

# HEATROPOLIS

R2 Alpha Show & Tell  
24<sup>th</sup> April 2024



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# Heat Networks, what's it all about?

# Understanding Heat Networks and their impact on decarbonisation

## Today



**Net-zero targets mean reducing emissions, and heating represents a large part of the UK's energy demand**

- + **Reduce UK emissions by 95%** by 2050
- + **Heat for buildings** was **20%** of **total UK emissions** in 2021
- + **Heat networks** can provide **cost-effective, low-carbon heat**
- + **14,000 heat networks: approx. 480,000 customers in UK**
- + **Less than 3%** of heat market (UK)
- + Over 90% are **fossil-fuel** driven

## Looking ahead



**The electrification of heating will increase energy demand, so District Heat Networks present an opportunity for efficiency**

- + Heat Networks are crucial role to decarbonisation of heat
- + **83%** will be driven by **electricity** using **heat pumps** (DESNZ)
- + UK Heat Networks
  - + **6% Year on Year growth**
  - + **20%** of UK heat market **by 2050**
- + **Represents increase from 13TWh to 95TWh by 2050**

# So, what's the problem?

Increasing demand from electrification of heat = **increased costs** and impact on customer

**Heat Networks** can deliver significant **flexibility** to reduce peak demand

**Lack of frameworks for effective collaboration and co-ordination** between the **heat and electricity** networks

No **effective** incentives for Heat Networks to **optimise** management of **capacity** with **electricity network**

**So... a major challenge, or opportunity?**

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# Heatropolis - what are we doing?

# Accelerating the transition to low carbon heating at the lowest cost for the customer

## Objectives:

- Maximising existing electricity network capacity and Minimising network reinforcement
- Identify pathways for Heat & Power sectors to collaborate to achieve Net Zero
- Develop commercial models for heat network investments to maximise flexible operation

## What does this look like in practice?

- King's Cross decarbonisation baseline for new opportunities
- Smart building controls with increased heat pump and thermal storage capacity for additional flexibility
- Whole energy systems thinking and collaboration

Addressing the **current barriers to entry** and **utilising whole system thinking**, by **linking heat and power**, will unlock opportunities & potential value streams that **aren't being utilised today**

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# Our progress so far

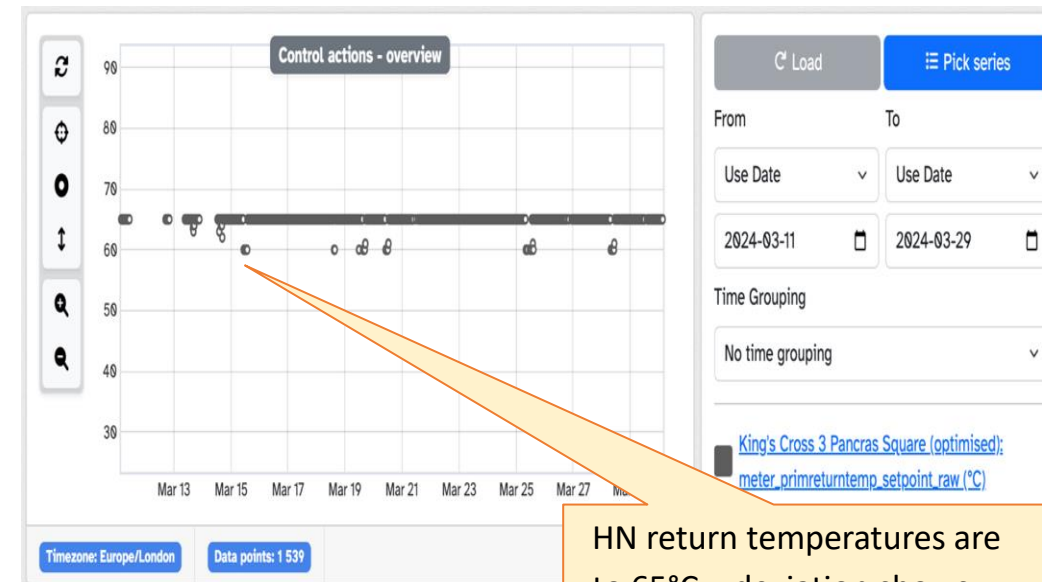
# Using smart control of thermal systems

## Thermal flexibility

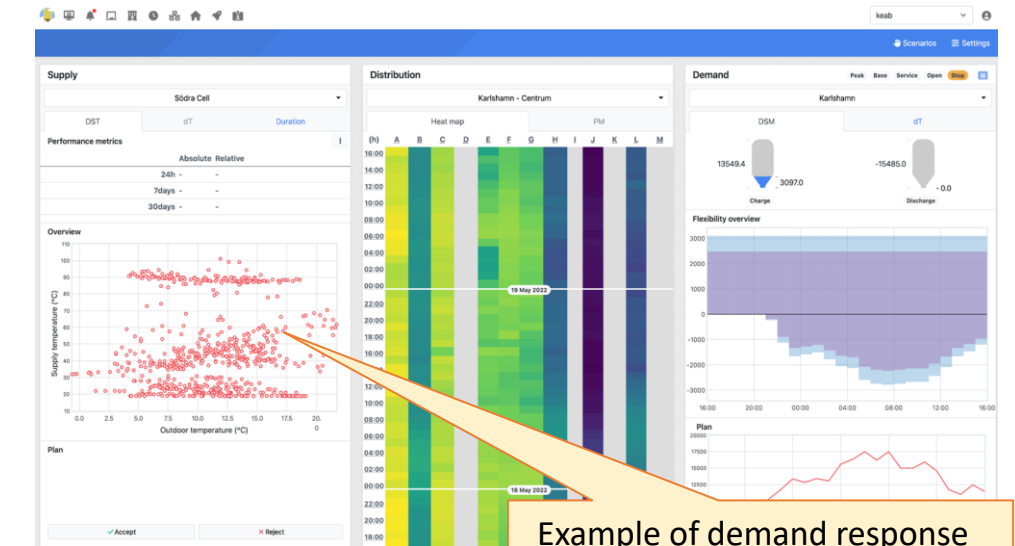
- Electrical systems – instant on/off response
- Heating systems have a time delay - thermal inertia which offers useful flexibility
- Response tests help to quantify levels of thermal flexibility (long/short)
- **Analysis**
- Alpha phase - response modelling to study the use of smart controls.
- Completed a three-stage integration process on a building in the King's Cross Heat Network
- Delivered a sequence of six smart control response testing events

## Impact

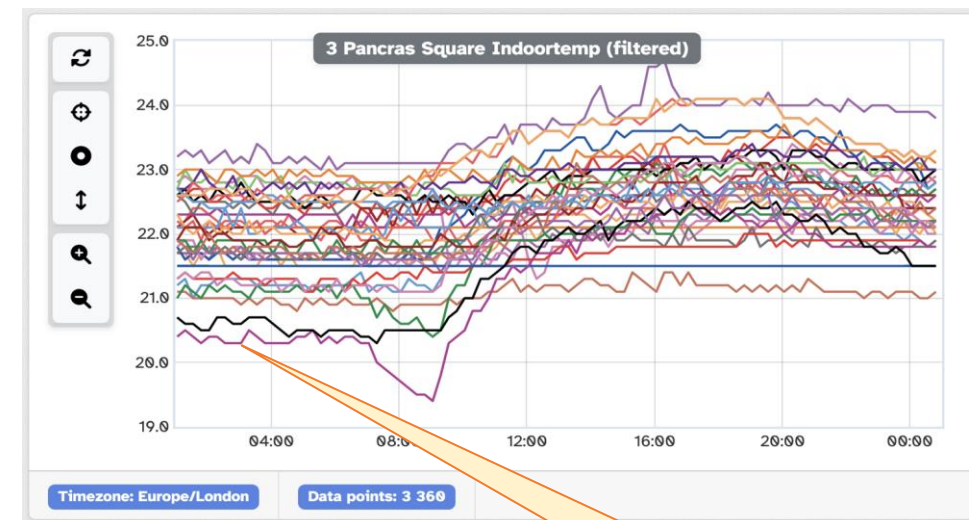
- No measurable impact on the indoor climate during test events
- Outputs from flexibility testing used to refine designs and commercial modelling



HN return temperatures are to 65°C. , deviation shows active smart control events



Example of demand response visualised as virtual storage (not Heatropis)



Indoor temperatures at Pancras Square



The heating system at Pancras Square

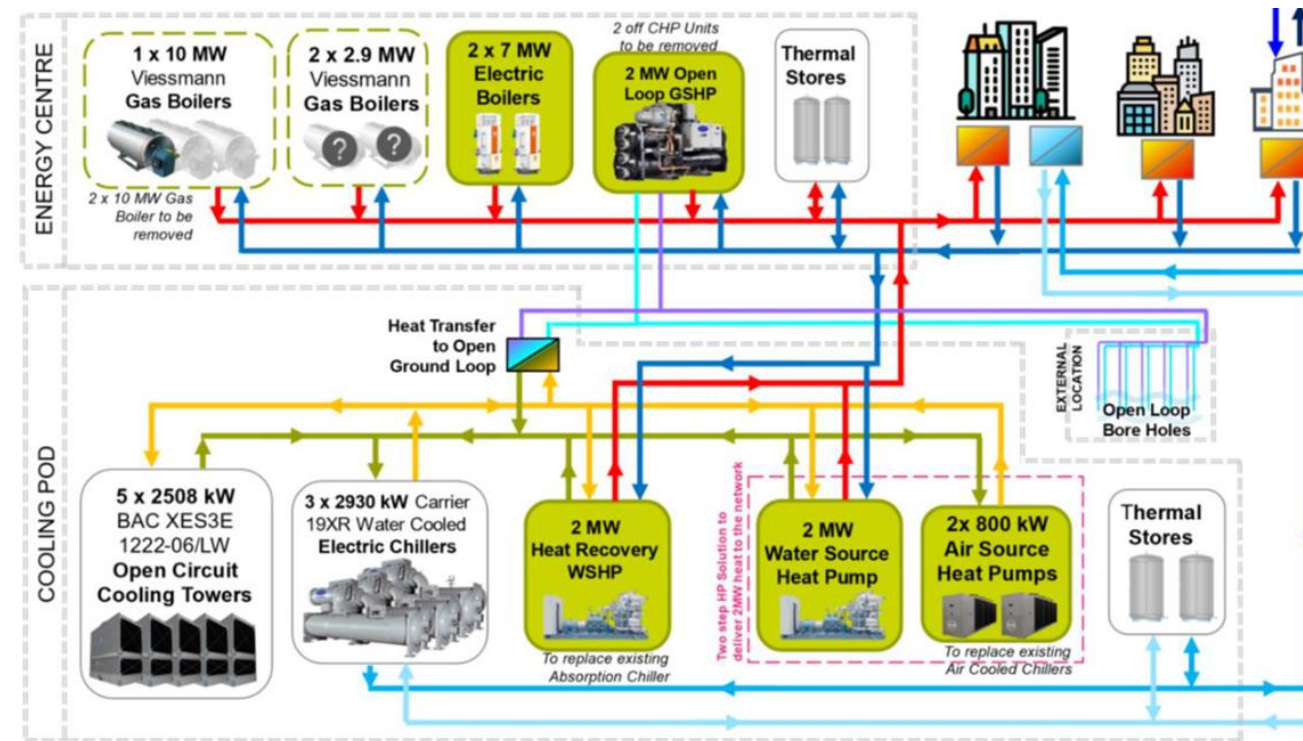
# Technical Assessment

## Design

- Optimised peak reduction using additional heat pumps and thermal storage alongside Smart building controls – 70-85% reduction across range of sites
- Space constraints addressed using compact phase change material based thermal storage
- Optimised design at King's Cross delivers >6MVA reduction during electrical peak demand periods

## Techno economic modelling

- Techno economic modelling to assess revenue improvements against investment required
- Revenue gap for investment to occur identified

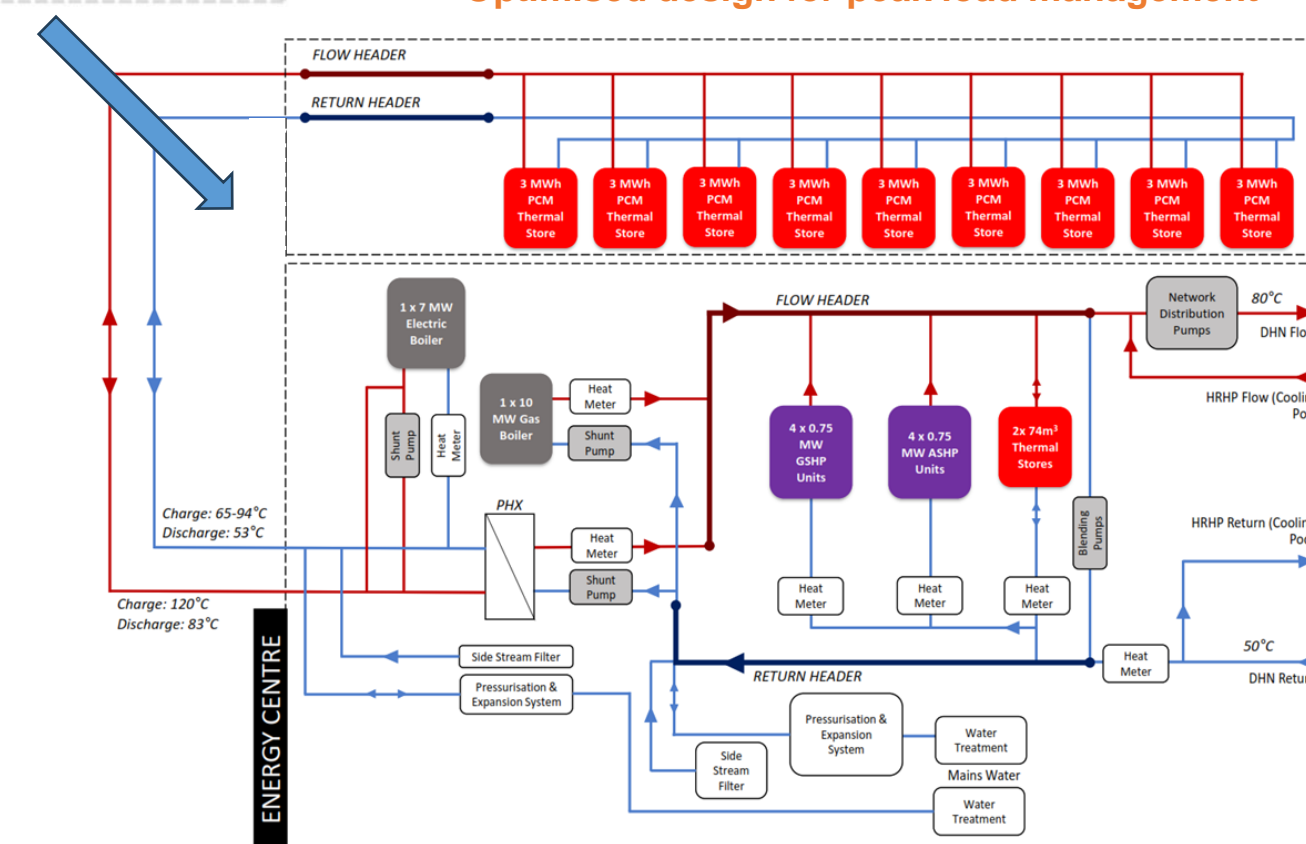


Business as Usual Decarbonisation Plan

Optimised design for peak load management



Example of phase change thermal store – Sunamp Central Bank (courtesy of Sunamp)



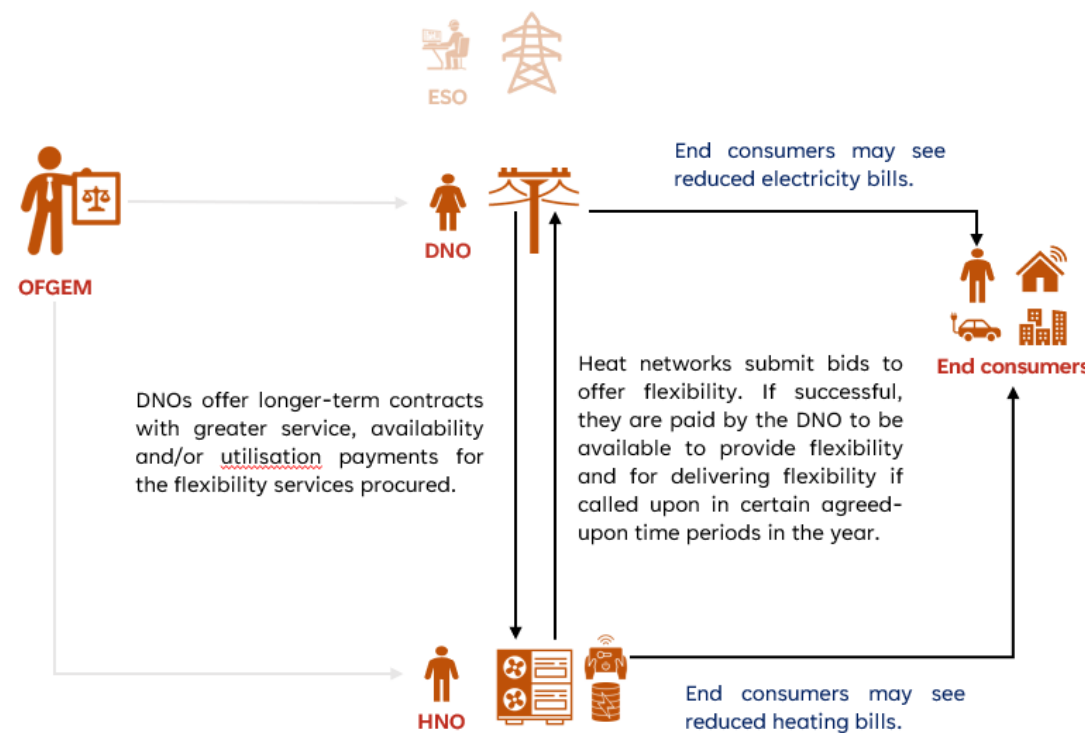
# Commercial and Operational Framework

Heatropolis will enable efficient network operation in an electrified world but requires commercial incentives to engage key stakeholders

## From our business model analysis we found...

### Business model #1: Greater value, longer-term DNO procured flexibility services for demand turn-down

Business model schematic



Pros and cons



- Guaranteed, improved and longer-term cash flows for heat network operators via availability and service fees from the secure and sustain flexibility services.
- End consumer heating bills may be reduced if above revenues are trickled down to them.
- Reduction in network reinforcements costs for DNOs keeps end consumer electricity bills lower by reducing Distribution Use of System (DUoS) charges.
- DNOs receive financial rewards from OFGEM via the financial output delivery incentive (ODI-F) for smart, flexible alternatives to traditional reinforcement.

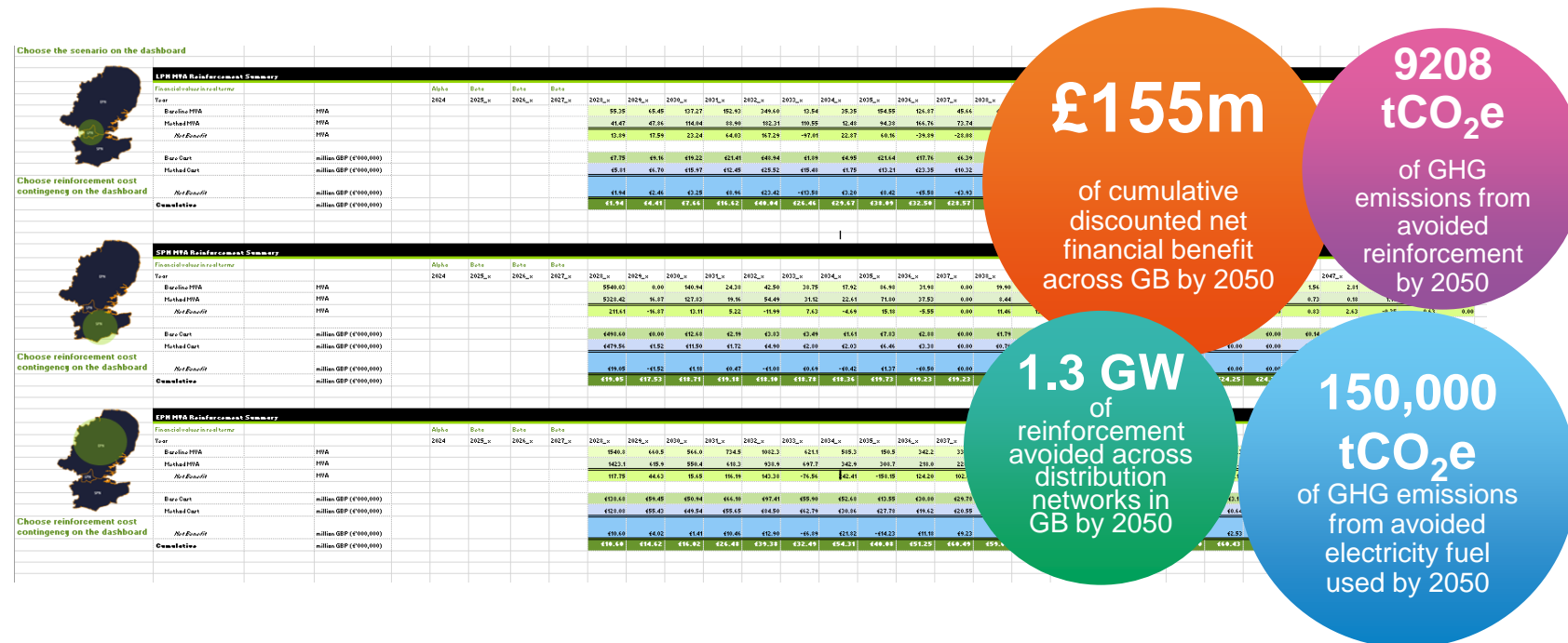


- Costs of flexibility procurement needs to remain competitive with traditional network reinforcement costs. This limits the potential increase in payments DNOs can offer heat network operators for smart controls and storage adoption.
- Longer-term contracts makes the flexibility market less competitive and increases barriers to entry.
- Competitive bidding process to secure flexibility service contract makes adoption of smart controls and thermal storage a high-risk investment.
- Limited opportunities to participate in multiple flexibility services and geographical constraints of flexibility service procurement limits revenue stacking opportunities.

- ▶ Current commercial mechanisms on their own do not provide sufficient incentive to unlock flexibility
- ▶ Evaluated eight refined business models that could support flexibility
- ▶ We recommend exploring a range of more dynamic curtailable connections agreements and flexibility services in Beta

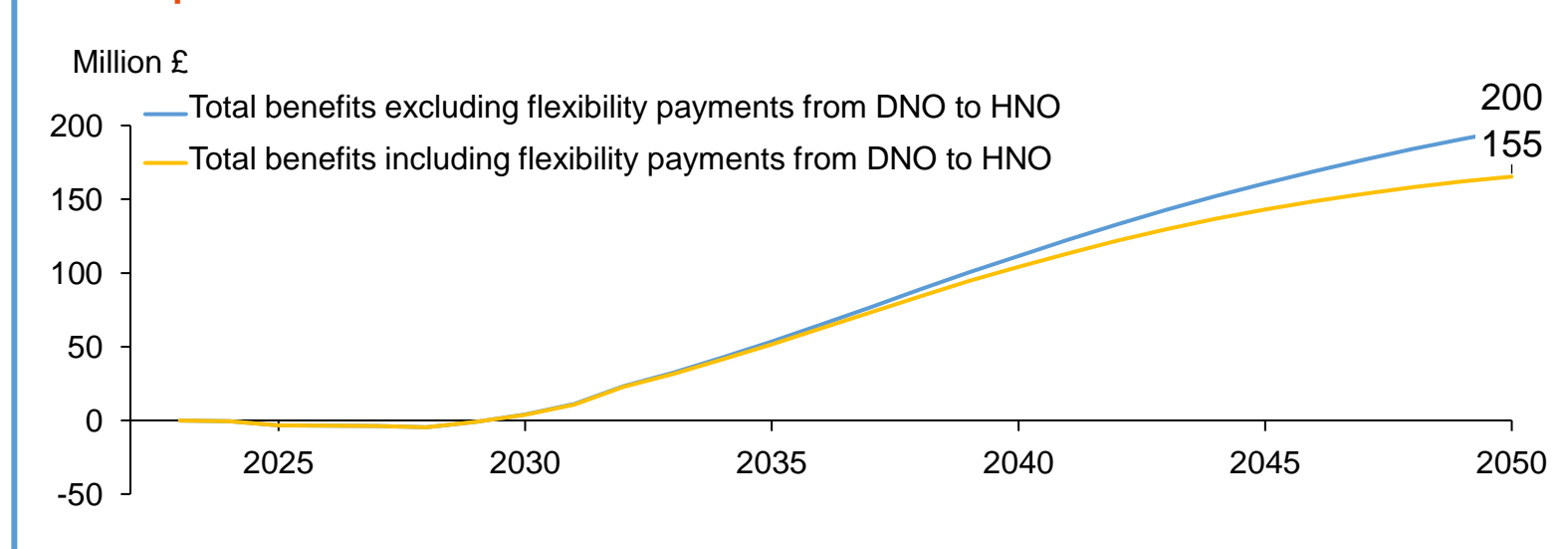
# Cost-Benefit analysis

The cumulative net discounted benefit, including flexibility payments to the heat network operators, is ~£155 million and 160,000 tonnes of CO<sub>2</sub> avoided



- ▶ Developed a DNO network impact model which calculates the benefits of avoided reinforcement by deploying the smart solutions, which directly reduce the peak demand across heat networks.
- ▶ The cumulative net discounted benefit, including flexibility payments to the heat network operators, is ~£155 million and 160,000 tonnes of CO<sub>2</sub> avoided
- ▶ The proposed solution identified additional qualitative benefits:
  - 1) reduced time to connect
  - 2) improved system balancing
  - 3) introducing new flexible assets and
  - 4) reduced need for generation

Heatropolis cumulative discounted net financial benefits



\*Based on modelling and calculations in Alpha phase, subject to validation in Beta trials

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**What's next?**

# Further analysis in the Beta phase is required to validate:

## Smart control

### Smart control Integration

- Detail building audit, specification
- Develop tools for performance measurement and data accuracy
- Improve integration between Heat Network Operators and Building Management Systems

### Smart control Operation

- Focus on temperature optimisation
- Activate consumer energy services
- Demonstrate operational Demand Side Response scheme

### Data access

- Refine processes for data access and integration

## Trials

### Communal Networks design

- Assessment of optimal system configuration for small sites

### Heat Network Controls

- Detail control strategy to respond to flexible/ curtailable connection agreements

### DNO/HNO System Integration

- Communications protocols for DNO instructions
- Monitoring and data exchange with DNO for validation
- Design of DNO interface for differing network scales

## Commercial & Operational Framework

### Business Models

- Quantify and flexibility across Use Cases
- Demonstrate integration of HNO with a DNO's DERMS
- Determine the reliability of HNO responses to flexibility instructions

### Cost-benefit analysis

- Modelling flexibility volumes and forecasting market value
- Quantify additional benefits with ESO
- Determine costs to HNO's based on end-user Use Cases

**THANK YOU**