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 2024

Project Reference Number

NIA2_NESO078

Project Registration

Project Title

Consumer Building Blocks Phase 2

Project Reference Number

NIA2_NESO078

Project Licensee(s)

National Energy System Operator

Project Start

September 2024

Project Duration

0 years and 9 months

Nominated Project Contact(s)

innovation@nationalgrideso.com

Project Budget

£400,000.00

Summary

This project will build on existing consumer building blocks to combine learnings from the first and second Demand Flexibility Service (DFS) and create a more granular set of archetypes for different electrified heating types with a large and recent dataset. We will do this by conducting social research with recent DFS participants to understand consumers interaction with flexibility and apply this to the consumer archetypes.

This project will explore defining more granular archetypes for different electrified low carbon heating types and types of consumers, to reflect the variation in technology mix and consumer behaviour that we are likely to see in the future low carbon domestic heating roll out.

Both updates to the consumer building blocks will ensure they are a more consistent, future-facing and robust set of archetypes.

Nominated Contact Email Address(es)

Innovation@neso.energy

Problem Being Solved

DFS Evaluation and Flexibility Insights

How consumers react to, think about and participate in flexibility markets is still relatively unknown. Modelling to date has used ‘old’ data that in some cases pre-dates the Covid pandemic. We are interested in linking the Demand Flexibility Service evaluation social research data with the domestic consumer archetypes so that the archetypes contain more information about consumer behaviour, which can feed into modelling work (e.g. in the Future Energy Scenarios modelling). This project will use data and insights from 1000s

of active participants of DFS to give an up-to-date picture of consumer participation in flex markets.

Low carbon heat

The decarbonisation of domestic and commercial heating is a key challenge to meeting the legislated net zero target, making up nearly 20% of the UK's carbon emissions. There is a commitment from Government to support domestic decarbonisation, including a target of installing 600,000 heat pumps a year by 2028 and a decision on the future of hydrogen for heating by 2026.

Heating type is one of the key factors that determines a household domestic energy demand profile. In future, there will be a variety of different heating options available and the ability to model low carbon heating demand profiles accurately will be key to inform pathway modelling, network planning and policy.

Existing pathway modelling has been largely based on gas boiler profiles and is therefore not fully reflective of the different technologies that will be deployed to meet net zero.

There has previously been little heat pump profile data available and the data that is available does not reflect more recent performance improvements. Analysing data from the ESC's 'electrification of heat' demonstration will bring new information about heat pump profiles. Alongside this, analysis of available data for other electrified heating types (such as direct electric or electric storage) will help to model future demand profiles for these heating types.

Method(s)

A partnership led by Centre for Sustainable Energy (CSE) and ERM, will explore the implications of the latest Demand Flexibility Service to understand consumer experiences and apply learnings on demand flexibility to the consumer archetypes. Alongside this, CSE will develop a more granular set of archetypes for low carbon domestic heating, including consideration of demand flexibility. CSE and ERM will do this using the following approach:

WP1: DFS Consumer Evaluation

As in the 2022-23 evaluation, a customer feedback survey will be designed to address agreed research questions. The survey will be shared with participants by their DFS Provider. A key difference to last year will be the expansion of the survey to include eligible non-domestic consumers (i.e., micro/ small businesses with smart meters and industrial and commercial businesses). Two separate surveys will be designed, bespoke to the domestic or non-domestic audiences, but these will be hosted by the same survey company or on the same in-house survey software and delivered in the same way to customers. We will seek expert QA of the questions.

For the domestic evaluation, 20 interviews are also proposed to delve deeper into the experience households that represent particular groups or topics of interest. We also propose to undertake interviews with non-domestic sector participants – in this case the focus will be on refining the survey prior to launching with the full group, hence the interviews will be performed in the early project stages. We have allowed for up to 20 interviews, to get a spread across sectors and organisation sizes.

WP2: Nationally Representative Opinion Survey & Heat insights Scoping

The DFS survey data is not a representative sample of every household that took part in the DFS and not a representative sample of the GB population. To address this issue, we propose to conduct a nationally representative opinion survey with questions that can allow us to classify the respondents into one of the archetypes, and enhance our knowledge about demand flexibility ability/behaviour.

Building on the existing set of domestic consumer building blocks developed by CSE, further analysis of available data and models will be conducted in order to deliver a more granular set of archetypes for different electrified technology and consumer types. WP2 will include scoping for this piece of work, including a review of existing data.

WP3: Enhancing Consumer Archetypes

We will classify domestic respondents from the DFS evaluation survey 22-23 and the new domestic survey respondents for 23-24 into the domestic consumer archetypes, calculate the distribution of certain survey responses, and conduct exploratory analysis to understand the flexibility strategies (e.g. load shifting, peak shaving, or no response) of different types of consumer.

For the non-domestic evaluation, we will classify respondents into the non-domestic proto-archetypes, analyse the results of the survey and use the outcomes to update the offer attribute matrix, which will return a revised archetype grouping.

These insights on demand flexibility will then be added to the consumer archetypes.

For the low carbon heat archetype enhancement, this may include desk-based analysis of heat pump data (including hybrids) to produce demand profiles linked to a range of ambient weather conditions for each consumer archetype, as well as how demand flexibility uptake might be considered. For other electrified heating types this would include desk-based analysis of other low carbon heating types (electric storage, direct electric etc) and modelling where needed, to produce archetypes to the same specification as for heat pumps.

WP4: Reporting, Dissemination & Archiving

WP4 will involve close collaboration across the teams to synthesise the insights gained through the evaluation and the update to the archetypes. A customer evaluation report for DFS 23-24 will be produced for publication. For the updated archetypes a short summary report and new data tables will be produced. We will also explore options for securely archiving the data for future research purposes. For the low carbon heat work, CSE will develop a tool and/or set of archetypes which take account of both consumer type and low carbon heating type. CSE will produce a report on their approach and methodology.

In line with the ENA's ENIP document, the risk rating is scored Low.
TRL Steps = 1 (1 TRL steps)
Cost = 2 (£387k)
Suppliers = 1 (1 supplier)
Data Assumptions = 2
Total = 6 (Low)

Scope

This project will last approximately 25 weeks and is comprised of 4 work packages, which can be considered in 2 parts.

Part 1: DFS evaluation and flexibility insights

The project outputs will support two objectives:
Enable NESO and energy system actors to improve the design and delivery of new flexibility services for domestic and eligible non-domestic consumers.
Improve future scenario modelling work by providing more information about consumer behaviour in the archetypes.

Part 2: Low carbon heat archetypes

This piece of work aims to join-up existing NESO work to create a consistent set of heating profiles for different types of consumers across low carbon heating types. This will improve our modelling for decarbonising heating. This piece of work is dependent on the outcomes of a number of internal pieces of work as input, therefore project scope and approach will be defined further as these projects are concluded.

The analysis in this work package would cover both heat pumps and other electrified heating (such as electric storage and direct electric).

Objective(s)

This project aims to:

- Document consumer (both domestic and non-domestic) experiences, motivations, perceived benefits and challenges through the second DFS.
- Summarise the different types of demand flexibility behaviour, understand the limitations of the data, and explore other options to gather insight into demand flexibility behaviour.
- Understand the differences and similarities between DFS participants grouped by the consumer archetype they have been classified into.
- Add detailed information regarding demand flexibility to the consumer archetypes
- Create a set of heating demand profiles for different types of consumers across heat pumps and other electrified heating types.

Consumer Vulnerability Impact Assessment

The NESO does not have a direct connection to consumers, and therefore is unable to differentiate the impact on consumers and those in vulnerable situations. Benefits of this project are summarised in Section 1.

Success Criteria

The project will be considered successful if the following deliverables are produced and meet the project objectives:

- An evaluation of the second year of DFS
- A national representation of GB consumer sentiment and potential drivers to change behaviour
- Enhanced consumer archetypes that consider likely changes to consumer behaviour
- A strategy for modelling the demand profiles from different types of electrified heating and flexibility and either a set of scalable profiles or a tool for generating such profiles

Project Partners and External Funding

A partnership between Centre for sustainable energy and ERM for WP1-4. For low carbon heat the work will be led solely by CSE. No external funding.

Potential for New Learning

As part of the proposed plan this project will help with further understanding of:

- Understanding how consumer behaviour may influence detailed scenario modelling and how flexibility offerings could be used to drive benefit for the whole energy system.
- Development of approach to creating demand profiles different types of consumers for electrified heating, including use of modelling or synthetic data where necessary.

Scale of Project

The project spans 9 months with 2 project partners. The project consists of desk-based research, stakeholder engagement with partner organisations and with consumers, data analysis and disseminations.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL5 Pilot Scale

Geographical Area

This project will be conducted in GB.

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:

DFS evaluation and flexibility insights
Demand flexibility is a key enabler in the energy transition, to lower the costs of net zero by shifting demand to times when energy is cheap and demand is lower. The project outcomes will be fed into our long term scenario modelling and will enhance our understanding of consumer behaviour and therefore could be used as an input into network development processes for future networks as well as identifying improvements that could be used by other organisations within GB who use scenario data to plan electricity and gas networks. In addition, the insights gained through the social research will aid actors across the energy system in the development of flexibility markets and products that consumers want to and are able participate in are fit for purpose.

Low carbon heat
Currently, around 78% of UK residents have mains gas heating. In order to meet the 2050 net zero target, domestic heating needs to be decarbonised. There is a commitment from Government to support domestic decarbonisation, including a target of installing 600,000 heat pumps a year by 2028 and a decision on the future of hydrogen for heating by 2026.
Depending on the uptake of different low carbon heating types by 2050, the potential impact on the energy system is extensive. For example, if a number of consumers decide to choose direct electric heating this would increase peak demand substantially relative to heat pumps. The preferences for different low carbon heating solutions is uncertain and heat profiles in NESO are currently based on gas boiler demand profiles. Given that technologies such as flexibly and non-flexibly operated heat pumps, electric storage heaters, direct electric and other electrified heating options operate in a different way and have different impacts on the energy system, it is important to take this into account when modelling future pathways. Daily demand profiles are also substantially impacted by the type of consumer that uses energy (e.g. household size, occupation/work pattern). Combining consumer type with technology type to produce a set of archetypes/demand profiles will enable modelling to take better account of these variables and can enable better decisions for investment and policy.

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

N/A

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

Not required as this is a research project.

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

This project is comprised of two parts.

- Part 1: DFS evaluation and flexibility insights
- Part 2: Low carbon heat archetypes

The outputs for part 1 will be shared directly with other network operators as well as being published on the NESO website. This will

build on current activities during phase 1 where the outputs were shared and are now being used for further work / innovation.
The output for part 2 will build on phase 1 of the consumer building blocks work to publish a set of archetypes and/or tool for different consumer and low carbon heating types, alongside datasets and methodology where relevant. This will enable wider GB energy participants to use these archetypes in their own modelling processes.

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

Updated consumer building blocks and outputs from parts 1 and 2 will be publicly available, and therefore insights from this work can be used across industry in modelling and analysis.Costs of rolling out should therefore be minimal.

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

As per phase 1 of the project the intention is to develop the archetypes so the network licensees can use them in scenario development at the regional level. This will lead to strong collaboration if a common language is adopted across the transmission and distribution interface and across vectors.

The low carbon heat element of the project will generate a set of archetypes for different consumer and low carbon heating types, alongside datasets and/or methodology where relevant. This will enable Network Licensees to use these archetypes in their own modelling process, for example as part of energy demand modelling for network planning.
For further benefits see "Benefits Summary" section 1.

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.

WP1-4 build on existing work that has been conducted through ENA innovation. The low carbon heat element will review existing literature and available data to help ensure there is no unnecessary duplication.

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

DFS evaluation and flexibility insights

The archetypes were developed in conjunction with the other network companies and this is the first set of DFS data of it's kind to be incorporated and provide more granular archetypes. The project will provide richer information on emerging flexibility issues which we are only just starting to understand. We can't rely on previous historic data whilst predicting future consumer behaviour.

Low carbon heat

There has previously been little heat pump profile data available and the data that is available does not reflect more recent performance improvements. Analysing data from the ESC's 'electrification of heat' demonstration will bring new information into NESO's heat modelling. Previous archetyping work has generally focused on building archetypes, whereas in this work we propose to understand how different consumer types impact on demand profiles and the extent to which these can be correlated with building types. Alongside this, analysis of available data for other electrified heating types will help to model future demand profiles for these heating types. Producing demand profiles which take into account both consumer and low carbon heating type is a new and innovative approach, which will enable better future demand and network modelling.

Relevant Foreground IPR

The deliverable for the DFS Evaluation will be a report detailing the insights from the domestic and non-domestic surveys and interviews including recommendations for future flexibility services, building on the report published from the DFS Evaluation Year 1. The deliverable for low carbon heat will be a report on a set of archetypes and/or tool for different consumer and low carbon heating types.

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'. NESO 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 Innovation | National Energy System Operator (neso.energy)
- Via our managed mailbox innovation@nationalgrideso.com

Details on the terms on which such data will be made available by NESO can be found in our publicly available "Data sharing policy relating to NIC/NIA projects" at 80797503.1 (neso.energy)

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

Given the level of innovation associated with this project there are a number of risks that mean we should use NIA funding including:

- As this is a research based project that relies on additional support from partner organisations, it does not fall into current BAU.
- First time development of consumer type and electrified low carbon heating type dependent energy demand profiles using both real data and/or synthetic data to model demand patterns.

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

Given the level of innovation associated with this project there are a number of risks that mean we should use NIA funding including:

- From an operational perspective if outputs from this project can be used as part of modelling to feed into RIIO ED3 then timelines are very short for a project of this complexity and an expedited funding process such as NIA will be required.
- Whilst we have established an outline methodology for developing low carbon heating demand profiles, there remains risk that it will not be possible to develop a manageable number of profile archetypes, as such there is a residual risk that the outputs cannot be applied within NESO modelling tools. Innovation funding is therefore appropriate given the uncertain outputs.

This project has been approved by a senior member of staff

☑ Yes