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

Jun 2021

Project Reference Number

NIA_CAD0073

Project Registration

Project Title

FI-0003 - Common future end states and transition pathways

Project Reference Number

NIA_CAD0073

Project Licensee(s)

Cadent

Project Start

June 2021

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Lorna Millington – Cadent Bethan Winter – WWU Colin Thomson – SGN Keith Owen – NGN Danielle Stewart – National Grid

Project Budget

£195,000.00

Summary

This project will develop a set of credible and compatible ends states, pathways to those end states and scenarios (example below) that can be used as test cases for the System Transformation programme, including any underlying assumptions, to allow comparison of the benefits and challenges associated within each.

These test cases will provide a clear view of which energy carriers (hydrogen, green gases such as biomethane or a blend), to what proportion and where the transmission and distribution networks could be transporting and to what extent they would be repurposed or require new networks in 2050 (end states) to support both the conveyance of hydrogen and provide the connectivity and resilience required by government, consumers and industry, as well as a set of credible transitional steps (pathways) required to achieve them.

Preceding Projects

NIA_NGGT0179 - HGR&D ST - Assessment Methodologies

Third Party Collaborators

Element Energy

Nominated Contact Email Address(es)

Innovation@cadentgas.com

Problem Being Solved

The UK has mandated that it shall reach Net Zero emissions no later than 2050. The UK was the first major world economy to set this target and it shows the UK's commitment to tackling climate change for future generations. This mandate has put the UK on an accelerated programme to reduce emissions across our entire society whether this is industry, transport, agriculture or the way we create our power and heat our homes. To achieve Net Zero by 2050 will require a co-ordinated effort across the whole of the economy and by individuals who will be required to make technology choices and potentially change habits and behaviours to live more sustainable lives.

The Prime Minister's Ten Point Plan for a Green Industrial Revolution set out the government's intent to explore the option of hydrogen to be used within the current gas network infrastructure. To support this the Gas Networks Operators are working with BEIS on the Hydrogen Grid R&D programme, which is split into 4 programmes of which System Transformation is one. The System Transformation programme objective is to identify the key gas system design options and make an assessment of their feasibility and attractiveness to iteratively identify, test and establish the technical, physical and economic viability of transitioning all or substantial parts of the gas grid infrastructure to 100% hydrogen as an option for decarbonising heat in accordance with HMG net zero targets.

This programme of work will assess the key strategic gas system options, impacts, barriers and opportunities in order to support policy decisions on whether to proceed with a transition to hydrogen to produce heat across domestic, commercial and industrial sectors. It will build this assessment via several projects, the first key one is setting the parameters that the overall programme will use. Currently there are multiple views on the potential 2050 end state and views on how to get there (transition pathways), with the key element for the Gas Network Operators being what these mean for the assets and infrastructure.

Method(s)

The project is looking to address the problem by utilising the following steps

1) Compile the current views from published work and expert knowledge of the various end states and pathways to these end states. Capturing the assumptions and data for each and review existing scenarios (FES, CCC etc.

2) The delivery partner will work with BEIS and the networks on the envelope or discrete set of scenarios to be used within the System Transformation programme. Identifying any short comings in the data or granularity of the work. All abandoned scenarios will be identified, and reasons given for not progressing.

3) Work with the networks to align the likely end states and pathways to scenarios. An initial information gathering session to then sense check that no gaps exist will be carried out.

4) A defined list of stakeholders to sense check the test cases and assumptions they contain will be developed between BEIS, networks and the project partner. The project partner will facilitate workshop(s) and carry out targeted engagement with the defined stakeholders to challenge and review the options and the corresponding assumptions.

5) After stakeholder engagement has been carried out the project partner will define a list of test cases and associated assumptions to be used within the System Transformation programme.

6) Identifying the evidence that would be used to narrow down the list of test cases in the future, including from other Hydrogen Grid R&D sub-programmes, to ensure they are credible. As part of this work assumptions for each option will note any interdependencies.

7) The project partner will also develop an enduring process for refreshing the test cases and any assumptions that underpin those test cases.

8) Assessment of each end state will be made to determine any added value options into non heat sectors which may influence the overall benefit of such an end state.

If there is insufficient granularity on a regional level of the completed review the project will potentially move into a second phase where further modelling will be carried out to fill gaps that are seen as critical to the project's success. This second phase if required will be a continuation of this project.

Data compiled in this process will be managed in the first instance by the lead network with the intention that the System Transformation Data project will establish the programmes data retention location and ongoing structure. The project is rated low in the common assessment framework detailed in the ENIP document after assessing the total project value, the progression through the

TRL levels, the number of project delivery partners and the low level of data assumptions.

No additional peer review is required for this project.

Scope

This project will develop a set of credible and compatible ends states, pathways to those end states and scenarios that can be used as test cases for the System Transformation programme, including any underlying assumptions, to allow comparison of the benefits and challenges associated within each.

These test cases will provide a clear view of which energy carriers (hydrogen, green gases such as biomethane or a blend), to what proportion and where the transmission and distribution networks could be transporting and to what extent they would be repurposed or require new networks in 2050 (end states) to support both the conveyance of hydrogen and provide the connectivity and resilience required by government, consumers and industry, as well as a set of credible transitional steps (pathways) required to achieve them. The size and shape of these networks, as well as the pathways to achieve them, will depend on supply, demand and storage volumes, profiles, uses and locations of hydrogen, natural gas and biogas (scenarios) across the transition.

The work is of benefit to the Hydrogen Grid R&D programme to set the parameters that the other projects will use to deliver sufficient insight into the options for hydrogen in 2050 and the route to it are robustly understood. This is key to a government decision on hydrogen in the mid 2020's.

Objective(s)

The objective of this project is to define a set of test cases that form the parameters which will then be used by other projects within the System Transformation programme. The overall programme will use these parameters to deliver sufficient insight into the options for hydrogen in 2050 and the route to it are robustly understood. The success of the overall programme is key to a government decision on hydrogen for heating in the mid 2020's.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

The insight this work supports will help to establish a clearer view of the impacts of the transition to Net Zero one of these will be cost and the impact on the customer. The assessment methodology priority project which is being delivered alongside this project will develop criteria in this area.

We conclude that this project will have a low impact on consumers in vulnerable situations. This is because the project methodology is within the development phase (TRL 5-6) and the solution will not deliver outputs that will impact the financial or well-being of any consumers. It is envisaged that this project will enable a future low carbon safe, secure and reliable energy supply.

Success Criteria

The success criteria for the project is the delivery of the following;

1) A shortlist of test cases (set in the definitions), that give the full range of impacts of the critical criteria.

2) A list of those test cases abandoned and reasoning for such.

3) The output highlights the variations created by geography, technological and deployment speeds.

4) Alignment of the test cases with the various end states, pathways and scenarios to support credibility ensuring they consider the whole system.

5) No new end states, pathways or scenarios will be delivered unless a gap is identified through the stakeholder engagement. If the gap is deemed an issue a continuation of this project will be triggered.

6) If further work is required, the gaps identified will be adequately filled via this second stage.

Project Partners and External Funding

The project will be delivered by Element Energy for stage 1, if a second stage is required there is potential for another supplier to be involved, funding for this second stage is unknown at this point.

Potential for New Learning

The learning from this project is a set of test cases that create the envelope that the networks and BEIS believe is credible to support

the understanding of the structure of the future gas network. This learning will then be shared with the other priority projects within the System Transformation programme. The work will be disseminated and shared with stakeholders via workshops within the project.

Scale of Project

As a desktop exercise the scale is appropriate as it considers mainland UK – this parameter has been set within the overall Hydrogen Grid R&D programme. Smaller scale would create insufficient information to support the understanding of the National Transmission System.

Technology Readiness at Start

TRL5 Pilot Scale

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Desktop based project covering the mainland UK geography.

Revenue Allowed for the RIIO Settlement

Not applicable to this R&D project.

Indicative Total NIA Project Expenditure

An indication of the total Allowable NIA Expenditure that the Funding Licensee expects to reclaim for the whole of the Project (RIIO1).

An indication of the Total NIA Expenditure that the Funding Licensee expects to reclaim for the whole of the Project (RIIO2).

Cadent	External	£65,000
	Internal	£21,666.66
WWU	External	£16,250
	Internal	£5,416.67
SGN	External	£32,500
	Internal	£10,833.33
NGN	External	£16,250
	Internal	£5,416.67
National Grid	External	£16,250
	Internal	£5,416.67

Stage 1 Total

£195,000

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:

The project will support the evidence building on conversion of the gas grid to hydrogen. It is the initial project that defines the parameters for the priority projects for the System Transformation programme.

How the Project has potential to benefit consumer in vulnerable situations:

Not applicable

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)

Not applicable

Please provide a calculation of the expected benefits the Solution

Not applicable (this is a research project)

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

The work is GB wide and considering all networks under this project.

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

Not applicable

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

The learning is the bringing together of the end states, transition pathways and scenarios to create test cases which explore the network implications of the configurations. This extends the current work to include the network in the application of the scenarios.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

Not applicable

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.

There is no previous work that is duplicated by this project it builds on work already published and develops it for the System Transformation programme needs.

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

Not applicable

Additional Governance And Document Upload

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

The project is the bringing together of the end states, transition pathways and scenarios to create test cases which explore the network implications of the configurations. This extends the current work to include the network in the application of the scenarios. The consideration of the network in this type of work can only be done with the knowledge the networks have. This is not BAU as these are networks that transport a new gas.

Relevant Foreground IPR

The foreground IP created in this project is the test cases which will be based on previously published work. Under phase 2, if it is required, specific data will be created to support the test cases.

Data Access Details

Current expectation is that all data used in this project will be sourced from published documentation, the test cases will be available upon request.

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC)

or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. Cadent already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at https://cadentgas.com/future-of-gas
- Via our managed mailbox futureofgas@cadent.com

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

The current work in this area is sufficient for natural gas networks, to understand hydrogen is not a BAU activity and is currently wholly funded via innovation mechanisms.

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

There is a risk that if hydrogen is not accepted as a means to heat homes in 2050 that this work is no longer valid. The technical, operational and regulatory risks around hydrogen are elements being explored across the Hydrogen Grid R&D programme.

This project has been approved by a senior member of staff

☑ Yes