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.

# NIA Project Registration and PEA Document

### Date of Submission

Oct 2020

### Project Reference Number

NIA_CAD0064

## Project Registration

### Project Title

I-0335 HyNet Basis of Design Project

### Project Reference Number

NIA_CAD0064

### Project Licensee(s)

Cadent

### Project Start

October 2020

### Project Duration

0 years and 6 months

### Nominated Project Contact(s)

Damien Hawke

### Project Budget

£149,918.58

### Summary

HyNet is a well-advanced, integrated Hydrogen and Carbon Capture Utilisation and Storage (CCUS) project located in the North West of the UK. It has been developed in order to materially reduce regional CO2 emissions from 'hard to reach' sectors of the economy, including industry, heat and transport. HyNet will provide low carbon hydrogen for fuel switching of industrial users and dispatchable power generators, together with injection into the local transmission system (LTS) for blending with NG at key points. Transport fuelling locations can also be served. The initial network will be developed incrementally over the coming decade to serve users with varying demand profiles and connect with hydrogen storage to provide balancing and system resilience.

Cadent intends to participate in HyNet by joining the consortium seeking partial funding for engineering design and consenting of the hydrogen distribution assets from the IDC Deployment fund competition organised by UKRI. If successful, Cadent will complete Front End Engineering Design (FEED) and Consenting of Phase 2 of the Hydrogen Distribution network. Cadent is seeking to prepare the Basis of Design (BoD) for the Hydrogen Distribution Network Phase 2 before the IDC Deployment funding is awarded, so that work can commence on the FEED as soon as the main funding is available.

### Nominated Contact Email Address(es)

Innovation@cadentgas.com

### Problem Being Solved

Clusters of large industrial plants for energy-intensive industries such as iron and steel, cement, refining and chemicals, have developed across the UK near ports and estuaries. These Clusters are found particularly in the north of England but there are clusters are also found in the south, such as South Wales, Southampton and the Thames estuary. Although industrial clusters are very significant contributors to both the local economy and their communities, they are also significant contributors to UK carbon emissions. Sitting within Cadent's North West network, Merseyside is one of the UK's 6 identified industrial cluster's and hence holds a significant number of industrial users including ports, refinery and other significant carbon emitters.

The UK government has passed legislation committing the UK to reducing greenhouse gas emissions to net zero by 2050. Decarbonising the UK will be a major challenge and unlikely to have a single “silver bullet” however one key solution that could play a significant role in decarbonising both industrial clusters and the gas networks themselves, is the use of hydrogen. Low carbon hydrogen has been identified as a suitable solution to enable the decarbonisation of clusters through the displacement of natural gas in several markets, including industrial heat, dispatchable power generation and transport fuels. It can also be delivered to consumers connected to the gas distribution network, initially as a blend with natural gas and subsequently as a pure fuel. Hydrogen networks are therefore being examined in several locations across the country and in different Gas Network Operator regions, emanating from low carbon hydrogen production sources.

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## Method(s)

The methodology is to call on experienced subcontractors and combine this with design experience of a Hynet multi-consumer hydrogen network.  The work will focus on the issues associated with operating such multi-consumer hydrogen networks.

**Work package 1** – Commercial and Demand. Conducting meetings with potential users to have an initial commercial conversation about connecting to the H2 pipeline and getting an update on potential demand. This updated demand will then be used to update modelling scenarios

**Work package 2** – End to End Chain Basis of Design. This includes defining key objectives, project stages and scope definition, key interfaces (including hydrogen production and storage interface), understanding Pre-FEED work including key locations and system description (overview e.g Pipelines, AGI and Storage), HSE requirements (Safety Case, COMAH, CDM, DSEAR, National Codes & standards). Key operating parameters, availability, design life

**Work Package 3** – Process BoD. Included within the Process Basis of Design are a Pre-FEED design summary including specific codes, standards and specifications. Specific process elements that will be included are flow assurance modelling requirements, including future connections, boundary limits and forecast flow and consumption/data demand. Other process elements to be considered includes process data (operating conditions, design limits, velocities and fluid properties), odorisation requirements, zoning (including hazardous and process hazard) and operation and control philosophies (pressure control, start-up/shut-down, gas quality, relief and blowdown, isolation, noise abatement, utilities, sparing and metering.

**Work Package 4** – Pipeline and Facilities BoD. This is a large work package and includes Pipeline control philosophy, pipeline material requirements, QRA and consequence modelling, pipeline design data, network schematic, connections, battery limit. Work will be done looking at and reviewing installation philosophy (including leak protection and pigging etc), commissioning and start-up requirements, logistical constraints and testing and pre-commissioning requirements.

## Scope

The primary scope of this project is the facilitation of a Basis of Design document for the HyNet FEED and consenting which is due to start in the new year.

The Basis of Design will cover and consolidate all the work undertaken in the Pre-FEED stage to date and will be handed over to the project team to execute the project.

The following areas are included with the scope of this project:

- Safety and environmental considerations: This includes safety cases identifying major hazards, risk assessments, Major Accident Prevention Document (MAPD). Environmental considerations should relate to Environmental Impact

Assessment (EIA) and H&SE environmental plan.

- Project phases: Any phasing that needs to be considered.
- Flow Assurance: Line sizing, any necessary flow assurance studies that have been carried out, overview of demand, exit and entry processes, operating design limitations at each connection, overall process macro demand and consumption profiles
- Flow Process Diagrams: High level PFD, Demarcations of next sections against the PFD, demarcation between facilities and pipeline
- Operating and Design Philosophies: Introduce overall operating and design philosophies. Including (but not limited to) control of pressure, gas quality, isolation, relief and blowdown, line sixing, noise etc. Other considerations includes operations manning levels, maintenance and inspection philosophy, process control philosophy, power supply/management philosophy, operating and installation philosophy
- Entry Facility: This section will look to define the entry facility provided at the interface from hydrogen production into the network. A number of different aspects will be looked at including but not limited to process gas specs, process flow diagram, cooling requirements, H2S scrubbing, site layout, site security etc.
- Hydrogen Pipeline System- Describe the pipeline system to transport hydrogen to end user exit connections. Detail codes, specifications, standards, size throughput and design requirements.
- Above Ground Installation: Describe the above ground installation to be provided for processing hydrogen gas into the distribution pipeline system as well as storage sites
- Commercial Arrangements for Connections: Draft process for connecting to the H2 pipeline is agreed. Also work is undertaking to look at a 'draft' Hydrogen UNC.
- Define hydrogen demand: Engage with potential consumers to further define hydrogen demand (which will go into the modelling) and look to agree outline connection philosophy.

## Objective(s)

The project will enable a FEED BoD to be developed, which will be further updated during the FEED itself. The FEED BoD will have:

- Sufficient detail to define the scope of work, Scope of Requirements (SoR) and design data to establish the design basis for the FEED project stage
- Once the BoD has been finalised and accepted at the end of the project, there after it will be subject to the project Management of Change Procedure (MoC)
- The BoD is to be followed and developed further if required by the project team who undertake the FEED. The BoD will be used to establish the scope and detailed design which is to be carried out during the FEED
- Refresh the feasibility study hydrogen demand forecasts which underpins the sizing and key connection locations of the planned network.
- Create a draft 'hydrogen UNC' and connections methodology. It will be necessary to outline the expected connections approach to customers whilst detailing connection and consumption profiles
- The BoD will also need to have an interface with other parts of the HyNet project such as the hydrogen production and storage. These interfaces will be managed to ensure that the BoD works alongside these interfaces.
- This BoD will also look at Policy Resilience. Including the project being categorised as an NSIP and any other relevant policy decisions that need to made at this stage of the project.

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

n/a

## Success Criteria

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

- A BoD is created that has encapsulated all the technical considerations of a hydrogen pipeline and this is then from before FEED and consenting starts
- The outline commercial agreement for connections is agreed
- Users potential hydrogen demand is agreed and this is put back into the FEED
- An outline Hydrogen UNC is considered, and this is used to form the basis of further discussion with important policy stakeholders in the near future.

## Project Partners and External Funding

This project will be funded via NIA

## Potential for New Learning

This work builds further upon work produced in previous NIA projects, all the learning needed has been identified and will be new.

## Scale of Project

This project will be focussed on the hydrogen pipeline that will be developed as part of the HyNet project. Although this will be specifically for the HyNet project there is no reason why this learning cannot be brought forward and applied to other hydrogen projects which are looking at networked hydrogen. The commercial work on connections and UNC will be particularly relevant for all the GDNOs.

## Technology Readiness at Start

TRL2 Invention and Research

## Technology Readiness at End

TRL4 Bench Scale Research

## Geographical Area

This study is focused on hydrogen pipeline infrastructure that can be replicated throughout the UK by all the Gas Distribution Networks

## Revenue Allowed for the RIIO Settlement

Not Applicable

## Indicative Total NIA Project Expenditure

**External Cost - £121,580,00**

**Internal Cost - £28,338.58**

**Contingency - £0**

**Total Cost - £ 149,918.58**

# 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 potential benefits of this project remain the same as the previous phase. 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_SGN_00064) Energy Map and Plan (2016) suggest the conversion of the gas network to hydrogen compared to electrification could save the consumer £7,000 to £9,500 each or £152bn to £214bn for GB.

The work will also guide the GD2 business plans for Cadent and other network licensees. This will reduce costs for all customers during GD2.

We would also expect the potential CO2 and air quality benefits from solving the problem to be significant. 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 will define a suitable approach to network operation and control, which can be replicated by other network licensees.

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

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 Teesside, Humberside South Wales and Eastern Scotland. Hydrogen clusters potentially similar to that proposed by Cadent in the form of HyNet are being developed in these areas. In such areas the method will guide GD2 business planning.

In the shorter-term, the method can also be applied as part of smaller demonstration 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 further consider how gas distribution companies will design and control, through the use of HAGIs, hydrogen pipelines in the near future. It is very likely that all gas distribution companies will be required to both repurpose and newly build hydrogen pipelines in the coming years, with HyNet being the forerunner.

It is envisaged that the information generated from this project can be applied by any gas network as they look to plan their respective hydrogen pipelines. Similar considerations will have to be worked through and this work will act as an ideal precursor to this work.

The above will also guide GD2 business plans for Cadent and other network licensees

### 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 FOAK project in respect of Network Licensees' consideration of operational routing and HAGI locations. This work has not been done elsewhere by GDNs and developing a hydrogen pipeline at the scale proposed by Cadent is unique.

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

The project will represent the first attempt by a network licensee to develop a purpose built hydrogen pipeline for a hydrogen distribution network involving a range of diverse consumers. Due to developments in the initial NIA on Optimising a hydrogen pipeline this new work is now required and has come into focus. To that end, this work has not been done elsewhere and is completely unique.

### 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 detailed option analysis and detailed design to enable the deployment of a new distribution network transporting a new low carbon gas, hydrogen. If achieved this will provide a quantum leap for the UK gas industry and thus cannot be regarded 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 to be overcome, which require NIA support include the current absence of a relevant support mechanism for CCS and hydrogen as a fuel. Mechanism is currently under consideration by Government, but in the meantime, any network licensee would struggle to justify investment of this nature. However, support in the short-term for this project under the NIA will allow all licensees to manage commercial risk and then move quickly at the relevant time to deliver maximum benefits to customers in the form of lower costs of network deployment.

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

☑ Yes