NIA Project Close Down Report Document

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.
Network Licensees must publish the required Project Progress information on the Smarter Networks Portal by 31st July 2014 and each year thereafter. The Network Licensee(s) must publish Project Progress information for each NIA Project that has developed new learning in the preceding relevant year.

Date of Submission

Jul 2024

Project Reference Number

NIA2_NGESO036

Project Progress

Project Title

Hydrogen Production for Thermal Electricity Constraints Management

Project Reference Number

NIA2_NGESO036

Project Start Date

March 2023

Project Duration

1 year and 6 months

Nominated Project Contact(s)

Louis Priday

Scope

This project will develop models and tools to build a detailed understanding of the potential for hydrogen electrolysis to reduce thermal constraints on the electricity transmission network. The results of work packages on location, commercial models, and the economic and regulatory feasibility will feed into a proof-of-concept design for an electrolysis facility.

The project will also investigate the feasibility (both technical and commercial) of the hydrogen produced to alleviate thermal constraints subsequently being injected into the gas grid.

Objectives

This project aims to:

- Identify where HPFs need to be located to provide balancing mechanism services to National Grid ESO and to achieve “optimal” commercial and system operability benefits.
- Investigate the high-level feasibility of operating hydrogen plants as a method of balancing thermal grid constraints and other system services.
- Define the regulatory requirements to deliver the right investment signals to hydrogen plants whilst minimising constraint management costs for the ESO.
- Develop modular HPF design concepts to assist in determining the high-level characteristics and constraints of archetype plant designs.
- Explore the feasibility of hydrogen produced from the HPFs being blended into the gas grid.

Success Criteria

The project will be successful if the following questions are answered:

- Can green hydrogen production facilities meet the operational and technical requirements to provide thermal constraint management services for transmission system operation?
- How should commercial terms be structured for green hydrogen production facilities to provide constraint management services?

- How can the right market signals (investment) be provided to green hydrogen developers given locational, operational and downstream H2 gas usage considerations?
- Are there any regulatory challenges around commercial terms?

Performance Compared to the Original Project Aims, Objectives and Success Criteria

National Grid Electricity System Operator ("NGESO") has endeavoured to prepare the published report ("Report") in respect of Hydrogen Production for Thermal Electricity Constraints Management, NIA2_NGESO036 ("Project") in a manner which is, as far as possible, objective, using information collected and compiled by NG and its Project partners ("Publishers"). Any intellectual property rights developed in the course of the Project and used in the Report shall be owned by the Publishers (as agreed between NG and the Project partners).

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All work packages have been concluded, with interim reports reviewed and finalised. The outputs from each work package have been synthesised into an overall report, which has also been reviewed and finalised. Below are the detailed contributions from each work package:

WP1: Site Location and Selection
Activity: Development of an interactive map tool.
Process:
Workshops: Conducted workshops with geospatial analysts and industry stakeholders to determine key criteria for site selection.
Data Collection: Gathered geographic, environmental, and infrastructure data to identify potential locations.
Tool Development: Created an interactive map tool that visualises optimal sites for a hydrogen production facility based on thermal constraints.

WP2: Commercial Model
Activity: Creation of a commercial model for hydrogen production.
Process:
Pathway Development: Developed three commercial pathways (electricity balancing, hydrogen to grid, hydrogen to refuelling station).
Modelling: Utilised economic modelling techniques to calculate the levelised cost of hydrogen (LCOH) for each pathway.
Workshops: Held collaborative sessions with industry experts to validate assumptions and refine the commercial model.

WP3: Economic and Regulatory Model
Activity: Economic and regulatory modelling.
Process:
Data Analysis: Modelled historical and predicted constraint data to understand economic impacts.
Constraints Model Development: Developed a constraints model to simulate different regulatory scenarios.
Regulatory Analysis: Conducted a detailed analysis of the existing regulatory framework and identified potential contract options for hydrogen facilities.

WP4: Modular Plant Design
Activity: Design of modular hydrogen plants.
Process:
Technology Evaluation: Created a technology evaluation note comparing small, medium, and large plant designs.
Design Basis Development: Established a design basis for potential hydrogen plant archetypes, including technical specifications and cost estimates.
Stakeholder Engagement: Collaborated with technology providers and engineering firms to validate design choices.

WP5: Hydrogen Injection into the Grid
Activity: Technical and regulatory considerations for hydrogen blending.
Process:

Technical Analysis: Assessed the technical requirements for blending hydrogen into the gas grid.
Regulatory Review: Evaluated the regulatory and commercial frameworks for hydrogen injection.
Cost Analysis: Conducted a cost-benefit analysis of blending hydrogen into the grid.
Scenario Testing: Tested different blending scenarios to understand the impact on grid operations and economics.

WP6: Synthesis and Recommendations
Activity: Compilation and synthesis of work package outputs.
Process:
Integration: Combined the outputs from all work packages into a comprehensive report.
Stakeholder Engagement: Held meetings with hydrogen project developers and other stakeholders to gather feedback and ensure the report's recommendations were aligned with industry needs.
Final Report: Delivered a full report with recommendations for next steps, including potential pilot projects and policy suggestions.

Project Activities and Governance
Since the project kick-off, several key activities were undertaken to ensure successful completion:

- Project Kick-off Meeting: Organised an initial meeting to align project goals and establish roles and responsibilities.
- Steering Group Creation: Established a steering group with representation from all project partners (ESO, Arup, NGT) to provide oversight and guidance.
- Regular Reporting: Implemented a fortnightly reporting mechanism to monitor progress and address any issues promptly.
- Knowledge Sharing: Engaged with Statera on the Kintore Hydrogen project to explore opportunities for knowledge sharing and collaboration.

Overall, the project has been completed successfully, with all work packages delivering valuable insights and practical recommendations for the development of hydrogen facilities utilising thermal constraints. The final report integrates these findings and provides a roadmap for future actions.

As part of the project the team have been able to recommend several next steps to further investigate the viability. These would include a full socio-economic benefit analysis of each of the contract mechanisms as well as lobbying for a positive decision of hydrogen blending into the gas grid to provide a viable offtaker for projects such as these. Additional information can be found in the Executive Summary of the final report on the Smarter Networks Portal. The final report is now on the Smarter Networks Portal.

Required Modifications to the Planned Approach During the Course of the Project

During the initial phases of the project, it became clear due to the interdependencies of each of the work packages that had been earmarked for completion, that this project would and could not be completed in a linear programme as first anticipated. As such it was decided in line with the NGESO project leadership team that the project would mobilise all WPs from the outset of the project, with each WP contributing towards the development of others.

Furthermore, as the project progressed it became clear that biggest learning and output was going to come from one work package (WP3) that originally only a smaller proportion of the scope It was agreed that due to the changing landscape of the project based on the findings that the project would be delivered less in work packages, but deliverables based, with deliverables spanning across each WP.

The project was altered to focus more on how hydrogen facilities using constraints could be commercially incentivised and encouraged rather than design of a single specific facility. This led to a focus on the commercial and regulatory modeling and specifically the development of commercial contract options.

Lessons Learnt for Future Projects

With highly innovative research projects such as this, deliverables and objectives are going to change as further findings as uncovered that alter the direction of the project, one key lesson from the Arup Project Management team was to ensure that there was relevant and available flexibility within the scope, or the mechanism from which to process change control.

Note: The following sections are only required for those projects which have been completed since 1st April 2013, or since the previous Project Progress information was reported.

The Outcomes of the Project

This innovation project has determined that it is technically viable to operate a hydrogen production facility in a manner that allows it to support management of thermal constraints on the electricity network. However, the project found that under current market arrangements there is not a sufficiently strong commercial incentive for hydrogen production facilities to play an active role in thermal constraints management without additional support.
This project has found that there is a viable commercial case for hydrogen production facilities to help manage thermal constraints providing:

- There is an alternative electricity supply to draw upon when constraints are not available, to firstly increase utilisation and thus revenue generated from the electrolysers and secondly ensure electrolysers are 'warm' enough to ramp up rapidly when required. This may mean hydrogen production facilities drawing energy from the grid during non-constrained times;
- There is access to a flexible offtaker. The most likely available flexible offtake option is blending into the gas network either as a sole or secondary offtaker; and
- A support mechanism is in place that will incentivise hydrogen production facilities to connect in the right locations and maintain operational profiles that will contribute to the management of thermal constraints in the electricity network. The design of this mechanism is critical to the commercial case and our proposed solution to a support mechanism is summarised below.

The project has outlined a number of proposed recommendations to explore the potential for hydrogen production supported by contract mechanisms.

Data Access

Details on how network or consumption data arising in the course of NIA funded projects can be requested by interested parties, and the terms on which such data will be made available by National Grid can be found in our publicly available "Data sharing policy related to NIC/NIA projects" and www.nationalgrideso.com/innovation.

National Grid Electricity System Operator already publishes much of the data arising from our NIC/NIA projects at www.smarternetworks.org. You may wish to check this website before making an application under this policy, in case the data which you are seeking has already been published

Foreground IPR

The following IPR has been generated through the project and can be found in the final report on the Smarter Networks Portal. This sets out:

- The findings and recommendations of the project this covers all of the areas developed in each work package.
- A UK wide GIS mapping tool that maps several variables for HPFs siting on energy constrained areas with cumulative ranking assessed to 1 km hexagon grid cells. A set of interim reports for each work package
- Modular HPF design outlined for up to three HPF archetypes.
- A hydrogen production facility technology note setting out the different available technologies available for green hydrogen production.
- A detailed commercial analysis setting out the variety of contractual options available for the ESO.
- A model of constraints on the network up to 2030 and the impact on transmission boundaries.
- Detailed information on the required next steps
- A detailed report for National Gas Transmission detailing the potential offtakers, with particular focus on the potential for blending any hydrogen into any future 100%/blended hydrogen grid.

Planned Implementation

As part of the project the team have been able to recommend several next steps to further investigate the viability. These would include a full socio-economic benefit analysis of each of the contract mechanisms as well as lobbying for a positive decision of hydrogen blending into the gas grid to provide a viable offtaker for projects such as these. Additional information can be found in the Executive Summary of the final report on the Smarter Networks Portal.

Other Comments

The Project outcomes and results contain confidential information and intellectual property rights that cannot be disclosed in this Report due to their proprietary nature. Should the viewer of this Report ("Viewer") require further details this may be provided on a case by case basis following consultation of all Publishers. In the event such further information is provided each and any Publisher that owns such confidential information or intellectual property rights shall be entitled to request the Viewer enter into terms that govern the sharing of such confidential information and/ or intellectual property rights including where appropriate formal licence terms or confidentiality provisions. Dependent upon the nature of such request the Publishers may be entitled to request a fee from the Viewer in respect of such confidential information or intellectual property rights.

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