Heatropolis – Show and Tell

Matthew Osborn, Passiv UK

Bruce Gerard, Metropolitan

15 June 2023

Ofgem Strategic Innovation Fund

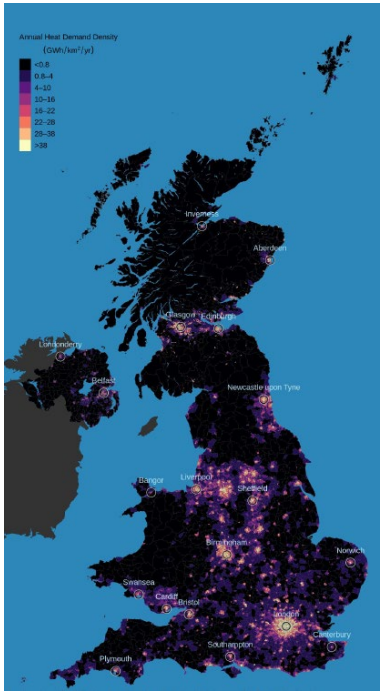
UK Power Networks
Delivering your electricity

INVESTORS IN PEOPLE™ We invest in people Platinum

NES NATIONAL EQUALITY STANDARD

Problem

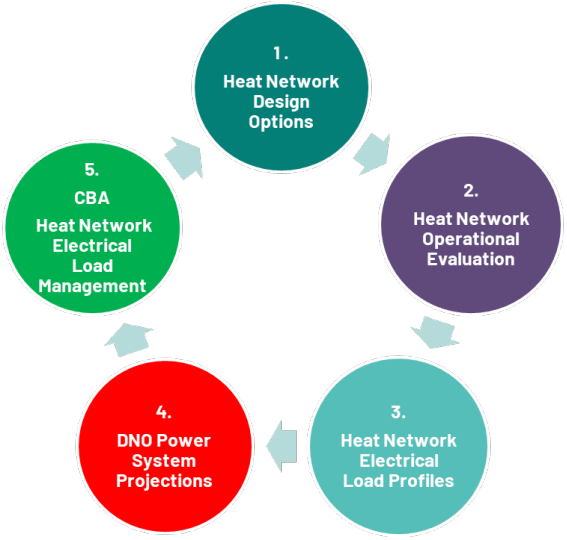
- To meet **net zero heating targets**, we will need to move away from fossil fuelled gas boilers
- **Heat networks** will play a critical role in this transition
- Replacing fossil-fuelled systems with heat pumps will have major **implications for the electricity networks**
- **Existing heat networks** wanting to shift away from fossil fuels present a near term challenge
- Understanding and **improving processes** for transition of these sites will provide valuable learning



UK heat demand density

Project overview

Heatropolis proposes a multi-stage decision **framework**



- Unlocking **commercial mechanisms to** link **heat network design** with **power system** planning
- **Hypothesis** – Smarter heat network design will deliver significant peak electrical load reductions for distribution network operators (DNOs)

Use Case – King's Cross

- Replacing fossil-fuelled combined heat and power (CHP) systems to reach net zero by 2030: **-1.5 MW (CHP)**
- Current plans for heat pumps and thermal storage will significantly increase in electrical loads: **+21 MW (low carbon technologies)**

User needs and opportunities

Improving cost efficiency by **coordinating multiple stakeholders** and decisions on **long-term infrastructure investment**:

Electricity network operators

- Managing power distribution system
- Planning network reinforcement to support net-zero transition

Heat Networks operators

- Controlling assets to deliver cost efficient heating.
- Understanding how smarter design can reduce electrical load

Technology providers

- Monitoring and optimising low carbon technologies

Local authorities (LAs)

- Understanding how heat networks impact local area energy planning (LAEP)

UK Power Networks
Delivering your electricity

metropolitan

passiv

Camden

Key activities during Discovery Phase

Compare different smarter low carbon heat network designs to understand DNO benefits:

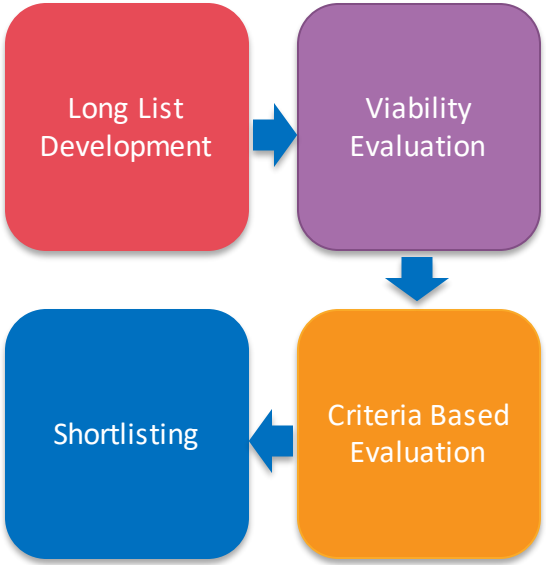
1. Review and **validate the current plan (counterfactual)** to decarbonise the King's Cross heat network
2. Investigate and **shortlist alternative options** (technological, operational, storage) for the heat network to better manage the electrical load on the DNO than in counterfactual plan
3. Evaluate the technical engineering requirements and increased costs for the heat network to realise a smarter, managed electrical load
4. Assess benefits of a smarter heat network type of solution in DNO **reinforcement planning**
5. Set out approach for **Alpha Phase**

Review of low carbon heat network design options

1) Review and validate assumptions used in counterfactual design to decarbonise the King's Cross heat network

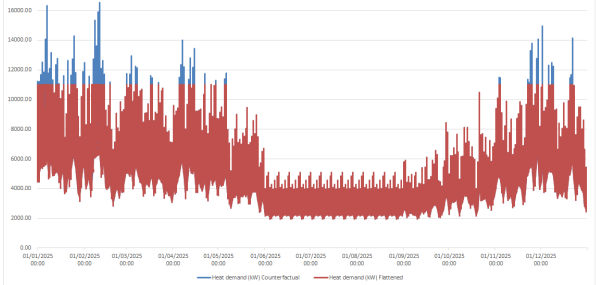
Stage 1

2) Shortlist smarter heat network design scenarios to better manage the electrical load on the DNO



Modelling outputs of smarter heat network designs

3a) Modelled impact of Demand Flattening on heat load



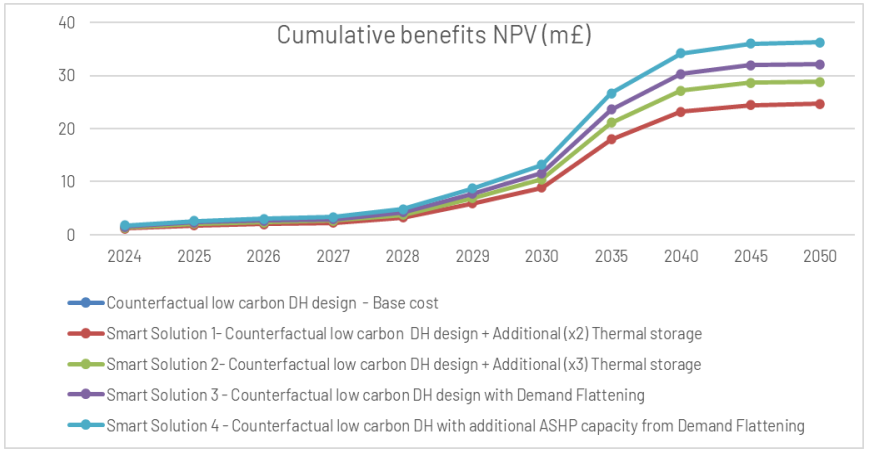
Yearly Heat demand Counterfactual vs Heat demand flattened

3b) Outputs from smart heat network design options identified

Heat network Design Options	Scenario	Reduction in Peak Electrical Demand (%)
Option 1 - Counterfactual	0	0%
Option 2 - "Smart" thermal storage capacity	2	23%
Option 3 - Double "Smart" thermal storage capacity (using PCM)	2	30%
Option 4 - "Smart" thermal storage + Demand flattening	1a	39%
Option 5 - "Smart" thermal storage + Demand flattening + additional ASHP capacity	1b	44%

PCM – Phase Change Material, ASHP - Air Source Heat Pump

4) Impact on network reinforcement



- Scaled across all UK Power Networks' areas, smarter heat network designs may avoid c£37m reinforcement by 2050
- Practical and operational limits for thermal storage

Lessons learnt – evolution of approach

Low carbon heat networks are set to have an increasing impact on the electricity distribution system, but there is a disconnect between DNO planning and heat network design and operation.

Technical requirements

a) Smarter HN design

- Counterfactual low carbon HN design is only optimised for heat network operation
- No incentive for HN design to reduce or manage peak electrical load
- 44% peak electrical load reduction is achievable

b) Power system modelling

- Early analysis suggest limitations to existing HN load impact projections
- Risk of higher levels of reinforcement than anticipated
- Urgent need to understand and foster smarter HN design and operation

Commercial mechanisms

- Limited incentives with existing flexibility and connection products
- Heat network and DNO interaction only considers peak load for a site
- Timing of peak load calculated with a diversity factor not designed
- Considerations for Alpha:
  - Pre-agreed energy performance-based contracting
  - Long term contract mechanisms

Dominant heating technologies in central London - System Transformation 2050

Source: Distribution Future Energy Scenarios Network-Level Outlook December 2020

Look ahead

5) Alpha will continue to focus on the two main functions of the Heatropolis framework

- **Technical requirements** – to design a smarter heat network
- **Commercial mechanisms** – to realise value from avoided reinforcement using smarter heat networks

Activities to test and validate the functions will be through four workstreams:

- **Proof-of-concept smart control** on a HN building – confirm modelling assumptions, simulation of demand flattening across the site
- **Develop detailed engineering** designs up to RIBA* Stage 3 – procurement of design and build contractor in Beta Phase demonstration
- **Outline of business case** needed to realise value from avoided reinforcement to enable replication. Develop appropriate power model projections and contractual options
- **Detailed planning for Beta Phase trial** and dissemination of findings from Alpha Trial

Additional stakeholders will include economic analysts, design engineers, and technologists.

*Royal Institute of British Architects (RIBA)

UK Power Networks
Delivering your electricity

THANK YOU