https://www.nationalgrideso.com/future-energy/innovation>
3. Via our managed mailbox [box.SO.innovation@nationalgrid.com](mailto:box.SO.innovation@nationalgrid.com)  
Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" at <https://www.nationalgrideso.com/document/168191/download>

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

Due to the nature of the project and that it is researching potential future impacts to the grid based largely on assumptions, this does not fall into current 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

The learnings from the project can be shared more widely to the Network Licensees which could not be achieved if deemed as BAU activities.

### This project has been approved by a senior member of staff

Yes