

## SIF Project Registration

### Date of Submission

Mar 2022

### Project Reference Number

10025661

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### Project Title

Flexible Heat

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10025661

### Project Licensee(s)

SP Energy Networks Transmission

### Project Start

March 2022

### Project Duration

2 Months

### Nominated Project Contact(s)

Michael Eves

### Project Budget

£153,142.00

## Project Summary

Flexible Heat will research and demonstrate the value that intelligent management can bring to unlocking flexibility from domestic Thermal Energy Storage (TES).

It will undertake a market review of existing and novel TES technology, identify the value in each, and establish the control requirements to harvest the available flexibility. Flexible Heat will demonstrate the control platform in operation - heating demand will be shifted to meet flexibility needs, whilst maintaining customer warmth and comfort.

By determining the benefits for the whole system, it will produce insights to inform government regulatory and commercial policies.

Flexible Heat meets the scope of the competition by:

- Using smart approaches to manage large-scale electrified heat deployment in a local area, reducing the need for network reinforcement
- Inclusion of a work package which focuses upon the commercial and investment case for financing heating technologies alongside energy network innovation

We will for the first time bring all critical stakeholders together and develop flexibility from domestic heat, including new and innovative technologies.

The discovery phase will explore the topic and define the technical, commercial, and customer considerations in optimising heat flexibility.

SP Transmission is the lead organisation. Our partners are industry leading organisations and key players in the development, manufacture and deployment of innovative heating solutions including TES:

- Active Building Centre Research Programme: Centre of excellence for buildings involved in developing new TES technologies.
- Connected Response: SME technology provider of smart controls for storage heating and hot water systems.
- Delta-EE: Consultancy with expertise in the domestic energy sector.
- E.ON Energy Solutions: Leading energy solution provider within the UK domestic sector.
- The University of Glasgow: Expert in developing flexible heating technologies; leading the UKRI FASHION project to improve heat pump efficiency and flexibility.
- Sunamp: A leading manufacturer of Phase Change Material thermal battery storage technology.

The end users of the proposed solution are domestic customers who will have heat pumps installed as heating is decarbonised. These users need a clear pathway to deploy and benefit from thermal storage. This includes: -

- Suitable TES solutions offered during the installation process
- The costs and benefits are clear to the consumer
- The needs of vulnerable customers are included
- New commercial arrangements are developed to realise the whole systems value of domestic TES

We will engage with key stakeholders, building on existing relationships including consumer organisations, housing developers, local authorities, housing associations, energy suppliers and aggregators.

### Third Party Collaborators

University of Glasgow

Sunamp

Delta-EE

### Nominated Contact Email Address(es)

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### Problem Being Solved

Problem:

The predicted pathways for decarbonising domestic heat will result in a large increase in electrification as gas and other fossil fuel fired boilers are replaced by heat pumps. Gas peak daily energy demand is currently 4-times that of electricity; even mitigated by high Coefficient of Performance (CoP) of heat pumps, peak electricity demand could increase by around 300%.

The unmitigated increase in peak demand will result in overloading of the electricity system including the transmission/distribution networks and generation capacity. The necessary reinforcement to meet peak demand will come at significant cost to the consumer, our research suggests this could be up to £1.3bn by 2030 across our SPD license area.

Opportunity:

Opportunity exists to enable flexibility from domestic Heat to mitigate this peak electricity demand. We can defer the network reinforcement which would be required to meet these challenges conventionally. Furthermore, flexibility from heat can help to manage network stability and balancing.

In the 2021 Future Energy Scenarios, the Energy System Operator (ESO) estimate that Thermal Energy Storage (TES) devices installed alongside heat pumps could reduce peak electricity demand from heating by 35% in the Leading the Way scenario.

Within the Carbon Trust's Flexibility in Great Britain report the possible flexibility available from Thermal Energy Storage (TES) is estimated at 900GWh. The report also states 'it is important to build flexibility into technologies and service offerings right from the start rather than retrofit in the future which would make it prohibitive. Examples of such integration includes .... with heat pumps in domestic and non-domestic buildings...'

By ensuring that an appropriate control platform and thermal storage are incorporated along with heat pump roll-out, we will create flexible low carbon heat demand and help build a compelling customer proposition for decarbonising homes. Understanding and managing domestic heat pumps and TES in an intelligent manner will allow flexibility available from heat to be accessed efficiently and support the transition to net zero.

# Project Approaches And Desired Outcomes

## The Big Idea

Changing the way we heat our homes and engaging customers on the journey to net zero heat are major challenges for the industry. Our proposal addresses the 3 aims set out in the competition challenge:

‘Develop innovative products...’

- We are partnering with SME's and academic institutes who are developing innovative TES solutions and the smart control technology essential for delivering flexible low carbon heat.

‘Produce insights and findings which facilitate decision making...’

- Our comprehensive review from a technical, commercial and customers standpoint will identify the pathways to BaU adoptions and generate learnings applicable to network licensees and other stakeholders including government.

‘Demonstrate how low carbon heating can be intelligently managed...’

- The project will demonstrate the use of smart controls to intelligently manage domestic heating and TES, shifting demand to meet the needs of a low carbon electricity system while helping customers enjoy warm and affordable heating.

Our Big Idea is integration of domestic thermal storage and heat pumps with a regional smart control platform, to reduce peak demand and therefore reduce infrastructure investment and operational costs, whilst demonstrating the solutions and benefits to customers.

Domestic TES technologies are in different stages of development:

- Existing and presently underutilised TES, including building thermal inertia, storage heaters and hot water tanks.
- Market ready TES but not yet widely deployed, including Phase Change Material (PCM) TES systems.
- New and developing TES technologies, such as flexible heat pumps and Thermochemical heat stores.

TES in conjunction with heat pumps will be essential for the future energy system. To ensure sufficient customer uptake of thermal storage technologies to meet future system requirements it is essential that an ecosystem is in place to support customers. The sector must provide accessible technical solutions

and ensure that the commercial framework is in place for customers to optimise heating systems with the appropriate level of thermal storage to support the energy system needs.

Flexible Heat will disseminate learnings to stakeholders, including governments, local authorities, house builders and housing associations so they may make informed decisions on commercial and technical options within their low carbon heat strategies and plans.

While there is existing IP in the technology, there is opportunity to develop the accessibility and framework in a manner which will comply with the arrangements set out by SIF governance.

## **Innovation Justification**

Transmission network operators need flexibility via the smart control of TES to manage peak demand in the future energy system. The recent Carbon Trust Flexibility report identified that domestic TES has far more barriers to overcome to be commercially ready in comparison with other technologies. These include enabling infrastructure, regulatory environment, and stakeholder acceptance. Flexible Heat is the first project which will unlock the potential of TES available at domestic level in conjunction with the smart control and intelligent management.

We require funding through the SIF to allow us to progress with the project. The application of TES to flexibility is novel and innovative. Significant technical and commercial development of products and services is required which cannot be undertaken as matter of course within business as usual activities and no allowance has been made within our RII0-T2 business plan.

Innovation projects have been carried out on topic of heat however there are still many barriers to deployment to be addressed. In particular the use of domestic TES has not yet been fully explored. We have identified the relevant projects within Appendix 1. In addition to projects researching decarbonisation of heat, we will take relevant learnings from projects investigating the wider topic of demand flexibility.

Network Innovation Allowance (NIA) projects of particular relevance in investigating how peak demand reduction can be achieved through use of TES:

- Small scale TES is addressed within NINES and ACCESS and we are building on this with our Re-Heat project in which we are trialling PCM thermal storage as a flexible asset alongside ASHPs on a wider scale.
- 4D heat found that storage heating could enable significant amount of presently constrained wind to be dispatched and we are investigating how flexibility from storage heaters can be utilised through our Flexible Tower project.

To ensure relevant learning is transferred, SP Energy Networks are partners on the WPD led Network Innovation Competition (NIC) submission EQUINOX which proposes to investigate commercial mechanisms to unlock flexibility for low carbon heat.

Throughout Flexible Heat we will leverage learnings from projects delivered under the UKRI funding stream. For example, the novel flexible ASHP technology being developed in the FASHION project led by the University of Glasgow.

# Project Plans And Milestones

## Project Plan And Milestones

Flexible Heat will build towards a demonstration project of domestic heat flexibility in a Beta phase project.

The discovery phase of the project consists of 3 work packages which will explore the different parameters that require definition for a Beta demonstration. Each WP has a different lead to ensure best use of skills and experience, with SPT providing overall authority and management, drawing on project partners experience.

WP1: Technical (Lead – University of Glasgow, support – other partners)

Building on learning from our Re-Heat project we will define the functional specification for an interoperable smart control platform.

In parallel, we will evaluate and appraise in-home technical solutions before designing and specifying the appropriate equipment for the demonstration trial. In addition, we will define the roadmap to uplift the TRL for compatible technologies.

The deliverables will be: -

- High level architecture of a regional smart control platform.
- An optioneering report evaluating domestic thermal storage technologies and their application in key use cases.
- A high level functional specification for a heat flexibility demonstration project including outline scope and scale of the trial.

WP2: Commercial (Lead – Delta-EE, support – other partners)

The deliverable will be a Cost Benefit Analysis (CBA) applicable to the different parts of the whole energy system; this will include: (COSTS) – different technology offerings, infrastructure requirements, potential regional variants, (BENEFITS), economic, environmental, and social benefits including incremental benefits to vulnerable customers and rural communities.

WP3: Customer & Stakeholder (Lead – Connected Response, support – other partners)

This work package will build on our existing relationships and ensure users' needs are given the appropriate focus in the project. It will develop a plan to research customer attitudes, concerns and feedback. Research will span existing heating and hot water services, across demographic groups by property tenure, age, occupancy profile, etc. Stakeholder mapping will inform an engagement plan for key stakeholders.

The deliverable will be a customer and stakeholder engagement plan for the Alpha phase.

Final Deliverable – All deliverables will then be summarised into a short document which details the steps for an Alpha project.

Project management (Lead – SP Energy Networks)

SP Energy Networks will have overall responsibility for successful project delivery and co-ordination.

## Route To Market

With a target of >600,000 heat pumps installations annually by 2028, the domestic Thermal Energy Storage (TES) market is set to double to be worth an estimated £200m/annum in the UK alone.

Following the Beta phase, we foresee the following routes to market for the smart control system developed in Flexible Heat through our project partners, each of whom would look to utilise the control approach to support the commercial proposition to the end user for rolling out heat pumps. This approach will benefit the project development as it is in the consortia interest to ensure it is interoperable and applicable across different domestic demographics, thus ensuring market competition:

- ABC-RP would look to integrate the solution with existing in-home energy systems such as heat pumps to significantly reduce carbon emissions whilst providing greater flexibility to the grid. They would work with an existing supplier of current-state-of-the-art thermal storage solutions to develop the product and manufacturing supply chains.
- The Connected Response product range includes a Smart Load Control device for managing loads such as heating and a Consumer Access Device that can read Smart Meters in real time. In the UK these may be adapted to use the control methods developed in the project as another avenue.
- A Patent Co-operation Treaty (PCT) has been filed to protect the novel flexible heat pump technology and proof of concept has been completed. The University of Glasgow will exploit the technology through licensing it to heat pump manufacturers.

Our users (owners, landlords and aggregators) will be able to purchase this either as additional interoperable functionality to existing installations or integrated into a new installation. We anticipate the latter will be the more common approach based upon the forecasted uptake of Heat Pumps. The smart control system developed in Flexible Heat will enable use of domestic TES as an alternative to conventional reinforcement by supporting the flexibility markers. To enable adoption of the smart control system in business as usual in this framework the learning around the technical and commercial viability of the demonstration will be used to inform the market of the potential opportunity (with the value being to both the network and customer); learning will include customer behaviour, visibility and availability of domestic TES & interoperability with aggregators and service providers. Furthermore, we will implement a commercial and regulatory arrangement which will support the wider flexibility market participation.

## Costs

### Total Project Costs

153142

### SIF Funding

137828

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

☒ Yes