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 2021

Project Reference Number

NPG_NIA_038

Project Registration

Project Title

The Value of Flexible Heat Demand as a Service to Distribution Networks

Project Reference Number

NPG_NIA_038

Project Licensee(s)

Northern Powergrid

Project Start

September 2021

Project Duration

0 years and 7 months

Nominated Project Contact(s)

Chris Artist

Project Budget

£35,000.00

Summary

A study to understand the heat performance of typical buildings, found on both the northern Powergrid and other distribution networks, and to massess there current and future impact on electricty demand and networks operations.

Nominated Contact Email Address(es)

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Problem Being Solved

The ongoing growth of LCT heating systems continues to offer a future challenge for reliable, cost-effective network operations.

In a net-zero carbon system where generation is more variable, an efficient system can only be achieved by consuming and supplying energy more flexibly. On the consumption side, demand patterns are changing as we are using electricity for heating and transport. For example, almost half of the final energy consumed in the UK is to provide heat (726 TWh)[1] – more than that used to produce electricity for transport. Around 57% of this heat (391 TWh) goes towards meeting the space and water heating requirements of our homes. This means that decarbonising domestic buildings forms a key part of the roadmap to net-zero carbon energy system. The recently unveiled a “Ten Point Plan for a Green Industrial Revolution”[2], bringing together ambitious policies and significant new public investment to continue the UK’s commitment to tackling greenhouse gas emissions. Point 7, Greener buildings, aims to increase the efficiency and comfort of homes, workplaces, schools and hospitals by reaching 600,000 heat pump installations per year by 2028. Thus, it is important to ensure enough electricity is available to meet these needs, whilst also taking advantage of opportunities to lower our bills by changing when and how we use electricity.

New sources of flexibility on both the supply and the demand side could help network operators respond to consumers’ changing needs while delivering a resilient, sustainable and affordable electricity system. In the context of the electrification of the heating sector, in particular in buildings, flexibility can be provided as a service to the wider energy system by: shifting electricity consumption to a different period of time; reducing demand for electricity at key times (that is, with a net reduction in overall consumption); and

increasing electricity consumption when needed (that is, with a net increase in overall consumption). These actions can be taken in response to a price or electronic signal, for instance, to support the Distribution Network Operator (DNO) to manage the loading level of circuits at critical times of the day.

It is therefore paramount to understand the flexibility potential that buildings, as a system, can provide to the electricity distribution network. In addition, it is important to identify the costs and benefits of the provision of flexible electric heating as a network flexibility service and the consequent techno-economic impact on distribution network development, operation and management.

Method(s)

The most significant impact of the decarbonisation of heat in buildings will be felt at the low voltage distribution networks where electric heat technologies will largely connect. The project will address the issues by applying the following methods:

Undertake stakeholder engagement on customer options for decarbonising heating of space in domestic buildings between now and 2030 across NPg's network licence areas.

· Forecast the levels of uptake of the individual technologies out to 2030 as well as their likely location of deployment throughout the licence areas.

· Create a web-based interactive regional map of the uptake of technologies to visualise hotspots areas which, in turn, could become areas of network constraints / intervention due to heat load growth.

Identify and characterise the most common building archetypes in NPg's network licence areas.

· Establish the composition of the building stock representative of the geographic areas served by NPg.

· Assess the magnitude and shape of the electric heating demand (both flexible and non-flexible) conditional to the building architype and then of the overall building demand.

Assess the technical impact of flexible electric heating on electricity distribution network design through detailed network analysis underpinned by power systems modelling.

Quantify and assess the techno-economic impact of electric heating (both flexible and non-flexible) on NPg's electricity distribution network.

· Assess the impact of low carbon heating on distribution network development, operation and management.

· Establish the flexibility potential that buildings, as a system, can provide to the electricity distribution network as an alternative to conventional network reinforcement.
Design and specify a real-world field trial to demonstrate the value of flexible electric heating demand that buildings as a system can provide as a flexibility service to the electricity distribution networks.

Scope

This project will investigate the advantages of flexible heating services to both the network and to its customers. This is achieved by performing stakeholder engagement; analysis and review of building types and their role in flexible services; power system modelling for analysis of impact on distribution networks and design of a field trial.

Objective(s)

The aim is to understand and analyse the potential impact of flexible heating services.

The objectives

1. Analyse customer options and take-up for de-carbonising heating.

2. Assess and model building types and customer behaviour within the NPg area and investigate flexibility options.

3. Quantify and assess the technical impact of flexible electric heating on electricity distribution network design through detailed network analysis underpinned by power systems modelling.

4. Perform a techno-economic assessment of the impact of electric heating and update NPg's Low Carbon Technology Network

Planner Tool to assess impact on the distribution network.
Design a real-world field trial to assess the efficacy of proposed flexible heating solutions.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

N/A

Success Criteria

This project will be successful if it clearly identifies one (or more) flexible operation strategies and their techno economic assessment, which could be taken forwards for real-world trials.

A number of specific project outcomes:

· Identification of stakeholder support and future take-up of LCT heating systems

· Catalogue of building demographics within the network area related to the possibility of implementation of different flexible solutions

· Assessment, by means of power simulation studies, of the technical impact of the proposed flexible solutions on the network

· Techno-economic assessment of the costs of implementation of proposed solution(s), and
Design programme for a structured field-trial

Project Partners and External Funding

N/A

Potential for New Learning

The project will investigate new flexible strategies related to network management with customer integration in load management. Not only will this project propose flexible solutions for the current market, but this is as an ongoing area: further development of these strategies will be required to factor in new LCT, the growth in LCT take-up and the development of smart (two-way) metering devices.

Scale of Project

At this stage of the project, the work completed will be a desktop research, modelling and analysis exercise to establish proof of concept for a flexible network operation solution.

If the project progresses to field trials at stage 2, technical and commercial solutions could be deployed in a number of buildings to investigate the flexibility actions in practice.

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Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

Desktop, appropriate to entire network arae plus other GB.

Revenue Allowed for the RIIO Settlement

None.

Indicative Total NIA Project Expenditure

£35000

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:

Understanding the decarbonisation of heat has a profound imapct on supporting futre developments with regard to net-zero and the transition of the broader energy system.

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)

Project is a low TRL project and therefore has no immediate cost benefit.
However, in implementation, financial benefit will arrive through movement of customer load to off-peak times thereby reducing customer cost. Optimisation of the network to support the decarbonisation of heat contributes to lower network management costs and the potential to keep future costs to customers down. The output of the study will contribute to an improved understanding of the precise benefit.

Please provide a calculation of the expected benefits the Solution

The solution in and of itself provides no immediate financial benefits.

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

The GB housing stock is similar across the country and the projects's outputs are therefore easily replicable across all networks.

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

No costs to rolling out the project's outputs.

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

Application of flexible heating/ home energy optimisation solutions/use of thermal storage are all important features for the operation of future distribution networks, not just Northern Powergrid. The methodology and modelling requirements can be documented and would be applicable to other network areas operated by other DNOs.

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

Support of environmental improvement in general and the journey to net-zero are specific requirements of NPg's innovation strategy

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.

A review of current and past network projects has revealed no similar projects.

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

Government rules for timely de-carbonisation have promoted customer uptake of LCT giving DNOs new load related problems. Flexible solutions involving adapting customer loading are more receptive to the customer due to promotions of changes in tariffs, introduction or smart metering, publicity on carbon reduction. These incentives are effectively game-changers, in terms of network operation. With a significant proportion of LCT heating systems + customer acceptance + smart devices now in increasingly common usage, DNOs have the new possibilities to improve load management.

Relevant Foreground IPR

All foreground IP on the project's findings will be dissmeninate and made available to other licenced entities.

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

The project is low TRL with an uncertain technical and economic outcome.

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 rpoeject is R&D, having a technical risk that the information gathered is not useful and an economic risk, in that even if the information gathered is useful it is not economically or commercially exploitable.

This project has been approved by a senior member of staff

☑ Yes