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

Apr 2024

Project Reference Number

NIA2_NGESO068

Project Registration

Project Title

Market Signals for the Electrification of Heating

Project Reference Number

NIA2_NGESO068

Project Licensee(s)

National Energy System Operator

Project Start

March 2024

Project Duration

0 years and 11 months

Nominated Project Contact(s)

innovation@nationalgrideso.com

Project Budget

£400,000.00

Summary

Significant electrification of heating is a fundamental requirement for decarbonisation. Electrification of home heating is expected to increase residential electricity demand by 50% in 2035, and to double peak demand by 2050, creating a significant additional cost for the GB electricity system. This project will look to understand how flexibility market signals can encourage electrification of heating, and the adoption of flexible heating practices from domestic consumers and their homes. This project aims to understand what market signals the ESO should develop to encourage electrified heating, flexibility practices and understand where these sit in the wider context of market signals for domestic consumers.

Nominated Contact Email Address(es)

Innovation@neso.energy

Problem Being Solved

Great Britain is largely dependent on natural gas for home heating. In order to decarbonise, significant adoption of electrified heating systems (heat pumps, storage heating, thermal storage etc) are required. Inflexible electric heating is likely to drive costs across the system, from localised distribution constraints and reinforcement needs to national generation peak capacity needs. Peak heating periods coincide with peak system and network demand, so therefore, unlocking flexibility from heating has the potential to significantly reduce costs for the electricity system and consumers. There is currently a poor understanding of what “optimal” market signals will encourage electrified heating adoption and flexible operating practices should look like.

Electrification of heat could lead to annual residential electricity demand increasing by 50% by 2035 and peak demand doubling by 2050, requiring more electricity generation and network capacity. Consumer engagement with smart appliances and thermal storage will be important to help mitigate the increase in peak residential electricity demand from electrification of heat. Most consumers are not on time-of-use tariffs, so have no incentive to operate electrified heating flexibly in response to market signals.

Current signals include the wholesale price (volatile), the Balancing Mechanism, and balancing services such as the Demand Flexibility Service (DFS). Individual consumers are only able to access DFS, which is highly irregular, unpredictable, and occasional. They are insulated from signals from other balancing services, the BM and wholesale price by flat retail tariffs.

Method(s)

This project aims to understand what market signals the ESO should develop to encourage electrified heating and flexibility practices and understand where these sit in the wider context of market signals for domestic consumers. Delivered through 5 quantitative and qualitative workstreams.

The key objective for this project is to investigate what market signals and enablers could be created to incentivise energy customers to switch to electric heating technologies, adopt flexibility enabling technologies and consume flexibly. The outcome of the project will be a roadmap for implementation of the optimal enablers, including design of a trial. The project will be structured in five work packages to deliver, with work package four focusing on stakeholder engagement running in parallel to work packages two and three. All workstreams will utilise ESO data and assumptions where available, such as FES data.

- A series of webinars, including an initial project launch and briefing meeting, a mid-project progress update briefing, and a close-down and reporting briefing
- Two workshops or round-tables, with groups of industry representatives from the key constituencies: energy suppliers, third party aggregators/ optimisers, and consumer representatives
- Direct engagement in the form of semi-structured interviews with interested parties, to include ESO experts and third parties which are identified by the project team or who self-identify through the wider engagement exercises.

Data Quality & Measurement Quality Statement: Publicly available ESO data such as Future Energy Scenarios workbook data will form the basis for scenarios for electrification of heating, and the project will align on assumptions with ESO subject matter experts to ensure alignment. As the project is focusing on modelling future outcomes, there is a high degree of uncertainty. The ESO Future Energy Scenarios are trusted across industry as viable pathways for the energy system and will form the foundation for this project. All other assumptions will be aligned with ESO subject matter experts as well as with wider industry representative active across electric home heating and flexibility markets. Where proprietary models will be used by WSP and Cornwall Insights, methods, data and outputs will be reviewed by ESO subject matter experts to ensure quality assurance.

Risk Assessment:
In line with the ENA's ENIP document, the risk rating is scored Low.
TRL Steps = 2
Cost = 1(£400,000)
Suppliers = 1 (1 Supplier)
Data Assumptions = 1

Scope

The project scope focuses on electric home heating including heat pumps, storage heaters, direct electrical heating and thermal storage including hot water and phase change materials. Domestic consumers are the focus for the project, and a number of home heating archetypes and profiles will be developed. The project does not include networked home heating solutions such as district heating solutions.

The project takes a whole electricity system approach to understanding costs and benefits from electrified heating, and for market signals. The project will however focus on market signals that the ESO have direct influence over and look to understand these in the context of other market signals and options to accelerate electrification of heating and flexible operation.
The project will only focus on home heating and will not focus in detail on other electrification or flexibility technologies or consumer segments. Whilst the project scenarios will have a long-term outlook, the market signals and options for interventions will focus on the medium term, up to 2030.

Objective(s)

The key objectives are to:

1. Understand electric heating uptake scenarios
2. Understand status quo, including counterfactual and identifying costs of “doing nothing”
3. Identify gaps, enablers and blockers for electric heating in the GB market
4. Identify what signals would be more effective with consumers
5. Design a trial of market interventions

Consumer Vulnerability Impact Assessment

The methodology proposed for this project will allow us to understand the incentives and market signals for vulnerable consumers to adopt electric heating technologies. It will also analyse the access of vulnerable consumers to services more complex than the baseline electricity tariffs.

Success Criteria

The key success criteria are:

- The delivery of an “actionable” list of recommended market interventions that can positively influence heating electrification and flexibility provision from heating.
- The design of an implementable trial.
- Increased learning and understanding of heating pathways and flexibility potential for home heating across the ESO.

Project Partners and External Funding

Project partner: WSP.

Potential for New Learning

1. Increased learning about the potential costs and benefits of home heating electrification, and associated provision of flexibility across the system.
2. Increased understanding of the potential flexibility from home heating technologies, domestic consumers and home archetypes.
3. Increased understanding of market signal options to accelerate home heating electrification and flexibility provision and operation.
4. Understanding of interventions the ESO can take forwards, including expected benefits

Scale of Project

This is a small scale project looking to increase ESO understanding of the potential impacts and benefits of electrified home heating. Outputs from the project will inform ESO actions to accelerate the growth of consumer energy resources across its markets, and wider electricity markets including DSO and wholesale markets.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The project will take place in Great Britain (GB) only. The ESO has a licence to operate the GB electricity system.

Revenue Allowed for the RIIO Settlement

None

Indicative Total NIA Project Expenditure

£400,000

Project Eligibility Assessment Part 1

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

The project has 2 main outcomes which are to accelerate the electrification of home heating and to enable the operation of electrified home heating in a flexible way. Decarbonisation of home heating, mainly through electrification is one of the greatest challenges in transitioning to net zero in the UK. In addition, increasing demand side flexibility in order to maximise the benefits of wind and sun powered electricity is a priority in the decarbonisation of the electricity system

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

By creating a new market in domestic flexibility, the project might be able to establish a more stable revenue stream for investments in domestic flexibility. This would enable more parties to invest in these technologies, particularly parties such as social housing operators, which typically will only be able to invest on an economic basis against a stable revenue stream. This would allow more vulnerable consumers – those living in social housing – to access the financial and carbon-emission benefits of electrified heating with flexibility.

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

N/A

Please provide a calculation and/or description of the expected benefits of the solution

An initial high-level assessment of savings notes that an additional 1GW of peak capacity costs GB consumers:

- £60mn/year in Capacity Market costs (at 2023 CM outturn prices)
- £500mn investment in 2-hour, Lithium-ion batteries
- An additional £93mn/ year in wholesale costs in 2029-30 (based on 1.5mn heat pumps, shifting half of their 12MWh/year load from peak to off-peak pricing periods)
- Network investment savings of £2.15bn per 1GW on the distribution network, plus additional transmission system reinforcement.

These figures are very high level – much of the purpose of this project will be to fully understand the nuances of this position and to therefore provide the context on savings to underpin the creation of a new market.

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

A single, GB-wide market is anticipated, covering all consumers. While integration with DNO/ DSO needs will be considered, this is primarily an ESO-led initiative.

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

This research and development project is intended to lead to establishment of a market for domestic flexibility, which will reduce peak GB electricity demand. This market will be implemented by the ESO, using its internal resources. At this stage, costs cannot be estimated as the project outcome will be exploring the relative merits of implementation, rather than developing an implementable solution.

Requirement 3 / 1

Involve Research, Development or Demonstration

Projects 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

Involve Research, Development or Demonstration - Please select all that apply

☐ 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

This project intends to test the revenues which could be available to underpin a new market in domestic flexibility (primarily smart control of flexible domestic heating technologies) in the near-term. If implemented, domestic heating flexibility could reduce the need for dispatchable generation buildout and network reinforcement of the transmission and distribution systems by reducing the peak demand on the GB electricity system. This flexibility could also help mitigate Balancing Mechanism (BM) price spikes. These measures will provide the Electricity System Operator (ESO) more tools to allow it to manage the electricity system at lower cost to the consumer, and thereby promote efficient system operation.

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. Networks must explicitly mention similar projects that they have considered and how these differ.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

Before kicking off the project, all related ESO, UK and international projects focusing on these topics have been investigated. This includes a number of ongoing projects and ESO initiatives that the project team will closely engage with as the project progresses:

- Future Energy Scenarios: FES represent a range of different, credible ways to decarbonise our energy system as we strive towards the 2050 target. Heating and flexibility are core outputs of FES scenarios.
- Spatial and temporal analysis of electricity consumption and flexibility (Regional Heat) NIA: Granular locational estimation of heat pump uptake scenarios and associated flexibility from thermal inertia in buildings.
- Bridging the Gap: This years BtG deep dive is focusing on heating decarbonisation.

- ESO Operational Metering: Updating ESO operational metering requirements to reflect the capabilities of smaller assets.
- Small assets in Balancing Mechanism (BM): Trail that is enabling small assets to participate in the BM, initially with electric vehicle charging.
- Crowdflex: Crowdflex is trialling flexibility market arrangements with suppliers and a flexibility service provider, for domestic consumers and their LCTs.
- Demand Flexibility Service: DFS has stimulated domestic flexibility propositions with suppliers, FSPs and consumers/
- Equinox: The NGED NIC project is focusing on DSO flexibility propositions for heatpumps with trials running in winters 2023/24 to 2024/25.
- Heatflex (Nesta and Octopus CNZ): This project explores how households can support a lower-carbon grid by shifting the energy demand of their heat pump away from peak times.

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

There have been a number of projects in the heating space. Most projects had a local or regional scope, focusing on heating technologies, energy efficiency and buildings solutions (e.g. Defender). This project focuses on the GB electricity market and electricity system. It will be the first of its kind and will bring in learnings from previous industry projects.

Relevant Foreground IPR

N/A

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:

1. A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click ‘Contact Lead Network’. National Grid ESO already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
2. Via our Innovation website at https://www.nationalgrideso.com/future-energy/innovation
3. Via our managed mailbox innovation@nationalgrideso.com

Details on the terms on which such data will be made available by National Grid ESO can be found in our publicly available “Data sharing policy relating to NIC/NIA projects” at https://www.nationalgrideso.com/document/168191/download.

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

The impact of the electrification of heating on the electricity market is still unknown. The solutions to manage that impact have not yet been defined and remain untested. There is a need for an innovation project to assess and understand electric heating and flexibility while the industry is still in the early stages of growth and maturity.

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 ESO does not have the internal capabilities to generate this understanding nor disseminate the findings as part of BAU practices

This project has been approved by a senior member of staff

☑ Yes