SIF Discovery Round 2 Project Registration

Date of Submission

May 2023

Project Reference Number

10061544

Project Registration

Project Title

Watt Heat

Project Reference Number

10061544

Project Licensee(s)

UK Power Networks

Project Start

Apr 2023

Project Duration

3 Months

Nominated Project Contact(s)

innovation@ukpowernetworks.co.uk

Project Budget

£109,160.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£86,697.00

Strategy Theme

Flexibility and market evolution

Challenge Area

Accelerating decarbonisation of major energy demands.

Lead Sector

Electricity Distribution

Other Related Sectors

Funding Licensees

Lead Funding Licensee

UKPN - London Power Networks Plc

Collaborating Networks

UK Power Networks

Technology Areas

Commercial, Energy Storage, Heat Pumps

Equality, Diversity And InclusionSurvey

Yes

Project Summary

Heat pumps draw a steady load from the network, but new forms of thermal storage for electric heating, such as electric heat batteries or water tanks, have the potential to shift load to off-peak periods, however, the data available is limited and flexibility products/market mechanisms do not yet exist.

The objectives of this project are to investigate the flexibility potential of thermal storage technologies, individually and in combination with heat pumps, and understand how far in time these technologies can shift electrical demand relative to customer heat demands. If successful, the solutions will help mitigate mass heat load on the low voltage network at shoulder or peak times and enable other network services such as resilience to outages, and cold start impact mitigation.

This proposal addresses two of the SIF challenges:

- Primary: Challenge 4: Accelerating the decarbonisation of major energy demands -- by increasing the use of flexibility from heat technologies to support the integration of multiple demands onto the network; and,
- Secondary: Challenge 2: Preparing for a Net Zero power system -- increasing the ability to access system support from novel demand-side heat technologies.

The Discovery Phase will be delivered through the collaboration of the following partners:

- UK Power Networks: the DNO providing key input on avoided network costs and service/incentive design;
- Baringa: a specialist energy sector consultancy who are ideally suited to lead utilising their commercial and market expertise, whilst ensuring we conduct a neutral market scan without favouring any specific technology in the Discovery Phase;
- Passiv UK: a technical heat systems consultancy suited to provide a broad perspective of heat storage solutions in the market;
- Tepeo: a technology supplier suited to provide deep expertise into heat batteries, a leading solution in this field; and
- GLA: as the local government representative to provide insight into London's multi-occupancy building customers, and the associated stakeholders.

If successful, this project will deliver the following value to its direct and indirect users:

- End consumers: maintaining comfort levels while offsetting the cost of new technology installation and lower energy bills through flexibility revenues;
- DNOs (and their connected customers): optimising network use across the day through minimising the network impact of heat technologies at peak times;
- The wider energy system: accelerating the uptake of heat technologies by evidencing the applicability of solutions to new customer segments; and
- Wider society: presenting possible market value to accelerate and offset the costs of transitioning to Net Zero.

Project Description

The decarbonisation of heat in homes is one of the more challenging problems of delivering Net Zero. Whilst technologies such as heat pumps are emerging and supply chains scaling up, we face a challenge in determining how to integrate these technologies into the network whilst maintaining customer heating comfort.

In combination with new connections for domestic electric vehicle (EV) chargers, heat pumps will have a significant impact on the network -- increasing peak demand of a typical residential property from 2-3kW (e.g. from a kettle) and adding 5kW and 7kW for heat pumps and EV chargers respectively.

If demand is flexible -- i.e. able to change the time of day of the electricity demand without impacting the customers' service -- this can help to minimise network reinforcement and ensure customers are able to consume cheap renewable generation when it is abundant. While the potential for flexibility from heat pumps alone is limited, the use of thermal storage solutions for electric heating -- such as heat batteries or water tanks -- is showing an increased potential for shifting load to off-peak periods. Currently, the data available is limited and flexibility products/market mechanisms do not yet exist.

WattHeat will investigate the flexibility potential of thermal storage technologies -- including new solutions such as thermal batteries, as well as the use of heat pumps in combination with other forms of heat storage. In Discovery Phase we will work with heat solution providers, investors, and other stakeholders, to identify the:

Customer segments, needs, solutions and benefits available for the use of thermal storage to enable the flexibility of domestic heat;
New customer propositions that could deliver heat flexibility whilst maintaining customer heating comfort; and,
Commercial flexibility products and market mechanisms that the DSO will need to develop to support these propositions.
We will then develop more detailed designs in the Alpha Phase, and test all of this in real life scenarios in the Beta Phase to

understand the level of customer acceptance and demonstrate the commercial viability of business models to take these solutions forward.

There is currently a lack of incentives for consumers to take up more flexible heat technologies. If successful in demonstrating the case for flexibility through heat storage, this project could unlock a new focus for investment and accelerate decarbonisation.

Third Party Collaborators

baringa

Tepeo

Passiv UK

Greater London Authority

Nominated Contact Email Address(es)

innovation@ukpowernetworks.co.uk

Project Description And Benefits

Applicants Location (not scored)

UK Power Networks: Newington House, 237 Southwark Bridge Road, London, SE1 6NP, UK

Project Short Description (not scored)

Watt Heat aims to accelerate the decarbonisation of residential heat and reduce costs for all by stimulating the market for greater demand flexibility through heat storage -- working with market participants, investors, and stakeholders to develop the flexibility products required to share the benefits that these technologies can deliver.

Video description

https://www.youtube.com/watch?v=UNgJpKAvHnw&list=PLrMOhOrmeR6ldr-EVoT8ABGhTCxgyBKqs&index=48

Innovation justification

The steady load drawn from heat pumps hinders uptake of this low carbon solution on the network as there is limited flexibility in shifting the load, for example, to avoid congestion on the network at peak times. WattHeat will investigate how heat storage could address this issue.

Enabling greater flexibility in heat demand could:

- Improve the ability to integrate new heating demand in constrained network locations
Create network capacity to integrate wider new demands through shifting or flattening heat load
- Enable the storage of renewable generation when it is abundant with heat storage
- Provide additional resilience of heat for consumers in the event of network outages

There is currently a lack of incentives for consumers to take up more flexible heat technologies. WattHeat is innovative as it seeks to promote the uptake of more flexible heat technologies. To do so will require investigation of available technologies and their capabilities, the constraints of buildings and consumer behaviours, and the value of flexibility delivered - designing novel market mechanisms to enable market participants to access this value.

Recent work, e.g. BEIS' Heat and Buildings Strategy, has provided valuable insight into the applicability of heat solutions in buildings. However, limited insight exists into the flexibility potential of heat solutions used in conjunction with thermal storage solutions (such as hot water tanks or heat batteries). New insight from engaging with the relevant stakeholders and CBA analysis will address this.

If successful, WattHeat will deliver value by enabling more efficient use of the network for integrating heat demand, leading to reduced reinforcement requirements, lower overall network costs and fewer connection delays. This will reduce costs for consumers compared to the counterfactual, using heat pumps alone, through reduced network charges and revenues from flexibility services.

Funding this innovation through BAU allowances is difficult as the technical solutions are not sufficiently understood or demonstrated. Relying on demonstration projects from established technology suppliers could result in favouring one technology over others in an embryonic stage. The phased structure of SIF allows the project to conduct discovery of technology options, understanding the potential value to the DSO and customers.

For market participants, there is limited incentive to explore the applications of these technologies in combination given the unclear revenue opportunities that heat flexibility presents. Through this project, we aim to stimulate the development of viable propositions, commercial products, and business models, which would enable BAU delivery of these solutions.

Benefits Part 1

Environmental - carbon reduction – indirect CO2 savings per annum against a business-as-usual counterfactual
Financial - cost savings per annum on energy bills for consumers
Financial - future reductions in the cost of operating the network
New to market – products, processes, and services

Benefits Part 2

Our expectations of the benefits from increased flexibility from heat rest on an assumption that the energy market will return to a pre-crisis mode, in which consumers are exposed to variable energy prices depending on the time of use of demand.

Financial -- Future reduction in the cost of operating the network

The benefits can be tracked using the following KPIs:

- (K1) -- Capacity (kW) and volume (kWh) of flexibility provided by each solution
- (K2) -- Number of thermal storage solutions identified
- (K3) -- Estimate of network reinforcement deferral (MW and number of substations)

Our RIIO-ED2 business plan includes the DSO commitment for making greater use of flexibility to defer £410m of load-related expenditure on the network. During Alpha Phase, we will estimate the potential cost savings from WattHeat more specifically.

Financial - cost savings per annum on energy bills for consumers

The benefits can be tracked using the following KPIs:

- (K4) -- Number of households that install the thermal storage solution
- (K5) -- Average bill reduction (£/household) through shifting demand throughout the day
- (K6) -- Average revenue (£/household) gained from participating in ESO and DSO flexibility schemes

Environmental - carbon reduction -- indirect CO2 savings per annum against a business-as-usual counterfactual

The benefits can be tracked using the following KPIs:

- (K7) -- Comparison of carbon grid intensity (kg CO2) of flexible heat demand profile compared to less flexible heat demand profile (counterfactual)

New to market -- products, processes, and services

These benefits can be tracked through the:

- (K8) -- Number of DSO services, incentives, or flexibility products available for heat flexibility

We will identify and evidence high-level assumptions for KPI 1 -3, and forecast 4 - 7 during the Discovery Phase; validate these in more detail through Alpha Phase; and demonstrate them in Beta Phase. KPI 8 will be tracked over time post-Beta Phase.

Project Plans And Milestones

Project Plan and Milestones

The purpose of the Discovery Phase is to develop insight into the customer segments, needs, solutions and benefits available for the use of thermal storage to enable the flexibility of domestic heat and to inform a selection of lead options to take forward for development and demonstration.

Six work packages (WP) are proposed in the two-month Discovery Phase:

- WP1: Project management (UKPN), £6,681: To manage the end-to-end delivery
- WP2: Stakeholder engagement (Baringa), £16,832: Insight gathering from customer representative bodies, heat technology providers, installers and service providers
- WP3: Customer and building insight (Baringa), £19,034: Mapping applicable low-carbon heating technologies to different customer/building archetypes to inform the potential market size
- WP4: Solution and ecosystem insight (Baringa), £14,966: Exploring the technical feasibility of heat pumps and other thermal storage solutions in providing flexibility in electricity demand, and testing cases where solutions can be combined
- WP5: Conceptual solutions and outline CBA (Baringa), £26,647: Developing and testing proposals for appropriate heat storage technologies, examining the uptake rate, testing potential benefits of flexibility assessing the delivery costs
- WP6: Assessment of barriers and enablers (including regulations) (Baringa), £2,538: Assessing the key barriers to overcome and enablers needed to make the proposed solutions successful, including supply chain, customer propositions, roles and responsibilities, as well as potential regulatory barriers

Contributors for each work pack and deliverables are set out in the accompanying Gantt chart and project management pack.

Our key risks in the Discovery Phase relate to the ability to gain sufficient insight to clarify and answer the strategic questions. Our overall mitigation strategy for this is through the breadth of knowledge of the engaged project partners and stakeholders.

The key risks and mitigation strategies are set out in the accompanying risk register, and constraints are discussed in our answers to Question 10. We will manage risks and issues using a RAID log, refreshed for weekly project meetings. Example risks include:

- If we cannot get access to the right data in time, or insufficient real-world data regarding the potential solutions exists, we may not be able to develop sufficient confidence in the cost/benefit assessment of feasibility
- If we fail to identify and leverage all existing insight and build on prior work, we may not add as much new insight to help drive the industry forward
- If we are unable to generate a sufficiently reliable dataset from trials and demonstrations we may not provide enough confidence for the market/industry to invest and change ways of working

Regulatory Barriers (not scored)

We are not aware of any specific derogations that would be required to proceed with a demonstration or trial of the technologies within the scope of this proposal.

Longer term regulatory and policy considerations exist that would need to be addressed to enable the uptake of flexibility provision from domestic heat technologies -- e.g.:

- Technology readiness: Relevant electric heating appliances would need smart functionality, which is not currently the case. Improved uptake of smart functionality could be achieved through commercial incentives, but regulatory intervention may need to be applied to the heating technologies themselves or the installation of electric heating solutions.
- Appliance standards: BSI standards PAS 1878 and PAS 1879 are designed to enable demand-side response from smart appliances, EV chargers, energy storage and electrical heating. Consequently, additions and modifications to the standards related to energy smart appliances could have an unexpected effect on the interoperability of systems
- Reducing barriers to entry: Policymakers must establish a proportionate and flexible licensing framework for organisations providing a demand-side response to domestic and small non-domestic consumers
- Half-Hourly Settlement: Market-wide Half-Hourly Settlement (MHHS) is not yet in place but is due to be introduced in 2025/26. This is a key enabler for flexible time-of-use tariffs. This data needs to be presented in a consistent and accessible way to allow consumers to engage
- Cyber security: Minimum cyber security regulations must be met before widespread residential flexibility is introduced to the market. Primarily, the hurdle relates to ensuring that heating solutions can meet the existing regulations, but the regulations themselves may need to be reviewed to ensure that they remain appropriate

- Flexibility products: Flexibility products must be launched that enable the procurement of flexibility from heat technologies. To maximise participation these should be consistent across DSOs, available for the widest possible range of devices, and provide access for heat technologies to deliver against the widest possible range of products. They should also enable greater incentives on technology types that can be most useful to the system.

Barriers and enablers will be assessed further during the Discovery Phase, and we intend to inform future policy and regulation through the Alpha and Beta Phases by:

- Assessing the value case and urgency for enabling flexibility from domestic heat technologies, thus informing the priority for policymakers; and,
- Designing and trialling real-world flexibility products for domestic heat, thus informing technology and cyber standards, connections standards, and flexibility product designs.

Commercials

Route To Market

To ensure new services are adopted into BAU, we will work with the relevant UK Power Networks teams throughout design and testing. This will include network planners, to ensure insight regarding heat flexibility can be adopted into planning policies; the connections teams, to co-develop connections services; and the DSO team, to ensure any resulting commercial products are aligned with business practices and priorities. The relevant teams will be involved in trials and demonstrations to ensure the rapid uptake of practices in BAU.

Any services and incentives developed through this project will be made available to all market participants. Whilst the project will necessarily work closely with a selection of providers for any installation and trials, all data gathered and insights will be made freely available through knowledge dissemination.

There is currently a lack of incentives for consumers to take up flexible heat technologies. If successful in demonstrating the case for flexibility through heat storage, this project could unlock a new focus for investment and accelerate decarbonisation.

Within the DNO, new services and incentives will need to be implemented by the respective teams, such as the connections team, network planners or the DSO. Roll-out of heat technology solutions to the customer will be left to the market, as of today.

The end customers targeted by this project are residential consumers. The specific target segments for the trial will be determined in the Discovery Phase. New DSO flexibility products and revenue opportunities will be targeted at market participants and service providers to residential consumers. The key value proposed to customers lies in delivering lower costs for installing and running domestic heat technologies -- achieved by offsetting costs through flexibility revenue opportunities and avoided peak charges. The project will also create a greater resilience of heat solutions during temporary supply outages and enable cold start benefits.

Once proven effective, new services and/or incentives to be provided by the DNO or DSO would be funded through BAU allowances, given the increased confidence in delivering a return for customers and shareholders. Roll-out of heating solutions will be funded by the customers themselves, as today, and potentially enabled by investment secured as part of the customer propositions delivered by service providers.

Intellectual property rights (not scored)

The parties agree to adopt the default IPR arrangements for this project as set out in Section 9 of the SIF Governance Framework.

The partners recognise that knowledge transfer is one of the key aims of the SIF and that the benefits of this project will be maximised by the ability of other licensees to be able to learn from the Project so as to create improved outcomes or reduce costs for consumers. The partners do not anticipate that the Discovery Phase (or any potential subsequent phases) will result in the creation of IPR that cannot be freely disseminated, and have no expectation of creating income streams or royalties from IPR outside of participation in a competitive marketplace for services that may be informed or stimulated via the outcomes of the project.

Costs and value for money

The estimated project cost to deliver the WattHeat Discovery Phase is £109,160. A compulsory contribution of £22,463 is provided by the combination of UK Power Networks, Baringa Partners and the GLA. The total SIF funding request is £86,697

A detailed cost/contribution breakdown across the project partners is reported below.

UK Power Networks

Total estimated cost: £8,425
Benefit in kind contribution: £18,964
Total SIF funding request: £1

Baringa Partners LLP

Total estimated cost: £90,210
Benefit in kind contribution: £1,000
Total SIF funding request: £78,670

Tepeo

Total estimated cost: £3,750
Total SIF funding request: £3,750

Passiv UK

Total estimated cost: £4,275
Total SIF funding request: £4,275

Greater London Authority

Total estimated cost: £2,500
Benefit in kind contribution: £2,499
Total SIF funding request: £1

This project delivers value for money for three key reasons:

- It is targeted at delivering reduced costs for all through unlocking the flexibility potential of thermal storage for residential heat. The benefits are set out in more detail in the benefits section. If the Discovery Phase concludes that this resource will not be valuable, the project can be stopped before Alpha phase. Without this project, the value of this resource will remain untested.
- The team has been assembled with the required skills, knowledge, and existing stakeholder relationships to deliver this project quickly, efficiently, and of high quality.
- Baringa Partners LLP devised the project idea and is a specialist energy-focussed management consultancy with long experience delivering innovation projects with GB DNOs. They are ideally suited to conducting this work and based on their specific expertise will be able to do so in an efficient manner and with confidence in successful delivery.
- Passiv UK is a technical heat systems consultancy suited to provide a broad perspective of thermal storage solutions in the market.
- Tepeo is a leading provider of heat batteries that can provide deep insight into this key technology.
- The GLA has deep insight into London's vertical community customers and will be critical to assist in navigating the stakeholder landscape.
- As the network operator, UK Power Networks will provide project oversight and provide key input on network impact and costs, as well as service and incentive design
- The budgeted days and cost are based on deep experience amongst the team of running multiple similar scale projects. The partners are well aware of the methodologies and tools they will follow and are confident an efficient cost has been proposed.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

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SIF Round 2 Discovery - Watt Heat Show and Tell (for upload).pdf

SIF Round 2 Discovery - Watt Heat End of Phase (for upload).pdf

This project has been approved by a senior member of staff

☑ Yes