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

Jul 2021

Project Reference Number

NIA_WWU_2_02

Project Registration

Project Title

Regional Decarbonisation Pathways

Project Reference Number

NIA_WWU_2_02

Project Licensee(s)

Wales & West Utilities

Project Start

July 2021

Project Duration

1 year and 1 month

Nominated Project Contact(s)

Henry James

Project Budget

£609,753.00

Summary

This spend will fund reports which will provide a strategic plan to decarbonise Wales and the South-West of England (Strategic Plan) and provide details of the future gas network requirements to achieve the optimal energy system for the WWU network (Conceptual Plan).

Preceding Projects

NIA_WWU_2_01 - SWIC Hydrogen Supply Pipeline Infrastructure

NIA_WWU_2_03 - SWIC Market-Accelerating Hydrogen Distribution and Storage

NIA_WWU_2_07 - SWIC: Assessment of potential hydrogen demand in 2030 - 2050

NIA_WWU_2_08 - SWIC - Hydrogen Peaking Plant Feasibility Study

Third Party Collaborators

Costain

Energy Systems Catapult

Nominated Contact Email Address(es)

innovation@wwutilities.co.uk

Problem Being Solved

To realise Net Zero emissions in 2050 and meet the UK's interim Carbon Budgets, the way we use, store, convert and transport

energy across the country will need to change dramatically. Every sector and energy vector will need to change, including network companies.

The UK has an extensive network for Transmission and Distribution of natural gas, delivering around 600TWh of the fuel to Domestic, Commercial, and Industrial consumers, and almost 300TWh to generate power. In energy terms, the UK uses around three times more gas than electricity. Around 85% of households use gas as their primary source of heating.

Much work has been undertaken by the Energy Networks Association, including the 'Pathway to Net Zero' and 'Gas Goes Green' to establish credible pathways for UK gas networks. However, limited work has been undertaken to understand how these high-level pathways translate to regional and sub-regional networks.

Method(s)

Project partners the Energy Systems Catapult (ESC) and Costain will deliver a Strategic and Conceptual Plan. The Strategic Plan will be developed using two of ESC's national whole energy system models and Costain's gas network engineering expertise. The modelling outputs will then be used to provide insights about how the wider energy system and networks within it will develop over time, establishing parameters for network development requirements.

These outputs will become the inputs for the Conceptual Plan, ensuring that the technical and engineering work starts from a position, consistent with the least-cost pathway to Net Zero for the WWU regions.

Strategic Plan: Scenarios will be developed, and assumptions agreed. Modelling will then be carried out using ESC's multi-regional Energy System Modelling Environment (ESME) and Infrastructure Transitions Assessment Model (ITAM).

ESME is a 26-region (13 onshore regions; 13 off-shore regions) UK least-cost, techno-economic whole system model. It covers all aspects of energy demand and supply, including generation, storage, distribution and transportation and supply vectors including hydrogen, biogas, hybrid heating and electricity. ESME will be used to understand the likely whole system energy solutions for the agreed scenarios. Nationally consistent outputs will be produced for the Wales and the South-West of England regions at 5-yearly intervals out to 2050.

ESME outputs will then be used by the ESC's Infrastructure Transition Assessment Model (ITAM). ITAM uses Middle Layer Super Output Areas (MSOA) and Local Authority data to interpret what the ESME outputs mean, specifically for network infrastructure. It enables further breakdown and assessment of the infrastructure investment required to meet these scenarios and underpin sub-regional assessments. During this phase of work ESC will work closely with WWU and Costain, leveraging their technical and engineering expertise to refine ITAM model logic (e.g., infrastructure development models) and test technical feasibility.

Conceptual Plan: The Conceptual Plan will take the outputs from the whole energy system modelling and assess the infrastructure requirements against the existing and evolving gas network configuration, sources of decarbonised gas and storage to develop concept designs for each scenario. Concept designs will be developed at five-year time slices to detail the conversion pathways and develop high-level regional conversion strategies.

Measurement Quality and Data Quality Statement

The ESME (Energy System Modelling Environment) model is a data-driven least-cost optimisation model of the UK energy system, with outputs of the model being the lowest-cost transition pathway from 2015 to 2050. This model was developed by the Energy Technologies Institute (ETI) to inform its position on technologies' roles within the transition to a low carbon energy system.

The model was initially developed between 2008 and 2010. A peer review was carried out in 2010 by experts including Imperial College, Mott MacDonald, the UK Government's Department of Energy and Climate Change and the International Energy Agency, and the model was found to be fit for purpose and complements alternative tools well.

ITAM was developed to allow users to calculate and compare network transition costs across several scenarios and vectors, including electricity, gas, heat, and hydrogen. It provides users with access to a robust, centrally stored database of infrastructure costs based on current industry data. ITAM uses Middle Layer Super Output Areas (MSOA) and Local Authority data to interpret what the ESME outputs mean, specifically for network infrastructure. It enables further breakdown and assessment of the infrastructure investment required to meet these scenarios.

It is paramount for models such as ESME and ITAM to remain accurate and up to date both in terms of data assumptions and the model's capabilities. ESME's nature focuses on transition pathways reaching some distance into the future and poor quality or incorrectly implemented data assumptions or model logic can lead to inappropriate and unintended behaviours. As a result, specific

processes are followed to ensure that the quality and integrity of data within ESME and ITAM is continually maintained.

Processes include:

- Periodic updates following ESC internal principles and processes.
- Ongoing quality assurance.
- Consultation of subject matter experts to capture technology evolution appropriately.
- Development of model user guides and publication of datasets and a Data Reference Book.

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 medium level of data assumptions.

No additional peer review is required for this project.

Scope

ESME will produce whole systems analysis for Wales and the South-West of England regions. These WWU regions connect to other regions in England as well as offshore regions containing energy resources and CO2 stores, enabling representation of energy flows to and from the wider UK system.

ITAM will provide an assessment of how the gas network infrastructure will look in 2050, comparing it to current network infrastructure requirements. ITAM produces a range of outputs (e.g., the geographical deployment of heating technologies) and a 'bill of quantities' for the network infrastructure required to reach Net Zero in 2050. The modelling will be developed for the following WWU sub-regions:

- North Wales Growth Deal
- Growing Mid Wales
- Swansea Bay City Region
- Cardiff Capital Region
- West of England Combined Authority
- Devon
- Cornwall

Conceptual Plan

The Conceptual Plan will take the regional outputs from ESME and assess the optimum locations for hydrogen production and storage to deliver the volumes of hydrogen required to meet the demand identified from the modelling. The capacity of the existing WWU infrastructure will then be assessed to deliver the volumes of hydrogen to the main demand centres, developing conceptual network designs for the LTS network.

The Conceptual plan will take the sub-regional outputs from the ITAM model and assess the suitability of the sub-regional WWU network infrastructure to meet the modelled demands, developing conceptual network designs for each of the sub-regions listed above.

There is a lot of ongoing work to identify the most effective route to meet net zero in the UK and this project is one of many projects to evidence the major or minor role hydrogen will have in different scenarios. Repurposing the UK gas networks with hydrogen to support the challenge of the climate change act has the potential to save £millions with minimal gas customer disruption verses alternative decarbonisation solutions

Objective(s)

- Provide a strategic plan to decarbonise Wales and the South-West of England (Strategic Plan).
- Provide details of the future gas network requirements to achieve the optimal energy system for Wales and South-West England (Conceptual Plan).

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project has a low impact on consumers in vulnerable situations because the outputs are technical reports to inform future decision making. When looking at decarbonisation options it is important that this is done not only with a technical focus but also with a focus on the consumer and the potential impact of change upon them. Future projects will look to assess the impact of any decision on all

customers, including vulnerable customers.

Success Criteria

The delivery of a modelled output for the WWU regions (Wales and South-West England) and sub-regions, identifying the optimum whole system decarbonised energy mix to achieve net zero by 2050.

The delivery of conceptual designs for the WWU network to deliver the volumes of hydrogen required to meet the modelling outputs on a regional and sub-regional basis.

Project Partners and External Funding

Project partners: Costain and Energy Systems Catapult. This project is being funded entirely by the Network Innovation Allowance.

Potential for New Learning

The outputs of this project will provide WWU with a series of detailed, consistent, and analytically robust outputs, nested in the wider UK decarbonisation trajectory. The outputs and final report will provide WWU with the information to guide its strategic decision-making and importantly engage various stakeholder and decision-makers, including Local Authorities.

All outputs will be published on the smarter networks portal website.

Scale of Project

The scale of the project is deemed appropriate for achieving the project objectives. Reducing the modelling or engineering components of the work will not allow sufficient analysis, in terms of detail and/or technical feasibility. Additional analysis may ultimately be required to develop the outputs of this project, however the current scale of work represents a lower risk approach, providing key outputs, that then allow a next stage of analysis to be assessed, scoped and delivered.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

This will cover the entire Wales & West Utilities Network.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External Cost: £457,315

Internal Cost: £152,438

Total Cost: £609,753

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 vision to decarbonise the Wales & West Utilities network has already been identified and it includes hydrogen, biomethane and hybrid heating systems, and we now wish to move to the next stage of the process and develop a consumer focussed outline plan along with a roadmap to enable us to achieve our vision. While the precise mix of technologies and gasses in the network is unclear, Wales & West Utilities need to undertake a major programme of change in order to support decarbonisation. This project is a suite of project which will help us achieve this objective.

The purpose of this project is to provide a strategic plan to decarbonise Wales and the south west of England

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)

N/A RIIO-1 Project Requirement

Please provide a calculation of the expected benefits the Solution

This is a research project

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

All networks in Great Britain are looking to decarbonise heat and the methodology from this project may be applicable to other networks.

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

Roll out costs are currently an unknown, this project will bring us a step closer to understanding these.

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 review of WWU's gas network configurations and the recommendations made from this project will provide learning and a methodology that may be applicable to other future conversion projects by 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

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.

All networks have been made aware of this project and no concerns over duplication has been raised. A series of projects under the Net Zero South Wales 2050 banner was funded in GD2, however this project looks at the entire network and not one area in isolation, it also looks at physical assets that would be needed to transition to net zero network, something the Net Zero 2050 Projects did not.

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 solution proposed uniquely combines whole energy system modelling – which optimises the pathway to Net Zero at a UK-wide level – with granular regional disaggregation and robust engineering design methods. This unified approach delivers energy system scenarios that are consistent across a variety of spatial and temporal scales and, through co-design and iteration between holistic system modelling and detailed engineering, may be tuned to be both practical and deliverable.

The ESME / ITAM framework proposed within this project offers a regional Net Zero energy system viewpoint as an output, which is not typically available within most whole system modelling platforms. Cost-optimal systems are at the heart of this framework rather

than being inferred through manual adjustment and reconciliation. The tuning and iteration approach proposed further grounds the solutions and offers a level of robustness that is challenging to achieve via alternative analytical methods.

Relevant Foreground IPR

The modelling and conceptual plan will be the generated foreground IPR

Data Access Details

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. Wales & West Utilities 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://www.wwutilities.co.uk/about-us/our-responsibilities/innovation/
- Via our managed mailbox innovation@wwutilities.co.uk

Details on the terms on which such data will be made available by Wales & West Utilities can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" here

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

In Ofgem's final determinations it included a variety of provisions to enable necessary development work on Net Zero projects. This project has the potential to facilitate the energy system transition and is eligible to use the NIA funding mechanism

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 would only be undertaken with support from NIA funding, it is in the interests of gas customers, the regulator and the UK government and the realisation of any benefits are outside the control of the gas networks. There is no allowance in BAU business plans for this type of work and the commercial benefits and technical/operational risks associated with this type of hydrogen project are outside the traditional environment of any gas distribution network or its shareholders.

This project has been approved by a senior member of staff

☑ Yes