SIF Discovery Round 2 Project Registration

Date of Submission

Apr 2023

Project Reference Number

10061606

Project Registration

Project Title

Net Zero Community Energy Hubs

Project Reference Number

10061606

Project Licensee(s)

SGN

Project Start

Apr 2023

Project Duration

2 Months

Nominated Project Contact(s)

stuart.sherlock@sgn.co.uk

Project Budget

£90,603.00

Funding Mechanism

SIF Discovery - Round 2

SIF Funding

£81,315.00

Strategy Theme

Net zero and the energy system transition

Challenge Area

Accelerating decarbonisation of major energy demands.

Lead Sector

Gas Distribution

Other Related Sectors

Funding Licensees

Lead Funding Licensee

SGN - Southern England (inc South London)

Collaborating Networks

SGN

Technology Areas

Green Gas, Heat Pumps

Equality, Diversity And InclusionSurvey

Yes

Project Summary

Project

To meet the aims of Innovation Challenge 4, the project will develop a model and control system (hardware/software) to facilitate an accelerated rollout of affordable, low carbon heat. Heat delivery to tens-of-thousands of residential and commercial buildings will come from community energy hubs within which multiple flexible assets operate together behind-the-meter.

Hubs include:

- Hybrid heat networks (heat from hydrogen boilers, heat pumps and thermal stores)
- Green hydrogen production and distribution
- Electrical/thermal storage
- Utilisation of existing gas infrastructure for 100% hydrogen
- Data analytics for targeted rollout of building fabric measures

Aims

We aim to develop a novel technoeconomic approach to operating hybrid heat networks alongside other flexible assets. This facilitates use of existing gas infrastructure for the transition to hydrogen and, accelerates and reduces the overall cost of decarbonised heat rollout.

There are various options for smart, flexible systems including li-ion batteries, demand side flexibility e.g. hydrogen electrolysers, and heat networks with storage. Whilst these options are important individually, it is critical they work together in a coordinated, sequenced and consumer focused manner to cost effectively achieve the decarbonisation targets set by the government.

Innovation

Co-location of hybrid heat networks with grid scale flexible assets can provide year-round, cross vector, energy flexibility. In this way the utilisation of the energy distribution infrastructure increases significantly compared to a standalone heat network. The innovation will also enable the conversion of whole sections of the existing gas infrastructure (including storage) to 100% hydrogen, facilitating the transition to hydrogen in a targeted phased manner.

The system will include a metering and verification protocol providing data to support a targeted rollout of building fabric measures and verify the benefits once installed.

Users

The users of the innovation are heat network and/or flexible energy asset operators. Users want to increase the rollout of their systems with optimised commercial performance whilst decarbonising and increasing efficiency of their energy usage. The innovation will reduce upfront capital cost and increase the availability of network infrastructure to accelerate rollout.

Project Partners

SGN are the lead partner, bringing expertise in gas and hydrogen as well as numerous sites in urban areas.

Vital Energi are the heat network provider. They are UK market leader in district heating schemes with 83,000 homes connected.

Imperial College London will be the academic partner, having developed an integrated whole energy systems (IWES) model.

Glasgow City Council and West Dunbartonshire Council will be Local Government partners.

Project Description

The project is to develop a model and control system (hardware/software) to facilitate an accelerated rollout of affordable, low carbon heat. Heat delivery to tens-of-thousands of residential and commercial buildings will come from community energy hubs within which multiple flexible assets operate together behind-the-meter.

Hubs include:

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Third Party Collaborators

Vital Energi

Imperial College London

Glasgow City Council

West Bunbartonshire

Nominated Contact Email Address(es)

sgn.innovation@sgn.co.uk

Project Description And Benefits

Applicants Location (not scored)

Southern Gas Networks St Lawrence House, Station Approach, Horley, England, RH6 9HJ

Vital Energi Solutions Limited Century House, Roman Rd, Blackburn BB1 2LD

Imperial College London Exhibition Rd, South Kensington, London SW7 2BX

Glasgow City Council 82 George Square, Glasgow G2 1DU

West Dunbartonshire Council 16 Church St, Dumbarton G82 1QL

Project Short Description (not scored)

Developing models and control systems for co-location of heat networks behind the meter with flexible assets.

Video description

https://youtu.be/X9Oq4jJ4yTo

Innovation justification

Problem

Several problems are addressed by this project:

- Decarbonised heat is not affordable for end users
- Switching to "green" heating (e.g. heat pumps) relies on consumers making complicated specification decisions; It is easier to stick with "what they know".
- Financial business case not viable for heat network developers
- Grid capacity constraints
- Existing gas infrastructure capacity insufficient for 100% green hydrogen
- Transition to 100% green hydrogen is challenging and expensive

Connecting and controlling multiple assets together, behind the meter, will reduce the cost and timescales for installing and operating heat networks.

Innovation

This type of co-location, integration and control across multiple behind the meter assets is novel. The innovation will include the creation of new models and control systems.

The project will review how the relative capacities of the heating and storage equipment interact and how variation in this impacts consumer costs, as well as wider energy infrastructure investment. New types of control methodology will be developed to optimise the commercial viability of a whole system.

Knowledge Gap

We must create a detailed model, which will determine equipment specification, and control system, which can operate multiple flexible assets in parallel. This requires a system which combines integrated commercial analysis with dispatch control. The system must account for changes in capacity as the heat network grows. Once the system is built and operating the rollout of hybrid heat networks can be accelerated.

Counterfactual

Proposed counterfactual:

A low carbon, low temperature hot water network with a central plant room, on its own grid connection, sized for growth, and implemented with no co-ordination with other local energy activities.

Economic Benefits:

- Lower upfront costs allow for a larger number of smaller networks with ability to grow
- Lower anchor customer requirements for heat networks to "stack up" financially
- Reduction in power and gas connection costs as shared with other assets
- High degree of storage allows assets to access multiple energy markets, lowering costs

Sustainability Benefits:

- Pathway to repurpose existing gas infrastructure for transition to 100% hydrogen
- Allows increased penetration of renewables by improving flexibility and efficiency
- Reduction in new energy distribution and generation infrastructure

Price Control

SIF funding is the only option within price control. It wouldn't attract any other type of funding as it is research led and is risky as it requires new models and control systems to be developed and proven.

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

Benefits Part 2

How will your project deliver net benefits to consumers? At Discovery Phase these can be high level; if the project progresses we would expect more granularity and evidence.
Financial - future reductions in the cost of operating the network

The key metric will be the volumes (MWh) of hydrogen and electricity required to provide the consumers heating. We will review the profile of these against the counterfactual and using Imperial's model, look at the local and national infrastructure and investment requirements to meet these demands. These savings would be achieved gradually during the transition to Net Zero.

Financial - cost savings per annum on energy bills for consumers

- We will make an estimate of how the savings on network reinforcement would translate into reduction in standing and variable charges on all gas consumer bills across various scenarios for deployment of the project.
- We will calculate the MWh of heating produced by hydrogen and electricity and will show how the heat network consumer costs will vary over several scenarios during the transition to hydrogen.
- We will demonstrate how access to flexible markets will further reduce the bills of those connected to the heat network.

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

The CO2 emissions applicable to our project will be zero from 2035. In 2017 the average household generated 2,745 kg of CO2 emissions from heating. We will identify several comparisons in the CO2 savings at various points between now and 2050 against the calculated gas and power mix.

We will identify the total volume of hydrogen required for gas only heating. We will calculate the volume of hydrogen produced during periods of excess generation in the 2050 energy mix. We will apply the assumption that any additional hydrogen would be blue hydrogen with 1kg of CO2 emissions for every 1kg of blue hydrogen used to calculate the kg of CO2 per MWh of heating. The CO2 savings per annum will be produced from these figures.

New to market -- products, processes, and services

Success will be once the product is available to other heat network operators and can be used to approach existing assets owners for behind the meter connections. We expect this to be in a 3-4 year time period.

Project Plans And Milestones

Project Plan and Milestones

The attached Project Plant will be updated throughout the project, our team is flexible, agile, and responsive to change.

We consider the key work packages to be:

WP1 Project Support (SGN lead)

Liaising with BEIS regarding deliverables, administration of claims and supporting documentation.

WP2 Project Management (SGNCS)

The project will require a dedicated project manager (PM) to disseminate the deliverables between parties and assemble the final report.

WP3 Modelling heat network equipment (Vital Energi lead)

VE will use Plexos simulation software to optimise sizing of the heat delivery equipment (heat pump, hydrogen boiler and storage). This will seek to identify the relative capacity of each of the elements to provide the optimum solution for an example heat network in Provan, Glasgow. This will consider upfront and ongoing operational operating costs. Vital will use data from existing heat network schemes for representative heat profiles. Develop high level functional specification for the control system.

WP4 Review distribution infrastructure (SGNCS lead)

SGN will analyse the existing local gas infrastructure for a number of example heat network zones. Using this data, we will calculate the maximum volume of 100% hydrogen which the existing infrastructure could support. WP3 interfaces with WP2 identifying the volume of hydrogen available to the heat delivery equipment.

WP5 Energy Asset Modelling (Vital Energi lead)

Vital Energi will use Plexos simulation software to simulate how the multiple flexible assets will operate behind the meter. The model will estimate the impact on the business case of each asset against the business-as-usual counterfactual. These models will prioritise consumers heat security and identify the limitations of co-location. Using the outputs we will develop a functional specification for the overarching control system and ensure the model is operating in a way which can be translated into real world actions.

WP6 Hydrogen Assessment (SGNCS lead)

Considering the outputs from other work packages, SGN will assess the volumes of green hydrogen being produced at different times of the year from the hub and the ability to store on-site for use in the local heat network. We will also explore alternatives such as grid injection, use on-site (e.g. vehicle fuelling) or transport off-site.

WP7 Review of impact (Imperial College lead) Using their advanced integrated whole energy system (IWES) model to analyse the impact of the project on the energy system in 2050. This will look at the impact of the concept depending on different levels of deployment.

Regulatory Barriers (not scored)

At present SGN and the project team, are confident the proposed concept would not provoke any regulatory barriers that could affect or hinder delivery of either the Alpha or Beta phases.

Heat Network contractors are not yet eligible for 'statutory undertaker' status, although this has been proposed. Lack of this status limits the obligations of contractors to respond in the instance of a fault with the heat network, which can negatively impact on quality of service, system KPIs, and acts as a regulatory barrier. There have been proposals for this status to be extended to the heat network sector in order to encourage development but details are not currently available.

As the utility industry aims to build a shared net-zero future by accelerating decarbonised energy solutions and minimising our environmental impact.

The project team will also be working closely with internal stakeholders including Operations, Network Planning and Policy, to help consider any policy and procedural impact. As the project develops through the different phases, we will also be making use of a suitable accredited Technical Consultant to help add further industry understanding.

Commercials

Route To Market

Business-As-Usual

SGN is already considering how heat network infrastructure can be included in on-going infrastructure works to accommodate hydrogen and heat distribution. This is expected to become business- as-usual across SGN's networks within a decade.

The project aims to prove that hybrid heat networks can operate behind-the-meter with multiple flexible assets. SGN have secured 50MWe grid connections on 5 former gas holder sites which are near high density residential. Of these sites one in Provan, Glasgow has been selected for this project, once proven we expect these types of projects to become common place.

Competitive Market

The market required for decarbonised heating is significant. To accomplish the ambitious requirements of Net Zero, many companies will be required to implement solutions with all requiring gas and/or power infrastructure. We aim to develop systems which will maximise the usage of existing infrastructure for all decarbonised heat solutions.

Implementation

SGN is in a Joint Venture with Vital Energi to deliver heat networks. The JV will be responsible for the implementation of the innovation incorporating the modelling and software into the delivery of future decarbonised heat networks. SGN are an experienced owner and operator of gas network infrastructure and Vital Energi are the leading UK heat network provider with experience of build, own and operation of heat networks. Vital also have developed control systems for existing heat networks and associated consumer interfaces.

Customers

The tangible innovation delivered will be a model and associated control system which demonstrate and implement the operation of heat networks behind-the-meter with other assets. The primary customer for this product would be heat network providers and flexible energy asset owners. The business model is to be established but one option would be to licence the base products which could be adapted by the user to fit their project specifics. This software would be equally suitable internationally.

Customer Value

The innovation will reduce the cost of owning and operating a network, allowing customers costs to be lowered. Heat will be provided as a service leveraging Vital Energi's "Glass" user interface to provide a reliable and transparent customer experience.

Funding

Adoption of the primary innovation should reduce the cost and timescales of installing heat networks. The intention to introduce heat network zones has increased investor interest and SGN have already had discussions with investors who would be interested in investing in further development and implementation of the concept once proven.

Intellectual property rights (not scored)

For SIF projects, each Project Partner shall own all Foreground IPR that it independently creates as part of the Project, or where it is created jointly then it shall be owned in shares that are in proportion to the work done in its creation. The exact allocation of Foreground IPR ownership will be determined during the contractual negotiations with the Project Partners on the agreement for the project.

We intend to ensure each Project Partner will comply with Chapter 9 SIF Governance Document through the contractual terms governing the project. However, precisely how this is done will be subject to contractual negotiations with the Project Partners on the agreement for the project.

Costs and value for money

Total Project Cost: £89,951

Private Funding: Our partners will fund ineligible costs and the none supported eligible costs of this project via retained earnings, these will be significantly in excess of 10% of the project cost.

SIF Funding:

The SIF funding will be split between the partners as follows:

SGN -- £1

SGN CS - £22,648

Vital Energi -- £37,805

Imperial College -- £19,360

GCC - £1500

WDC - £1

Subcontractors:

In the Discovery Phase we have not identified any requirement for subcontractor assistance

Value for Money:

The project aims to develop a model and control system which allow heat networks to be installed and operated in parallel with other assets behind the meter. These systems will lead to a reduction in load on both the gas network and the electrical network and reduce requirements for reinforcement costs to increase network capacity. The infrastructure costs behind the grid connection will be borne by the project and assets owners. This should lead to a reduction in charges on customers' bills and make savings far beyond to costs of the SIF investment.

In addition, the results of this discovery phase will feed back into our business as usual, allowing us to focus on other areas if the project results in alternatives that deliver more value at lower cost. There is overlap between the Work Packages of this application and those within application 10061578. Should both applications be successful in obtaining funding, there would be a saving of £7,500 against this application as a result of efficiencies gained.

Document Upload

Documents Uploaded Where Applicable

Yes

Documents:

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Community Energy Hubs - Show and Tell v1.pptx

This project has been approved by a senior member of staff

☑ Yes