SIF Project Registration

Date of Submission

Mar 2022

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10027293

Project Registration

Project Title

Multimodal Hydrogen Transport Refuelling Study

Project Reference Number

10027293

Project Licensee(s)

Northern Gas Networks

Project Start

March 2022

Project Duration

2 Months

Nominated Project Contact(s)

DGill@northerngas.co.uk

Project Budget

£89,447.00

Project Summary

The Multimodal Hydrogen Transport Refuelling Network Study will evaluate the potential for hydrogen's use in transport across the North of England. It will create a joined-up, regional strategy to cost-effectively kick-start the hydrogen economy in the North and directly support the growth of zero-emission transport options. The project will begin by selecting hydrogen vehicle types with promising use cases: high utilisations, challenging duty cycles, heavy loads etc. We will then map centres of concentration for these vehicles such as bus and truck depots, ports, airports and rail stations. Having engaged with both large, local fleet operators and fuel cell electric vehicle OEMs, we will model localised vehicle up- take scenarios. By combining information on fuel cell vehicle efficiencies and standard vehicle mileages, we will convert the vehicle deployments into regionalised hydrogen demands. We will analyse vehicle routes on road, rail and otherwise to identify hydrogen demand hot-spots. We will overlay this data with information on the location of existing fuel stations, and gas and electricity grids to identify a number of sites that would be prime, future-proofed locations for hydrogen refuelling stations. We will investigate the hydrogen production and supply options to supply the stations and will model the expected hydrogen production from each of these through time. This will take into account any available information on near- and medium-term Northern hydrogen production projects e.g. large-scale electrolysers and reformers with carbon-capture facilities as well as likely sites for new hydrogen production projects like large wind farms and biomethane plants. This will also include an analysis of how hydrogen can be delivered to the stations with a focus on evaluating the potential of the gas grid to deliver hydrogen to high- capacity hydrogen stations compared to incumbent technologies. The initial findings of these analyses will be worked up into a document that will be shared with key stakeholders, such as local governments, vehicle operators and technology providers for review and feedback, letters of support from some key stakeholders are in the appendix. This report will be submitted at the end of the Discovery process with conclusions on more detailed work to be done in the Alpha and Beta phases which will culminate in the deployment of several fleets in strategic use cases and locations to evidence the strategy and pave the way for a wider vehicle roll-out in the north.

Preceding Projects

NIA_NGN_420 (1) - Visualising the opportunity for pipeline hydrogen for mobility applications

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Problem Being Solved

The UK has made a commitment to become Net Zero carbon by 2050 which will require almost all sectors to entirely decarbonise. The government is making its aspirations towards the heavy-duty sector increasingly clear with announcements to end the sale of diesel lorries, buses and trains by 2040. Transport, as a sector, accounts for more GHG emissions in the North than another other sector, and nearly 20% of those surface transport emissions are generated by the heaviest HGVs. However, the heavy-duty transport sector has so far proven one of the most difficult sectors to decarbonise. The UK government had promised a 'world leading' and comprehensive strategy for decarbonisation of transport and has often referenced hydrogen as a key component of that. However, both the Hydrogen and Transport Decarbonisation documents released in the Summer of 2021 lacked clear and integrated strategy for how this can be done. This has left almost all participants in the heavy transport sector without a clear, overarching strategy to achieve complete fleet decarbonisation within 20 years. To date, the cost of hydrogen vehicles and refuelling infrastructure has been prohibitively expensive to achieve large scale deployment. However, hydrogen transport scales up extremely cost-effectively and reliably with larger stations retailing lower cost hydrogen and having higher reliability due to multiple component redundancy. Hydrogen refuelling infrastructure reflects diesel in its ability to quickly refuel a wide range of vehicle types from the same station which allows all modes of hydrogen transport to benefit from the scale derived by multimodal deployments. Achieving the benefits from this requires an overarching regional vehicle and infrastructure deployment strategy which is currently lacking. This project will create an integrated, multimodal hydrogen vehicle and infrastructure deployment strategy for the north of England. It will take advantage of the inherently multimodal characteristics of hydrogen refuelling for vehicle technologies as well as the potential which hydrogen presents for the integration and decarbonisation of the electricity, gas and transport sectors. This strategy will provide confidence to heavy-duty vehicle operators and local government about the potential for hydrogen to contribute to their fleet decarbonisation and the steps required to begin a transition to zero-carbon technologies. The project will evidence the drafted strategy created in the Discovery and Alpha phases with the first commercial fleet deployments in the Beta phase.

Project Approaches And Desired Outcomes

The Big Idea

This project will create a strategy and demonstrate a pathway to decarbonising the hard-to-treat transport modes while simultaneously supporting the decarbonization and integration of gas and electricity networks. The response to the Government's consultation on the phase out date for non-zero emission HGVs indicates that freight operators and trade bodies require further certainty on the technological pathway for achieving these ambitions, as soon as possible. This project will provide vehicle operators, policy makers and the hydrogen infrastructure supply chain certainty on how a hydrogen transport system would work for them. Viewing the hydrogen transport sector from a system perspective, the project will create a regional, integrated, multimodal strategy for hydrogen for heavy duty transport for the north of England. This will pave the way for large scale transport decarbonisation, local air quality improvements, job creation and investment in northern transport infrastructure in line with government's Levelling Up agenda. The transport sector is a strong go-first sector for hydrogen with smaller, discrete projects competing with diesel which has a higher cost per unit energy in transport than natural gas used in heat and industry. The demand scale-up and technology cost reductions achieved by deploying hydrogen in transport support the onward progression of hydrogen for use in heat and industrial decarbonisation by providing opportunities to transport hydrogen in the gas grid. In addition, the use of hydrogen for transport, particularly for public transport modes such as bus and train, will familiarise the public with the use of hydrogen as an alternative fuel source, addressing existing safety risk perceptions and increasing societal readiness for the use of hydrogen more widely.Hydrogen production facilitates the integration of the electricity, gas and transport sectors. Electrolytic hydrogen can be made during times of low renewable electricity price, supporting the business case for new renewables build-out by allowing electricity retailers to sell energy into both the transport and gas sectors. The UKRI funded ATHENA project on which this proposal builds, is already underway and due for completion in January 2022. Focused on strategic corridors in the North of England, project outputs include the hydrogen energy demand from HGVs and the optimal number and location of refueling points along the corridor. The model will be openly available to those wishing to explore different scenarios. Ownership of other background IP will be defined in a collaboration agreement prior to the discovery phase

Innovation Justification

The consortium members have worked on many hydrogen for transport, heating and industry projects, evidenced in the appendix. Through these projects, the team have gained a strong knowledge of the sector and an understanding of the current limitations in government departments' ability to take a systems view of the hydrogen sector. For example, BEIS has created a £100M Clean Hydrogen Production Fund while DfT is reluctant to stimulate, high-value hydrogen demand by creating dedicated, heavy-duty hydrogen vehicle deployment schemes. In addition, while the DfT's thinking has begun to see hydrogen mobility in a multimodal way as in the Tees Valley Hydrogen Transport Hub, it has so far only applied this in a top-down political approach rather than identifying where hydrogen for transport is required and where it can add the most value. This project will consider the entire North of England's energy and transport sectors in a holistic and integrated fashion. It will incorporate up-to-date evidence on the performance of hydrogen technology and the status of the North of England's energy and transport infrastructure to build vehicle total cost of ownership models and geospatial mapping to create an evidence-based strategy and investment case for initiating a hydrogen economy for the North of England. The project will go beyond the remit of any individual government department and consider the infrastructure systems impact of the entire hydrogen value chain from production and distribution into the array of transport end-use cases. The consortium is well placed to deliver this piece of work with partners having deep experience of the transport, energy and hydrogen sectors in the North of England:

- Element Energy has over 20 years of experience with hydrogen and fuel cell technologies and has initiated and coordinated many of Europe's largest strategic hydrogen transport deployment projects.
- Northern Gas Networks have an unrivalled understanding of the energy infrastructure of the North of England.
- Network H2 has already pioneered and will build upon a northern-focused, agent-based ATHENA model for the movement of HGVs, developed through previous UKRI funding in collaboration with TfN and NGN
- TfN holds in-house transport models for the North's highways and rail system, as well as a local freight tool, and will provide the travel and trips data for the project. TfN's governance framework means that the stakeholder engagement structures with local authority partners and delivery authorities are already in place to support the stakeholder driven elements of the project.

Project Plans And Milestones

Project Plan And Milestones

We propose 4 work strands which are integrated and continue across the Discovery, Alpha and Beta phases. The key activities and deliverables from the Discover phase are below.

Strand 1 -- Fuel Cell Vehicle Deployments:

- Explore options and down select fuel cell vehicles for deployment, including vehicle total cost of ownership comparisons, fuel cell vehicle availability, specifications and performance.
- Map large existing centres for potential hydrogen transport demands in the north, e.g. bus depots, truck depots, ports, airports & rail stations etc.
- Model potential vehicle uptake and total hydrogen demand creation through time.

Outputs:

- Interactive map and model to locate and quantify expected hydrogen transport demands and the changing location of demand over time.

Strand 2 - Develop a Refuelling Station Strategy:

- Create a geospatial map overlaying several infrastructure networks including the North's Strategic and Major Road Networks, rail routes, Gas and Electricity Transmission and Distribution Networks to identify strategic, future-proofed locations for hydrogen refuelling stations.
- Engage with hydrogen station providers to clarify the technologies, approaches and costs available for hydrogen refuelling.

Outputs:

- Identification of ~20 strategic locations for future-proofed, large-scale, public hydrogen stations.

Strand 3 - Optimise Hydrogen Supply Solution:

- Engage with hydrogen production and supply companies to understand optimal hydrogen production and supply technologies, production project plans and indications of appetite to supply to stations and use-cases selected.
- This will include a feasibility study of the potential, timeframe and volume of hydrogen demand required to supply hydrogen through the gas grid to large stations and model how this may change over time.
- Integrate the proposed hydrogen supply infrastructure into a GIS model which shows temporal snapshots and carbon intensity and state of development of the hydrogen supply and distribution to ensure that it meets Government and TfN decarbonisation commitments.

Outputs:

- GIS-based platform showing how hydrogen supply infrastructure and carbon intensity changes through time

Strand 4 Communication and Barrier Removal:

We will create several key Stakeholder Groups and organise workshops to gain iterative feedback into the plan and articulate its conclusions. These are broadly categorised as:

- Large Vehicle Fleet Operators e.g. train, truck and bus fleets
- Hydrogen Production, Supply And Refuelling Businesses (e.g. gas companies, refuelling station operators)
- Government e.g. Councils and combined authorities, DfT, OZEV
- Key Third Parties e.g. Regulators, financiers, other network operators, industry associations

Route To Market

The project will create a strategy that uses an integrated systems approach to both decarbonise heavy-duty vehicles and catalyse the repurposing of the gas grid for a zero-emission world. This analysis and approach to vehicle deployment and system integration can quickly and easily be applied to other regions in the UK and globally. The project partners will actively share these learnings with other gas network operators, transport operators and government to support their efforts to reduce emissions, integrate infrastructure systems and catalyse deployment projects.

Low-Cost Hydrogen Supply

In particular, the project will deploy several heavy-duty vehicle fleets, develop several large, multi-modal hydrogen stations and evidence the benefits of these being supplied via the gas pipelines (e.g. for a 10 train or 100 truck deployment). High-capacity stations supplied by large-scale hydrogen production plants and delivered by the gas grid will significantly reduce the price of hydrogen for mobility applications helping hydrogen vehicles to become cost competitive.

Hydrogen Vehicle Capital Cost Reductions

Capital costs for hydrogen vehicles will reduce as vehicle deployment volumes increase. The UK Government has already begun to introduce the first zero- emission, heavy-duty vehicle deployment policies (e.g. ZEBRA) and government signals suggest a complete suite of these to be in place for all heavy-duty vehicle types by the mid-2020s. These schemes will lower the capital cost barriers to deploy larger fleets of hydrogen vehicles across a wider range of heavy-duty vehicle types. Numerous industry analyses show that hydrogen can become cost competitive with diesel in heavy-duty vehicle applications by ~2030, accounting for the sector scaling up and policy pressures increasing on diesel, see the Roland Berger study on fuel cells hydrogen trucks for Hydrogen Europe, 2020. The combination of accessible, low-cost, reliable hydrogen supply and reducing capital cost for hydrogen vehicles reduces the ownership cost hurdles for future hydrogen vehicle deployments and will trigger large-scale vehicle deployments in the mid-and-late 2020s. At large supply volumes, gas grids are the lowest cost way to deliver hydrogen. Hydrogen supply for transport through the gas grid will become business as usual and will pave the way for the gas grid to deliver for heat and industry.

Costs

Total Project Costs

89447

SIF Funding

89445

This project has been approved by a senior member of staff

☑ Yes