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NIA Project Registration and PEA Document

Date of Submission

Jun 2017

Project Reference Number

NIA_CAD0001

Project Registration

Project Title

Industry and Network Blends – Delivering Reduced Carbon Intensity on the Network

Project Reference Number

NIA_CAD0001

Project Licensee(s)

Cadent

Project Start

May 2017

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Andy Lewis – Cadent Peter Whitton – PEL

Project Budget

£930,600.00

Summary

The work programme will involve collaboration with a number of companies, identified in the previous conceptual study. These include industrial gas users and infrastructure owners covering the complete delivery chain.

The work programme involves packages of work aimed at defining the optimum network deployment Project in the Liverpool - Manchester area. It will include the essential demonstration testing to understand what hydrogen blend can be adopted in the existing distribution network including by industrial users. It will also consider the testing required for high hydrogen use. To cost effectively roll-out hydrogen blending a holistic understanding of the full network system is required. In particular defining the impact of the use of high hydrogen –gas use by industrial users on overall network operation and costs is critical to cost effective decarbonisation of the network. Network analysis to determine the hydrogen injection locations is also needed

Demonstration tests

Demonstrating testing of hydrogen use in furnaces and kilns and in boilers is required to understand the range of hydrogen-gas mixtures where hydrogen can be used, and operational limits and compatibility with hydrogen injected in the wider gas distribution network and that the potential for industrial users to help manage network demand fluctuations can be defined. Confidence in the use of blends, at the level proposed for the network (5-20% by volume) is required for these industrial applications as our industrial customers are highly heat intensive. The HyDeploy programme is trialling blends in a private network and a public trial is needed prior to adoption of a blend in the network.

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

To achieve 80% emissions reduction by 2050 compared to 1990 emissions requires deep 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, but, as stressed by the Committee for Climate Change in its 2016 carbon budget recommendations, very little progress has been made in reducing the carbon intensity of heat. Gas combustion for heat is the dominant source of emissions in buildings and in many industries.

The opportunity to secure deep carbon reductions by use of the upgraded gas distribution network in urban areas to transport hydrogen, rather than gas, was examined in the recent (2016) Leeds City Gate (H21) study by NGN. The work showed that use of the distribution network and conversion of the connected appliances and equipment is technically possible, subject to resolving a number of challenges. These include: the need to convert or replace all connected appliances and equipment across residential, commercial and industrial users; the need to put in place hydrogen storage facilities to enable hydrogen supply to meet a demand which fluctuates considerably on a seasonal and, to a degree, daily basis; and the need for CCS infrastructure to be in place prior to deployment, justified against other needs. The project concept proposed requires the development of a supply chain for converted or new appliances and considerable expenditure on infrastructure. The H21 study concluded that to capture and store ~1.5mt CO₂/yr by substituting hydrogen for gas in Leeds would require a capex of £2bn and opex of £140m/yr. Hence a policy commitment to widespread network conversion and the establishment of CCS would be needed prior to undertaking the proposed H21 project.

Cadent commissioned the H2 Clusters project (NIA_NGGD0086) to consider deployment strategies for network decarbonisation using low carbon hydrogen which addressed the challenges identified in the H21 study and enabled material deployment at affordable cost and with acceptable risk. The deployment strategy formulated a conceptual first project for the network changes that met these requirements, had the potential to be operating in the early 2020s and can be expanded subsequently. Building on this, the project concept proposed here involves:

- Use of a hydrogen/gas blend, with the blend level set at the maximum level achievable without requiring modification of appliances in residential buildings and commercial buildings and most industrial plant, minimising cost, development and deployment risk.
- Deployment in a large urban, industrialised, area with the required multipoint injection of hydrogen into the network from a dedicated hydrogen pipeline system
- Conversion of a tranche of nearby major gas users with manufacturing processes that lend themselves to the use of hydrogen as transported in the network as a fuel to operate on a high hydrogen/gas mixture. This industrial tranche of users, which are connected to the network, could provide a large and relatively constant hydrogen demand throughout the year and the facility to manage daily fluctuations in the hydrogen supply to the wider gas network. This avoids the need for investment in underground hydrogen storage facilities minimising costs and delivering a material reduction in emissions of CO₂.
- Hydrogen production in a location in which low cost CCS infrastructure can be available. This enables the CCS infrastructure to be justified by the network conversion project alone and minimises costs

The work concluded that the Liverpool/Merseyside area and its respective network is a very good location for this initial Project. The project concept developed in this location was shown to have no fatal flaws and to offer the prospect of a project with manageable development risk, producing material emission reduction at affordable cost, whilst also forming a platform for subsequent extension of the initial Project to provide wider and/or deeper network decarbonisation, as extensive hydrogen and CO₂ storage capacity is available nearby. The area already has industrial hydrogen production, some pipeline infrastructure and an extensive distribution network with domestic and industrial customers on it. There is Local Authority and wider industrial support

The work proposed here develops this project concept to produce a Project Definition and Execution Plan, together with the Development Plan needed to provide the information and confidence to support a Final Investment Decision on the Project by c2023.

Method(s)

The work programme will seek to assemble a viable, investable project, building on the results of the conceptual H2 Clusters study and is entirely network focused. Possible practical project configurations will be examined against the development risks involved and the barriers that must be overcome. The programme will examine the constraints in supplying a suitable blend to the distribution network in the Liverpool/Merseyside area, fixing the geographical limits and maximum blend percentage. The ability of industry to accommodate the blend has not been addressed in previous studies and will be examined as this could inhibit the eventual deployment of hydrogen on the network if it is not thoroughly investigated. The hydrogen delivery pipeline routed and designed and a tranche of industrial users accessible from the pipeline able to accept a high hydrogen gas identified. The location, technical design and potential commercial arrangements for the hydrogen production and for the transport and storage of captured CO₂ will be fixed. The programme will involve significant interactions with industry, suppliers and other bodies who will facilitate hydrogen being injected onto the network.

The business case will be developed for the preferred Project. This will involve costing (at pre-FEED accuracy), financial and risk assessment. Funding options and the regulatory and policy issues involved will be defined, including benchmarking against alternative routes for decarbonising heat. Close contact will be maintained with the Liverpool and Cheshire LEPs and with the recently created N-W Hydrogen Hub building on their existing involvement in hydrogen initiatives. Interactions with BEIS on policy will be channelled

through Cadent.

The H2 Clusters study identified the barriers to be overcome before undertaking the required network changes to allow hydrogen on the distribution network. These included the need for experimental demonstration of the use of a hydrogen blend in certain industrial equipment, notably furnaces, boilers and possibly CHP plants as the HyDeploy programme and other studies have not examined this and this could act as a barrier to hydrogen deployment on the network. The HyDeploy programme aims to establish the principle of hydrogen blending with the HSE and define the appropriate maximum hydrogen blend on the distribution network. Before deployment, a subsequent demonstration trial in a public network is required. CHP plant trials are expected to be progressed by DNV in a separate work programme. The work programme here will consider the work required for applications at industrial sites to confirm the acceptability of a blend and the potential for high hydrogen use, and also the opportunities for a blending public network trial. This will include location, justification and the design of the network trial programme. A number of companies in the Liverpool/Merseyside area have indicated a willingness to make equipment available for a trial programme on industrial equipment. It is envisaged that the tests themselves will be funded separately, perhaps as a NIC project. The results of the Future Billing Methodology study will be relevant to formulating a viable Project.

Scope

The work programme will involve collaboration with a number of companies, identified in the previous conceptual study. These include industrial gas users and infrastructure owners covering the complete delivery chain.

The work programme involves packages of work aimed at defining the optimum network deployment Project in the Liverpool - Manchester area. It will include the essential demonstration testing to understand what hydrogen blend can be adopted in the existing distribution network including by industrial users. It will also consider the testing required for high hydrogen use. To cost effectively roll-out hydrogen blending a holistic understanding of the full network system is required. In particular defining the impact of the use of high hydrogen –gas use by industrial users on overall network operation and costs is critical to cost effective decarbonisation of the network. Network analysis to determine the hydrogen injection locations is also needed

Demonstration tests

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WP1. Industrial Application Test Programme

Identify limits on use of hydrogen blends and of hydrogen gas mixtures in boilers, kilns and furnaces, and for the former the plant modifications required to implement such that the parameters are known for network impacts. Consider options for a demonstration test at an industrial site. Design test programme, including hydrogen supply, burner and other modifications, and plant monitoring and the commercial arrangements and costs for test execution.

Produce a template for the assessment and conversion process to be undertaken as part of a roll out to multiple sites and boiler installations

Provide financial justification for test programme and the associated carbon benefits

WP2. Blend test in public network

-Identify a suitable location in the Liverpool/Merseyside area as a candidate for a public test of a hydrogen blend at a level informed by the HyDeploy test programme which will be integrated into this project.

Design the network demonstration test, including hydrogen supply, test programme, regulatory approvals and stakeholder management. Network modelling inputs (as studied in H21 modelling project) are required.

Provide financial justification for the test programme and assess the associated carbon benefits

Execution Project Definition

WP3. Project Formulation

To determine the distribution network area to be supplied with hydrogen blend and identify injection points, blending equipment and monitoring. Network modelling is required (and is being informed by the urban centre modelling for the wider H21 project rollout).

Select the networks distribution connected industrial sites for high hydrogen supply and define hydrogen supply and appropriate blending arrangements. Finalise hydrogen production location and define pipeline route connecting production to industries to be supplied.

Determine appropriate hydrogen production arrangements to meet industry plus network blend requirement. Consider role of additional hydrogen production, including existing hydrogen sources, and bio hydrogen from waste plant, and include in Project where justified

WP4. CO2 transport and Storage

Working with ENI, identify and develop optimum transport and storage arrangements, recognising requirement to minimise costs for initial project but benefits of storage complex being capable of expansion to allow a greater amount of hydrogen to be distributed onto the network

WP5. Definition of Preferred Project

Formulate and fix project to be developed consider risks, barriers, funding options, need to deploy all elements of the Project – network blend, network and linked industry conversion, impact on CCS - and timing and the need to ensure that the Project can be extended at a later date. Produce Project Definition and Project Execution Plan

Business Case

WP6. Project Economics, funding and value for money

Undertake financial assessment of preferred network conversion Project.

Compare Project with alternatives strategies for securing similar carbon reduction benefits.

Identify options for funding of full Project including network, industrial and CCS elements

WP7 Stakeholder Engagement

Seek support from stakeholder groups, including Combined Authorities, key industry companies, Government and others

WP8 Programme Management

Manage work programme, providing progress reports and a final report.

Objective(s)

The overall objective is to scope and define a network hydrogen deployment Project in the Liverpool/Merseyside area that clears the barriers for deployment of hydrogen into the gas network and could be financed and under construction in the early 2020s.

The objective is to produce a practical, preferred, design which is defined in sufficient detail that the execution risks and barriers, and financial and technical performance, are known in sufficient accuracy to allow comparison with alternative strategies for reducing the carbon intensity of the gas network and decarbonising heat supply to a range of users

The business case, including possible funding mechanisms and comparison with alternative approaches to decarbonising heat, will be developed to allow stakeholders to assess their willingness to invest in FEED and other work needed to enable a Final Investment Decision.

Certain practical demonstration testing is required prior to commitment to proceed with the Project and the objective is to develop executable work programmes to:

- Establish an acceptable network blend level and decide on the maximum hydrogen level sensibly achievable in high heat, industrial applications
- Establish an acceptable network blend level for boilers and define the work needed to enable boilers to be converted to operate on a high hydrogen fuel as well as a blend.

- Enable a proving test to be undertaken for a blend in a public network

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

- Assemble a viable, investment project for H2 use in the Liverpool – Manchester network
- Develop feasible project configurations, including business case.
- Assess barriers to the use of hydrogen network blends including the ability of industrial gas users to utilise a network blend.
- Assess the ability of industry in being able to provide demand management for the use of a H2 network blend in the distribution network.
- Establish storage and transport configurations for CO2 to meet gas network needs.
- Assess the opportunities to trial furnace and boiler configurations for H2 conversions linked to the network.

Assess opportunities for blending on an open 'public' network.

Project Partners and External Funding

n/a

Potential for New Learning

n/a

Scale of Project

This project will be a desk top study throughout and will be centred on the Merseyside/Liverpool region.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

This study is centred in the Merseyside/Region of NW England.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External Cost - £697,950.00

Internal Cost - £232,650.00

Total Cost - £930,600.00

90% of costs eligible under NIA - £837,540.00

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 £7000 to £9500 each or £152bn to £214bn for GB.

Please provide a calculation of the expected benefits the Solution

NA – this is a project development project that understands the feasibility for a larger demonstration project. Therefore, this is not applicable.

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

By maximizing the potential of hydrogen to simultaneously decarbonise both industry and the gas network by the creation of a symbiotic commercial arrangement can be replicated in Teesside and Humberside as well as Merseyside. However, it is believed, as a result of the H2 Clusters project Merseyside/Liverpool represents the most financially and technically advantageous place to start

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

The cost of rollout will be clearer once the feasibility project concludes and it will enable the decision to be made whether to pursue a demonstration project 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 look at the next steps for the current HyDeploy NIC and look at the feasibility in terms of site, H2 production, regulatory barriers, and cost for blended H2 on a public network. The work will establish the extent to which industrials can accommodate hydrogen blends and will consider conversion to 100% hydrogen for industry in the cluster area. Once H2 blend has been demonstrated on a public network this can then be rolled out nationally, throughout all the networks. However, in order to maximize cost reduction in decarbonizing through adoption of a H2 blend this project looks at the feasibility of going a stage further enabling the deep decarbonisation of large distribution connected industrial gas users.

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.

n/a

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

n/a

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

n/a

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

n/a

This project has been approved by a senior member of staff

Yes