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NIA Project Registration and PEA Document

Date of Submission

Aug 2020

Project Reference Number

NIA_WWU_066

Project Registration

Project Title

HyCompact

Project Reference Number

NIA_WWU_066

Project Licensee(s)

Wales & West Utilities

Project Start

August 2020

Project Duration

1 year and 8 months

Nominated Project Contact(s)

Oliver Lancaster (Wales & West Utilities) and Jack McKellar (UK Power Networks)

Project Budget

£461,217.00

Summary

A project to demonstrate the efficiencies of installing a single-unit hybrid heating system to further develop customer acceptability, minimise disruption, improve cost efficiency and enhance smart controls with boiler modulation

Nominated Contact Email Address(es)

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Problem Being Solved

In the UK, domestic energy use is responsible for more than a quarter of national greenhouse gas (GHG) emissions and 75% of household energy use is for space and water heating. Finding effective low-carbon heating solutions for buildings is one of the biggest challenges in reducing emissions across the energy system to net zero by 2050. Energy efficiency, decarbonised gas, renewable electricity and district heating all have potentially important roles in delivering the most cost-effective solution for reducing emissions from domestic heating.

Hybrid heating systems have the potential to play a pivotal role in the decarbonisation of heat. A hybrid system sees a heat pump working alongside a traditional boiler. They are a technology solution that is readily acceptable to consumers that helps limit disruptive retrofitting such as solid wall insulation and radiator upgrades that are a pre-requisite for heat pump-only systems.

The ENA/Navigant 'Pathways to Net Zero' report also highlights the importance of hybridisation, with 22 million domestic systems in use by 2050 – single unit hybrids enable quick progress in this area.

This project builds on the Freedom Project which demonstrated that hybrid heating systems, when integrated with grid enabled domestic demand-side response (dDSR) controls, are able to make highly efficient use of new renewable generation capacity and minimise the impact on electricity network peak demand, despite shifting a significant proportion of demand across from the gas

network.

Additionally, Freedom delivered valuable insight and learning regarding customer acceptance, installation skills and hybrid equipment costs.

In this project we will seek to act on this feedback to develop and demonstrate a solution that meets these requirements and explore a system that delivers least disruption and cost to the homeowner.

This proposal builds from and expands on the Freedom Project, which investigated the implication of deploying high volumes of grid-aware hybrid heating systems on the broader energy system.

Method(s)

Since the Freedom Project commenced, it has been desirable to identify a single-unit hybrid heating system to further develop customer acceptability, minimise disruption and improve cost efficiency, whilst also providing multi-vector flexibility and the opportunity to achieve decarbonisation. This had previously been researched through the opportunity for a single gas-electric heat pump unit; however, a single hybrid unit within a boiler casing provides the greatest opportunity for customer acceptability, avoids the requirements for external space for a heat pump and is deliverable by the army of gas appliance installers – reducing the pressure on the upskilling pressures across the workforce to become F-Gas qualified.

Having both appliances within the boiler unit presents the opportunity to maximise efficiency across the heating system and energy system, as well as introduce smart boiler modulation as part of the hybrid controls.

This project will be a technical demonstration of a single unit hybrid heating system that is tested with the advanced controls deployed in Freedom. The project will:

- Select trial participant location(s), engage and recruit
- Select the type and size of heat pump
- Develop communications interface between PassivSystems existing smart controls software and the new hybrid heating system
- Trial and field test the equipment
- Analysis and reporting

Scope

The proposed project runs for 11 months and has been broken down into the work packages outlined below:

- Develop an interface for PassivSystems to communicate with the hybrid heating system.
- Demonstration of technical capabilities of PassivSystems advanced algorithms to unlock value from operational efficiencies and energy markets, through simulations of a predictive aggregated dDSR control system.
- Customer engagement and recruitment understand the customer journey and experience of hybrid heating system (including willingness, installation, to daily use)
- Complete market survey and analysis to better appreciate the supply chain and potentially identify more suppliers

Objective(s)

- Establish the asset, installation and operational costs of using a single unit hybrid heating system to deliver grid flexibility services.
- Demonstrate system benefits of large-scale deployment of such low cost, integrated hybrid heating systems with an aggregated dDSR control system.
- Capture and analyse consumer feedback on the comfort levels provided and other aspects such as noise, visual appearance, installation experience, bill impact etc.
- Analyse and evaluate the performance of a single unit hybrid heating system for various types of housing stock
- Provide project partners with a full operational data set, reporting on performance and network impacts and support project dissemination and promotion activities.

Results and outputs developed by this project will contribute to the understanding of the UK's roadmap to net zero. This includes:

- reduction of consumer carbon emissions
- opportunities for lower energy bills through increased heating system efficiencies
- reduced energy cost arising from demand flexibility services

- role of hybrids in a low carbon energy system.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

n/a

Success Criteria

To successfully demonstrate a single unit hybrid heating system with a communications interface between PassivSystems existing smart controls software. Through this we will collect a body of evidence to support this forward-looking concept. The research will document the outputs of:

- The pilot installations
- The system interfaces and smart controls
- Customer feedback

Gain insights into the means of balancing the interests of the consumer, supplier, and network operators when seeking to deliver a cost effective national decarbonisation strategy, where 'Hybrids First' is one scenario to achieve this transition.

The above will assist in identifying the next steps towards a commercial roll-out solution of smart, grid-aware, single unit hybrid heating systems. In addition to this we will better understand the customer journey required in such a rollout

Project Partners and External Funding

The project will be funded using Network Innovation Allowance.

Project partners PassivSystems will be contributing £31,888.50 towards the project.

Northern Gas Networks, Cadent Gas and SGN are supporting this project as non-financial partners.

Potential for New Learning

By integrating PassivSystems advanced, grid-connected smart controls with the single unit hybrid system, this project will gather in-home performance data and demonstrate aggregated dDSR simulations. This will enable WWU to update our whole system modelling with a revised hybrid price point incorporating data on the actual performance of the unit. Similar benefits are also expected for other network partners. It is our expectation that data from this project will have a significant impact on the sensitivities of our energy system modelling. This will further our understanding of the role of hybridisation in achieving a cost-effective transition to net zero carbon emissions for consumers, installers, energy networks and the wider economy.

Scale of Project

The scale of the project is to install seven single unit hybrid heating systems in customer properties as a pilot demonstration. This will enable the project to gather real life data combined with aggregated dDSR simulations. The learning will be used to survey a wider cohort of consumers as part of the project.

Technology Readiness at Start

TRL6 Large Scale

Technology Readiness at End

TRL7 Inactive Commissioning

Geographical Area

The demonstrator is not constrained to a particular area. The learnings can be applied to the modelling of any given area or energy network configuration.

Revenue Allowed for the RIIO Settlement

N/A

Indicative Total NIA Project Expenditure

External cost: £321,996.50

Internal cost: £107,332

Passiv cost: £31,888.50

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 unit is expected to come at a lower capital cost and lower installation cost, as well as provide heat at a lower operational cost than a smart hybrid system with two separate units. The downward capital cost trajectory for the single unit hybrid system is also expected to stay lower than the trajectory of the smart hybrid system with two separate units.

Please provide a calculation of the expected benefits the Solution

The Freedom Project findings showed that hybridisation of heat, at-scale, offers up to £15.2b/yr saving compared to full electrification. Analysis for Freedom was carried out pre-net zero. The value of hybrids may now have changed slightly; however, the reduced cost of capital alone with a solution like the single unit hybrid heating system is expected to add benefit to the total energy system cost.

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

This would be suitable for all network licensees to roll out.

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

In the immature market with low numbers manufactured and deployed, the single unit hybrid system has a ~25% cost advantage (~£6,250) over a Freedom Project-style hybrid heating system (~£8,500), which includes a new boiler & heat pump, ancillary equipment, controls, metering, survey and installation. The cost of both types of hybrid systems is expected to reduce over time as the market matures, but that the single unit hybrid would maintain a cost advantage.

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

A smart, grid aware, hybrid heating system that has a combined heat pump and boiler in a single unit has the potential to operate both appliances independently, but importantly also simultaneously, with the opportunity for significant complimentary appliance efficiency benefits needing to be explored across the whole energy system.

Higher heat pump efficiencies with these systems in a proliferated deployment scenario may support the electricity distribution system to deliver more heat within a network capacity limit, enable greater electricity network utilisation, reduce electricity generation capacity requirements (both low carbon sources and flexible back-up) investment needs.

Higher gas boiler efficiencies with these systems may support smarter gas grid pressure control from less peaky consumption, whilst still needing the full network capacity for peak requirements. Higher gas boiler efficiencies may also use green gas more sparingly in areas expected to retain a biomethane grid and provide further insight into a system design for blue and green hydrogen production capacities, hydrogen storage capacities and CCS demand profiles for those parts of the network expected to convert to 100% hydrogen.

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 single unit hybrid heating system is a unique device which has not been trialled with grid aware optimisation controls anywhere else in the UK.

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

This appliance is new to market and one-of-a-kind. It offers significant potential and has not yet been tested with optimised grid-aware smart controls. The Freedom Project opened up and pushed the cross-vector boundaries of innovation to decarbonise domestic heat with a low-disruption solution at lowest whole system cost (building, technology, networks and supplies). The testing of a simpler hybrid system to understand its network impact is now needed, which pushes the boundaries of this innovative, flexible system further still. As well as demonstrating this new system as being an acceptable installation to households, its capability to still meet net zero carbon emissions is critical. The roll-out of stand-alone heat pumps or heat pumps in hybrids presents a significant installer skills gap; however, the single unit hybrids can be installed by Gas Safe Registered engineers and provide an opportunity to overcome a skills shortage and threat to net zero timelines.

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 did not form part of the RII0 GD1 or ED1 settlement. It requires funding outside of this.

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 single unit hybrid solution is not ready to offer as a commercial proposition with smart grid-aware controls – it has not been technically proven. This is a risk and so needs NIA funding. Also by using NIA funding, project partners will share all findings, thus enabling wider decarbonisation across the whole of the UK and not just the project partners' networks.

This project has been approved by a senior member of staff

Yes