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NIA Project Registration and PEA Document

Date of Submission

Sep 2018

Project Reference Number

NIA_CAD0025

Project Registration

Project Title

HyNet Motion; Optimising Network Delivery of Hydrogen for Vehicle Transport

Project Reference Number

NIA_CAD0025

Project Licensee(s)

Cadent

Project Start

September 2018

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Cadent Innovation Team

Project Budget

£411,000.00

Summary

The project can broadly be split into the following three phases:

1. Detailed scoping of the nature and scale of future opportunities to supply hydrogen from the distribution network for road, rail and marine transport projects in the North West.
2. Use of the resulting evidence to identify short-term project development opportunities, which enable wider, subsequent deployment as part of the HyNet project.
3. Development of a roadmap for deployment of hydrogen demonstration opportunities in the North West.

Nominated Contact Email Address(es)

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Problem Being Solved

To achieve the 80% emissions reduction target by 2050 (compared to 1990 emissions) mandated by the Climate Change Act requires deep emissions cuts across all sectors. The UK relies predominantly on three energy vectors; electricity, gas and oil. Progress is being made in reducing the carbon intensity of electricity (and to a lesser extent, heat), but, as stressed by the Committee for Climate Change in its 2018 review of the Government's Clean Growth Strategy, very little progress has been made in reducing the carbon intensity of transport. Petrol and diesel combustion by road vehicles (and trains) represent the dominant sources of emissions in the sector.

The opportunity to secure deep carbon reductions (and incidentally air quality benefits) via converting the gas distribution network in urban areas to transport 100% hydrogen, rather than gas, was examined in the 2016 Leeds City Gate (H21) study by NGN. This study was built upon in subsequent work by Cadent (NIA_NGGD0086), which examined the potential to create a new hydrogen distribution system in the North West. Under this model, energy intensive users would be supplied with 'high' hydrogen, and a lower level blend of hydrogen would be injected with natural gas into the distribution network. This Cadent study was being developed further under (NIA_CAD0001) to create a more detailed design and business case to support future deployment. This latter study was completed in May 2018.

At the same time, air quality concerns, particularly in major cities, are such that Government (local, regional and national) is seeking to identify ways to reduce emissions, specifically of both oxides of nitrogen (NOx) and particulates from combustion of transport fuels. In

London, the Mayor's office has put in place a programme which includes a zero emission zone in central London by 2020 and other regional Governments in Liverpool, Birmingham and Manchester are considering similar initiatives. Each of these cities within the Cadent LDZ area has historically been in breach of EU-mandated air quality thresholds and therefore must find solutions to reduce emissions of NOx and particulates from transport. Alongside electrification of vehicles, a switch to hydrogen represents one of very few options to achieve this.

During the course of the two aforementioned NIA's it has become apparent that there is a critical need to:

- Consider the magnitude and nature of benefits to gas networks and their customers from the supply of hydrogen for transport;
- Explore the technical and commercial barriers to realising these benefits and to provide analysis as to how such barriers might be overcome;
- Develop a long-term strategy (linked to the realisation of the HyNet project), which sets out a pathway to deployment of hydrogen-related transport infrastructure; and
- Identify a set of short-term actions and projects, which gas networks might support to promote hydrogen related transport.

The work proposed here will provide information to fill these data gaps and describe a roadmap to deliver upon the potential of Cadent's and other gas networks' participation in this market.

The project will ultimately encourage use of the network by organisations and individuals seeking to use hydrogen as a vehicle transport fuel. As a consequence, a greater number of customers will seek to connect to the network, therefore reducing costs for all network users. Furthermore, as wider sectors of the economy will start to depend upon the network, this will add to the case for its longevity.

Method(s)

The project can broadly be split into the following three phases:

1. Detailed scoping of the nature and scale of future opportunities to supply hydrogen from the distribution network for road, rail and marine transport projects in the North West.
2. Use of the resulting evidence to identify short-term project development opportunities, which enable wider, subsequent deployment as part of the HyNet project.
3. Development of a roadmap for deployment of hydrogen demonstration opportunities in the North West.

As set out below, the work will require a range of approaches to development of evidence in respect of the tasks defined above.

Phase 1:

- A comprehensive desk-top assessment and 'baselining' of current (and planned/funded) road and rail transport emissions (CO₂, NOx and particulates) in the North West:
 - o This will be achieved by way of engagement with local transport planning authorities and academia (for example, the Manchester Fuel Cell Innovation Centre), along with review of relevant documentation including, for example, national emissions data, and regional transport plans, such as that published by Liverpool City Region Authority;
- Analysis of current policy-making in respect of local regional transport infrastructure:
 - o Again, this will rely upon engagement with local transport planning authorities and 'city region' mayoral offices in Liverpool and Manchester to determine not only current policy, but the direction of travel in respect of future policy-making;
- Determination of private sector ambition and strategies in respect of moving to lower emission vehicle fleets. This will require engagement with, in particular:
 - o Local bus operators, such as Arriva, First and Stagecoach
 - o HGV fleet operators, which have large depots based in the North West;
 - o Local train operators, such as Virgin and NorthWestern Railway;
 - o Local providers of 'rolling stock', such as Alstom (now part of Siemens);
 - o Local port operators, primarily Peel Ports, in relation to the new Liverpool 'SuperPort'.
- Identification and mapping of all key transport hubs across the local road, rail and marine networks:
 - o This work will focus upon major fleet depots for road travel, key maintenance and refuelling stations in the rail sector and major ports;
- Based upon the above information, determination and spatial presentation of what a local network of refuelling stations (likely located to serve fleet and bus depots) might look like:
 - o This will be undertaken under a number of scenarios including assumed build-out of the hydrogen pipeline infrastructure proposed under the HyNet project and a 'business as usual' scenario, whereby HyNet is not progressed.
- High level analysis of the geographies (beyond the North West) in which refuelling stations would be needed to support use of hydrogen in HGVs, along with the location of any existing refuelling stations.
- Modelling of the comparative costs of some hydrogen transport applications versus the alternative of electrification:
 - o This will build on wider work, for example, that undertaken under the EU-funded JIVE programme, which has been set up to enable procurement of hydrogen-fuelled buses by public bodies;
- High-level modelling of the comparative 'well-to-wheel' CO₂ benefits of some hydrogen transport applications versus the alternative of electrification:
 - o Again, this will rely upon existing third party data, publicly available data and focus upon a limited number of variables in respect of energy source and application.
- Undertake a detailed analysis of the GVA ('gross value added') benefits of the above scenarios, linked to an assessment of the benefits that would accrue from the deployment of the wider HyNet project.

Phase 2:

- Identification of suitable, 'network relevant' hydrogen transport related projects, which might be deployed within a two year time period in the North West:
 - o It is anticipated that identification of these will arise via the above processes of engagement with local stakeholders and Cadent's wider engagement as part of the HyNet project, which, for example, has highlighted potential sources of currently 'available' hydrogen,

which might be directed to transport applications;

- Development of commercial model(s) and associated outline business case(s) to support the development of these projects:
 - o This will require engagement with potential consortium members, private sector investors and public sector funding streams (for example, Innovate UK) to determine suitable business models and funding structures;
- Identification of any further technical evidence gaps, which need to be filled to support deployment of these projects:
 - o During the production of business case information, it is likely that further technical barriers will emerge, which constrain investment appetite and funding. Whilst these will not be solved within the scope of the proposed study, they will be documented and related methods proposals towards their resolution.

Phase 3:

- Development of a roadmap for deployment;
 - o This will bring together the Phase 1 and Phase 2 analyses to present a 5-year plan towards realisation of a major switch to hydrogen fuelled transportation in the North West, which can be enabled by hydrogen supplied by Cadent.

Scope

The study will be focussed upon opportunities in the North West of England, and specifically upon the area defined in the aforementioned 'Clusters' report (NIA_NGGD0086). This area has a current natural gas use of 37 GWh/annum, which equates to a significant proportion of total gas use across Cadent's entire distribution network.

The emphasis of the work will be upon road and rail transportation, which accounts for the vast majority of emissions in the area. However, there will also be analysis of opportunities in the marine transport sector in specific relation to the Port of Liverpool. Whilst the North West includes two major airports (in Manchester and Liverpool), air travel is excluded from the analysis on the basis that hydrogen is unlikely to be a suitable aviation fuel.

In respect of road transport, the study will concentrate on buses and commercial (non-passenger) fleets, such as those including HGVs, LGVs and other smaller vehicles which are prevalent in cities, for example, 'transit' type vans used by courier companies. In relation to rail, the focus will be upon lines which have not yet been electrified, as in some areas, such as Liverpool, some lines have only recently been converted to electricity, which has the potential to be low carbon.

The analysis will concentrate on both, hydrogen from the proposed new hydrogen distribution network (which will transport 100% hydrogen) in the NW, and that which will be injected as a blend (with natural gas) into the existing gas distribution network. These present different challenges for use in transport, both technically and commercially.

In terms of analysis of the potential climate change benefits of converting the transport sector to hydrogen, the work will solely consider emissions CO₂ from fossil fuel combustion. Similarly in respect of potential air quality benefits, the focus will be upon NO_x and particulates (PM₁₀) only.

It is intended that this study will complement and draw upon analysis from wider future work being considered by Cadent. This wider suite of projects can be summarised as follows:

- Analysis of contamination of hydrogen, which is injected and delivered by the existing distribution network;
- Assessment of the impact of hydrogen blends (with natural gas) upon the operation of existing CNG vehicles; and
- Determination of the potential to separate hydrogen from network blends to enable both wider distribution of hydrogen for transport (as part of HyNet) and to enable CNG vehicles to continue to use CNG from existing refuelling stations.

Whilst the scope of the work is upon Cadent's distribution network, the majority of the work and methods can be applied across other GDN areas and the work will inform other GDN's planning of strategies in relation to supply of hydrogen for transport applications within their networks.

Objective(s)

The overarching objective of this work is to develop a long-term strategy (linked to the realisation of the HyNet project), which sets out a pathway to deployment of hydrogen-related transport infrastructure in the North West. To support this objective, there are a range of task-oriented sub-objectives, which can be summarised as follows:

- To define the nature and scale of future opportunities to supply hydrogen from the distribution network for road and rail transport projects in the North West;
- To consider the magnitude and nature of benefits to gas networks and their customers from the supply of hydrogen for transport;
- To explore the technical and commercial barriers to realising these benefits and to provide analysis as to how such barriers might be overcome;
- To identify a set of short-term actions and projects, which enable wider, subsequent deployment as part of the HyNet project, and which other gas networks might support.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

The success criteria for the project can be summarised as follows:

- Quantification of the future financial benefits of hydrogen related transport in the North West;
- Quantification of the future CO₂ benefits of hydrogen related transport in the North West;

- Identification of suitable, 'network relevant' hydrogen transport related projects, which might be deployed within a two year time period in the North West:
- Development of commercial model(s) and associated business case(s) to support the development of these projects:
- Identification of any further technical evidence gaps, which need to be filled to support deployment of these projects;
- Delivery of a roadmap for deployment of hydrogen related transport infrastructure supplied by the gas network.

Project Partners and External Funding

This project will be funded via NIA

Potential for New Learning

This project will enable stakeholders from industry, local transport authorities and the local GDN to formulate projects that mutually benefit both parties due to the opportunities it brings to decarbonise transport with use of hydrogen.

Scale of Project

The project will be a desktop study. Phase 1 and 2 are vital in setting the precedent for future scenarios which will be investigated in phase 3. It is imperative we understand the current and future situation of road and rail transport emissions within the NW. The project will encourage use of the network by organisations and individuals seeking to use hydrogen as a vehicle transport fuel. As a consequence, a greater number of customers will connect to the network, therefore reducing costs for all network users. Furthermore, as wider sectors of the economy start to depend upon the network, this will build the case for its longevity. A scale of this size is important as anything smaller would not provide sufficient evidence to undertake phase 3.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

This study is focused on the North West of England.

Revenue Allowed for the RIIO Settlement

Not Applicable

Indicative Total NIA Project Expenditure

External Cost - £283,000

Internal Cost - £91,000

Contingency - £37,000

Total Cost - £411,000

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:

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)

The HyDeploy project suggests that if a 20% H2 blend is rolled out throughout the UK this will enable 29TWH of low carbon heat to be injected onto the GB network and this has the potential to save the consumer £8Bn compared to other methods/routes to decarbonisation such as heat pumps. On a wider scale, the 2050 energy scenario report by KPMG, produced on behalf of the Network Licensees as part of (NIA_SNG_00064) Energy Map and Plan (2016) suggest the conversion of the heat network to Hydrogen compared to electrification could save the consumer £7,000 to £9,500 each or £152bn to £214bn for GB.

We would expect lower benefits to accrue from the decarbonisation of a proportion of the transport sector using low carbon hydrogen from the HyNet project and subsequent wider national projects. However, we would expect the benefits to be in the same order of magnitude as those presented above. We would also expect the potential CO2 and air quality benefits from solving the problem to be significant, and probably greater than those from decarbonising the heat network. Such environmental and health benefits can be converted to financial benefits (using 'damage' costs).

Please provide a calculation of the expected benefits the Solution

N/A – this is a research project that seeks to identify opportunities for demonstration projects.

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

The potential of hydrogen to decarbonise the transport sector is significant. The method can be replicated at any locations in which low carbon hydrogen is available in bulk. In most cases, this will require access to carbon capture and storage (CCS) infrastructure (to capture and store the CO2 from hydrogen production from natural gas) and therefore the most appropriate areas are Humber and Eastern Scotland. In the shorter-term for demonstration projects, electrolysis (using renewable electricity) is becoming a viable technology for hydrogen production and therefore the method can be applied in most areas of the UK in respect of such smaller scale projects.

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

The cost of rollout will be clearer once the research project concludes. This will also enable the decision to be made as to whether to pursue initial demonstration projects or not.

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

This project will consider how gas networks can be best configured to supply hydrogen as a transport fuel and the technical barriers that need to be cleared to do so. It will also provide information on the benefits of such supply of hydrogen not only to gas networks and their customers, but to the populations and businesses in the areas in which deployment takes place. Furthermore, it will provide information on the business models that are likely to be required to enable deployment of transport-related hydrogen projects.

It is envisaged that the above information can be used by relevant Network Licensees to determine the attractiveness of project development in relation to the supply of hydrogen as a transport fuel. It can also subsequently be used to guide development and roll-out their own projects around the wider UK. In addition, it will help Network Licensees to quantify and to then realise the potential benefits of network supply of hydrogen for the transport sector.

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

- Has the Potential to Develop Learning That Can be Applied by all Relevant Network Licensees

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.

This is a first-of-a-kind (FOAK) project in respect of Network Licensees' consideration of the use of a blend of hydrogen to supply the transport sector. Cadent has discussed the project with other Network Licensees and can confirm that there is no duplication with either other historic projects or those currently being considered.

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

n/a

Additional Governance And Document Upload

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

Due to the complexity of delivering hydrogen from the distribution network to transport mechanisms this type of project has not been tried before. Currently studies have only examined utilising hydrogen from the network to supply domestic and industrial properties.

Relevant Foreground IPR

n/a

Data Access Details

n/a

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

This project will provide the necessary analysis to develop a long term strategy for the deployment of hydrogen related transport infrastructure within the NW. If achieved this would provide a quantum leap for the UK gas industry and this cannot be seen as business as usual.

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 project conforms to NIA requirements. Commercial risks which require NIA support to overcome include identifying relevant hydrogen projects which can be delivered within two years providing a suitable source of hydrogen from the network is in place. Moreover, high-level analysis of the required locations of a national network of hydrogen refueling stations / infrastructure produces a potential risk.

This project has been approved by a senior member of staff

Yes