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

Feb 2024

Project Reference Number

NIA_WWU_02_60

Project Registration

Project Title

Development of Microgrids

Project Reference Number

NIA_WWU_02_60

Project Licensee(s)

Wales & West Utilities

Project Start

February 2024

Project Duration

1 year and 3 months

Nominated Project Contact(s)

Ben Carwardine

Project Budget

£477,333.00

Summary

Larger buildings tend to be harder to decarbonise, larger structures tend to house facilities such as university sites, college campuses, schools, leisure centres, hospitality settings etc. All of which (if connected to the energy grid) will require a considerable amount of energy to heat, not only for staying warm but other things such as swimming pools, scientific equipment and other niche processes.

We believe that the development of micro-grids on larger harder to decarbonise buildings will help ease the burden on the energy system. We propose that these micro-grids are placed on the sites of these larger buildings and use renewables such as solar, wind, hydropower etc to not only power the sites themselves but to store any surplus with the use of H2 production and storage where connection to the grid isn't possible avoiding wasting renewables.

Preceding Projects

NIA_WWU_2_16 - Hydrogen for Industrial Estate Heating

Third Party Collaborators

Frazer-Nash Consultancy

Nominated Contact Email Address(es)

innovation@wwutilities.co.uk

Problem Being Solved

The UK Government's Energy White Paper (2020) has identified hydrogen as a potential source of decarbonised heat in buildings. In order to prove the viability of hydrogen the UK Government requires a strong evidence base before deciding whether to promote hydrogen distributed in the existing gas network infrastructure (at all current pressures) to decarbonise heat. A number of different areas of evidence will be required to satisfy the use case for hydrogen including evidence on the feasibility, cost, convenience and safety of transporting 100% hydrogen.

In order to reach a net zero future there will need to be changes across the whole energy landscape. Moving away from the current 'one-size fits' all energy system we have today, to a more local approach whereby authorities choose energy systems that are best suited to their needs and resources.

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We believe that the development of micro-grids on larger harder to decarbonise buildings will help ease the burden on the energy system. We propose that these micro-grids are placed on the sites of these larger buildings and use renewables such as solar, wind, hydropower etc to not only power the sites themselves but to store any surplus with the use of H2 production and storage where connection to the grid isn't possible avoiding wasting renewables.

Method(s)

Microgrids with hydrogen production and storage capability have the potential to support the energy transition by conferring whole system resilience and flexibility benefits to a range of stakeholders:

- Commercial benefits for facilities with high variability in energy demand (e.g. academic facilities).
- Resilience benefits for facilities with high reliance on uninterrupted energy supplies (e.g. hospitals).
- Flexibility benefits to reduce peak electrical loads and thus avoid or defer reinforcement costs.
- Energy transition at lowest cost by maximising utilisation of existing gas distribution network assets.

A key aim of this study is to identify locations that are suitable for future microgrid solutions and the project will seek to define potential facility types, understand likely technology configurations, and explore possible operational use-cases. Using this information, archetypes and locations will be identified that show the greatest promise for developing a microgrid

A generalised microgrid cost benefit capability will provide long-term transferable benefits to WWU (and other stakeholders across the region), beyond the value of simply assessing a small number of initial candidate sites for a one-off demonstration. Therefore the project will produce an archetype-based hydrogen-capable microgrid feasibility study combined with, and guided by, studies of specific sites identified during the project. This will provide transferable outputs for use in future engagement activities and detailed analyses of specific candidate sites for potential demonstration projects.

Measurement and data quality statement

Frazer Nash's quality system requires that each project has a nominated project auditor; providing an independent reviewer to deliver a balanced assessment of the project objectives, including satisfying the client's requirements, combined with a review of the technical and commercial risks across the complete project. The project will receive formal project audits, with the project manager and auditor meeting to discuss the project and agree that the project risks are controlled.

The deliverables will be recorded in the project's Quality Plan, which will also appoint a suitably qualified and experienced independent verifier and an independent approver for both the model and report. Each deliverable will be subject to a "Deliverable Verification and Approval Record" (DVAR), which will record the agreement between author, verifier and approver that the deliverable is fit for purpose. These measures, in addition to a formal project audit, will ensure that an objective record of project quality is maintained throughout delivery.

We have identified where we will require data from WWU in the methodology section of the proposal, this will be reiterated during the project kick off meeting with WWU and any risks associated with supply of this data will be discussed and mitigations agreed.

Frazer Nash will employ their standard data management system for received data from WWU and keep a record of it within our electronic project folder. We can issue this list of received data as an appendix within the final report and re-issue that back collated in a zip file if required. All processed data will be clearly labelled and issued with the final report. All data processing will go through our verification processes, carried out by an independent member of staff. All assumptions will be made explicit in the final reports and data sources will be referenced.

We will restrict access to the project file within our systems so that data is only available to the project team. We do not expect to deal with any personally identifiable information within this project. If this becomes the case we will carry out a risk assessment and put relevant mitigations in place to manage the data properly.

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 high level of data assumptions. No additional peer review is required for this project.

Scope

Facility Archetype Development

Description: Create facility archetypes by identifying appropriate facility types and scales and generating typical energy demand profiles requirements to be estimated and a cost profile to be calculated

Output: Facility archetypes and their estimated energy demand profiles

Microgrid Technology Optioneering

Description: Identify most appropriate renewables for sites (Key output 2) and viable microgrid tech combinations.

Output: Defined microgrid concepts for each facility archetype (including renewables). Defined hydrogen use cases describing the demand and storage scenarios for different facility archetypes.

Cost Benefit Analysis (CBA)

Description: Understand and document the costs and benefits of deploying the concept microgrids. The CBA will use the business-as-usual costs of running a facility without a microgrid as a counterfactual.

Output: CBA tool to enable efficient site-specific analysis. Archetypal CBA results for the archetypes/concept combinations. These will provide contextual value in their transferability to specific sites considered by this project but also future work by WWU.

Regional and Site-Specific Viability Assessment

Description: Identify and engage with high potential microgrid candidate sites and the relevant Local Authorities (LAs) and deliver site-specific technology and commercial feasibility studies for up to two sites. The scope of the project can be extended if WWU wish to look at additional sites.

Outputs: Region wide visualisation of the sites in the WWU area where installing a microgrid may be feasible. Specific site data including energy demand data). Results from site-specific CBAs using data provided from shortlisted sites within WWU's licence area.

Road mapping, Reporting and Stakeholder Engagement Material

Description: Detail the project conclusions, including identification of viable facility types for hydrogen capable microgrids, required features for commercial viability, and demonstration roadmap for specific high potential sites within WWU's licence area.

Output: Defined route to demonstration of the proposed microgrids at specific sites

November 2024 Increased Scope

During the course of current activity, the project team has identified the potential to progress this idea for a SIF Beta Application to build on the desk-based research carried out to date and demonstrate selected aspects of the identified benefits.

However, the Microgrids projects was not scoped with the intention of leading directly into a demonstrator. As such, the project team recognise that further work is required to define an approach for a Beta Application, including identifying and engaging with the required partners, and developing a more detailed scope and costs for the Beta Project.

Requirements and Hypotheses

This work package will kick-off the modified Microgrids project scope and agree the overall aim to develop the maturity and enhance the cost estimate for the intended demonstrator. Two key outputs of this meeting will be generating some hypotheses on the demonstrator we aim to manufacture, and a plan for bringing partners into the project.

Following this, a set of user requirements will be developed to understand how the demonstrator shall perform and operate, as well as non-functional requirement considerations such as safety, environmental, maintenance and human factors. It is likely the user requirements from the HyVoltage VCS outline design will be adapted for this new project phase.

The user requirements will be linked to hypotheses around the aspects of a microgrid performance that the Beta project aims to demonstrate

Engaging Partners

It is vital to get partners onboard in this project as early as possible, as design decisions will be de-risked once partners can confirm or inform any assumptions made. The key partners to identify are:

- Site Partner
- Network Partner
- Electrolyser Supplier
- Fuel Cell Supplier
- Hydrogen Storage Supplier

The team will engage with local areas and councils to understand their decarbonisation challenges and how the concept could support their regional plans. This will provide an opportunity to define the scale of the opportunity for the concept and where it may provide most value.

Design Development

System Requirements

Frazer Nash will develop a set of system requirements to understand how the technology shall perform at individual system levels, for example the electrolyser performance. This will include functional performance criteria as well as non-functional requirements.

Design Development

Concept Design

At this stage of the project, the team will generate a concept solution that meets the user and system requirements. They will utilise the team’s diverse range of experience in developing concept designs for process plants to complete this design. The methodology to achieving a mature concept design from which a cost estimate can be developed involves completing the following steps

Process Flow Diagram

Frazer Nash will produce a high-level diagram that describes how the system will operate in a single operating mode. It will indicate the key components within the system and how they inter-relate. The flow of energy and substances from network connections, through to the electrolyser, hydrogen storage and fuel cell will be clear from this diagram. Furthermore, the stream conditions, such as temperature, flow rates and pressure at key parts of the system will be identified – a key element that allows equipment sizing to be established later in the project. To achieve this, a heat and material balance will be conducted for the system.

Process Description

Frazer Nash will write this document to provide a description of system operation, building upon the process flow diagram. This will include:

- Operation Philosophy
- Control Philosophy
- Isolation Philosophy
- Over Pressure Protection Philosophy
- Shutdown Philosophy

Design Development

Electrical Architecture Diagram

Frazer Nash will produce a high-level level Single Line Diagram (SLD) showing the key electrical components (electrolyser, fuel cell, protection devices, transformers etc.).

Design Development

Initial Safety Assessment & HAZID

From the previous three deliverables, a high-level concept will be in place and thus a high-level safety assessment can be completed.

Design Development

Piping & Instrumentation Diagram (P&ID)

A P&ID will be produced to begin to define the pipework, valves and control system components that are required in the system to link all the key components.

Equipment Sizing Calculations

In parallel with P&ID production, Frazer Nash will calculate the size of equipment required. This will be for key components such as compressors and heat exchangers and will calculate properties such as power, heating and pumping volumes as well as operating pressures. It will also identify how large piping must be.

Optioneering & Component Selection

Upon completion of the sizing calculations, Frazer Nash will complete an optioneering stage to determine which electrolyser, fuel cell, storage and grid connections are needed. This will involve contacting suppliers and using previous knowledge from the existing HyVoltage and Microgrids projects to down-select optimum components to use for the demonstrator.

Design Development

Control System Architecture Diagram

The concept-level control architecture diagram will provide a high-level overview of the system's structure and key components. Frazer Nash will produce one to identify interface types and present the flow of data between components and sub-systems. The architecture will also specifically highlight components which are important to safety.

Concept Operating Philosophy

Frazer Nash will develop a concept-level control system philosophy to provide a high-level overview of the system's structure, functionality, and key components. It will outline the main subsystems and their responsibilities, as well as how they interact through interface definitions and overviews of the main control loops.

Work Package 8: Design Development

Failure Mode and Effect Analysis (FMEA)

Efficiency will be a key parameter to demonstrate the concept is a viable solution, therefore a Failure Mode and Effects Analysis (FMEA) will be undertaken to identify potential failure modes and help the demonstrator achieve high availability.

Interface Definition

It's vital to understand how the system will integrate into the site, in terms of process connections, utilities, control system, power supply, mounting, structures and access.

3D CAD Modelling

A high-level model of the whole system will be produced. This model will provide a 3D visual aid in how the plant looks, the length and position of primary pipe-runs and how the site is laid out. This model will not be detailed, however seeing it would allow a user with no-prior knowledge of the site to understand where components lay, how the system integrates to the site and how people will operate, maintain and interact with the site.

Work Package 8: Design Development

General Arrangement (GA) Drawing

Upon completion of the CAD Model, a GA drawing will be produced to indicate the site layout, size, interfaces and access routes.

Concept Design Review & HAZOP

A HAZOP will be conducted to identify further safety concerns with the concept design. The concept design review will be an opportunity to provide comments on all aspects of the design, with input from senior individuals expected.

From undertaking this concept generation phase, the team will aim to produce a Class 3 cost estimate suitable for a SIF Beta application.

Work Package 9: Demonstrate Business Case

This work package will develop an outline initial business case around the economic and commercial viability of the solution, providing value for money evidence in support of the Beta application

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)

To identify the data required to establish the size of a microgrid, along with the equipment to run it along with the feasibility of owning, maintaining and operating the site by a local authority or third party.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and wellbeing related) for this project has been carried out using a bespoke assessment tool, which assesses the project as having a positive, negative or neutral effect on consumers in vulnerable situations. To help inform the assessment, this tool considers the categories of consumers identified in the Priority Services Register. This project has been assessed as having a neutral impact on customers in vulnerable situations.

Success Criteria

A successful project will see the production of a report detailing:

- Demand data from chosen sites and profile over a 12 month period.
- Renewables required in order to create such microgrids.
- Generation split between what is needed when and what surplus can be used in the hydrogen production and storage process
- Safety and regulation impacts on owning, maintaining and operating a microgrid
- Cost to implement and maintain a microgrid, including detailed costs of equipment required
- Alternative options of surplus hydrogen production, such as refuelling, sale of hydrogen, storage or future connection back into a 100% hydrogen gas network.

Project Partners and External Funding

The project partners delivering this project are Frazer Nash. The project will be wholly funded via NIA.

Potential for New Learning

The project will help networks understand if microgrids are a feasible option, as well as the type of locations they could be best suited to.

Scale of Project

This is a desktop study. This is the appropriate scale and de-risks the project, as future phases are unknown.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL3 Proof of Concept

Geographical Area

The project will look at Micro-grids that are suitable for the WWU network, however the project will also provide transferable outputs for use in future engagement activities and detailed analyses of specific candidate sites for potential demonstration projects in other areas.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External Cost: £358,000 Internal Cost: £119,333 Total Cost: £477,333

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 facilitates the energy system transition. We believe that in order to reach a net zero future there will need to be changes across the whole energy landscape. Moving away from the current 'one-size fits' all energy system we have today, to a more local approach whereby authorities choose energy systems that are best suited to their needs and resources.

It is possible that some local authorities will look to rely upon electricity as a way to decarbonise, putting extra strain upon the electricity network that in places is already at it's peak. Without proper funding and investment to develop the electricity networks in these areas it could lead to a number of electric blackouts, due to demands not being met.

Therefore we believe that the development of micro-grids on larger harder to decarbonise buildings will help ease this burden

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

Please provide a calculation of the expected benefits the Solution

This is a desktop/research project. So there are no tangible benefits at the current time.

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

The project will produce an archetype-based hydrogen-capable microgrid feasibility study combined with, and guided by, studies of specific sites identified during the project. So is replicable across the entire network.

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

Roll out costs are unknown at this early stage.

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

As the project will produce archetype-based hydrogen-capable microgrids, other networks can use this to locate suitable locations in their network.

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 of duplication have been raised.

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 is not only innovative in a technical sense, but also because it challenges the way we currently use energy, whilst providing evidence for how future technology operators may align with a future energy system.

The UK gas networks are working on a wide range of projects to understand the feasibility of hydrogen as an energy solution for the UK as part of the net zero targets for 2050.

Relevant Foreground IPR

The relevant foreground IPR produced will be the final report.

Data Access Details

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'. WWU 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 here
- 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

Ofgem published its final determinations which included a variety of provisions to enable necessary development work on Net Zero projects but also to ensure vulnerable customers are thought about in any decision making. This project has the potential to facilitate the energy system transition and is therefore 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 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.

This project has been approved by a senior member of staff

☑ Yes