SIF Discovery Round 2 Project Registration

Date of Submission

May 2023

Project Reference Number

10061341

Project Registration

Project Title

Full Circle

Project Reference Number

10061341

Project Licensee(s)

UK Power Networks

Project Start

Apr 2023

Project Duration

3 Months

Nominated Project Contact(s)

innovation@ukpowernetworks.co.uk

Project Budget

£122,574.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£108,453.00

Strategy Theme

Optimised assets and practices

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

Transformers

Equality, Diversity And InclusionSurvey

Yes

Project Summary

Full Circle addresses Challenge 4: Accelerating decarbonisation of major energy demands. Specifically, it is looking at improving the efficiency of heat networks to make heat networks cheaper and more accessible for everyone. The heating of housing developments and urban communities usually comes from high-carbon, low-efficiency, and high-cost heating sources such as natural gas or resistive electric heating. This project aims to deploy a new industry-leading framework for how heat network developers, property developers and ESCos can operationally and commercially recover low-grade waste heat from DNO transformers to use as an input into their heating networks and deliver lower cost and carbon heating.

The design of the heat recovery from transformers and thermal storage capacities will be at the forefront of energy network innovation as it requires collaboration and agreement between UK Power Networks and multiple parties on complex technical and commercial considerations to be successful. This project requires cross-vector collaboration with industry and community to develop a framework that can be applied across UK Power Networks' regions and across other DNOs.

Full Circle has four key partners:

1. **UK Power Networks** are the DNO for electricity and have been leading multiple innovation projects to increase the resilience and efficiency of its assets and will provide the technical knowledge to support this project.
2. **Arup** is an engineering consultancy that develops innovative heating and energy infrastructure and solutions. They have a wealth of experience developing innovative energy solutions for national regions, cities, and individual developments.
3. **SGN** is a gas distribution network and developer of heat networks. They are perfectly placed for this project as SGN Place are the property development subsidiary of SGN and has a senior living development planned in Wandsworth near UK Power Networks' transformers which will be the demonstrator.
4. **Wandsworth Council** provides planning permission to developments within the council boundaries and has the target to achieve carbon neutrality by 2030.

This project is focused on solving the needs of all the stakeholders in this value chain: the heat network and property developers, the electricity network and finally the end customers. For the heat network developers, ESCos and end customers will benefit from an improved coefficient of performance (COP) for the heating system all year round and reduced costs. The electricity network will benefit from reduced reinforcement costs that also cause construction delays and influence customer energy costs.

Project Description

Heat networks are seen as a cost-effective solution to heat decarbonisation but with the current energy crisis, electrifying heat sources can be expensive, and inefficient when considered all year round due to system inefficiencies and cause reinforcements on the network side. However, low-income and vulnerable customers and communities in concentrated urban settings do not have the same abilities to afford or pick low-carbon heating solutions for themselves.

Full Circle aims to help provide affordable low-carbon heating to vulnerable and hard to reach customers by developing a new industry-leading framework for how Energy Service Companies (ESCo), heat network developers and property developers can operationally and commercially interact with Distribution Network Operators (DNOs) to recover low-grade waste heat from DNO substations and use it as an input in their heating systems to improve efficiencies and reduce operating costs.

This Discovery Phase plans to deliver the cost savings and benefits directly to the residents of a planned senior living development in Wandsworth that will be connected to the local heat network. This project will also explore the benefits for DNOs as extracting the heat from the transformer will reduce peak operating temperatures and therefore increase the asset life cycle.

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Full Circle has four key partners: Arup, SGN, UK Power Networks and Wandsworth Council. For the demonstrator in Wandsworth, the primary customer of the innovation will be SGN and we expect the benefits to be passed onto the end users who will be the future residents of SGN's planned senior housing development in Wandsworth. However, this project will be developed and designed with all users in mind to ensure rapid adoption in business as usual (BAU), this includes the heat network developers and operators, the electricity networks and end consumers.

Third Party Collaborators

Ove Arup & Partners Ltd

Atelier Ten Limited

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

OVE ARUP & PARTNERS (01312453): 8 Fitzroy Street, London, United Kingdom, W1T 4BJ

SGN COMMERCIAL SERVICES (05969465): St Lawrence House, Station Approach, Horley, Surrey, RH6 9HJ

Wandsworth Borough Council: Wandsworth London Borough Council, The Town Hall, Wandsworth High St, London SW18 2PU

Project Short Description (not scored)

Full Circle aims to make low-carbon heating affordable for vulnerable and hard to reach customers by developing a commercial and operational framework for heat network developers, property developers and ESCos to recover low-grade waste heat from DNO transformers to improve the efficiencies of their heat networks and reduce their costs.

Video description

https://www.youtube.com/watch?v=T-arOEx5k60&list=PLrMOhOrmeR6ldr-EVoT8ABGhTCxgyBKqs&index=46

Innovation justification

Full Circle aims to accelerate the decarbonisation of heat by exploring an engineering solution to recover low-grade waste heat from grid transformers to improve heat network efficiencies, coupled with a commercial and operating framework for DNOs to support the development and deliver low-carbon heating to vulnerable and hard to reach consumers. The proposed solution aims to address the high-cost and seasonal inefficiency barriers to heat decarbonisation by providing a one-size-fits-all solution that minimises the infrastructure and energy costs and is suitable for different types of property.

The approach for Full Circle is novel and risky because it will be investigated using a real live environment (Wandsworth Heat Network), bridging the gaps of previous innovation projects in the UK that demonstrated high-level technical feasibility but did not consider its operational and commercial delivery. This needs to be considered to ensure the solution not only is technically feasible but benefits the users and DNOs. The project requires strong cross-vector collaboration and a complex array of partners to achieve success for a demonstrator and to design it with BAU in mind.

Several innovation projects in the UK have looked to solve a similar challenge:

- SSE Heat study case for geothermal/heat extraction, upgrading low-grade heat from aquifers
- DEEP funded project by the GLA and SSE on water-sourced heat pump DHN solution from the river Wandle
- Northern Powergrid Transformer Heat Recovery Project delivered by Arup showed technical feasibility but limited commercial viability due to 2019 market conditions which are changed now.
- SSE and National Grid pilot project to turn electricity transformers into heat network 'boilers'

This project has clear benefits as extracting the heat from the transformer will reduce peak operating temperatures, increasing the asset life cycle. If most of the heat required for the end users comes from the waste transformer heat, then less energy needs to be generated from higher-cost and carbon sources. We will look to forecast the future capital and operating costs, energy consumption and carbon emissions against the counterfactual of Wandsworth's Heat Network operating without heat recovery from transformers.

Full Circle is a demonstrator project that will test a new cross-vector approach to scale waste heat solutions to communities across the UK. SIF is the most suitable funding mechanism because of the phased approach, allowing the partners to conduct technical feasibility of the proposed design and then perform a demonstrator as part of the Beta Phase.

Benefits Part 1

Environmental - carbon reduction – direct 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

Revenues - creation of new revenue streams

Benefits Part 2

Quantified percentage target outputs are derived from Arup calculations using 2020 Wandsworth transformer data with an assumption of 50% recovery of transformer heat based on counterfactual heat network assets; to be measured in the Discovery stage feasibility study. Ranges are because of unknown parameters to be quantified in the Discovery stage and timelines to achieve these targets' outputs are end of Beta.

Financial benefits

Reductions in the cost of operating the network will indirectly benefit consumers:

- Target Output: 5-50% reduction in total Operating and Maintenance cost and replacement expenditure for electricity transformer and a reduction in base load requirement compared to counterfactual (without transformer heat recovery).
- Tracking metric assumptions and calculations: Thermal heat loss per transformer and equate this to a forecasted asset lifecycle duration and forecast of reinforcement costs. To be measured against a performance benchmark for these metrics of the transformer without the proposed heating solution.
- Justification for assumptions: The offtake of heat in and back to the transformer should increase the lifecycle of the asset and reduce the need for replacement.

There will be direct cost savings per annum on energy bills for consumers

- Target output: 9-18% reduction on customer bills
- Tracking metric assumptions and calculations: p/kW on consumer tariff for consumers connected to the heat network using recovered heat from the transformer
- Justification for assumptions: Cost savings per annum on energy bills for consumers connected to the heat network are estimated to be between 5%-50%. To be compared against a counterfactual for consumers using a similar heat network without recovered heat.

Environmental benefits

Carbon reduction -- direct CO2 savings per annum will benefit consumers' net zero ambitions

- Target Output: 5-50% reduction in CO2 produced from a heat network
- Tracking metric assumptions and calculations: (Number of kW recovered * CO2 emissions factor)
- Justification for assumptions: Carbon reductions estimate is based on the transformed losses being recovered, ~50% of total losses at the grid emissions factor and assume seasonal recovery and the number of years of the lifecycle. To be measured against a counterfactual transformer and heating system that does not use waste heat.

New revenue streams and services

New business models and commercial cases will be produced.

- New service offering for UK Power Networks and a new channel for off-takers (heat off-take from the transformer) - capacity/connections offering, the design process for heat recovery and bulk heat sale contracts
- Replication of commercial partnering arrangements with site-specific development off-takers.

Project Plans And Milestones

Project Plan and Milestones

The project is going to be organised in the following work streams:

WP1- Transformer impact assessment and implementation -Lead: UK Power Networks - £5,000

- Description: Evaluate the feasibility of using transformer waste heat at the Wandsworth substation and design the operational and commercial delivery of future stages of the project (Alpha, Beta, BAU)
- Success: Production of a feasibility study to demonstrate that the project is feasible and can meet engineering requirements and risk assessments.

WP2 - Development site heat demand profiles - Lead: SGN - £9,945

- Description: Provide heat demand data for evaluation against waste heat data from the electrical transformers.
- Success: Calculation and understanding of network heat loss and heat demand of heat network/development that demonstrates the feasibility of continuing the project.

WP3 - Heat and transformer data analysis and CBA Development -Lead: Arup - £72,946

- Description: With inputs from SGN and UK Power Networks, transformer and heat demand analysis, Arup will model, evaluate and analyse the data sets to forecast the benefits of the proposed solution.
- Success: Final report on techno-economic feasibility of solution produced and shared with stakeholders for feedback.

WP4 -- Customer benefits and dissemination - Lead: SGN- £10,188

- Description: Analyse the cost and benefits of the proposed heating design on customer bills.
- Success: Final reports produced and shared with stakeholders for feedback.

WP5 - Project Management - Lead: UK Power Networks - £10,375

- Description: Ensuring that the project is completed on time, within budget, and to the required level of quality.
- Success: Project governance is set up and adhered to.

Key risks and constraints include:

- Lack of availability of data from project partners to perform analysis
- Lack of availability of expert resources available from project partners to perform analysis.
- Local planning policies and building regulations.

The mitigation measures for these risks are planned in detail in the risk matrix included in the Project Management template. In general, early engagement and liaison with asset management teams to gather operational data and review requirements for BAU adoption will prevent any bottlenecks to delivery and lead to a methodical and data-led solution. UK Power Networks have an experienced project management team and have the expertise to manage these risks during delivery and continually review and update the register at a regular cadence as the project develops.

Regulatory Barriers (not scored)

DNO regulations and policies will form part of the requirements gathering during Discovery and design phase and the project will collate findings in their reports where existing or new policies could be developed to increase the success of the project and accelerate the route to market and scale. We do not anticipate the demonstration to require derogation or exemption.

Local Planning Policies and Building Regulations could hinder the delivery of Alpha Phase or Beta Phase but the proposed energy solution is compliant with Part L SAP regulations and London Betterment condition, so we do not see this as an issue. Regulatory barriers will be mitigated through Discovery Phase discussions with Wandsworth Council and SGN.

Commercials

Route To Market

To ensure new solutions and services can be quickly adopted into BAU practices, the project will work with all the relevant stakeholders throughout the project lifecycle through design and testing to ensure solutions are based on real BAU situations. The commercial and operational framework will be developed with BAU in mind to enable it to be scaled across the country with other DNOs, heating providers and property developers.

Any market frameworks and incentives developed through this project will be made available to all market participants as part of BAU. The framework and findings can be used by any relevant party to undertake a similar project.

SGN, Arup and UK Power Networks are all jointly responsible for the implementation of this innovation as there are technical and commercial interdependencies. The project will also require a commercial framework and contract between the parties as all are involved in either build or operations. The primary customer segment for this innovation is heat network and property developers and ESCos. The service or opportunity is for UK Power Networks to provide a new heat connection. As part of the Alpha Phase, we will identify all transformer sites that have the capacity for heat and power provision to developers. The route to market would be for UK Power Networks to publicise these under their current mapping system for developers to view and make formal connection applications for heat and or power. UK Power Networks would check the availability and capacity to make a commercial offering like the current connection process offering to do the non-contestable works to design the changes to the transformer and supply a heat plate connection for a developer to use. A service contract will then be signed for the supply of bulk heat.

The customer proposition and business case for the developer are that using the low-grade waste heat will increase the efficiency of their heating network and therefore should deliver them lower operating costs and also lower carbon emissions for the heating they produce. This will be validated in the Discovery Phase.

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 developers/ESCos and effectively passed onto the end customers themselves.

Intellectual property rights (not scored)

The IPR arrangements for this project will be in line with the terms set in the SIF Governance Document Chapter 9 and the project participants agree to comply with the default IPR conditions Each project partner will be using standard energy calculations to analyse the initial data so we do not see any IPR issues. This may change during the Alpha Phase when more formal engineering designed are required.

Costs and value for money

The total project costs are £122,574 and the total SIF funding request of £108,454 after taking into account project partner contributions. The project partners are contributing 11.5% 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.

The breakdown is as follows:

UK Power Networks:

- Total costs - £27,425
- SIF funding request - £15,375

SGN Services:

- Total costs - £20,703
- SIF funding request - £18,633

Arup:

- Total costs - £72,946
- SIF funding request - £72,946

Wandsworth Council:

- Total costs - £1,500
- SIF funding request - £1,500

This project delivers value for money as:

- SGN Place is a partner company of SGN Commercial Services who have a JV ESCO with Vital Energi working together on this project, but Vital Energi is supporting in a subcontractor role, providing all the Heat demand data and site requirements for the Wandsworth development. Vital Energi has 30 years of experience and has proven to design flexible, resilient and future-proofed energy schemes across cities in the UK, having created award-winning energy centre solutions for new-build and retrofit projects across all sectors.
- Learnings from Discovery Phase can be applied across not only other networks but other developers, councils, and communities across GB
- The outputs of this project can directly benefit consumers that are most in need of support depending on the commercial framework that is developed
- Discovery Phase considers the needs of the consumers
- Discovery Phase is focused on the feasibility and viability of implementing this solution and therefore there will be no over-spend if discovery indicates this project is not feasible
- If successful, this project will deliver value for money through financial and carbon savings for the consumer when implemented.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

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

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

SIF Round 2 Discovery - Full Circle Show Tell (for upload).pdf

This project has been approved by a senior member of staff

☑ Yes