SIF Round 3 Project Registration

Date of Submission

Mar 2024

Project Reference Number

10103019

Initial Project Details

Project Title

CoolDown

Project Contact

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Challenge Area

Unlocking energy system flexibility to accelerate electrification of heat

Strategy Theme

Net zero and the energy system transition

Lead Sector

Electricity Distribution

Other Related Sectors

Electricity Distribution

Project Start Date

01/03/2024

Project Duration (Months)

3

Lead Funding Licensee

Electricity North West

Funding Licensee(s)

Electricity North West

Funding Mechanism

SIF Discovery - Round 3

Collaborating Networks

Electricity North West

Technology Areas

Heat Pumps

Project Summary

As Britain warms due to climate change, electrification of heat will mean increasing customer access to space cooling leading to increased summer peak demands. In current distribution network planning cooling demand is currently poorly accounted for and based on limited, high-level modelling. Additionally, cooling's potential to provide flexibility during periods of network stress has not been considered.

CoolDown will, for the first time, explore the impact of cooling on network capacity by producing improved uptake and demand projections as well as developing novel commercial models to incentivise and unlock space-cooling flexibility, reducing network reinforcement requirements and optimising value for customers.

Add Third Party Collaborator(s)

Guidehouse

UCL Consultants Ltd

Project Budget

£168,743.00

SIF Funding

£149,996.00

Project Approaches and Desired Outcomes

Problem statement

As electrification of heating accelerates and GB warms due to climate change, customers are increasingly likely to exploit the potential use of domestic heat pumps in cooling mode, or the use of combined Heating, Ventilation, and Air Conditioning (HVAC) systems, to provide Space Cooling (SC).

SC already accounts for 10% of the UK electricity demand according to Building Research Establishment (BRE), with 65% of offices and 30% of retail spaces using it. Whilst domestic SC remains nascent, a UKERC study forecast that 5-32% of UK homes will adopt it by 2035 which demonstrates the current uncertainty around uptake. Despite representing a sizeable and growing load which could lead to significant summer peaks triggering network reinforcement, SC forecasting is currently poorly accounted for in network planning. For instance, ENWL's DFES modelling for SC demand is currently based on uptake curves from a 2016 study and there is no consideration of its potential as a flexible load.

CoolDown will improve understanding of the relationship between electric heating and SC, helping to maximise the energy system flexibility which building temperature management can provide as a consequence of heating electrification, addressing Innovation Challenge 3: project scope 2.

By building on existing research to understand the relationships between buildings and networks to improve SC uptake projections and load curves, CoolDown will explore SC's relationship with peak summer substation demand and distributed renewables output to quantify the network impact including the need for, and value of, SC flexibility to minimise network reinforcement and contribute to efficient grid operations.

To realise these network benefits, CoolDown will explore novel commercial models to incentivise and unlock SC flexibility and optimise value across all stakeholders. The models will incorporate best practices from geographies where SC flexibility is more ubiquitous, such as the US. The project will also consider how these commercial models can build on other low-carbon heating flexibility products such as those being developed in the NGED EQUINOX Network Innovation Competition project, synergising the value and capture of system benefits from both heating and cooling flexibility.

Video Description

https://www.youtube.com/watch?v=QU2fxHG0lmU&feature=youtu.be

Innovation justification

To date, the impact of SC on electricity demand has only been modelled on a national grid scale, and even then only at a high level. No DNO-led or supported project has explored distribution network impacts of SC and how flexible SC demand can be unlocked to alleviate them.

CoolDown will be the first project to consider these elements in-depth, particularly using network impact insights to appraise the value of demand response and how to incentivise and commercialise SC flexibility from end users.

The lack of prior detailed consideration given to SC network impact means that bolstering understanding of future SC scale and exploring novel commercial models to improve the value and capture of system benefits from flexible building temperature control are innovative activities which cannot be considered part of business-as-usual activities.

So that SC's network impact can be properly forecasted and planned for, CoolDown will apply high-resolution dynamic thermal simulation modelling to explore the SC response of the building stock under a range of scenarios. This will determine, for the first time, which distribution substations may be at risk of overload due to SC demand, and how these substations are characterised in terms of building types, numbers, and solar PV penetration.

CoolDown will use these insights to assess the need for, and feasibility of, specifically designed new and innovative commercial models to incentivise SC flexibility and minimise the need for network reinforcement. The Discovery phase will produce a longlist of potential models informed by learnings from international markets and UK network innovation, such as the NGED EQUINOX project.

The TRL and CRL are currently at 1 and will have moved to 2/3 by the end of the Discovery phase. There is no technology integration associated with CoolDown.

Given these low current readiness levels, the Discovery phase will provide a suitable vehicle to build network knowledge of potential SC impacts and assess its value as a flexible load. A future Alpha phase can then delve deeper into the value of SC flexibility products from a consumer perspective, undertaking consumer-focused research, identifying and onboarding consumer-focused partners, and further narrowing potential commercial models to be trialled at scale in the Beta phase. Given this, CoolDown is well-suited to the SIF process, guiding the concept of UK SC distribution network flexibility through the different readiness levels to deliver a business-as-usual network flexibility product.

Impacts and benefits selection (not scored)

Financial - future reductions in the cost of operating the network

Financial - cost savings per annum on energy bills for consumers

Environmental - carbon reduction – direct CO2 savings per annum

Environmental - carbon reduction – indirect CO2 savings per annum

Revenues - creation of new revenue streams

New to market – products

Impacts and benefits description

The impacts and benefits of network flexibility from domestic, office and retail SC have not yet been appraised and quantified in the UK. The core benefit is the expected financial savings from deferring or avoiding network reinforcement.

CoolDown is expecting to deliver the following:

- **Financial – future reductions in the cost of operating the network** – Network flexibility derived from SC load could defer or avoid the need for summer-peaking substations to be reinforced, reducing expenditure. Additionally, improving SC demand projections and load profiles will improve network forecasting and lead to more financially efficient network investment plans, as well as fewer faults on the network due to overloaded assets.
- **Financial – cost savings per annum on energy bills for customers** – New commercial models designed to incentivise customers to reduce their SC electricity usage during peak demand times could provide benefits to customers by:
    1. Receiving compensation for reducing their electricity demand through mechanisms such as demand response payments or a new time-of-use tariff.
    2. Saving money that would have been spent on electricity during periods where they reduce usage, or through wider behaviour change instigated by being on that commercial model.
    3. Reduced network charges on their energy bill due to better network management and reduced reinforcement costs.
- **Environmental – carbon reduction (direct)** – Reduced SC demand will reduce the amount of greenhouse gas emissions associated with electricity production during times when flexible SC is requested.
- **Environmental - carbon reduction (indirect)** – Reduced network reinforcement requirements will save the emissions associated with their construction and installation.
- **Revenues - creation of new revenue streams** – As detailed above, novel commercial models for SC flexibility will offer revenue opportunities to businesses and homes with relevant technologies installed, increasing the potential market for local flexibility requirements.
- **New to market – products, processes, and services** – SC demand response commercial models will be a new addition to the growing and maturing GB flexibility market. We will consider how such models complement other low-carbon heating flexibility products such as those being developed in NGED EQUINOX. There is also an opportunity for aggregators to further develop their business models, earning fees for coordinating demand response programmes amongst customers.

Teams and resources

ENWL, UCLC, and Guidehouse will collaborate as Project Partners on CoolDown. This is a new relationship, but it brings the right expertise needed to deliver the project.

Each organisation will utilise its skills and experience to deliver its project role:

ENWL: ENWL will adopt the overall project governance role as part of WP1 as well as leading the work exploring the impact SC will have on the ENWL network (WP3). ENWL will use existing business processes to quantify the impact and inform the business case for the commercial models.

UCLC: UCLC will lead the modelling of SC demand (WP2), drawing on over a decade of development of high-resolution building-by-building models of the UK building stock. The 3D Stock method pioneered by the Building Stock Lab will be used to develop a detailed description of the thermo-physical properties of the buildings in each case-study area. This will be used to understand their SC performance in a rapidly warming climate.

Guidehouse: Guidehouse will lead the evaluation of SC demand response (WP4) and longlisting of commercial models for network SC flexibility (WP5) in addition to providing overall project management support and leading the benefits analysis (WP1). Guidehouse have successfully delivered innovation projects for various DNOs and bring expertise, specialised resources, and domain experience. Examples of relevant work include the delivery of the design of the commercial arrangements for NGED's NIC-funded project EQUINOX.

Collectively, the Project Partners have the resources, equipment and facilities needed for the Discovery phase. The resource requirements are mainly in the form of individuals with the necessary skills and expertise to conduct the work. In terms of equipment and facilities, there are no additional requirements beyond existing computers, software and applications and office facilities.

In terms of other external parties, NGED has already been engaged and have provided input to the scope of the Discovery phase and there are plans to bring them on board as a project partner in the Alpha phase. NGED has ongoing innovation projects related to flexibility and the decarbonisation of heat (i.e., EQUINOX) and similar to ENWL has substations in their license area which are summer peaking. Therefore, they are interested in the ability to access flexibility from SC. Consumers will ultimately prove vital to the overall project but are not critical to this Discovery phase. We are planning to engage them, especially property managers, during the Alpha phase.

Project Plans and Milestones

Project management and delivery

As the PMT outlines, this project contains five work packages (WP). Please see Q8 for responsibilities for and outputs from each WP.

WP1 is the Project management and benefits analysis package. A project manager (PM) from the ENWL Innovation Team will adopt the project governance role with the day-to-day PM role undertaken by a Guidehouse PM. Together, they will define and implement processes for governance, stakeholder management, and finance.

This will include setting up a project charter, a steering committee to liaise with the UKRI monitoring officer, and weekly meetings for project status, as well as defining reporting expectations. They will also create a stakeholder engagement plan to ensure efficient and valuable engagement of internal and external stakeholders throughout the project. The plan will be proactively updated throughout the project. For finance, we will employ monthly reporting by all partners on actual vs budgeted spend and regular invoicing to promote transparency and cost-effectiveness.

The accompanying Gantt chart illustrates the project delivery timeline, milestones, and dependencies between work packages, including:

- The outputs from WP4 feeding into the commercial model longlist creation activity in WP5.
- The outputs from WP2 feeding into network impact analysis in WP3.
- The outputs from WP3 feeding into the cost benefit analysis in WP1.

The risk register within the PMT captures our present assessment of risks and planned mitigation actions.

As part of WP1, we will review project progress and the risk register weekly to maintain updated risk impacts, likelihoods, and mitigation actions, and review whether new risks should be considered and monitored. Risks will therefore be actively managed through best-practice project management. WP5 will assess key regulatory and policy barriers, challenges, or risks limiting the trialling or deployment of any commercial models longlisted within a future Beta phase.

CoolDown Discovery phase will not result in any supply interruptions for consumers. A future Beta phase would trial commercial arrangements to incentivise commercial and residential consumers to reduce network demand for SC, but never to interrupt supply for customers. During the Alpha phase, we will reach out to commercial property managers and customer-facing groups like energy suppliers and aggregators, who would help design future trials and engage directly with potential customers.

Key outputs and dissemination

The key outputs and deliverables across all work packages are detailed below and will be disseminated on the ENA Smarter Networks Portal and in the Discovery Show and Tells.

WP1 – Project management and benefits analysis.

- Objective: Manage project on time and to budget, oversee risk management, liaise with monitoring officer and ensure Governance requirements are met as well make preparations for Alpha Phase, including a full analysis of CoolDown's benefits.
- Outputs: Alpha phase application process agreed, including publishing a CBA. All project deliverables published on time and to budget.
- Lead: Guidehouse.

WP2 – Modelling SC uptake and demand.

- Objective: Establish bounds for SC uptake across offices, retail and domestic spaces, distribution network SC demand on a peak summer day, and potential impact of SC demand response on SC demand.
- Outputs: Report on network SC demand published. Relevant modelling outputs successfully fed into WP3.
- Lead: UCLC.

WP3 – Exploring network impact of SC.

- Objective: Explore network impact of increased SC demand and establish inputs to the SC demand response business case.
- Outputs: Report on SC demand network impact and recommendations for improved DFES SC modelling published. Network impact quantified and provided as an input to WP1.
- Lead: ENWL.

WP4 – Evaluating SC demand response.

- Objective: To identify current domestic and international SC demand response landscape and best practices.
- Outputs: Report identifying and synthesising SC demand response best practices published and provided as an input to WP5.
- Lead: Guidehouse.

WP5 – Longlisting commercial models.

- Objective: Create longlist of potential commercial set ups for network SC demand response and identify any barriers to deployment.
- Outputs: Key properties of commercial models being longlisted identified. Report listing commercial models published, including evaluation of suitability for UK set ups, any regulatory barriers, and high level process for more detailed feasibility on the most suitable models in the Alpha phase.
- Lead: Guidehouse.

CoolDown will be engaging with a wide variety of stakeholders, including energy suppliers, network operators, consumers, and policymakers over the Alpha and Beta phases. This will ensure our findings are relevant and useful to all stakeholders, and that they contribute to the development of a fair and competitive market for network flexibility services.

We will operate with transparency and accountability and make our findings available in a timely manner to interested stakeholders. We believe that CoolDown will help inform future decision-making on how to develop and implement network flexibility in a way that is compatible with competitive markets.

Commercials

Intellectual Property Rights (IPR) (not scored)

Each Project Partner will comply with the default IPR arrangements as set out within Chapter 9 of the SIF Governance Document.

For the Discovery phase all selected Project Partners, whilst they have significant ability and the relevant expertise to deliver, are bringing minimal background IPR to the project.

UCLC has background IPR in the form of data processing algorithms and modelling techniques which will be used to develop models of the building stock and its energy consumption-related characteristics in each of the case study areas. The models developed will be based on publicly available data sources and will be made freely available at the relevant stage of the project.

Any learning developed during the Discovery will also adhere to the default IPR arrangements. Section 9.7 outlines that "each party participant shall own all Foreground IPR that it independently creates as part of the project, or where IPR is created jointly then it shall be owned in shares that are in proportion to the work done in its creation". For the purpose of this project, "the proportion to work done in its creation" is defined by the days to be spent on the project. Prior to starting the Discovery phase, each project Partner will make a declaration of background IP to be included in the consortium agreement that will clearly define any background IP they bring to the project. If any specific IP issues arise during project delivery, they will be addressed by the project Steering Committee and, if necessary, raised with the monitoring officer.

In addition to complying with the default IPR arrangements, data generated during the project will be shared and made available through knowledge dissemination to allow other parties to benefit from the outputs.

Value for money

The total Discovery Phase cost is £168,743.

The total SIF funding request is £149,996.

Compulsory Contribution

All Project Partners will provide the 10% contribution in the form of a reduced day rate.

Balance of costs across Project Partners

The SIF funding request, contributions, and balance of costs across partners are shown below:

- ENWL – SIF request £28,209 (£33,188 including 15% contribution via reduced rates) 18.8% of total requested costs.
- Guidehouse - SIF request £73,400 (£81,792 including 10.26% contribution via reduced rates) 48.9% of total requested costs.
- UCL - SIF request £48,387 (£53,763 including 10% contribution via reduced rates) 32.3% of total requested costs.

There are no subcontractor costs and no additional funding from other innovation funds. UCL's existing Building Stock Lab tool will be used within WP2, minimising the time and effort required to model SC uptake and load profiles.

Regarding commercialisation, WP5 in Discovery will longlist potential future commercial arrangements and undertake high level assessments of their suitability to the UK market. These arrangements will be further refined in the Alpha phase, before being developed more substantially into a business-as-usual product in the Beta phase.

Supporting documents

File Upload

CoolDown Show and Tell.pdf - 780.6 KB
WP5 Demand response commercial models.pdf - 703.6 KB
WP4 Evaluating cooling demand response.pdf - 909.2 KB
WP3 Network impact of cooling.pdf - 1.2 MB
WP2 Modelling cooling uptake.pdf - 1.4 MB
SIF Round 3 Project Registration 2024-03-27 3_35 - 61.9 KB

Documents uploaded where applicable?

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