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## NIA Project Registration and PEA Document

### Date of Submission

Jan 2026

### Project Reference Number

ENWL\_NIA\_045\_THISTLES

## Project Registration

### Project Title

THISTLES - Transforming Heating Into Storage for Local Energy Systems

### Project Reference Number

ENWL\_NIA\_045\_THISTLES

### Project Licensee(s)

Electricity North West

### Project Start

February 2026

### Project Duration

0 years and 9 months

### Nominated Project Contact(s)

InnovationTeam@enwl.co.uk

### Project Budget

£744,665.00

## Summary

THISTLES will look to test thermal batteries as an alternative to heat pumps and explore how best to integrate them into flexibility markets to reduce network pressures.

### Nominated Contact Email Address(es)

innovation@enwl.co.uk

## Problem Being Solved

The need to decarbonise domestic heating to achieve Net Zero is well understood. However, the primary technologies available to move off fossil fuel heating (Heat Pumps and Heat Networks) leave ~20-40% of properties without a viable solution. Flats, terraced houses, listed or protected buildings struggle with the external space requirements and/ or planning restrictions around installation of these default options. Additionally, customer preferences also create a challenge to heat decarbonisation e.g. where homeowners are unwilling to alter their property to accommodate a heat pump, or where they are reluctant to connect to a heat network. These properties are also more likely to be occupied by lower income and otherwise vulnerable customers, creating a significant gap to delivering a just and fair transition.

The current solution for hard-to-heat-pump and non-heat network area properties is a standalone electric boiler or biomass system. These can be up to four times less efficient than a heat pump, resulting in significantly increased costs for consumers and higher demand on the network. A large-scale rollout of electric boilers will cause constraints on the Low Voltage (LV) network and require large amounts of reinforcement, delaying and increasing the cost to achieve Net Zero.

With increasing penetration of renewable generation in the GB energy system there is also national need for greater demand flexibility. A core part of the Clean Power 2030 plan is to onboard an additional 10GW of consumer flexibility, with 1GW expected to be provided by thermal storage, rising to 8GW by 2050 (excluding storage heaters).

Flexible, electric heating provides a solution to these two challenges: an option for properties that are under-served by existing

solutions and flexibility to the electricity system on the route to Net Zero.

## Method(s)

This project is categorised as a Research project; however, an indicative benefit pathway has been considered based on the counterfactual scenario.

**Base Cost (Counterfactual):** In the absence of heat battery deployment, homes unsuitable for heat pumps or heat networks will continue to rely on fossil fuel heating, leading to higher carbon emissions, poor air quality, and limited flexibility for the electricity system.

Electrification of these homes using direct electric heating would increase peak demand and require costly network reinforcement, particularly in constrained LV areas. Additionally, vulnerable consumers in these homes may face higher energy bills and limited access to decarbonisation support.

**Method Cost (THISTLES):** The proposed solution leverages smart heat batteries that can charge during off-peak periods and provide controllable, high-temperature heating without requiring major infrastructure upgrades. By smoothing demand and enabling participation in flexibility services, heat batteries reduce the need for reinforcement and improve network efficiency. The technology is cost-comparable to gas boilers and heat pumps, but with lower servicing costs and better alignment with consumer needs in hard-to-decarbonise homes.

A high-level calculation suggests that, if deployed at scale, heat batteries could deliver significant benefits, these benefits will be calculated during the project, including a CBA to corroborate initial assumptions.

Recipients of the benefit include:

Consumers, through lower energy bills, improved indoor air quality, and access to clean heat.

Network operators, through deferred reinforcement, improved LV network utilisation, and enhanced flexibility.

The wider system, through reduced emissions, better integration of renewables, and support for a just transition.

## Scope

Project THISTLES will evaluate the role of smart heat batteries in decarbonising homes that are currently underserved by mainstream low-carbon heating solutions, such as heat pumps or heat networks. These homes –often flats, terraces, or properties with limited outdoor space– face significant barriers to electrification and risk being left behind in the transition to Net Zero. THISTLES will assess whether heat batteries can provide a viable, flexible, and cost-effective alternative for these households, while also delivering value to the electricity distribution network.

The project will undertake a comprehensive analysis of housing stock within the local authority areas covered by SP ENW (with specific focus on Greater Manchester Combined Authority) to identify properties without a clear route off fossil fuel heating. It will then evaluate the suitability of heat batteries for these homes, model their electricity demand profiles, and simulate their impact on LV networks. We will also undertake an analysis of the flexibility services potential of heat batteries, to inform the extent to which they might support grid services provision and the running cost reductions that may be achieved in doing so. By completing this scope, we will establish a methodology for heat battery appraisal, network impact modelling and consumer proposition development which can be used to inform future roll out.

The project will deliver benefits to the GB electricity distribution system some of these benefits will be calculated during the project life cycle, other benefits include:

**Financial:**

Potential deferral of network reinforcement by shifting heating load away from peak periods through smart thermal storage.

Reduced operational costs by improving load balancing and avoiding localised overloads.

Lower customer heating costs through off-peak electricity use and reduced standing charges.

**Environmental:**

Significant carbon savings per household by replacing gas boilers with zero-emission heat batteries.

Supports the decarbonisation of hard-to-electrify homes, accelerating progress toward Net Zero.

Enables greater use of renewable electricity by aligning heating demand with periods of low-carbon generation.

**Operational:**

Improved LV network resilience through demand smoothing and flexibility provision.

Informs DSO planning processes and RIIO investment strategies with new data on heat battery deployment.

Leverages existing infrastructure (e.g., smart meters, LV networks) to deliver new value with minimal disruption.

The project is structured around seven work packages, covering project management, housing stock analysis, heat battery suitability, electricity demand profiling, network readiness, stakeholder engagement, and trial design. These will culminate in a final report with recommendations for a future demonstrator and integration into BAU planning.

## Objective(s)

The project objectives are:

Verify the residential decarbonisation gap left by heat pumps & heat networks

Assess the extent to which heat batteries can address this gap

Evaluate the LV network impact of heat batteries optimised across various tariffs and flexibility signals

Complete a technical design for the integration of heat batteries into flexibility markets

Develop the customer proposition and technical solution design required for a demonstrator project to prove these findings in practise

## Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

An assessment of distributional impacts (technical, financial and well-being 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 an overall positive impact on consumers in vulnerable situations. The assessment has identified that this project will look to provide alternatives to electrification for customers. Other considerations, including the project's impact on supply, immediate health and safety in the home have been made in carrying out this assessment.

## Success Criteria

The project will deliver the following outputs:

Housing stock heat decarbonisation gap analysis

Heat Battery suitability evaluation

Electricity network impact report

Stakeholder engagement and heat battery literature review

Demonstration project design including customer proposition development and flexibility market access technical design.

## Project Partners and External Funding

LCP Delta £15,556

Tepeo £26,850.

PNDC

## Potential for New Learning

The project will provide insights into the suitability and application of heat batteries to address gaps in local plans for heat decarbonisation (Local Area Energy Plans or Local Heat and Energy Efficiency Strategies). The project will help inform these strategies, quantifying the potential for a new technology both in terms of housing stock and LV network capacity.

Scenarios will be developed, tested and built into our project report covering the LV network impacts of heat batteries in combination with other low carbon technologies and with a range of tariff pricing assumptions. This will provide a world-first insight into the aggregated demand from a diverse range of electric heating deployment.

Flexibility service providers, aggregators and DSO / NESO teams will gain insights into how heat batteries can access flexibility markets with a review of the services that can be provided, technical feasibility of doing so via an aggregator and an indication of the potential value to customers.

Project outputs will be shared publicly on the Smarter Networks Portal, the SP Electricity North West website and at dissemination events such as the Energy Innovation Summit.

## Scale of Project

Decarbonising heat is multi-faceted, requiring an understanding of building stock, heating systems, electricity networks, relative fuel / tariff costs and customer preferences. Project THISTLES covers each of these key areas with industry expert research, analysis and testing to provide a holistic assessment of the potential at the project's conclusion.

We are focusing on a broadly representative part of the UK rather than attempting a national study – this allows the scope to be controlled, while still delivering useful insights that can be applied nationally.

We will model the implications of heat batteries on LV networks using PNDC's virtual network tooling. This will leverage the significant investment and IP already built into these tools. A similar approach will be taken with using existing data from heat batteries in operation – instead of using this project to fund the installation of additional hardware, we will be utilising data from existing, already

installed hardware.

To ensure the project can progress to a demonstration stage, we are also completing core activities relating to delivering a real-world demonstrator. This includes a technical design for flexibility service provision, customer proposition design and engagement with Local Authorities & housing providers.

### **Technology Readiness at Start**

TRL3 Proof of Concept

### **Technology Readiness at End**

TRL5 Pilot Scale

### **Geographical Area**

SP Electricity North West's distribution network.

### **Revenue Allowed for the RII Settlement**

£0

### **Indicative Total NIA Project Expenditure**

£702,259

## 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:

THISTLES will investigate a promising solution to households that are currently unable to cost-effectively shift off fossil fuel heating. By exploring the application, network impacts, customer proposition and flexibility service potential of heat batteries, we will identify whether this technology can solve three problems simultaneously: progress toward net zero, a just transition for all, consumer led demand flexibility enabling the shift to a clean power system. Electrifying heat with flexible technologies has huge potential for the UK's climate change obligations and energy system development.

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

Project THISTLES has strong potential to benefit consumers in vulnerable situations by targeting homes that are typically excluded from mainstream heat decarbonisation pathways, such as flats and terraces often occupied by lower-income or older residents. These homes face barriers to installing heat pumps or connecting to heat networks, leaving occupants at risk of being left behind in the energy transition. By offering a low-disruption, cost-comparable alternative through smart heat batteries, the project enables access to cleaner, safer heating. Vulnerable consumers stand to benefit from lower energy bills via time-of-use tariffs, reduced standing charges, and potential participation in flexibility services. Additionally, electrification improves indoor air quality and thermal comfort, contributing to better health and wellbeing outcomes. We will engage directly with Local Authorities and Housing Providers to this end, investigating the potential for tenants as well as homeowners.

### 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 project is categorised as a Research project; however, an indicative benefit pathway has been considered based on the counterfactual scenario.

**Base Cost (Counterfactual):** In the absence of heat battery deployment, homes unsuitable for heat pumps or heat networks will continue to rely on fossil fuel heating, leading to higher carbon emissions, poor air quality, and limited flexibility for the electricity system. Electrification of these homes using direct electric heating would increase peak demand and require costly network reinforcement, particularly in constrained LV areas. Additionally, vulnerable consumers in these homes may face higher energy bills and limited access to decarbonisation support.

**Method Cost (THISTLES):** The proposed solution leverages smart heat batteries that can charge during off-peak periods and provide controllable, high-temperature heating without requiring major infrastructure upgrades. By smoothing demand and enabling participation in flexibility services, heat batteries reduce the need for reinforcement and improve network efficiency. The technology is cost-comparable to gas boilers and heat pumps, but with lower servicing costs and better alignment with consumer needs in hard-to-decarbonise homes.

A high-level calculation suggests that, if deployed at scale, heat batteries could deliver significant benefits, these benefits will be calculated during the project, including a CBA to corroborate initial assumptions.

Recipients of the benefit include:

Consumers, through lower energy bills, improved indoor air quality, and access to clean heat.

Network operators, through deferred reinforcement, improved LV network utilisation, and enhanced flexibility.

The wider system, through reduced emissions, better integration of renewables, and support for a just transition.

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

The method is highly replicable across GB, with potential applicability to an estimated 20-40% of UK homes that are not suitable for heat pumps or heat networks (primarily flats, terraces, and smaller semi-detached properties). These homes are distributed across urban, semi-urban, and rural areas, making the solution relevant to a wide range of network licensee regions. Subject to validation in this phase, the method could be rolled out across tens of thousands of LV network sites, particularly in areas with constrained capacity and high concentrations of vulnerable consumers.

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

The cost of rolling out heat batteries across GB will depend on housing archetype, regional network constraints, and installation scale. Initial estimates suggest that unit costs are comparable to gas boilers and heat pumps, with lower servicing and operational costs. Network upgrade requirements are expected to be minimal due to off-peak charging and flexibility capabilities. A detailed cost-benefit analysis will be conducted during this phase to inform rollout economics, with potential future phases providing real-world cost validation.

### **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**

The learning generated through Project THISTLES, including housing suitability criteria, demand profiling, network impact modelling, and flexibility service design, will be directly applicable to all electricity distribution licensees across GB. The methodologies developed will be replicable across diverse network areas, particularly those with high concentrations of hard-to-decarbonise homes. Outputs will support RIIO planning, inform future innovation projects, and enable BAU integration of heat batteries as a scalable clean heat solution.

#### **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.**

THISTLES will build on work completed in previous projects and has been designed specifically to leverage existing insights to avoid duplication and deliver value for money. The key projects we will draw on are:

Neat Heat – an NIA project delivered from 2022-2024 which explored the installation and user experience of heat batteries and the ability for heat batteries to track a time-of-use tariff price signal. The project findings give confidence in the underlying technology, the user experience and the ability to operate flexibly using simple signals, but this project did not cover the scope outlined for THISTLES. Homes For Net Zero – a DESNZ funded project investigating the range of low carbon solutions available to homeowners. The project uses data from existing heat battery customers to evaluate running cost, performance and user satisfaction. However, this project is not specifically focused on hard-to-treat properties, does not assess LV network impacts nor flexibility market potential.

THISTLES builds on both projects by specifically investigating properties where heat batteries offer the greatest potential benefit and assessing the electricity system implications of deploying heat batteries at scale.

A review of the Smarter Networks Portal and discussion at the ENA Innovation Steering Group meetings has not revealed any other projects in this area.

### **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**

Project THISTLES is innovative because it explores the use of smart heat batteries as a scalable, flexible, and low-carbon heating solution for homes that are currently excluded from mainstream decarbonisation pathways. These homes, often unsuitable for heat pumps or heat networks, represent a significant gap in the UK's transition to clean heat. The business case for heat batteries in this context is unproven, particularly in terms of network impact, flexibility service provision, and consumer outcomes. The project involves novel modelling, stakeholder engagement, and feasibility assessment, all of which carry technical and commercial risks that justify a dedicated research and demonstration phase.

### **Relevant Foreground IPR**

Expected Relevant foreground IPR to be generated is:

Development of Local Area Energy Planning (LAEP) Local Heat and Energy Efficiency Strategy (LHESS) and equivalent methodologies for determining pathways to net zero buildings. This will include housing stock suitability models for heat battery deployment, including criteria for identifying homes that are not suitable for heat pumps or heat networks.

Heat Battery power consumption profiles across selected scenarios, including combinations of housing archetypes and tariff structures.

Network impact simulations and modelling outputs assessing the feasibility and implications of large-scale heat battery deployment. Architecture for heat battery participation in flexibility markets via an aggregator.

These outputs will be developed collaboratively by the project partners and will be made available in line with NIA dissemination requirements.

Background IPR:

Tepeo systems, hardware and knowhow relating to heat battery design, operation and integration with tariffs and flexibility services.  
PNDC models of LV system dynamics and product characterisation

## Data Access Details

Data generated can be requested by interested third parties by contacting the innovation team in accordance with our data sharing policy which is available on our website.

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

There are multiple uncertainties, including technical feasibility, network impact, consumer acceptance, and integration with flexibility markets.

The methodology involves exploratory modelling, stakeholder engagement, and strategic planning. These activities not typically funded under BAU.

BAU funding would require clear evidence of effectiveness, cost-efficiency, and regulatory alignment, which this project aims to generate.

The innovation is untested in real-world network contexts and carries commercial and operational risks that justify limited research and demonstration funding.

## 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

Project THISTLES requires NIA support due to several key risks and uncertainties that make it unsuitable for business-as-usual funding:

Commercial risk: The business case for heat batteries in hard-to-decarbonise homes is unproven, particularly in terms of consumer uptake, cost-effectiveness, and long-term value.

Technical risk: The impact of heat batteries on LV network performance, flexibility provision, and integration with existing infrastructure has not been validated at scale.

Operational risk: Deployment logistics, installation feasibility, and customer engagement strategies for this technology are still being explored.

Regulatory risk: The role of heat batteries in DSO service provision and RIIO planning is not yet clearly defined, requiring further evidence and stakeholder input.

NIA funding enables the project to address these uncertainties through targeted research, modelling, and stakeholder engagement, laying the groundwork for future demonstrator phases and wider rollout.

## This project has been approved by a senior member of staff

Yes