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NIA Project Registration and PEA Document

Date of Submission

Apr 2025

Project Reference Number

NIA_UKPN0110

Project Registration

Project Title

HeatScape

Project Reference Number

NIA_UKPN0110

Project Licensee(s)

UK Power Networks

Project Start

April 2025

Project Duration

1 year and 0 months

Nominated Project Contact(s)

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Project Budget

£809,879.40

Summary

The project aims to explore the impact of all-electric heat networks on the power grid and how Distribution Network Operators can manage them flexibly. The project will conduct a thorough analysis to assess whether network capacity can be freed up through smarter and more flexible design approaches.

There is currently a limited understanding of existing and upcoming heat networks as well as their potential impact on the electricity network. By using external datasets from DESNZ and other sources, and applying modelling, the project will provide a more accurate picture of potential heat network uptake than is currently possible. The scope includes mapping existing networks and developing a pipeline of new heat networks anticipated in UK Power Networks' licence areas through to 2033.

Nominated Contact Email Address(es)

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Problem Being Solved

Heat networks are seen as crucial for achieving the nation's net zero goals. Heat networks distribute heat from a central source to multiple buildings using a system of pipes, utilising various technologies such as heat pumps, gas CHP, electric boilers, or waste heat. Shifting from gas to heat pumps or heat networks for building heating will have a significant impact on the country's electricity infrastructure capacity. Currently, heat networks account for only 2% of heat demand in the UK but are projected to increase to 20% by 2030.

The availability of network capacity in urban areas is a challenge for decarbonisation of heat. Heat networks with thermal stores offer significant flexibility to the local electricity distribution system by operating heat pumps during periods of low electricity demand and storing the generated heat for later use. By considering the potential flexibility of heat networks through thermal storage during the

design stage, peak demand could be reduced by 20-40%, leading to a decreased need for overall electricity network capacity.

As the energy system evolves, it is important to develop a deeper understanding of how the growth and decarbonisation of heat networks will interact with electricity infrastructure. Improved forecasting and planning approaches can help ensure that the potential challenges and opportunities associated with this transition are effectively managed.

Method(s)

HeatScape aims to improve our understanding of heat networks today, their growth and their decarbonisation as part of the transition to net zero. This will be done through modelling and combining data sources to assess the impact of heat network decarbonisation of heat networks on the electricity distribution network. To ensure alignment with UK Power Networks' forecasting requirements, we will incorporate insights from industry expertise and relevant forecasting tools.

· Engagement with key stakeholders such as DSO, network planners and connections experts to explore how heat networks' electrical profiles may impact network assessment and connection offers (timed/profiled), as well as network planning processes.

· Mapping and modelling of existing and future heat networks and their energy centres (in UK Power Networks' licence areas) in different electrification scenarios, to understand their impact on the electricity distribution network. By using external datasets, we intend to obtain a detailed insight of the potential uptake of district heating with the aim to allow more accurate and realistic representation of heat networks and their energy centres today.

o This will contribute to improved forecasting and planning capabilities, as well as more accurate data on flexibility provisions for the DSO team.

o It will also allow DNOs to better understand heat network electrification's impact on the electricity distribution network by modelling how heat networks operate through various scenarios.

· The project will summarise findings from modelling, forecasting, and stakeholder engagement to identify key factors to consider for future implementation plans.

· Assess the role of heat network end-users in flexibility markets to understand regarding whether, to what extent and they would participate in such provisions.

· Identify the regulatory, commercial, and technical barriers that would need to be addressed in the design of the connection of heat networks.

Scope

Work Package 1: Impact analysis of existing heat networks and their decarbonisation through electrification

1. Mapping of existing heat networks in UK Power Networks' licence areas

a. Review the number, locations, and archetypes of existing heat networks in UK Power Networks' licence areas today based on available datasets.

2. Existing heat networks

a. Modelling archetypes of existing heat network energy centres to produce electrical profiles to understand their impact on the electricity distribution network.

3. Decarbonisation of existing heat networks

a. Consider decarbonisation of these heat networks in the future, i.e. decarbonised heat networks and electrically provided heat.

b. Model different operational behaviours (i.e. flexible vs. non-flexible) of the archetypes of existing energy centres decarbonised through electrification to produce relevant electrical profiles representing different operational behaviours.

Work Package 2: Impact analysis of future heat networks

1. Heat network pipeline development and priority areas identification

a. Determine the number, locations, and archetypes of heat networks anticipated in UK Power Networks' licensc areas through external data collection and pipeline development.

2. Heat networks: heat profiles and counterfactual scenario development

a. Produce bulk heat profiles for the future heat network archetypes.

b. Produce counterfactual analysis for the future heat network archetypes.

3. Heat networks: energy centre modelling and electrical profiles

a. Identify methodology for determining energy centre archetypes for future heat networks.

b. Model different operational behaviours (i.e. flexible vs. non-flexible) of the archetypes of future energy centres to produce relevant electrical profiles representing different operational behaviours.

4. Network impact forecasting and result analysis

a. Extend the UK Power Networks Strategic Forecasting System for integration of heat network energy centre electrical profiles.

b. Assess the impact to the electricity network of heat networks within UK Power Networks' licence areas.

Work Package 3: Business case and BaU transition

1. Business case methodology development

2. Business case delivery and insights for BaU transition

Work Package 4: Discovery market research

1. Research Initiation: Definition of research objectives and primary research scope with UK Power Networks and heat network operator

2. Primary research design

3. Primary market research delivery

Findings and recommendations

Objective(s)

The project aims to explore the heat network landscape and analyse the impact of decarbonising existing and future heat networks on the power grid. The key objectives are:

· Gain a better understanding of existing heat networks by mapping their locations, characteristics and energy consumption.

· Explore future developments of heat networks by leveraging existing data driven insights to identify potential areas for heat network uptake.

· Assess how the transition from fossil-fuel to electric power heat networks may impact the distribution network and electricity demand under different operational scenarios.

· Understand market and consumer perspectives by gathering insights on their preferences and adoption behaviours.

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

This project will enable benefits across the whole of UK Power Networks' areas upon full rollout and so HeatScape is not directly impacting vulnerable customers, but vulnerable customers who are supplied by heat networks will benefit from this project. By

improving the heat network and electricity network efficiency through flexibility, the cost to connect and run heat networks would be decreased, enabling heat networks to be more accessible and affordable to end-consumers.

Success Criteria

Objective 1: Gain a better understanding of existing heat networks

· Success Criteria: A comprehensive understanding of the characteristics of existing heat networks, highlighting their role in the current electricity system.

Objective 2: Explore future developments of heat networks

· Success Criteria: A preliminary assessment of the potential growth areas for heat networks, supported by data-driven insights into demand profiles.

Objective 3: Assess how the transition from fossil-fuel to electric power heat networks may impact the electricity distribution network

· Success Criteria: A strategic assessment of how the electrification of heat networks will affect electricity distribution networks under various operational scenarios.

Objective 4: Understand market and consumer perspectives

Success Criteria: Comprehensive market research findings that provide strategic insights into consumer preferences.

Project Partners and External Funding

To support the successful delivery of the project, we are strategically collaborating with expert partners who bring specialised knowledge and resources to address the complexities of heat networks. We are engaging with Arup and ERM, two leading energy consultancies.

Arup will provide engineering expertise on heat networks and energy centre modelling, as well as lead the design and delivery of market research to explore end-consumer attitudes toward flexibility and decarbonisation. ERM will develop the pipeline of future heat networks during RIIO-ED3 and will integrate new heat network data and functionality into UK Power Networks' Strategic Forecasting System (SFS). This will enable more accurate forecasting of network impacts under different scenarios and support longer-term business planning.

These partners will help enable more accurate network impact assessments and will support the development of scenarios for long-term network planning.

Additionally, we have selected to collaborate with Bring Energy, a heat network operator, who will contribute by labour-in-kind by offering valuable operational insights and data from their existing heat networks, as well as facilitating customer engagement for the market research. This collaboration ensures access to essential technical advice, supports data sharing, and strengthens the project's ability to gather insights directly from end-users, enabling more informed decisions and enhancing the scalability of electrified heat networks within the network planning framework

At this stage, no additional external funding has been allocated to the project.

Potential for New Learning

New learnings are described in the project objectives section and are focusing on :

· Improved Understanding of heat networks: Enhancing knowledge of heat networks and their integration into the power grid.

· Capability Development: Building internal expertise to assess and manage the implications of heat network electrification.

· Data Utilisation: Developing a stronger understanding of how data can inform decision-making and strategic planning.

· Forecasting and Impact Assessment: Improving forecasting methods for heat network uptake and its potential impact on the electricity distribution network.

· Consumer Insights: Gaining insights into consumer behaviours, particularly in relation to flexibility services.

Scale of Project

In order to ensure that the project's findings are applicable to all DNOs, the project is designed at a scale that goes beyond UK Power Networks. The purpose of the project is to generate broad insights, particularly around the impact of flexible and non-flexible heat network operations on the electricity distribution network

The methodologies, scenarios and insights developed will be published, enabling other DNOs to adopt the same principles, assumptions and modelling approaches using their own forecasting tools.

Lastly, the project will consider analysis of the impact of heat networks across various network conditions, including congested areas. This ensures that the results are reliable, and representative of the challenges faced by DNOs across the UK.

Technology Readiness at Start

TRL4 Bench Scale Research

Technology Readiness at End

TRL6 Large Scale

Geographical Area

Impact analysis of existing heat networks and modelling of energy centres will be based on available datasets of overall heat networks within all UK Power Networks' licence areas.

Similarly, pipeline development for new heat networks and forecasting will be based on available datasets on heat network suitability within all UK Power Networks' licence areas.

Lastly, we have partnered with a heat network operator, providing a site in London, which will provide valuable insights into the operation of heat networks and their associated energy centres.

Revenue Allowed for the RIIO Settlement

There is no revenue allowed for this project in RIIO-ED2

Indicative Total NIA Project Expenditure

We estimate the UK Power Networks' NIA expenditure to be £809,879.40 of which £728,891.00 (90%) will be recovered from NIA.

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

This project supports end-consumers, by helping ensure that the integration of heat networks into the electricity system happens in a way that is cost-efficient, equitable, and aligned with net zero goals.

By improving forecasting and planning around heat network electrification, the project will reduce the need for reinforcement of the distribution network, ultimately lowering long-term costs for end customers.

Lastly, by identifying and addressing flexibility opportunities through better modelling of different operational behaviours, the project aims to help reduce the network's peak demand. This supports a more resilient and affordable electricity network, delivering benefits to all users.

How the Project has potential to benefit consumer in vulnerable situations:

N/A

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

N/A

Please provide a calculation of the expected benefits the Solution

Research project

Please provide an estimate of how replicable the Method is across GB

If successful, the solution has the potential to be replicable across all other DNOs.

Please provide an outline of the costs of rolling out the Method across GB.

The cost of rolling out the research across other networks will consist of access to data and enhancement of modelling capabilities.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ A specific piece of new (i.e. unproven in GB, or where a method has been trialled outside GB the Network Licensee must justify repeating it as part of a project) equipment (including control and communications system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☑ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☑ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☐ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

The learnings generated by this project, can inform Electricity Distribution licensees and wider industry partners for network planning and management by:

· Providing learnings on improved network forecasting: By integrating heat network data into forecasting models, DNOs can enhance their demand predictions, improving long-term planning and capacity management.

· Assessing network impact: By understanding how decarbonised heat networks might impact the electricity demand, DNOs can identify priority areas for network reinforcement.

· Understanding heat network end-consumers' awareness around decarbonisation and willingness to participate in flexibility provisions.

In summary, the project's findings will support the long-term planning for the uptake of decarbonised heat networks, ensuring that DNOs are not a blocker for the transition to net zero while maintaining network resilience.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

N/A

Is the default IPR position being applied?

☑ Yes

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

We have undertaken:

- A review of the ENA Smarter Networks Portal;
- Initial engagement with stakeholders and DNOs;

We have not found a similar project that has looked to understand the impact of decarbonised heat networks on the electricity network.

While there are projects that have looked/are looking at:

· Investigated the scale and location of district heating in the UK and consequential impact on power and gas systems lead by National Gas Transmission PLC in 2015

· Net Zero Community Energy Hubs by SGN through SIF Discovery - Round 2 is developing a novel technoeconomic approach to operating hybrid heat networks alongside other flexible assets (thermal storage, hydrogen boilers, heat pumps) alongside with using the existing gas infrastructure for the transition to hydrogen. While this project will provide significant learnings on feasibility of heat delivery to residential and commercial buildings through multiple flexible assets operating together behind-the-meter, it is not analysing the electricity impact and the DNO perspective.

· Heat balance (within SIF discovery- Round 1) explored the commercial and technical feasibility of network flexibility from large-scale thermal energy storage in conjunction with heat networks, to reduce peak demand on the transmission and distribution networks over multiple timescales, reducing the need for network reinforcement. In this project, the main objective was to demonstrate large-scale thermal energy storage (LTES) to exploit curtailed wind and support inter-seasonal alignment of wind generation and thermal demand.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

N/A

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

N/A

Relevant Foreground IPR

The data created, outputs and deliverables produced as part of the project will conform to the default treatment of IPR.

The project partner's background IPR will be essential to use some of the foreground IPR.

Data Access Details

To view the full Innovation Data Sharing Policy, please visit UK Power Networks' website here:

https://d1oyzg0jo3ox9g.cloudfront.net/app/uploads/2023/10/UKPN-InnovationDataSharingPolicy-Nov-23-v1.0.pdf

UK Power Networks recognises that Innovation projects may produce network and consumption data, and that this data may be useful to others. This data may be shared with interested parties, whenever it is practicable and legal to do so, and it is in the interest of GB electricity customers. In accordance with the Innovation Data Sharing Policy, UK Power Networks aims to make available all non-personal, non-confidential/non-sensitive data on request, so that interested parties can benefit from this data.

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

The research project's objective is to model, understand and compare different heat network decarbonisation scenarios and their impact on the electricity network, using latest datasets that not been previously used for this purpose.

As a result, the project is considered high-risk for the business to undertake without prior validation. However, if the project succeeds in achieving its objectives, the innovation could accelerate the adoption of this methodology, making it easier for the business to transition using it as part of its regular operations.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

The NIA funding will enable UK Power Networks to undertake a research project which has technical and commercial risks associated with it, due to its speculative nature and uncertain commercial returns

This project has been approved by a senior member of staff

☑ Yes