



Heatropolis Business Case 2025

Heatropolis SIF Beta



Heatropolis is an Ofgem Strategic Innovation Fund (SIF) Beta project led by UK Power Networks and supported by PassivUK, Metropolitan and Guidehouse

Overview:

- Heatropolis is a four-year SIF Beta project (2024–2028) led by UK Power Networks and funded by Ofgem and Innovate UK.
- It is pioneering technical and commercial solutions to unlock flexibility from electrified heat networks.
- It will drive better outcomes between heat networks and electricity networks.
- It will enable more efficient use of electricity network capacity so that heat networks can decarbonise faster.

Impact:

- Driving heat network innovation.
- Maximising use of network capacity.
- Lowering consumer bills.

Funded by:



Partnership:



Without intervention, the electrification of heat networks will drive substantial reinforcement of distribution networks



Heat networks: a key technology for decarbonising heat

- Heat networks will be a key contributing technology to building heat decarbonisation in the United Kingdom (UK).
- They currently serve around 3% of UK buildings and are typically powered by fossil fuels.¹
- Heat networks are expected to become more prevalent and be increasingly electrified using industrial heat pumps and electric boilers.
- The Climate Change Committee and UK government envisage such low carbon heat networks could provide 20% of UK building heat demand by 2050.¹



Potential challenges without intervention

- As heat networks electrify, they stand to significantly increase peak electricity demand, since traditional heating routines coincide with peak electricity usage times.
- This surge in demand will necessitate costly network reinforcement at distribution network level, leading to higher bills for consumers.
- This is because the cost of reinforcement to connect demand-side assets is typically recoverable through Distribution Use of System (DUoS) charges. Generation asset developers, in contrast, must pay directly towards reinforcement costs.²



Heat Network Operators (HNOs) lack incentives to operate flexibly

- Non-firm³ connections can enable new assets to connect with minimal reinforcement, if operators can commit to load reduction during congested periods.
- Participation in flexibility markets additionally rewards network de-loading.
- These benefits are less clear for HNOs. Unlike generation asset operators, HNOs do not see the same cost-saving benefits from non-firm connections. Both non-firm connections and flexibility market participation require HNOs to invest in additional flexibility enabling technologies.



Heatropolis' aims and WP2 focus

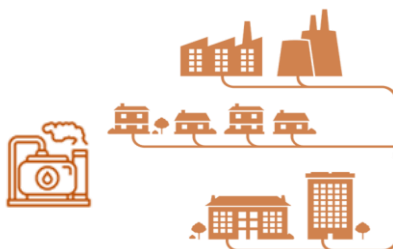
- Heatropolis is a four-year innovation project that aims to promote flexible operation of electrified heat networks by facilitating coordinated investment planning between HNOs and Distribution Network Operators (DNOs).
- Central to this effort is designing and testing commercial arrangements that align the interests of HNOs and DNOs and demonstrate value to HNOs to compensate them for up-front investments in flexibility enabling technologies.

¹DESNZ, ²Ofgem, ³A connection with variable capacity limits, e.g., they may have lower capacity limits during peak hours 4-7pm and higher capacity at other hours.

Heatropolis primarily envisages electrified heat networks adopting smart controls and increased thermal storage capacity, but HNOs currently lack clear incentives for this

Kings Cross example: The Archetype 1 Kings Cross site¹ is a large heat network which is currently reliant on a gas-fired boiler plus CHP¹ system. It has been the main heat network on the project since the 2023-24 Alpha phase. Its counterfactual decarbonisation pathway is to transition to heat pumps for base-load heating, with electric boilers to support during peak heating demand. As a Heatropolis trial site, its operators will instead install less electric boiler capacity, and significantly more thermal stores, which can be heated during off-peak hours and discharged at peak hours to meet customer heat demand.

Existing system: Gas-powered boiler and CHP system



Kings Cross site existing system:

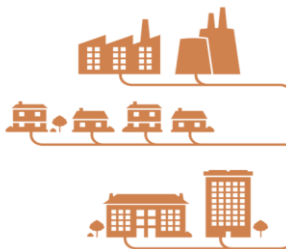
- 1x 10M gas boiler
- Flow and return header
- Water treatment
- Pressurisation and expansion
- Side stream filters
- Network distribution pumps
- 11.2MWh thermal stores
- Heat meters (thermal stores, gas boiler, network)



Increased load on DNO



Counterfactual: Transition to heat pumps and electric boilers



Kings Cross site counterfactual system additions:

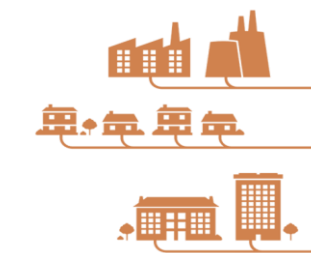
- 1 x 2.3MW HRHP³
- 4 x 0.75MW GSHP⁴
- 2 x 0.75MW ASHP⁵
- 3 x 8.75MW HV⁶ electric boilers
- Heat meters (GSHP, ASHP, electric boilers)



Reduced load on DNO



Heatropolis: Transition to heat pumps and thermal stores

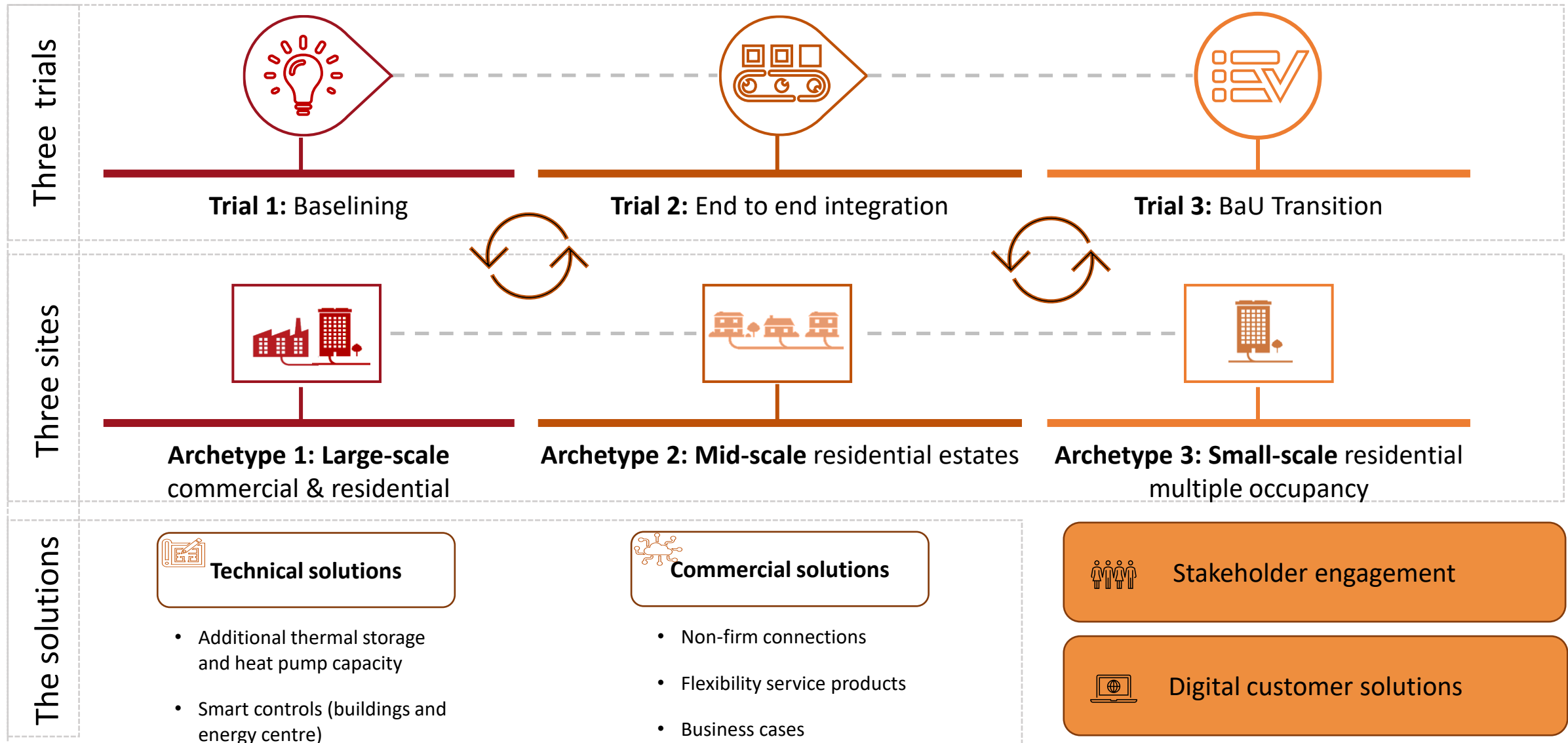


Kings Cross site "Heatropolis" optimised system additions

- 2x 0.75MW ASHP
- 4 x 0.75MW GSHP
- 1x 7MW HV electric boilers
- 32.2MWh PCM⁷ thermal stores
- PCM circuit pumps
- Heat meters (GSHP, ASHP, electric boiler)

¹All components obtained from Metropolitan, ²Combined heat and power, ³Heat Recovery heat pump, ⁴Ground source heat pump, ⁵Air source heat pump, ⁶High voltage, ⁷Phase change material

Heatropolis will conduct trials at three heat network sites



Implementing Heatropolis could see heat networks reduce their contribution to peak load by 46-63% across the three participating heat network archetypes

Summary: Heatropolis is being implemented at three heat network archetypes, a large site serving Commercial and Residential customers, a medium-sized site serving Residential customers in a housing estate, and a small heat network serving Residential customers in a multi-occupancy building. Across the three sites Heatropolis' implementation achieves a modelled reduction of peak load of 46-63%.

Implementation of Heatropolis by archetype, and modelled reduction in peak load



Archetype 1: King's Cross, large heat network serving Commercial and Residential customers in urban area

Category	Peak load (MVA)
Counterfactual	13.3
Heatropolis	7.2
Saving	6.1 (46%)



Archetype 2: Chilton Woods, medium-sized heat network serving Residential customers in a housing estate

Scenario	Peak load (MVA)
Counterfactual	1.7
Heatropolis	0.8
Saving	0.9 (53%)



Archetype 3: TBC location, small heat network serving Residential customers in a multiple occupancy building

Scenario	Peak load (MVA)
Counterfactual	0.14
Heatropolis	0.05
Saving	0.09 (63%)

This business case evaluates Heatropolis' net benefits for key stakeholders, scaling up from the three Archetype trial sites to all of Great Britain

D2.1.1 (b) evaluates the net benefits of Heatropolis for these stakeholders



HNOs: Whether benefits of the commercial arrangements can recoup the costs of the flexibility enabling technologies.



DNO: Whether the benefits of HNOs engaging in DNO flexibility outweighs the costs of procuring flexibility from HNOs.



DESNZ: How Heatropolis results in improved costs and benefits for DESNZ which funds NESO flexibility services.



Consumer: Heatropolis impact upon consumer bills.



Environment: Quantification of emissions reduction benefits.

Out of scope for D2.1.1 (b)



TNO¹: Upstream net benefits of Heatropolis upon the transmission network.

Three case study heat network Archetypes trial sites



Archetype 1:
Large heat network serving Commercial and Residential customers in urban area.



Archetype 2:
Medium-sized heat network serving Residential customers in housing estate.



Archetype 3:
Small heat network serving Residential customers in multiple occupancy building.



Scale up method from the trial sites to GB

Three Archetypes: Evaluate the impacts of Heatropolis for all stakeholders, at the live trial sites.

UK Power Networks: Scale up the impacts of Heatropolis across the DNO's license areas.

GB: Scale up the impacts of Heatropolis across GB (England, Scotland, and Wales).

¹We intend to engage with TNOs to acquire necessary data on this. It is a key goal for iterations of the business case scheduled for 2026-28.

For each stakeholder, costs and benefits have been identified, and the difference in value between the Heatropolis and Counterfactual scenario has been calculated

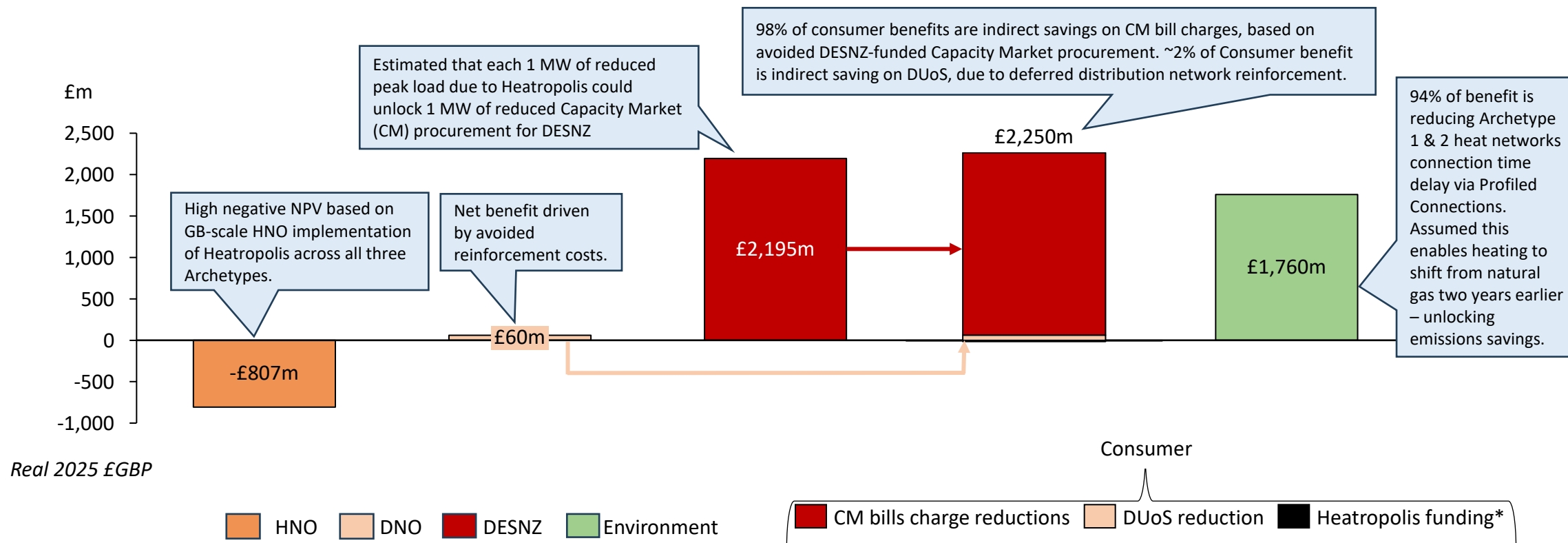
Summary: The analysis for each stakeholder is based on defining the net differential in costs and benefits of heat networks adopting Heatropolis, “the delta”. In some cases, the delta may take the form of benefits to a given stakeholder, and in other forms it may result in increased costs. Viability of the project from the perspective of each stakeholder is defined as the sum of the total costs and benefits achieving a positive net present value once discounted at the appropriate discount rate for each stakeholder.

	 HNO	 DNO	 DESNZ	 Consumer	 Environment
Costs	- Costs or savings in CAPEX, REPEX, DEVEX, OPEX associated with building and operating heat networks through the Heatropolis design. - Cost of bill credits to Consumers if considered.	Cost or savings on flexibility payments awarded to HNOs if applicable.	Cost of paying for Capacity market contracts to HNOs.	Cost of DNO or NESO flexibility payments if awarded to HNOs, since these are funded through DUoS and bill charges.	Displaced gas heating emissions due to accelerated connection of heat networks.
Benefits	- Heatropolis savings on electricity procurement costs. - Revenue from DNO or NESO flexibility services if considered.	Savings on deferred or avoided reinforcement of substations due to Heatropolis.	Avoided total system cost of paying for Capacity Market contracts	- Reduction in DUoS if distribution network reinforcement can be deferred or avoided. - Reduction in bill charges if NESO can procure lower CM volumes. - Bill credits if provided by HNOs.	Reduction in annual electricity generation emissions due to Heatropolis optimisation.

Business case by stakeholder across GB: Current state analysis indicates all considered stakeholders secure net benefits through Heatropolis except for HNOs

Summary: Current state analysis indicates all business cases are positive, except for the HNO. The greatest benefits accrue to DESNZ, the Consumer, and the Environment. DESNZ benefits from reduced system peak load, which lowers Capacity Market procurement requirements. Since the Capacity Market is funded through consumer bills, this reduction indirectly benefits Consumers. Environmental benefits arise primarily from Heatropolis enabling HNOs to obtain Profiled connections, allowing earlier electrification by avoiding delays associated with reinforcement for Firm connections. This accelerates the replacement of gas-fired heating and supports earlier emissions reduction..

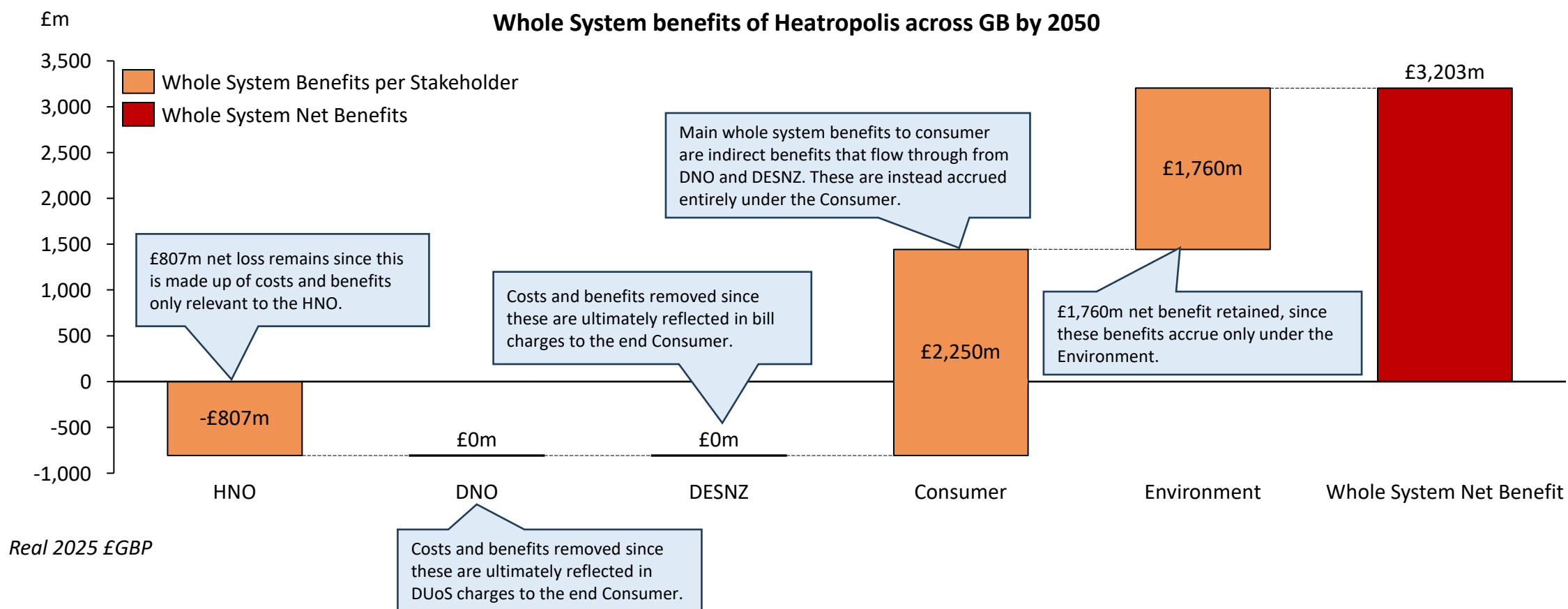
Cumulative benefits to all stakeholders across GB by 2050: extrapolation from UKPN area



*The Heatropolis SIF funding is allocated as a Consumer cost as this is paid for through bills. This is not visible on the graph as it is such a small proportion of the total costs/benefits.

Current state analysis indicates £3,203m total whole system discounted net benefits by 2050, primarily from Consumer and Environment benefits

Summary: Current state analysis indicates £3,203m whole system benefits of Heatropolis. This has been quantified based on eliminating duplicative cash flows and focusing on the end Consumer impact. DNO costs and benefits have been removed, since costs or savings to DNOs are ultimately reflected in end Consumer DUoS charges. Likewise, DESNZ savings have been removed since increased or reduced Capacity Market procurement costs are ultimately reflected in end Consumer bill charges.

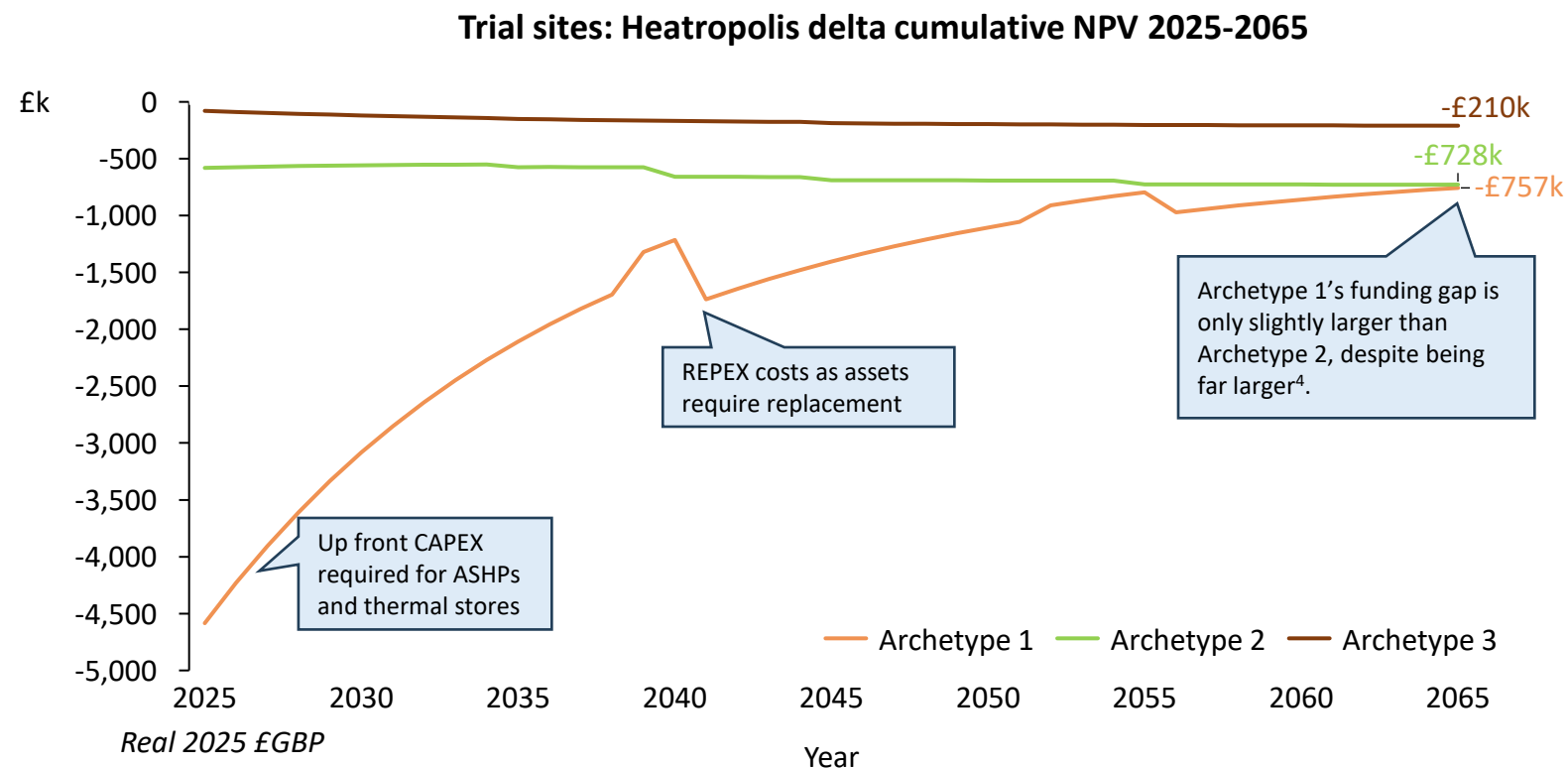


Results indicate all Archetypes are non-viable for HNOs without additional revenue or funding support mechanisms, supporting the need for novel commercial arrangements

Summary: Initial analysis indicates all three Archetypes are non-viable without additional revenue or external funding support. Flexibility payments are excluded from the Base Case scenario, and their inclusion delivers only marginal improvement. The annualised funding gaps are £60k, £58k, and £17k for Archetypes 1, 2, and 3, respectively. Although Archetype 1 has the largest absolute funding gap, it is the most cost-effective relative to its scale and heat delivery, indicating it is closest to commercial viability.

Key Findings:

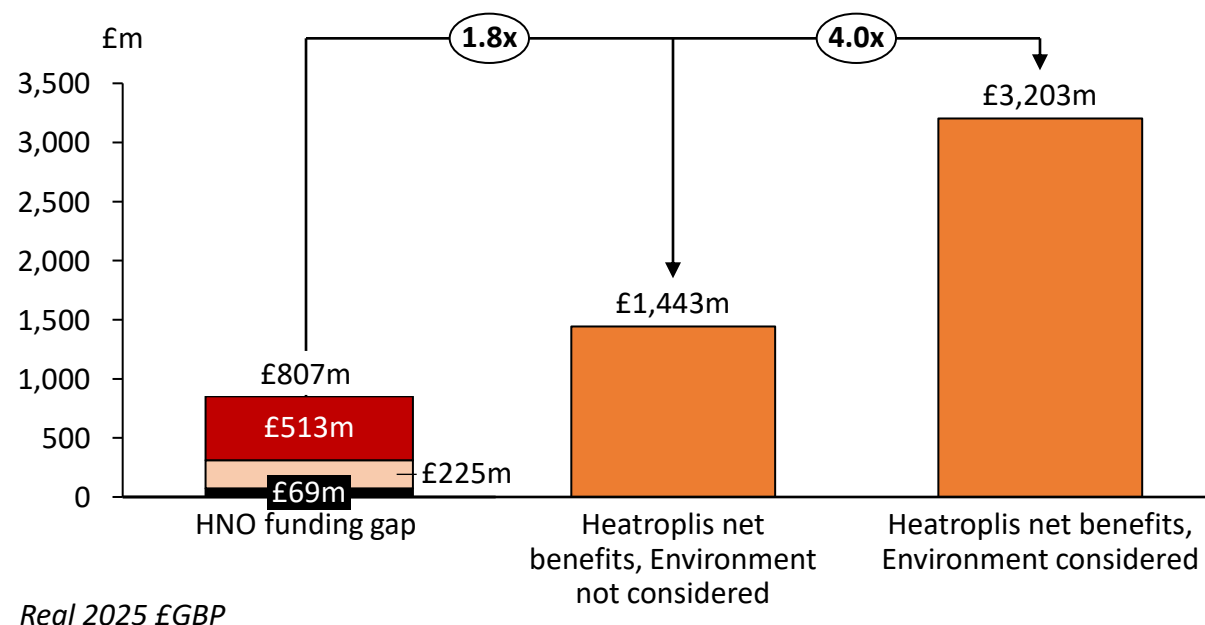
- **Archetype 1:** Non-viable currently. NPV of -£757k. The funding gap is £757k in Year 0, or £60k annually year 1-40.
- **Archetype 2:** Non-viable currently. NPV of -£728k. The funding gap is £728k in Year 0, or £58k annually year 1-40.
- **Archetype 3:** Non-viable currently. NPV of -£210k. The funding gap is £210k in Year 0, or £17k annually year 1-40.



Analysis indicates a 1.8x to 4x value add to the GB whole system per £1 spent on resolving the £807m HNO funding gap, highlighting the system value of Heatropolis

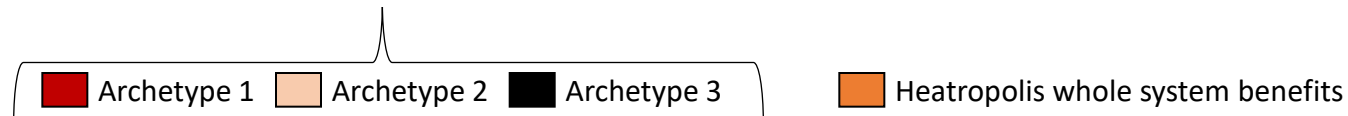
Summary: Analysis indicates resolving the funding gap would achieve a positive whole system multiplier effect of £1.80-£4.00 per £1 spent, depending on whether Environment benefits (emissions avoidance) are considered. This highlights the value of defining new commercial models that can address the HNO funding gap. Note, most of the funding gap sits with Archetype 1 heat networks, given they deliver the majority (63%) of heat across heat network Archetypes.

Whole system impact of resolving HNO funding gap by 2050



Real 2025 £GBP

HNO funding gap breakdown

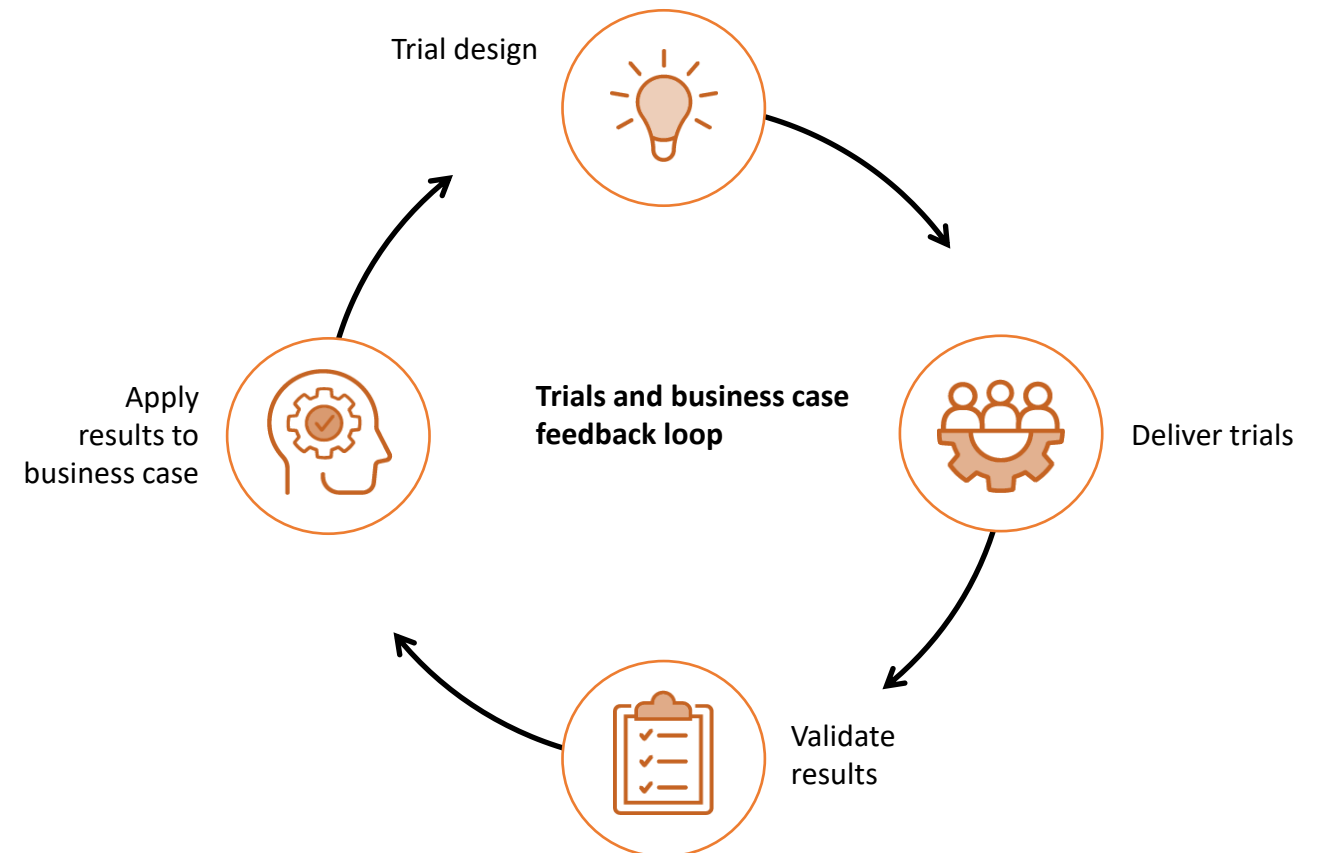


A focus for future iterations of the business case will be incorporating findings from the Heatropolis live trials to validate assumptions

Summary: The business case will evolve based on real-world insights from each trial, replacing assumptions with verified data on costs, demand profiles, and technology performance. These learnings will guide commercial arrangements for HNOs and shape the design of future trials.

Future iterations of the business case will be informed by the trials

- Trial results will increasingly shape the future iterations of the business case, replacing reliance on modelling and assumptions with trial data.
- Procurement and installation progress on trial sites will reveal actual technology costs and confirm technical performance of the Heatropolis solution.
- Insights from Heatropolis and counterfactual scenarios collected in the trials will inform commercial arrangements for HNOs, including connection agreements and flexibility products.
- Each trial's outcomes will refine the business case and guide the design of subsequent trials.



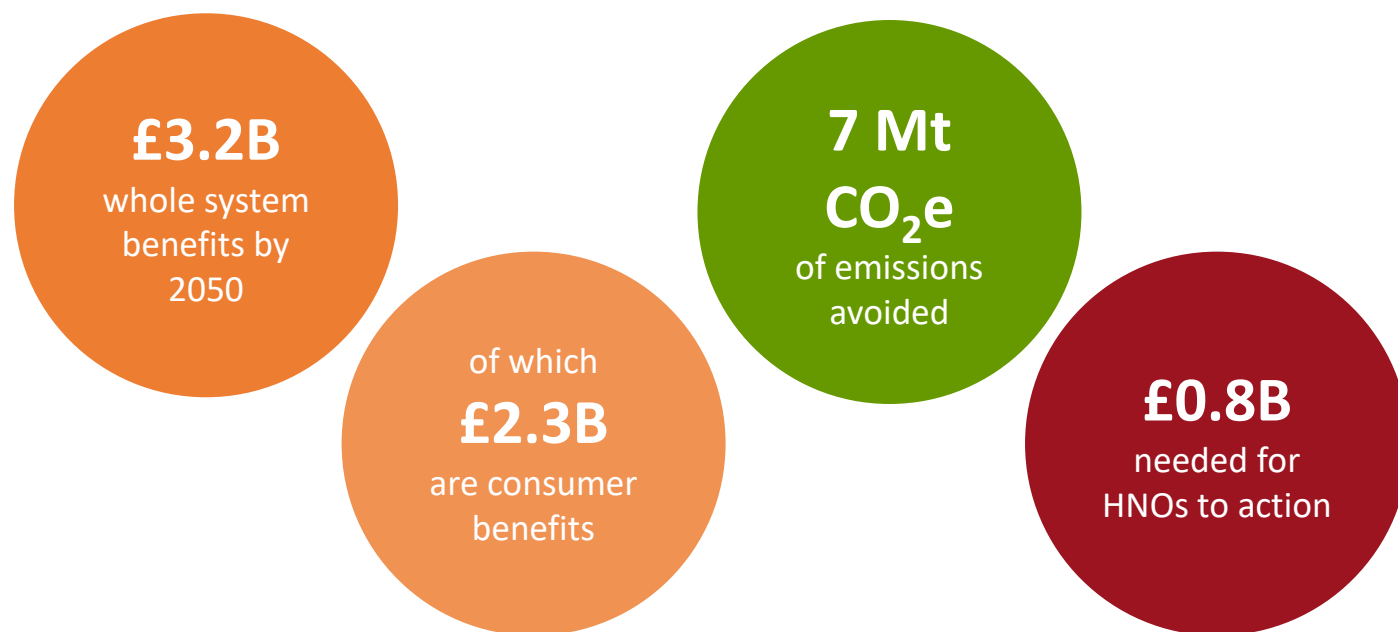
Heatropolis could unlock over £3B in whole system benefits, but to do so it must unlock £800M for heat networks to invest in necessary technology

Business Case Results

Without intervention, the electrification of heat networks will drive the need for **substantial reinforcement** of distribution networks.

Heatropolis is a set of interventions (including smart controls, thermal storage and heat pumps), which allows heat network operators to shift, flatten and manipulate their load to drive **better heat and electricity system outcomes**.

This 2025 iteration of the business case demonstrates that Heatropolis could lead to:



Next Steps

To enable Heatropolis, it will be necessary to unlock revenue streams which recompense HNOs for investing in the solution to drive better whole system outcomes for all stakeholders. Four key areas have been identified to explore and develop:



Long-term flexibility products



Regulatory support incentives



Update DUoS capacity charging methodology



Funded profiled connection agreement

Future iterations of the Heatropolis business case will also seek to quantitatively assess additional cost-benefit streams.

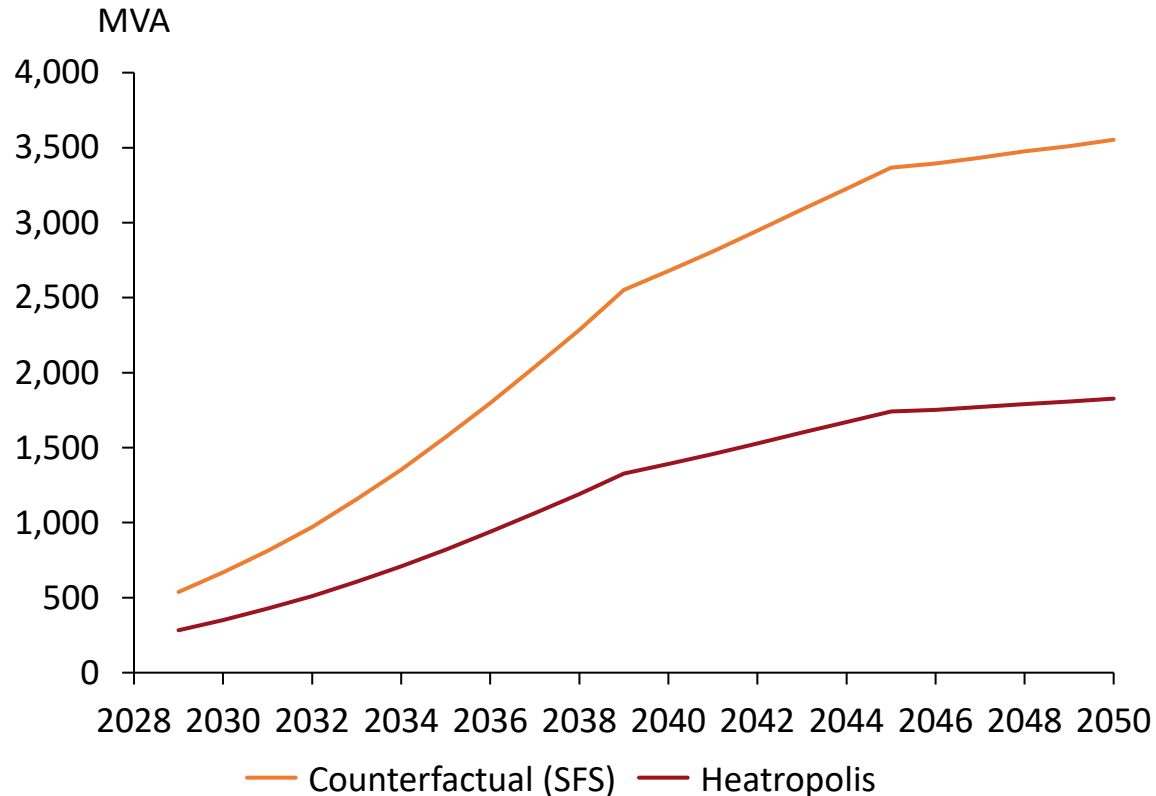
1. Up-front HNO connection costs
2. Accelerated connection time benefits for HNOs
3. Emissions from construction
4. Cost of transmission network reinforcement

Appendix: Business Case Assumptions

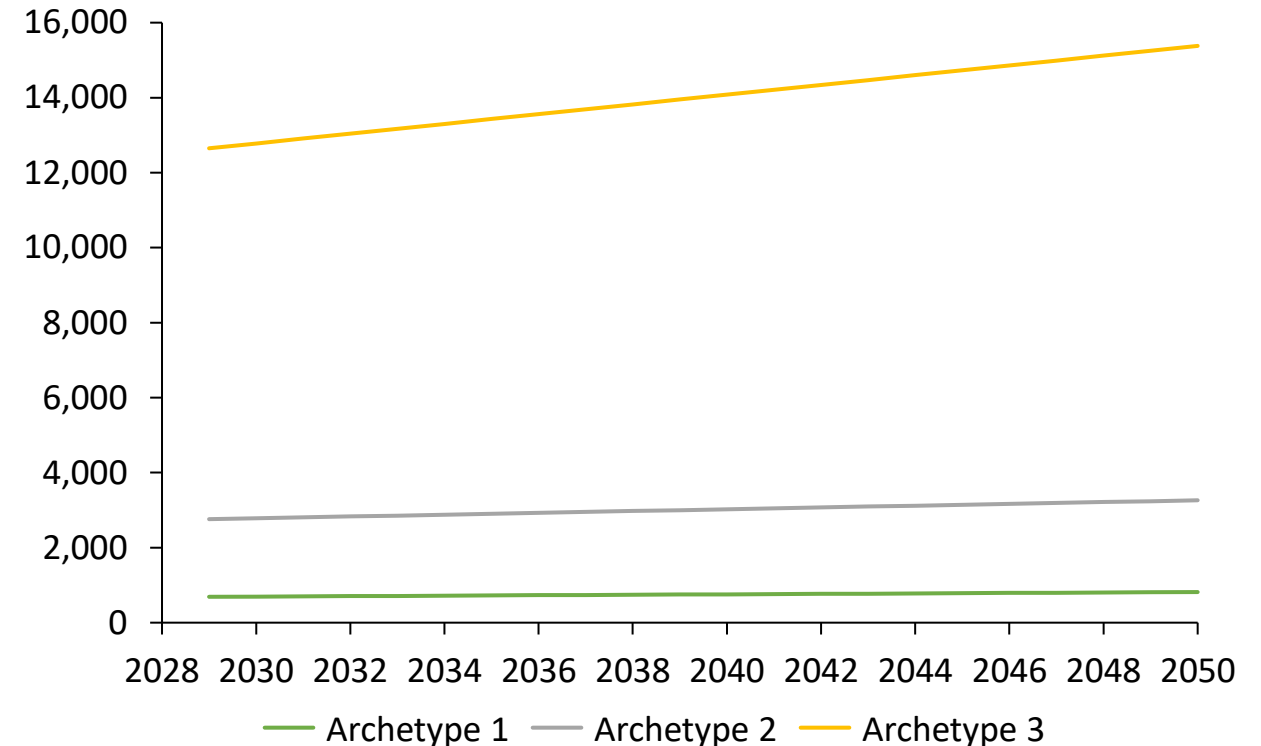
Heat network rollout is based on UK Power Network's Strategic Forecasting System

- The Strategic Forecasting System (SFS) presents peak demand per technology per substation – we used the district heating heat pump values (see left graph)
- These were split by archetype using projections based on inputs from heat network SME Metropolitan (see right graph)
- UK Power Networks results were scaled using the projected 2050 heat demand share of areas covered by UK Power Networks relative to the rest of GB

Heat network rollout in the UK Power Networks licence area

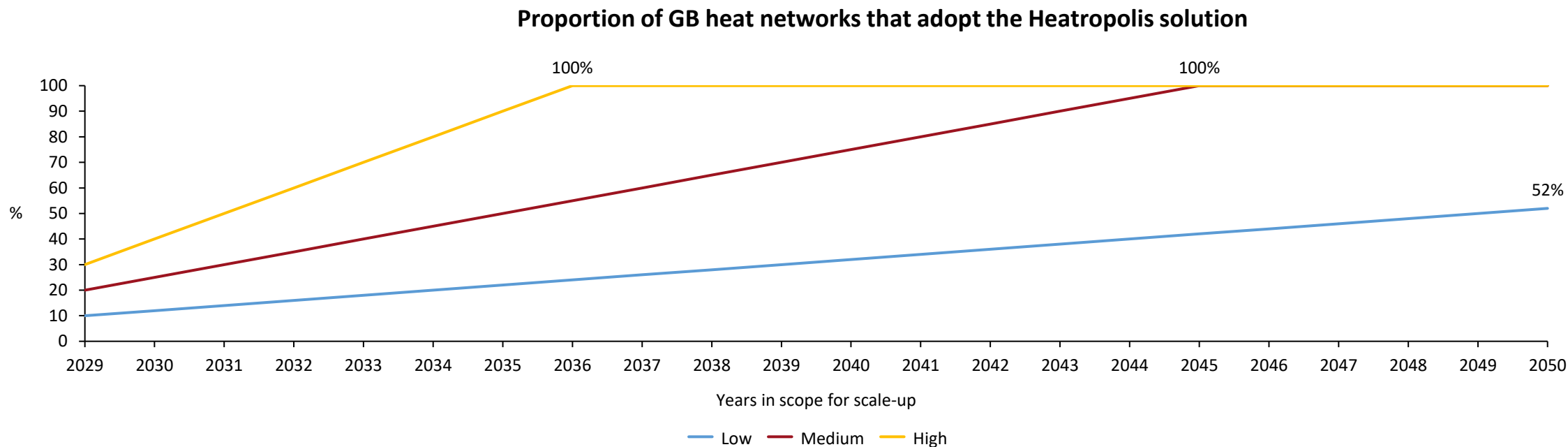


Projected number of heat networks by Archetype in the UK Power Networks' licence area



The business case applied HNO adoption rates for Heatropolis to more forecast the system net benefits

Summary: The scale-up analysis begins by assuming Heatropolis is adopted by all GB heat networks. A following step is to recalculate the system net benefits by assuming more realistic uptake of Heatropolis by GB heat networks: low (10% of heat networks adopt Heatropolis in 2029, increasing to 52% by 2050), medium (20% in 2029 increasing to 100% by 2045), and high (30% in 2029 increased to 100% by 2036)—to better estimate system-wide benefits. The core scenario is the Medium scenario.



Heatropolis adoption by HNO is configured to reach 100% by just 2035 in the high scenario, falling to 2045 in the medium scenario. It caps out at 52% by 2050 in the low scenario.



Contact

If you would like to find out more about the project or details of the business case, please reach out to:



heatropolis@ukpowernetworks.co.uk



metropolitan

passiv



Guidehouse