

SIF Discovery Round 2 Project Registration

Date of Submission

May 2023

Project Reference Number

10061339

Project Registration

Project Title

Heatropolis

Project Reference Number

10061339

Project Licensee(s)

UK Power Networks

Project Start

Apr 2023

Project Duration

3 Months

Nominated Project Contact(s)

innovation@ukpowernetworks.co.uk

Project Budget

£177,993.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£146,195.00

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

Heat Pumps

Equality, Diversity And InclusionSurvey

Yes

Project Summary

Heatropolis addresses Challenge 4: Accelerating decarbonisation of major energy demands; developing a new evidence-based framework for delivering net-zero district heating that will support a smarter, more flexible, and integrated energy system.

Decarbonising large-scale district heating systems will have profound implications for investment planning in the electricity networks. The challenge of distributing power to low-carbon heat networks is growing and BEIS estimates that by 2050 they will serve over 18% of the heat demand for buildings.

The Heatropolis project is at the forefront of energy network innovation as it requires the collaboration and coordination of a complex array of stakeholders to deliver a whole system approach and thinking with flexibility as the core theme. The project will deliver a highly scalable demonstration of accelerated decarbonisation for existing heat networks, as the methodology will have transferable properties for new infrastructure developments.

The project will deliver:

- A replicable solution -- a data-led framework for improving operational planning in power network investment and heat network infrastructure
- An integrated approach -- reduced risk for a cost-effective transition, in partnership with institutional investors, heat network operators and DNOs
- Flexibility services -- validated demand response mechanisms that can function within an agreed-profiled connection to manage capacity constraints, support increased use of variable renewable technologies, and reduce costs that are passed on to customers.

Project success will be achieved through involvement and support from the following partners:

- Distribution Network Operator -- UK Power Networks is the UK's largest electricity distributor delivering power to 8.4 million homes and businesses
- Heat Network Operator -- Metropolitan manages over 75 ESCO's contracts for district heating networks, and is responsible for provisioning the design-engineering sub-contractor for the heat-load modeling and data validation
- Smart controls -- Passiv UK are market-leader in delivering net-zero innovation projects with deep domain expertise in monitoring, controlling and optimising low-carbon technologies
- Local Authority -- Camden London Borough Council, a progressive local authority with ambitious net zero targets by 2030 and a track record in district heat innovation, in which the energy centre for the Kings Cross heat network is located

Our hypothesis is that we can help heat network operators transition to net zero. The commercial, reputational, environmental, safety and delivery needs of heat network operators and all other impacted stakeholders will be investigated through the discovery phase and inform the rest of the project.

Project Description

Conventional approaches to transitioning to heat networks from fossil fuels are made in isolation from the strategic investment and operational planning on electricity networks.

To avoid unnecessary upstream reinforcement and seasonal capacity constraints on the electricity network, the heat networks' decarbonisation plans will need to be integrated within the operations of the emerging smarter and more flexible whole energy system. This will require a new evidenced-based framework for coordinating multiple stakeholders including network operators -- planning and managing local power systems, heat network operators - controlling on-site assets and investors -- owning live assets on heat networks.

Heatropolis will establish a new framework for accelerating the decarbonisation of major energy demands that takes a whole system perspective to evaluate the costs, benefits and efficiencies that can be achieved through a collaborative approach between the heat network developer and distribution network operator (DNO) to coordinate investment decisions from the multiple stakeholders.

The Heatropolis project will optimise the decarbonisation of existing heat networks by integrating the use of smart technologies and flexibility into a data-driven framework for reducing costs overcoming network challenges and delivering greater value from whole system coordination. Heatropolis aims to develop and apply this framework to the high-profile heat network at the Kings Cross Development to showcase an improved pathway for the decarbonisation of other heat networks.

The flagship Kings Cross site has committed to reaching net zero by 2030 using on-site solutions, with the aim to remove all dependencies on off-site carbon offsetting schemes.

Kings Cross' ambitious onsite decarbonisation plans aim to replace all fossil-fuelled systems with low-carbon electric heat pumps. These plans present complex technical and commercial challenges for the site that will also ultimately have considerable implications

for the local power network infrastructure and operation, raising an existing connection from 1.5 MW to 17 MW.

In discovery, Heatropolis will:

- Investigate the amount of flexibility that low-carbon heat network assets could provide to the electricity network through load shaping and demand reduction
- Evaluate the commercial opportunities to reduce the load on the network through the better use of data for smart control optimisation, and profiled connections planning
- Define a methodology for organisations to plan and agree a tailored profiled connection offering suitable for heat networks with the DNO that maximise the use of existing capacity, minimises the need for network reinforcement and reduces connection upgrade costs for consumers

Third Party Collaborators

Passiv UK

Metropolitan

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

Camden Council:

5 Pancras Square, London, N1C 4AG

Metropolitan Infrastructure (05759935):

Synergy House Windmill Avenue, Woolpit, Bury St. Edmunds, England, IP30 9UP

Passiv UK (12929432):

Synergy House Windmill Avenue, Woolpit, Bury St. Edmunds, England, IP30 9UP

Project Short Description (not scored)

The Heatropolis project aims to accelerate the decarbonisation of existing heat networks by developing, deploying, and testing a data-driven framework that will deliver a smarter, more flexible, and integrated energy system. The framework will maximise the use of existing electricity network capacity while minimising the need for network reinforcement, the curtailment of renewable generation, and cascading costs to customers.

Video description

<https://www.youtube.com/watch?v=7UgFZ4qIpa0&list=PLrMOhOrmeR6ldr-EVoT8ABGhTCxgyBKqs&index=45>

Innovation justification

The decarbonisation of existing heat networks faces key barriers like cost of managing increased electricity demand on the network. Heatropolis aims to leverage the use of flexibility to develop a data-driven framework to overcome these challenges and provide a viable decarbonisation pathway.

Historically, asset-management decisions and operational strategies for heat-networks and electricity networks have been developed largely in isolation from each other. Heatropolis aims to address the problem of coordinating investment planning decisions. Developing new evidence-based investment mechanisms to enable Kings Cross Development and others to transition to net-zero using novel low-carbon technologies, e.g., heat-pump, thermal-storage, fuel-cells, hydrogen, demand-side-response mechanisms. Active demand management and flexible connections have been trialled in previous heat-network innovation projects, but commercial integration within an ongoing energy transformation project is highly innovative, complex and carries risk that could not be overcome without SIF support.

The project is risky as understanding how to coordinate long term investment decisions with interdependent processes such as active demand management is complex. The financial mechanisms for delivering flexible connections for heat-networks are untested and there is high-degree of uncertainty around using conventional energy modelling for future operational scenarios. The Heatropolis project is at the forefront of energy network innovation as it requires the interaction of an array of stakeholders to deliver a whole-system approach and thinking.

Heatropolis will incorporate the latest innovations in dynamic heat-network control, AI based energy simulations and incorporate near real-time data exchanges. The project will draw on learnings from previous innovation projects led by Passiv UK:

- SMOOTH -- this project explored the use of demand control throughout a heat network and into the home
- NOTICE -- this project explored to use of end-point demand control to improve the operational efficiencies of a heat-network

The Kings Cross Development has already considered demand reduction measures to maximise the contribution from the low-carbon technologies. However, the benefits of active management to take advantage of low-cost renewable energy and a flexible connection have not been investigated. The existing plans for decarbonisation will provide a counterfactual against which the economic and sustainable value of Heatropolis will be evaluated.

Heatropolis could not have been funded elsewhere within the pricing control or as part of business-as-usual (BaU) activities. As the multi-asset and -party approach is unproven, the agile approach provided by SIF is ideal to ensure sufficient level of investigations is undertaken before the complete solution is developed in collaboration with stakeholders.

Benefits Part 1

Environmental - carbon reduction – direct CO2 savings per annum against a business-as-usual counterfactual
Environmental - carbon reduction – indirect CO2 savings per annum against a business-as-usual counterfactual
Financial - cost savings per annum for users of network services
Financial - future reductions in the cost of operating the network
New to market – products, processes, and services
Revenues - improved access to revenues for users of network services

Benefits Part 2

Consumer benefits are developed based on the assumption that load-shifting on a low-carbon heat-network using smart controls, storage can help to reduce seasonal, (short-term) misalignment of heat demand and electricity generation.

All benefits are expected to be achieved by the end of Beta.

Financial - network operations:

- Consumer benefit: Indirectly in the long-term by reduced distribution use of system (DUoS) costs.
- Target output: 5-50% cost reduction associated with secondary-substation where the heat-network connects (initial connection, operating, maintenance cost and reinforcement expenditure) due to retrofit of heat-network with low-carbon heating technologies.
- Tracking metric assumptions and calculations: Cost/Quote for reinforcing electricity distribution network, cost of new connection for heat-network and connections to electricity distribution network. This will be based on the local electricity connection capacity and flexibility assumptions.
- Justification for assumptions: Increased network flexibility from heat technologies can reduce ESO balancing costs and DSO flexibility costs. This will be against a benchmark of the cost to UK Power Networks to operate its network and upgrade substations where the retrofitted heat-network is connected, without taking into account flexibility.

Financial - network service users:

- Consumer benefit: Reduced socialised costs for network connection upgrades using DNO funding to incentivise heat-network owners to invest in asset-based solutions.
- Target output: 5-50% reduction in cost per annum for users of network services.
- Tracking metric assumptions and calculations: Number of kW of electricity required per annum for heating and the average pence per kW.
- Justification for assumptions: Cost of connecting an energy centre will impact the final cost of operating the heat-network and operating costs passed to customers. Benefits to be estimated during the discovery phase, validated and tested during trials.

Environmental – direct carbon reduction:

- Consumer benefit: Enables consumers, including in vulnerable circumstances, to benefit from the energy transition.
- Target output: 5-50% reduction in CO2 produced from operating heat network.
- Tracking metric assumptions and calculations: CO2 profile of the electricity required for heating in the flexible heat-network compared with CO2 profile of electricity required for non-flexible heat-network.
- Justification for assumptions: Carbon savings will be achieved by taking advantage of cheap renewable power generation using active load shaping across the whole heat-network.

Non-financial:

This project aims to build a new commercial framework that considers particularly consumers in vulnerable circumstances and will support them in reducing their fuel poverty and/or improve their health and social inclusion with healthier, more comfortable new and refurbished homes that are cheaper to run.

Project Plans And Milestones

Project Plan and Milestones

The partners have a strong track delivering innovation projects demonstrating success through established practices. An appendix with a detailed schedule providing a baseline of activities and milestones is attached.

WP1) Project Management – (Passiv) - £44,402

- Mobilisation, governance processes, detailed planning, milestones - set up risk register for review

Deliverables: Project Initiation Document (PID) and updated risk-register

WP2) Counterfactual system design (Metropolitan) - £20,000

- Energy demand profiling: Data gathering, and validation of energy demands used in decarbonisation plan
- Counterfactual design: Review cost model for counterfactual

Deliverable: Counterfactual system review

WP3) Smart system design (Metropolitan) - £55,587

Options and review - shortlist interventions for smart system design based on:

- Operational improvements -- DSR, load flattening and advanced end-point control
- Technology switching -- innovative on-site solutions for heat and power
- Storage --maximise operation of onsite technologies for flex services and optimisation penetration of external renewables
- Internal stakeholder review -- assessment of smart design solutions to and prioritisation of options for detailed analysis

Deliverable: Shortlist of smart system solutions

WP4) Techno economic assessment (Passiv) - £20,000

- Sizing -- Analysis of shortlisted design options for equipment sizing and configurations
- Optimisation -- Evaluation of demand-reduction options, end-point controls and operational savings from maximising renewables
- Network connection Options -- Cost of connection for counterfactual, smart network solutions, options for flex services and contracted connection profiles
- Value Proposition -- evaluation of benefits case and value proposition from smart system design and operation

Deliverable: Proposition for development in Alpha

Dissemination and route to market (UKPN) - £6,206

- Development of communications material about the project
- External workshop with wider industry to review outputs and outline plans for Alpha
- LA dissemination and feedback within LEAP (Camden Council)

Deliverable: Dissemination and publication of key outputs

Risks

A risk register for this project has been provided as an appendix, primary risks identified to-date:

- Commercial -- level of savings realised is too uncertain to support required investments
- Technical -- smart systems designs are too complex and unreliable
- Political/Policy investment framework is made obsolete because of regulatory changes

Mitigations for each are detailed in the appendix.

Additional risks will be assessed throughout the project.

Major constraints

- Short timeframe for resource planning, partner contracting prior to commencement
- Technology solution not achievable in project budget/timeframe

Regulatory Barriers (not scored)

We do not foresee any regulatory barriers for fully embedding our expected project outcomes into business as usual (BaU).

As part of the Discovery Phase, we will explore any opportunities for modifications to regulations that could enhance the benefits of our innovation and provide an assessment of how achievable these changes would need to be. All learnings across the phases will be shared with relevant stakeholders to develop mitigation strategies for any identified barriers when the framework is applied to either existing heat networks or new developments.

Commercials

Route To Market

Heat Networks will play a key role in achieving net zero. According to the Association for Decentralised Energy (ADE), there are over 14,000 heat networks in the UK providing 446,517 residential connections. BEIS forecasts the role of district heating will rise from 2% of all UK heating to 18% by 2050 and have an investment potential of up to £80 Billion. The majority of existing networks rely on fossil-fuel-derived gas connections that will need to be decarbonised using low-carbon technologies.

Heatropolis capitalises on a market opportunity for a framework that can accelerate the decarbonisation of heat networks. The project will not undermine the development of competitive markets by working with relevant, multi-party stakeholders throughout design and testing stages to ensure solutions are based on existing BaU applications. All findings, frameworks, connections services and incentives developed through this project will be made available to all market participants to accelerate adoption as part of BaU.

Both Passiv and Metropolitan have significant routes to market in the build and heat network sector through the wider BUUK Infrastructure group of businesses serving over 1 million homes. The level of heat network investment and smart control expertise they offer makes them best placed to implement the innovations that will be demonstrated through this project. Core target markets are housing developers, local authorities, and heat network providers (such as the ESCO's operated by Metropolitan) that are looking to decarbonise their existing infrastructure to meet net-zero targets.

The value proposition is that a smarter operation of a heat network in partnership with the electricity distribution system will deliver important benefits including reducing congestion, reducing costs for both DNOs and heat network operators and providing flexibility to the grid. We will work to estimate the associated savings during Discovery and Alpha phases, additionally exploring the use of a control system to increase the use of power from renewable sources and avoid curtailment. The framework that will be developed will detail the commercial arrangements, financing mechanisms, and business cases for heat network operators to integrate flexibility in their decarbonised heat network.

Once proven effective, new services and/or incentives to be provided by the DSO would be funded through BaU allowances for connection upgrades, incentivising heat network developers to cover the upfront expenditure for asset-based solutions required to access the funding.

Intellectual property rights (not scored)

We recognise the importance of managing IPR in the delivery of a research and innovation project. All the project partners intend to comply with the default arrangements for IPR and Chapter 9 SIF Governance Document.

The activity for the Heatropolis Discovery Phase will be an initial feasibility study that evaluates the use of different low carbon heat network assets, control systems and commercial arrangements that will be needed to realise potential operational benefits.

The project will help develop an understanding of the interdependencies of operating a major heat network in coordination with the power system and identify any constraints to investment planning and options for the management of those limitations.

Prior to starting the Discovery Phase, each project partner will make a declaration of background IP for the consortium agreement that will clearly define the background IP they bring to the project. Specific IP issues arising during project delivery will be addressed by the Project Steering Group.

An IP Register will be created at the beginning during the set-up phase and will be developed and maintained throughout the project. Any restrictions on freedom to operate from individual components or know-how used in Heatropolis will be evaluated as part of the project delivery.

Costs and value for money

The total cost of the Discovery Phase will be £177,993 with a total SIF-funding request of £146,195, after taking project partner contributions. The project partners are contributing 18% of the total project costs which is more than the minimum 10% compulsory contribution. This demonstrates a commitment to the project from partners as well as value for money to customers.

Breakdown:

UK Power Networks:

- Total costs: £21,450
- SIF-funding: £5,206

Metropolitan:

- Total costs: £80,208
- SIF-funding: £72,187

Passiv UK:

- Total costs: £75,335
- SIF-funding: £67,802

Camden Council:

Total costs and funding requirement: £1,000

Metropolitan are allocated the largest share of costs and SIF-funding as they own and operate the Kings Cross heat-network and are providing specialist commercial and system design capabilities. They will manage a subcontractor providing engineering, modeling data and tasks. Based on previous quotations, subcontractor costs are estimated at £34,000. A procurement process to ensure best-value with any shortfall covered by Metropolitan.

Passiv has the second largest share of costs as they will undertake the majority of the project management and delivery. They will ensure successful management of risks, performance, timelines, quality and budget. Passiv will also carry out analysis of smart-system optimisation to explore the value proposition

UK Power Networks require a small share of costs and SIF-funding as they will provide oversight and engagement to their internal Connections Team and support dissemination. Camden Council requires a small share of costs and SIF funding as they will be providing oversight and dissemination of the project outcomes to local government partners.

Without support from the SIF, innovations realised through this project would not go ahead in their current form and commercial frameworks put forward would not be achieved within the same timeframe endangering the transition to net-zero.

The project delivers good value for money as it establishes new mechanisms to reduce whole-system costs from heat decarbonisation, unlocking long-term investments from multiple stakeholders. Our approach to evaluating these is clearly defined in the benefits section. The learnings from discovery will be applied across DNOs and heat-network operators across the country.

The new framework developed through this project helps unlock private sector investment in long-term assets as part of a smarter energy system. The approach will prevent wasted spend and enable both the project and others to be more targeted with how they allocate their spend. Without this funding and development of the project, significant savings in the future will not be realised.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

SIF Discovery Round 2 Project Registration 2023-05-30 10_27

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

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

This project has been approved by a senior member of staff

☒ Yes