# Cross-Borough Energy Masterplan

November 2023

Centre for Sustainable Energy

Sustainable Energy Ltd

| Version | Prepared | Date | Reviewed | Date | Submitted | Date |
|---|---|---|---|---|---|---|
| 1.0 | JO, AN, LM, AG | 31.07.2023 | KH, MH, TH | 31.07.2023 | JO | 31.07.2023 |
| 2.0 | JO, AN, LM, AG | 04.10.2023 | JO, AN | 04.05.2023 | JO | 10.11.2023 |

# Contents

# Executive summary

## A Cross-Borough Energy Masterplan

In 2019 Kensington and Chelsea Council (K&C) and Hammersmith and Fulham Council (H&F) declared climate emergencies. To help achieve their net zero and zero carbon targets, they formed a partnership that secured funding from the Mayor of London to develop a Cross-Borough Energy Masterplan for the decarbonisation of heat in the two local authorities.

There are over 92,000 buildings across the two boroughs. The vast majority use gas boilers to provide space and water heating and produce around 916kt of $CO_2e$ emissions every year. To reduce these emissions, these existing carbon intensive heating systems will need to be replaced by either heat network connections or individual low-carbon solutions, such as heat pumps, alongside installation of retrofit measures, where needed.

The scale of change required is significant and the rate of change must be rapid. The upfront investment needed to achieve this change across the public and private sectors is substantial. However, this would in turn create great savings in avoided carbon costs across the two boroughs and present the most cost optimal solution to decarbonising heat.

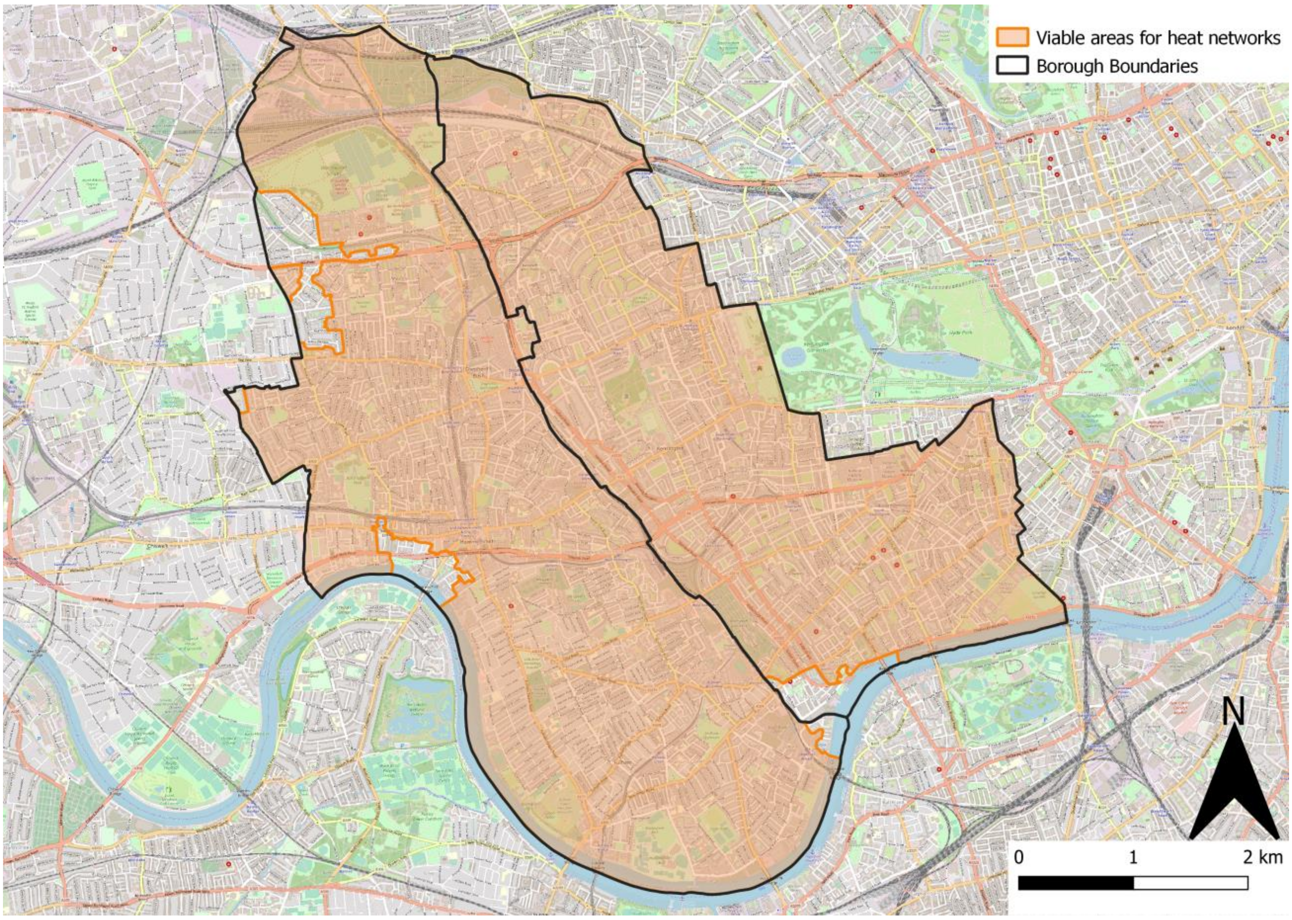
This masterplan represents a springboard to implement and enact the change. K&C and H&F are both working to deliver their ambitions to achieve this and continue to collaborate across the borough boundary wherever possible and beneficial.

## Why heat networks?

Heat networks, also known as district heating, supply heat from a central source to consumers Heat networks, also known as district heating, supply heat from one or more central sources to consumers through a network of underground pipes carrying hot (or, in some cases, ambient temperature) water, which deliver space heating and hot water to individual buildings. This avoids the need for individual heating systems installed in every building. The central heat source can be one of many technologies. Common low carbon examples are very large heat pumps, geothermal sources and waste heat from data centres.

Heat networks present a cost-effective way to reduce carbon emissions from space and water heating in many urban areas. The modelling undertaken in the development of this masterplan showed high viability of heat networks across the entire study area, as illustrated in Map A. This reflects the dense nature of heat demand across K&C and H&F, rendering both boroughs very attractive for heat network development in the coming years.

Map A: Areas across the two boroughs where heat networks are a highly viable option for decarbonising heat in buildings




Heat networks work best at scale and their potential for carbon saving increases as they expand. The Energy Act, which received Royal Assent on 26 October 2023, gives local authorities powers to make regulations to designate heat network zones[1]. This will help heat networks to grow at the scale required to meet net zero.

Heat network zoning requires certain buildings to connect to a heat network. Zoning is particularly effective in areas that benefit from high building density and availability of heat sources, such as K&C and H&F. The work undertaken in developing this masterplan builds a solid foundation that will enable both boroughs to capitalise on the opportunity heat network zoning presents.

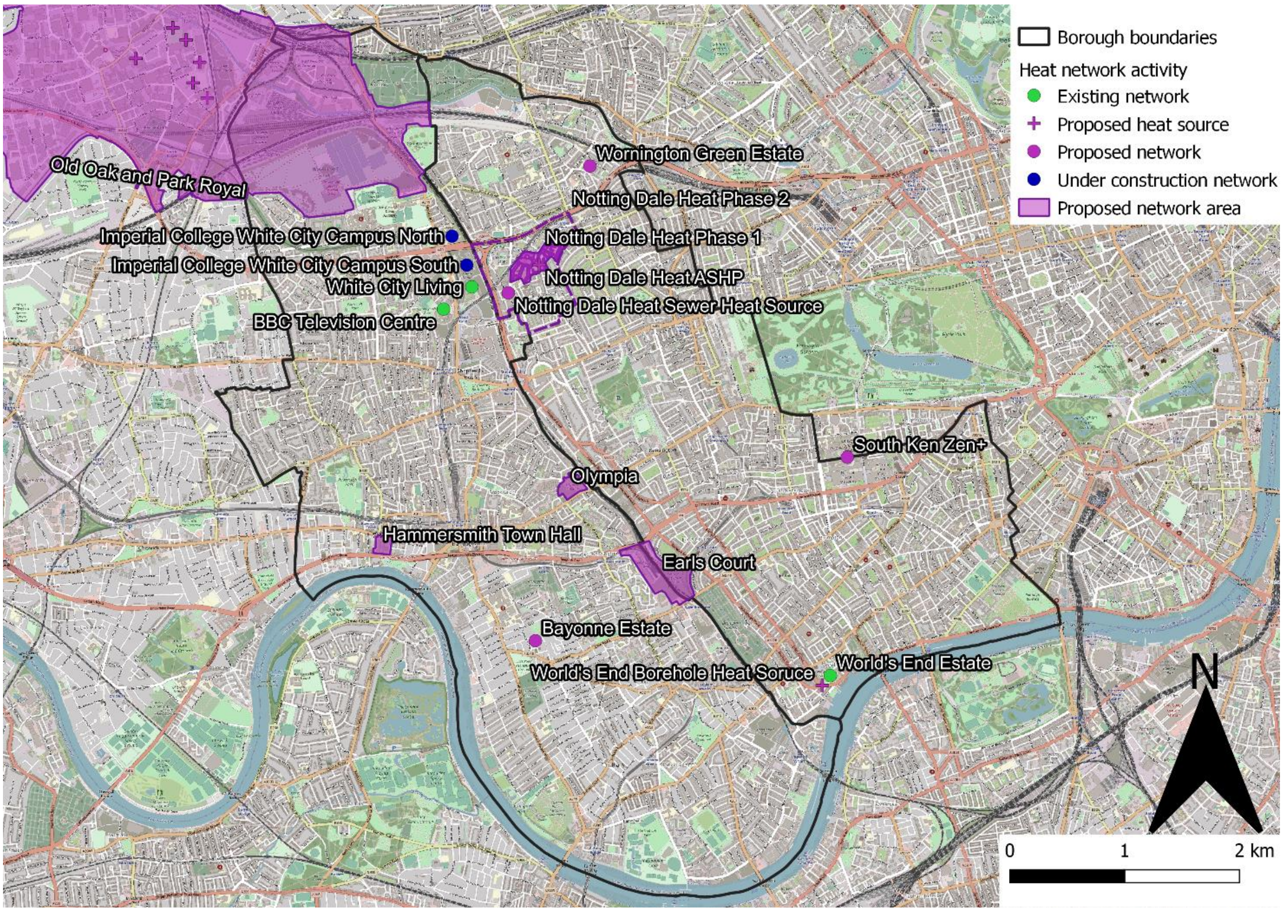
## The opportunity across the two boroughs

The two local authorities are not starting from scratch in their efforts to decarbonise heat in their buildings and encourage the development of heat networks. There are a number of heat network initiatives underway in both boroughs, both public and private. Map B shows some of the existing and planned heat network activity in the area, including at the H&F Civic Campus,

[1] https://www.legislation.gov.uk/ukpga/2023/52/enacted

White City and TV Centre, the Earl's Court Development, Kensal Canalside, Imperial White City campus and South Ken ZEN+.

Map B: Existing and planned heat network activity and heat supplies in the study area




Borough boundaries should not be a barrier to heat network development. By acting in partnership, K&C and H&F have a unique opportunity to be at the forefront of heat network investment and capitalise on the important enabling role of local authorities in developing city-scale low carbon heat networks.

## The modelled solutions

The modelling undertaken through the development of this masterplan showed that most of both boroughs are of sufficient density to prefer heat networks as a decarbonisation option for heat in buildings. In addition to the broad range of potential heat supplies available, there is appropriate capacity in the electricity grid and a large number of routes to choose from in laying heat network pipes. This makes heat networks an optional solution for heat decarbonisation across the two boroughs.

Given the scale of the opportunity in K&C and H&F, there are many different ways to drive forward heat network development. In the creation of this masterplan a number of different solutions were modelled and explored alongside local, regional and national stakeholders. The aim was to identify an achievable number of tangible opportunities with local buy-in and a mandate that could be pursued by the two authorities in the short to medium term. To this end, through the process five key heat network opportunities were identified. These are shown in Map C and are:

A) Earl's Court

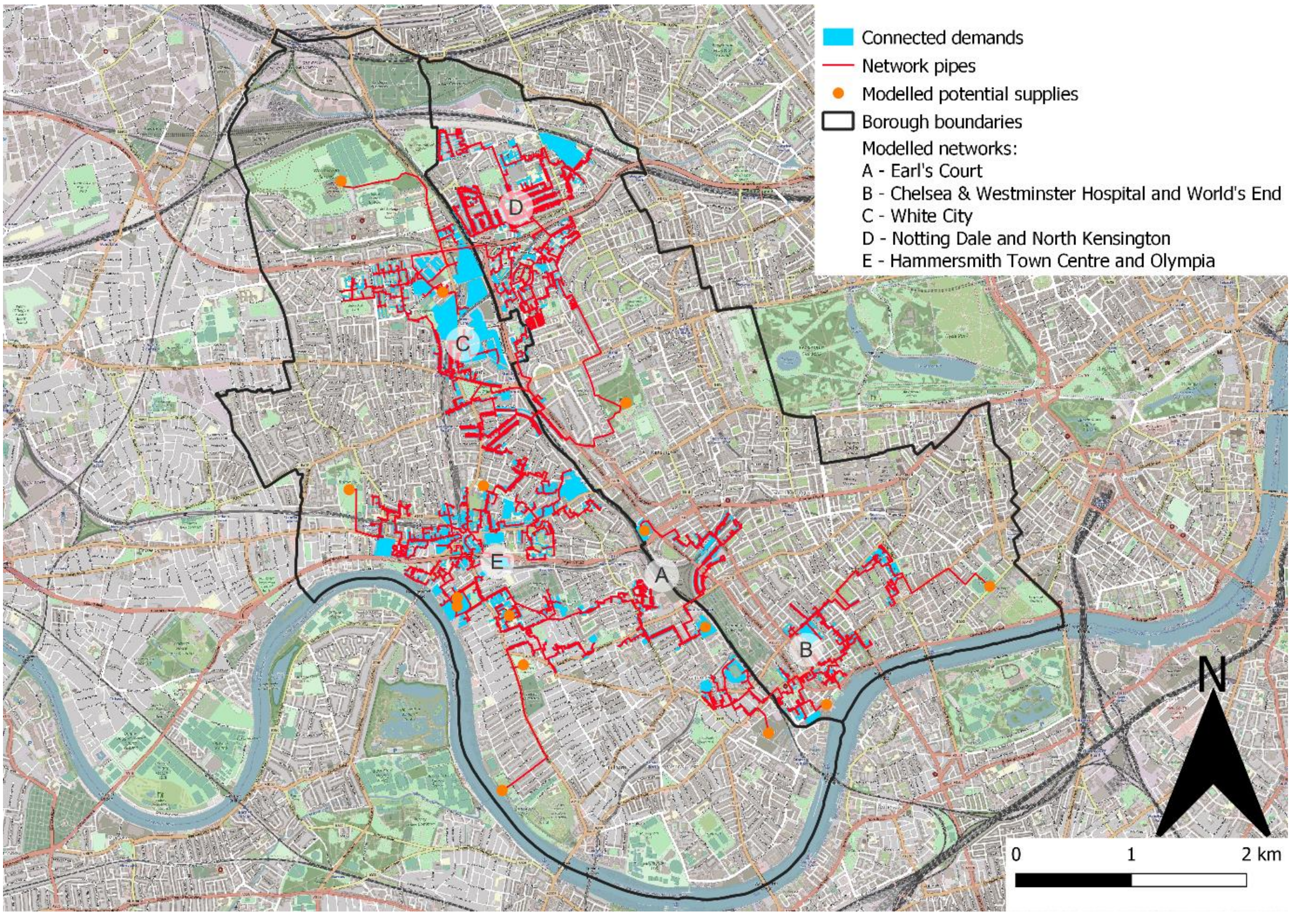
B) Chelsea & Westminster Hospital and World's End

C) White City

D) Notting Dale and North Kensington

E) Hammersmith Town Centre and Olympia

Map C: The five modelled heat networks




To support the two local authorities in the implementation of these networks, a combination of technical considerations and stakeholder priorities helped shape a suggested phasing approach for each proposed network. Whilst these phasing approaches are illustrative only, they provide a suggested order of implementation that prioritises assets under the control of the local authorities in the early stages. This makes the proposals achievable in the short term and shows intention and ability to act. It will support the local authorities in the later stages of implementation when they are building interest with external stakeholders and attracting investment.

Most modelled networks meet more than 50% of the heat demand of the area they are in.

All the networks offer significant carbon savings compared to current heating systems. These carbon savings are proportional to the amount of heat demand met by the network, therefore connecting more demand to networks will lead to greater carbon savings.

The techno-economic analysis of these five networks shows that they all represent cheaper solutions than individual air source heat pumps for the buildings in those areas. The modelled heat networks also emit significantly less carbon than both existing gas boilers and modelled air source heat pump solutions.

Heat networks are expected to be the solution which delivers the lowest cost of heat to customers. They would also offer many added benefits, including:

- Potential for the Councils and their residents to benefit from private investment and public/private partnerships in heat delivery
- Reduced building-level disruption to customers from decarbonisation compared to the installation of individual heat pumps
- Avoided visual disruption in heritage assets such as listed buildings and conservation areas from the installation of individual heat pumps
- Ability to benefit from financial incentives and Government grants aimed at developing heat networks
- Resilience to future changes in the energy landscape, particularly regarding the gas supply
- Ability to use economies of scale to exploit waste heat sources that would not be economically viable at the individual building scale

As illustrated in Map C, the five modelled networks are all in relatively close proximity to one another, largely along the borough boundary. Through the stakeholder engagement process there have been discussions of the idea for a north-south "heat spine" along the boundary between the two boroughs. The future interconnection of some or all of these opportunities to each other could lead to development of city-scale networks with the ability to attract institutional and private investment.

The modelling and analysis presented in the masterplan concludes that the study area is extremely well placed for the development of low and zero carbon heat networks in and across the two boroughs. The five modelled networks are a viable solution that should be explored with further feasibility studies.

## Realising the change

This masterplan shows that there is great opportunity in K&C and H&F to develop city-scale heat networks, starting from the five modelled networks and going beyond. To maximise their enabling role and the scale of the opportunity revealed, the two local authorities should maintain the significant momentum generated by the engagement undertaken to develop this masterplan.

Through the development of this masterplan, a broad range of stakeholders have demonstrated and expressed interest in working alongside the local authorities to implement the modelled solutions, including those with both the resource and ability to turn them into reality. Ultimately, this has the potential to attract significant private and public investment to enable city-scale heat networks across both boroughs.

To seize on the opportunity created by this masterplan and realise the solutions identified, in the short term both K&C and H&F should place their focus on these key next steps:

- Building capacity within the local authorities and capitalising on internal opportunities for collaboration and co-ordination around net zero initiatives
- The incorporation of the outputs of the masterplan into local strategies and planning policy
- Publicising the outputs and outcomes of this work and continuing to engage with interested stakeholders to build on the momentum created
- The prioritisation of heat network opportunities alongside local stakeholders and commissioning feasibility studies as a first step to explore options for implementation, including using local authority control over assets such as social housing to catalyse initial core networks

Furthermore, achieving the changes required will involve a co-ordinated effort within and across both authorities and a clear plan to simultaneously address the challenges of capacity, funding, regulation and social consent to collaboration and change.

Working together, the local authorities can capitalise on the opportunity to act as enablers of change in their capacity as sustainability leaders, conveners and landlords of social housing and corporate property, as well as through their statutory responsibility as local planning authorities. Together, they can attract greater private and public sector investment to deliver heat network priorities and realise local benefits.

K&C and H&F should use this Cross-Borough Energy Masterplan as a springboard for the decarbonisation of heat in the two boroughs. Whilst initially it may be appropriate to focus on the local level and develop heat networks within each borough, the two local authorities should maintain the focus on heat network development and expansion in the wider context of a common net zero goal.

# 1. The challenge

## 1.1. Introduction to the masterplan

Kensington and Chelsea Council (K&C) and Hammersmith and Fulham Council (H&F) declared climate emergencies in 2019. K&C has adopted two carbon reduction targets: the Council's operations and buildings to be net zero carbon by 2030 and the borough to be carbon neutral by 2040. H&F aims to reach net zero carbon emissions by 2030 for both the Council and the entire borough.

To help achieve these targets, the two local authorities formed a partnership and secured funding from the Mayor of London's Local Energy Accelerator (LEA) programme.[2] In 2022, they appointed the Centre for Sustainable Energy (CSE), in partnership with Sustainable Energy Limited (SEL), to produce a Cross-Borough Energy Masterplan.

The core aims of the masterplan are:

1. To develop robust place-based techno-economic evidence to justify the city-scale deployment of zero carbon heat networks across the two boroughs, with a route map of options and recommendations for implementation that can inform and support key local policies, plans and decisions

2. To produce techno-economic modelling and key sensitivity analysis for up to five new heat network opportunities identified in the study area, providing sufficient evidence for the local authorities to determine whether to progress these to more detailed techno-economic feasibility work

To achieve these aims, the technical analysis of decarbonisation options for the two boroughs and the techno-economic modelling for the identified new network opportunities factored in local conditions and non-technical factors that would affect the implementation of the masterplan. A strong and structured stakeholder engagement process ran throughout the development of the masterplan to help gain a deep understanding of these unique factors and the required conditions for the successful decarbonisation of the local energy system.

This masterplan is accompanied by the following supporting evidence:

- Techno-Economic Models (TEMs)
- GIS (Geographic Information System) data
- Appendix A: Zone modelling method
- Appendix B: Techno-economic assumptions

[2] https://www.london.gov.uk/programmes-strategies/environment-and-climate-change/energy/low-carbon-accelerators/local-energy-accelerator

- Appendix C: Full project process
- Appendix D: Stakeholder involvement
- Appendix E: Full ranking and scoring criteria for the network prioritisation matrix
- Appendix F: Detailed recommendations

## 1.2. Scale of the challenge

There are over 92,000 buildings in the study area, which comprises the two boroughs of K&C and H&F. The vast majority of these buildings use gas boilers to provide space and water heating. In 2023 this is anticipated to produce emissions of around 916kt of $CO_2e$ across the two boroughs[3]. For K&C and H&F to meet their ambitions and become net zero carbon boroughs, the use of natural gas in these boilers will need to be phased out and replaced by zero carbon heating solutions.

To achieve this, the current least cost option is to replace them with heat network connections or individual heat pumps. Unproven technologies (e.g. using hydrogen for heating), may become viable in the future but are not currently financially or technically viable. A prerequisite to decarbonising heating systems will be to insulate buildings across the two boroughs (within technical and planning limits). This will reduce the demand for heat as much as possible, in line with the energy hierarchy set out in the London Plan[4].

The scale of change required is huge and the rate of change must be rapid if the local net zero targets of 2030 and 2040 are to be met. As identified in this masterplan, the upfront investment required to achieve this change in the two boroughs is approximately £4.7 billion. Whilst finding funding for this transformation will be a major challenge in decarbonising heat, this large-scale investment would save around £5.9 billion in avoided carbon costs across the boroughs[5]. This will require a combination of Government support, regional opportunities from the Greater London Authority (GLA), local authority investment, investment fund managers and private enterprise.

## 1.3. Setting the scene: opportunities and challenges

### 1.3.1. Heat networks

Heat networks, also known as district heating, supply heat from one or more central sources to consumers through a network of underground pipes carrying hot (or, in some cases, ambient temperature) water, which deliver space heating and hot water to individual buildings. This avoids the need for individual heating systems installed in every building. The central heat source can be one of many technologies. Common low carbon examples are very large heat pumps, geothermal sources or waste heat from data centres.

[3] Calculated from known and modelled data on building heating systems and heat demands in the two boroughs
[4] https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf
[5] Carbon abatement cost calculated under medium cost scenario from Green Book carbon prices

Heat networks present a cost-effective way to reduce carbon emissions from space and water heating in many urban areas. Heat networks provide an opportunity to integrate a range of low carbon generation technologies, as they are technology agnostic and can be run on industrial waste heat, heat pumps, geothermal sources, biomass boilers, etc.

Heat networks work best at scale, as they can access heat sources of a size not available for individual buildings. Their carbon saving potential increases as heat networks expand, making them an attractive solution for decarbonising heat in densely populated urban areas, such as K&C and H&F.

To help reach the scale of expansion of heat networks required to meet net zero, the 2020 Energy White Paper committed the Government to supporting local authorities in designating new heat network zones in England. To deliver this, the Energy Act, which received Royal Assent on 26 October 2023, includes powers to make regulations to designate heat network zones across the country[6]. The Government highlighted that heat network zoning presents an effective solution to decarbonising heat in certain areas that are particularly suited to heat networks, due to a range of factors such as building density and availability of heat sources. This masterplan shows that both K&C and H&F present these characteristics.

As a significant wider benefit, if regulated and managed fairly, low carbon heat networks can also help reduce fuel poverty, particularly in the context of the recent energy crisis and considerable increase in gas prices.

However, heat network deployment can be challenging. Heat networks require high upfront capital investment and returns are relatively long-term. In addition, there are uncertainties surrounding customers willingness to connect and the resultant generation of enough revenue to make the solution cost-effective. In addition, a regulatory framework for this heating technology has until recently been lacking the UK and is still in development.[7] This means that many heat network customers have not been protected by energy price caps, fair pricing and reliability of the heat supply.

Heat networks in the UK are monopoly suppliers of heating and hot water for the properties that are connected to them. Reports of poor customer experience with some operators have generated bad press and therefore been a barrier to the delivery of city-scale heat networks across the UK. However, Ofgem together with the Department for Energy Security and Net Zero's (DESNZ) have recently published a consultation on their proposals for the introduction of heat network regulation which seek to protect consumers. This will also act as a protective counterweight to the introduction of mandated heat network zoning under the Energy Security Bill.

[6] https://www.legislation.gov.uk/ukpga/2023/52/enacted

[7] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1143674/Policy_Statement_Heat_Network_Market_Framework.pdf

From a regional perspective, the GLA, who has funded this project, has also been supporting the development and expansion of heat networks and in the London Plan 2021 established Heat Network Priority Areas[8]. Both boroughs are fully represented within these areas, reflecting their significant heat network potential as highly densely populated urban areas.

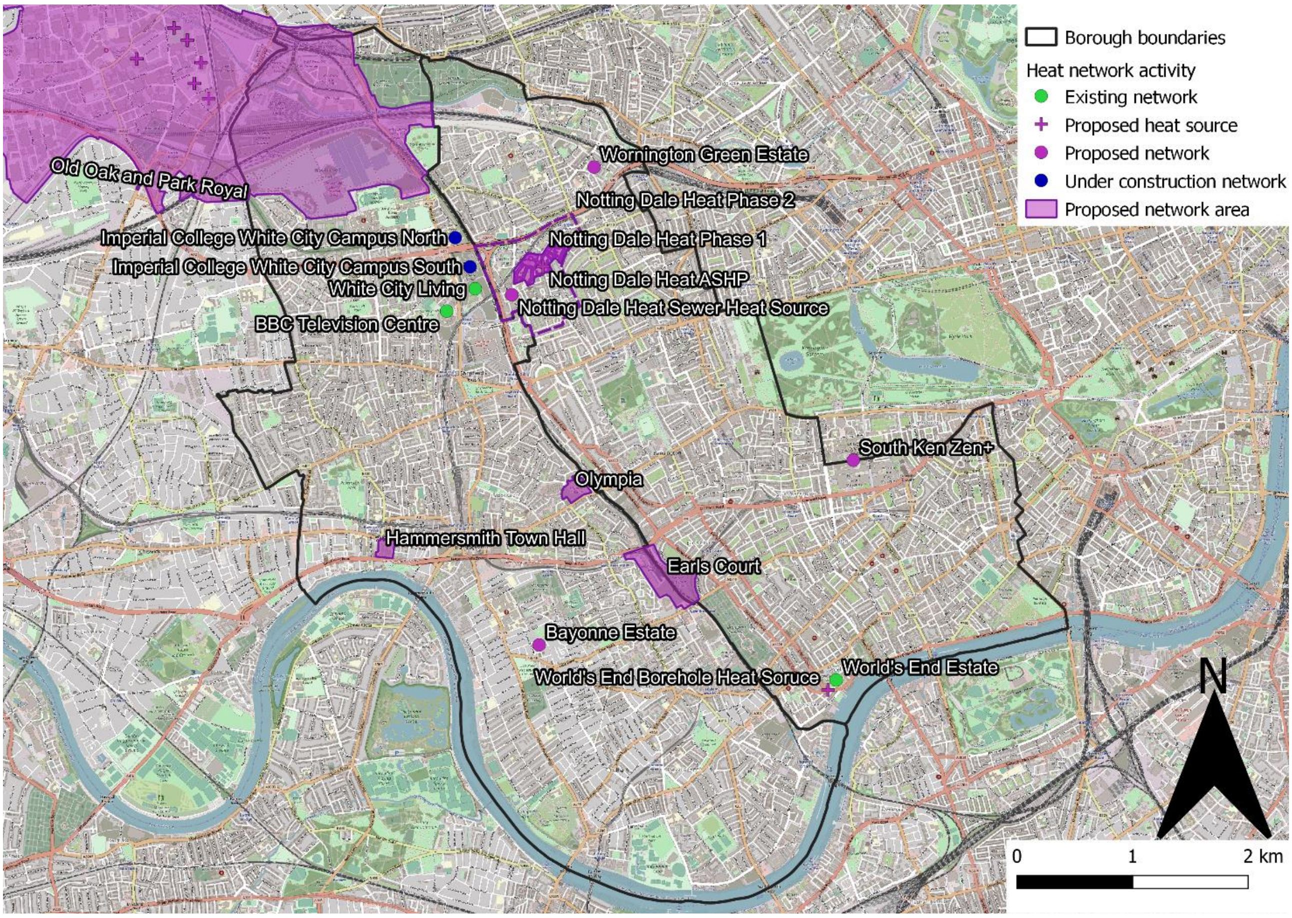
### 1.3.2. Heat network activity across the two boroughs

There are several heat network initiatives underway in both boroughs, both public and private. These include planned networks for White City and TV Centre, the Earls Court Development, Kensal Canalside, Imperial White City campus and South Ken ZEN+. In addition, K&C and H&F have several existing heat networks and communal heating systems serving council housing estates and private mansion blocks.

The two local authorities are currently in the early stages of heat network development. Earlier in 2023, Kensington and Chelsea Council approved a £26.5 million Final Investment Decision for Phase 1 of the Notting Dale Heat Network. Furthermore, Hammersmith and Fulham Council, in partnership with A2Dominion, won £2 million funding from the Green Heat Network Fund to develop a 700kW heating and cooling network for the Civic Campus development. Some of this and other existing and planned heat network activity in the two boroughs is presented in Map 1 (note that this map is illustrative and may not be an exhaustive representation of all heat network activity in the area).

[8] https://www.london.gov.uk/sites/default/files/the_london_plan_2021.pdf

Map 1: Existing and planned heat network activity and heat supplies in the study area




Borough boundaries do not need to represent a barrier to heat network development and the newly formed partnership between K&C and H&F recognises the important enabling role of local authorities in developing city-scale low carbon heat networks.

By acting in partnership, the two local authorities have the opportunity to be at the forefront of heat network investment. Knowledge sharing and joint learnings can create efficiencies along the journey and help develop best practices.

A joint approach across the two boroughs creates additional benefits, including economies of scale and associated cost savings for consumers throughout the development of heat network projects, from the supply chain to commissioning the works. Working across borough boundaries will also have the potential to attract interest and potentially investment for the larger-scale opportunities available.

Nevertheless, a cross-borough approach presents complexities, particularly linked to two different political environments that could lead to contrasting interests and aspirations. It will be important for the two local authorities to capitalise on their partnership with continued collaborative efforts that maintain the focus on heat network development in the wider context of a common net zero goal.

## 1.4. Overcoming the challenge

Although the scale of the challenge of decarbonising the heating systems for all the buildings in K&C and H&F is significant, the work undertaken by both local authorities and engaged stakeholders to develop this masterplan forms strong foundations to implement the changes required. In the long-term, decarbonising heat is also highly likely to generate wider benefits for the local area, such as reduced fuel poverty, better air quality, improved public health and wellbeing, development of new skills and the creation of new jobs.

This masterplan provides a springboard for the two boroughs to continue on a decarbonisation journey that will enable them to reach net zero. To this end, the masterplan focuses on the key steps that K&C and H&F need to take in the immediate term to ensure they maintain momentum and enable the implementation of the longer-term plan. This work is the starting point that is aimed at giving the local authorities and relevant partners sufficient evidence to justify progression towards more detailed feasibility work for the opportunities identified.

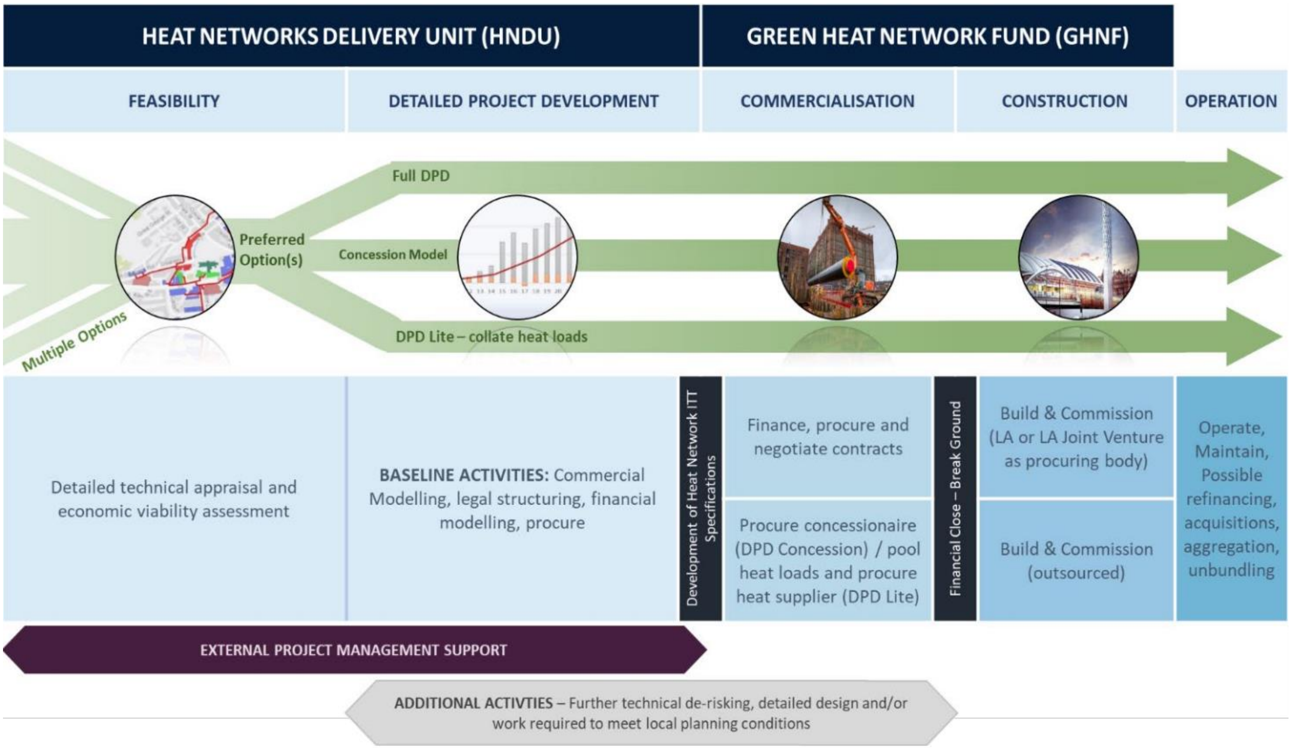
# 2. Technical solutions

## 2.1. Introduction

This chapter presents the technical evidence base that underpins the recommendations and route maps set out in this masterplan (see A route map to decarbonising heat across the two boroughs).

The main objective of the technical evidence is to provide a detailed place-based analysis that demonstrates a justified pathway to heat decarbonisation for the study area, which comprises the Royal Borough of Kensington and Chelsea and the London Borough of Hammersmith and Fulham. The technical and economic modelling and analysis that form part of this evidence seek to establish the case for the deployment of zero carbon heat networks across the two boroughs. New heat network opportunities have been identified in five areas that could be prioritised for further feasibility work and short-term implementation. Figure 1 shows the major stages in heat network development as identified by the Heat Network Delivery Unit (HNDU)[9].

Figure 1: Major stages in heat network development




The scope of the technical modelling and analysis undertaken for this masterplan included:

[9] DESNZ (2023) Heat Network Delivery Unit Round 13 Guidance. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1156827/hndu-r13-guidance.pdf (last accessed 05/09/2023)

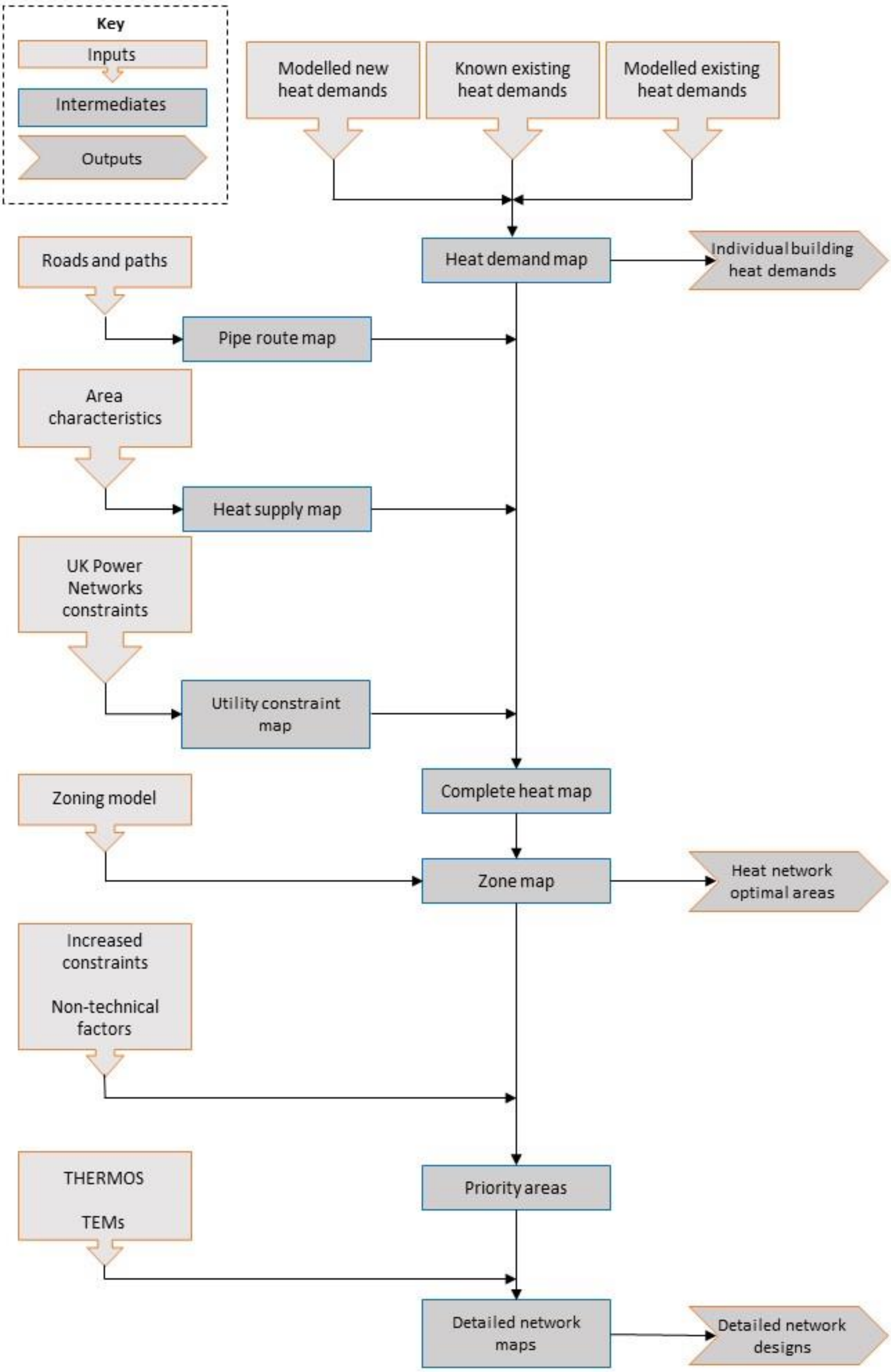
- Mapping: creating a detailed map of heat demand, opportunities for supply and options for network routing in the study area
- Zone modelling: using a detailed whole-system cost-optimised network representation to identify areas where heat networks are competitive against other zero-carbon alternatives (typically individual heat pumps), together with cost optimal decisions
- Detailed network modelling: within the zones which appear the most profitable and appropriate, characterising five heat network designs that can be taken forward, including an assessment of their economic viability and sensitivity analysis of key techno-economic variables

As with most analysis work, there are limitations to what can be covered within the time and resource boundaries of one specific piece of work. For the technical work presented in this masterplan, the following should be noted:

- The modelling undertaken is based on a set of assumptions that may change over time depending on a wider range of factors (e.g. data availability, demand estimates, costs, local factors, policy, etc.) and therefore results in varying outcomes
- Detailed techno-economic modelling was undertaken to develop each of the five priority networks. Although the potential exists for interactions between these networks, these were not modelled or analysed in any detail.
- The modelling and analysis work provides a certain level of detail for the design and economic viability of the identified heat networks, but does not include details that are pertinent to engineering feasibility studies, which would be part of the next steps required for the development of these networks

The technical evidence underpinning this masterplan was informed and shaped by extensive stakeholder engagement (see Social processes), which was key to decision making throughout the process and to ensure that the choices made will have on-the-ground support. Full details of the methodology employed for each task of the technical work are presented in this chapter. An overview of the modelling process is shown in Figure 2.

Figure 2: Overview of the technical methodology



## 2.2. Methodology

### 2.2.1. Mapping method

Heat mapping involved gathering, unifying and representing heat data across the study area. This comprised:

- Heat demand for existing buildings
- Heat demand for new and/or planned buildings and developments
- Identification and quantification of heat supplies in the study area.

#### 2.2.1.1. Existing heat demand mapping

In the context of this study, heat demand is understood to mean the total requirement for both space heating and hot water.

There are 92,213 buildings in the study area. Building level heat demand information was gathered through stakeholder engagement, with a focus on the largest heat demands in the borough. Where heat demand data was not available in a consistent or useable format, it was extrapolated from other information available. Where first hand heat data could not be gathered, demand was modelled. The data gathered through the engagement process was used in the analysis where its accuracy is likely to exceed modelled data. To further improve the quality of heat demand estimation in the study area, display energy certificates (DECs) were reviewed, where available. DECs give the estimated energy demand primarily for local authority-occupied buildings, though some privately owned buildings may also have one.

The remaining heat demand data was estimated with CSE's own software model THERMOS[10], which has been validated throughout its development and use, including by extensive comparison of modelled outputs with real world data. Finally, heat demands which had been modelled were calibrated to reflect metered consumption data known from DESNZ small-area statistics publication (note that only modelled demands were calibrated, so known values were not adjusted). The THERMOS heat demand model uses building polygons from OS Mastermap with address data from Addressbase and the national LiDAR dataset to produce a map of heated buildings, including estimated peak and annual heat demand. These values are estimated using either floor-area benchmarks or taken from DECs where matched to the building.

After the baseline heat demands of buildings had been established, they were adjusted for potential insulation measures. Information on planned insulation measures in the near term, received through stakeholder engagement, was used to adjust heat demand to reflect the reality of building stock over the next few years. Heat demand estimates were amended based on heat reduction percentages per measure, derived from the National Household Model[11], which were then adjusted to non-domestic properties, as appropriate.

[10] https://www.thermos-project.eu/home/
[11] https://www.data.gov.uk/dataset/957eadbe-43b6-4d8d-b931-8594cb346ecd/national-household-model

#### 2.2.1.2. New development heat demand mapping

A review of planning applications submitted to K&C and H&F, alongside information gathered through the engagement process, sought to identify major planned new developments and the estimated heat demand they would be likely to generate. Heat demands for these developments were estimated based on the size of the site and the size and number of any commercial and residential units within it. Finally, the sites of these new developments were spatially analysed to remove any existing buildings within the site boundaries to prevent double counting.

#### 2.2.1.3. Heat supplies mapping

Any heat network requires at least one heat supply. Generally, heat supplies are lowest cost (and therefore the heat network is more viable) where the heat supply can take advantage of existing characteristics of the area. For instance, they can make use of waste heat (e.g. from industrial processes, data centres, transport network), heat from an underground reservoir (aquifer) or heat from surface water bodies such as rivers. In most of these cases a heat pump would be used to "upgrade" the heat to a temperature suitable for use in building heating systems.

Heat pumps that are used to upgrade waste heat generally have higher capital cost than standalone large-scale air source heat pumps. This is due to the increased complexity of accessing the heat source, however as heat is available at temperatures closer to network operating temperatures, higher coefficients of performance (COP)[12] are achieved and therefore lower the operating costs. In some cases, such as heat offtake from electricity generation plants, waste heat is already available at a suitable temperature and does not require a heat pump to "upgrade" the temperature.

The heat network has been assumed to run at 80°C. Initially, the network may need to run at higher temperatures to serve existing building systems, however in the long term a lower operating temperature should be achievable as building heating systems are upgraded. The COPs used in this study have been based on 80°C network.

The following different types of heat sources were identified as potentially feasible in the assessment area:

- Aquifer source heat pump (AqSHP)
- Sewer source heat pump (Thames Water)
- Transport for London (TfL) pumping station heat pump
- Water source heat pump (WSHP) using the River Thames
- Large-scale air source heat pump (ASHP)
- Waste exhaust heat from tube (TfL)
- Waste exhaust heat from data centres

Expert analysis of the study area, alongside stakeholder engagement, allowed the identification of suitable heat supplies. For each heat source, a GIS outline of the potential heat source was

[12] COP is a measure of the heat returned for the electricity used in a heat pump. For example, a heat pump with a COP of 3 would output 3 kWh of heat for each kWh of electricity inputted.

created. Heat supply for each of these was estimated based on the size of the sites available for an energy centre and the heat resource available.

Based on experience developing other low carbon energy centres, the economical low carbon element was sized to meet 55% of the peak heat output. When serving a heat network, a typical energy centre will output 36% of its theoretical maximum output (the output if all plant ran for every hour in the year) over the course of a year. For example, a heat network that is served by a 1MW energy centre would have an annual demand of 3,154MWh[13]. Therefore, using these numbers, the potential energy centre size and total output can be estimated for the potential low carbon heat source.

While canals have been identified within the assessment boundary, they were not considered viable heat sources, as previous project experience indicates that canals are typically not resources of significant enough scale.

From experience of many large-scale heat network projects, the costs for each technology type were characterised in terms of fixed capital costs and variable costs that depend on the required heat output. Each heat source was given a different operating cost which is derived from the expected COP for a heat pump using the different source temperatures available.

Because these are the most economical supplies to use in developing heat networks, they have been the focus of the analysis. It is also possible to build a standalone heat network without one of the above heat supplies, for example by building a standalone large-scale air source heat pump. This is likely to produce a lower capital cost network, however the operating cost will be higher and a large area available for the air heat exchangers will be required.

#### 2.2.1.4. Route mapping

Route mapping helps establish the potential routes that heat network pipes may be able to run along and the costs associated with the installation of these pipes. As it is already commonplace to install pipes under roadways, as these are under local authority control, there is a high likelihood of being able to route heat network pipes along roads as well.

Route mapping was based on the roads dataset available in OS Mastermap data. This provides line data of the roads[14] within the study area, as well as characteristics about the type of road. This data was supplemented by datasets collected through the stakeholder engagement process to increase knowledge of locally accessible roads.

To finalise the road map, a “soft dig” model was run. Soft dig refers to the relative ease, and hence lower cost, of excavating a trench for pipe installation. This model assigns a cost category to each road that reflects the costs of installing pipe under different road conditions. These cost categories then allowed the setting of cost parameters in the subsequent zoning and detailed modelling phases of the technical work.

[13] Calculated as follows: 1MW x 8760h x 36%

[14] Roads is in this section to mean any route through which traffic (regardless of classification) can travel. This would include cycleways, footpaths, etc.

The model is limited to deriving these categories and there may be some differences that are overlooked. For example, raised highways are considered the same as ground-based ones although suspending pipes from raised highways carries different costs. Further studies (e.g. at feasibility level) would need to review highways in detail to account for these limitations.

#### 2.2.1.5. Utility constraints mapping

Utility constraints are those where conditions or costs imposed by utilities (water, electricity, etc.) could impair the construction of a heat network. Data was gathered from publicly available sources as well as through stakeholder engagement with the local authorities, UK Power Networks and Thames Water. As the routing methodology follows roads, it is unlikely that major utilities will impact the routing of pipes. However, as the decarbonisation of heat relies on its electrification, electrical constraints were considered.

UK Power Network's Distribution Future Energy Scenarios (DFES) describe four scenarios of what future pathways to net zero could look like in their network area, which were considered in the utility mapping through using UK Power Network's headroom report. The DFES forecast the number of low carbon technologies under the four different scenarios. Further analysis is then done to create the UK Power Networks DFES Network Headroom Report, which indicates the usage of demand and generation at grid and primary substations. This Network Headroom Report then informs their Network Development Plan.

In developing this masterplan, the four DFES scenarios were compared at key years across the two local authorities to identify where there may be constraints posed by grid capacity.

### 2.2.2. Zone modelling method

This section provides an overview of the zone modelling method, with a more detailed account of how the model operates presented in Appendix A: Zone modelling method.

The best areas for heat networks have a low-cost heat supply, a reasonable density of heat demand and the ability to minimise the route between demands. All this information was made available by the mapping exercises. CSE's own heat network zoning tool analysed combinations of these factors across the two boroughs to determine areas where heat networks are likely to be viable under a set of input financial parameters. To produce this, the zoning model operates as follows:

- It divides the map into smaller areas of around 750 buildings each. Within these clusters the model assigns each building to either a heat network connection or a heat pump, based on what the cost optimal solution is within the cluster

- The model then produces density maps of areas where there are significant concentrations of buildings suitable for potential heat network connections. Contours are drawn to produce "potential zones" where the viability of running a heat network is then evaluated

- To evaluate the viability of each of the many potential zones, the model considers the costs associated with supply and transmission of heat within the network and calculates a break-even unit price for heat from the energy centre. Any zone that are not viable at this stage are discarded
- A range of scenarios are produced on each remaining zone to determine whether the supply would break even if it were selling heat to the distribution network at an assumed unit price

The result is a series of zones for each scenario where heat networks would maximise savings over the base case of individual air source heat pumps and remain financially viable. Whilst more detailed optimisation is required to derive a network design (see section 2.2.2), the zoning process seeks to identify the most viable areas for further detailed modelling.

### 2.2.3. Detailed network modelling method

The zone modelling work and stakeholder engagement process (see chapter 3 for further details) identified five priority areas for heat networks in the two boroughs, which are presented in section 2.5. The objective of the detailed network modelling was to establish a financially viable heat network within each priority area.

To do this, each priority area was imported to THERMOS, a software tool that CSE developed as part of the EU-funded THERMOS project[15]. This is a tool which aids the development of heat networks, by finding the cost-optimal network given a set of user-defined constraints. Based on these constraints, THERMOS conducts a network optimisation, which considers heat supplies, heat losses from piping, insulation applied, etc. The optimisation chooses which loads to connect and how to route the network, so as to maximise the net present value (NPV) to the network operator, given a set of assumed tariffs. These tariffs are chosen to be cost-competitive for the end user with an individual air source heat pump counterfactual, which aligns with the whole-system cost-minimising approach taken for zone modelling.

The modelling undertaken focuses on fourth generation heat networks, which distribute heat through hot water, usually at temperatures between 60°C and 80°C. This operating temperature means that they can usually directly replace existing central heating systems. Fifth generation networks are a nascent technology and involve using low temperature water, normally between 10°C and 30°C. This is then increased to a temperature suitable for use in buildings by a heat pump. As a result, consumers need to install a heat pump and may have to change the central heating systems in their home if a lower temperature is achieved. Due to fifth generation networks being a relatively new technology, the details of their operation and impacts on consumers are relatively uncertain. However, many of the district heating principles that are important for fourth generation networks remain significant for fifth generation networks.

The heat demands of existing buildings and new developments, the potential pipe routing and the supplies as mapped in the previous stages were uploaded for THERMOS to use as the basis

[15] https://www.thermos-project.eu/home/

of its optimisations. Financial parameters were aligned with SEL's techno-economic models (TEMs), which analyse the economic performance of a network in more detail.

THERMOS allows the user to constrain each heat supply, building and route as one of three options: "forbidden", "optional" or "required". It also allows new routes and supplies to be drawn. These constraints allow the user to decide which buildings, supplies and routes should be included in a heat network optimisation.

As the priority areas selected through the engagement process contained several thousands of buildings, some decisions had to made about which buildings should be prioritised in the detailed network modelling phase. These decisions were informed by local priorities identified in each area, as well as expert judgement of which buildings could constitute anchor loads for the heat networks. This methodology mirrors how heat networks are often developed. Generally, it is easiest to secure the agreement of a few initial large loads to connect. If those loads ensure the commercial viability of the network, then it can be expanded to include other heat demands in the area. The optimisation was also refined in an iterative process to review cases where unexpected outcomes had occurred. These issues were reviewed and addressed to ensure the model would create results that are as accurate as possible.

Whilst these networks have been designed to be achievable by following heat network design principles, they are relatively large. Therefore, a phased approach was designed for the development of each network. Phasing was based on a combination of priorities as defined by stakeholders, balanced against the need to maintain the economics of each phase. Phasing was tailored to each of the priority areas according to their individual characteristics, but in broad terms the following method was applied:

1. Phase 1 focused on the highest priorities for the two local authorities which in most cases were within their own housing or corporate stock, as well as accounting for the practical difficulties that cross-borough working may pose in the short term.

2. Phase 2 was designed around the expansion of the networks to additional large loads, prioritising those where stakeholders had already been engaged in the development of the masterplan, for example NHS assets, but also major planned new developments, schools and other education centres and large commercial or residential buildings (particularly where owned or operated by the councils or registered providers)

3. Phase 3 was set as expansion to the full network designs. In general, this would mean connecting the smaller loads that are along the network routes defined by the larger loads

Should the level of ambition and drive from this masterplan be maintained, it is considered that these phases could be delivered within three years of each other, with the following forecast delivery dates:

- Phase 1 to complete in 2027
- Phase 2 to complete in 2030
- Phase 3 to complete in 2033

It should be noted that the modelled network designs and phasing are illustrative and one of many ways to drive heat decarbonisation in the study area. Alternative network deployment routes may become more appropriate depending on a number of non-technical factors. For example, it may be more feasible to develop a higher number of smaller networks which later join to create larger networks, or to plan for a large network to expand across the two boroughs. This masterplan seeks to show the scale of opportunity in the study area based on modelled solutions that resulted from decisions made through the stakeholder engagement process detailed in chapter 3.

It should also be noted that the timing of the phasing is based upon an understanding of what may be achievable within an ambitious timeframe for heat network deployment, based on expert knowledge. It is recognised that if H&F are to meet their borough-wide 2030 ambition for net zero, other measures such as carbon offsetting or individual ASHPs may be required in the shorter term.

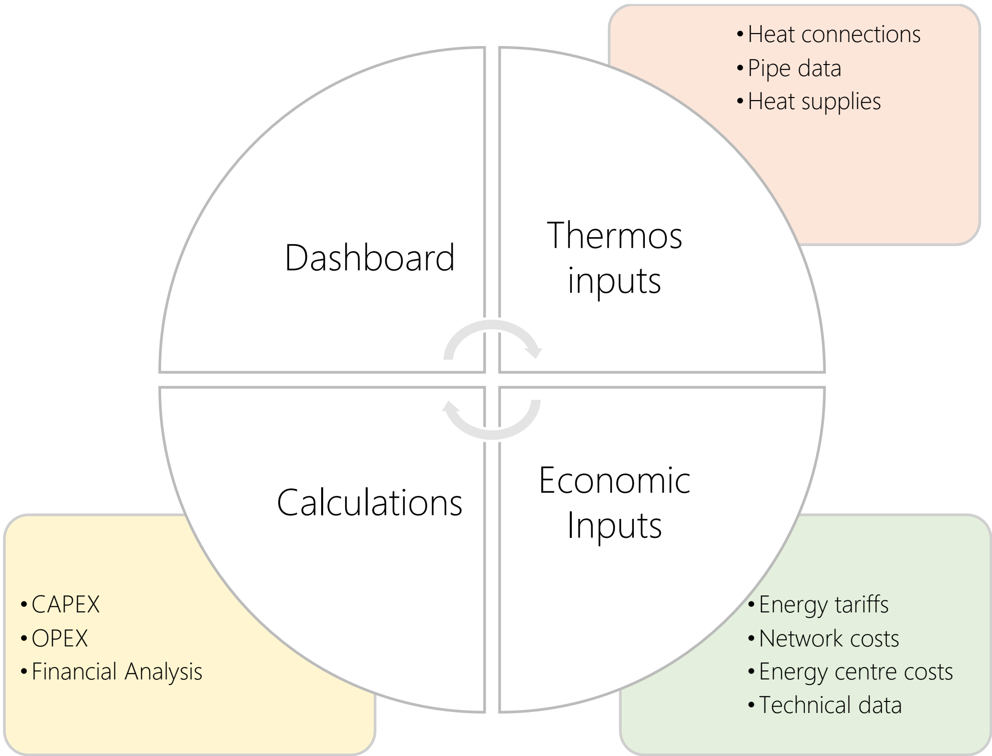
### 2.2.4. Techno-economic modelling method

A techno-economic model was constructed to assess the economics of each of the priority areas. The TEMs allow key variables to be revised and the associated impact assessed in the future.

As shown in Figure 3, the TEMs include:

- A dashboard that allows control of typical economic variables including fuel costs, heat charges and network timings. This is also where all key results from the model are displayed
- Tabs with technical inputs derived from the THERMOS model, including data on all connecting buildings, a high-level overview of pipe lengths and sizes and a summary of the required heat supplies
- Economic inputs developed from SEL's previous project experience
- Calculations that form the basis of the economic assessment

Figure 3: TEM tab structure




The following inputs were derived from THERMOS:

- Heat connections – information from each heat connection, including an annual demand, a peak demand, the number of individual connections associated with the network connection and information about the expected use type (e.g. domestic, commercial, etc.)
- Pipe data – information on the network route, including lengths, nominal diameters and surface type for each pipe section
- Heat supplies – energy centre information, such as annual output, required capacity and energy centre costs

The main economic inputs are controlled via the dashboard and can be adjusted to see the overall impact on the results. The technical inputs tab accounts for other variables, such as secondary side costs, pipe costs and operating efficiency of the heat generating equipment. The main variables that were included in these inputs are:

- Energy sales tariffs: the energy sales tariffs used in the economic assessments were based on targeted network internal rates of return (IRRs) of 3.5%, 5% and 8%. A network with lower economic performance (i.e. networks that are more expensive to construct and operate) should aim for a 3.5% IRR, while networks with better performance should target an IRR of 5% or 8% accordingly

- Energy centre tariffs: due to the current energy crisis and uncertain energy prices, gas and electricity purchase tariffs for energy centres were based on a competitive rate for large energy users

- Initial capital and replacement costs: technology replacement costs were modelled on an annualised basis and consider the capital costs, expected lifetime, fractional repairs and the length of the business term

- Pipe costs: to develop an estimate of the heat network costs, the proposed network was broken down into trench lengths, nominal pipe diameter and difficulty of dig surface (which directly affects capital build cost)

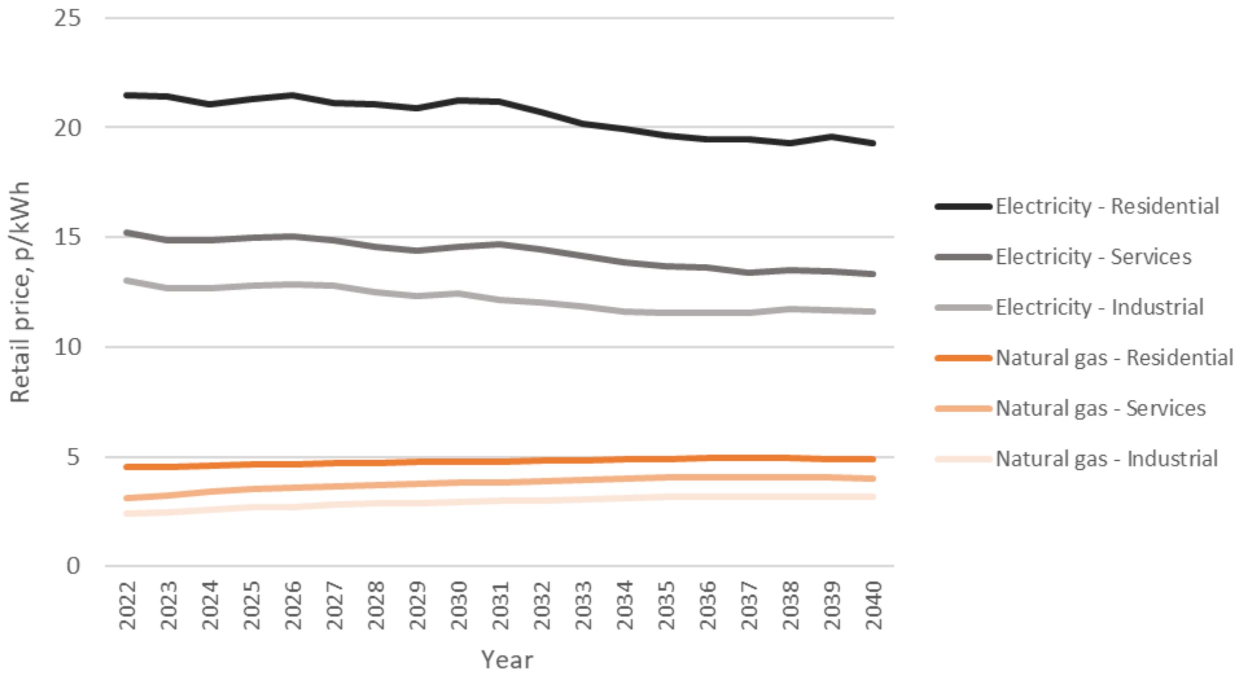
- Connection cost and connection charges: it was assumed that a one-off payment, associated with connecting individual buildings or properties to the district heating system, would be charged to customers as replacement cost for existing or planned domestic technologies, such as gas boilers or individual ASHPs

- DESNZ energy price projections: to assess the impact of expected future price changes on the financial outputs, the DESNZ central scenario price projections (2022) for natural gas and electricity have been used[16]. The projected changes in prices for electricity and natural gas for residential, commercial and industrial are illustrated in Figure 4[17]. These indicate that while both gas and electricity prices are predicted to increase in the short and medium term, in the long-term electricity prices are expected to show a decreasing trend, while gas prices continue to increase. The Government are also expected to shift the carbon taxation on energy, the Climate Change Levy (CCL), more heavily onto gas and less on electricity, which will accelerate these trends. This will result in improved viability of heat from heat pumps, including heat networks deploying them, compared to gas fired systems. The projected price variations were applied to the energy tariffs.

[16] DESNZ (2023) Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal (last accessed 29/09/2023)

[17] The most recent 2023 DESNZ price projection was not used in the modelling and analysis due to the high projected prices resulting from the energy crisis. The 2022 DESNZ price projection offers a more stable and relevant price projection towards today's market.

Figure 4: DESNZ price projections – central scenario




Using the THERMOS inputs and the economic inputs, an annualised operating model was created. This is based on the heat demand and the energy input from gas or electricity required to serve this demand. The capital and operational expenditures (CAPEX and OPEX) were then calculated on an annual basis. Finally, the levelised cost of heat over a 40-year period was assessed for the heat network solution, as well as for individual air source heat pumps and individual gas boilers for comparison.

The main outputs from the TEMs focus on the comparison between the heat network solution and an alternative low carbon solution, namely individual ASHPs. The following results help to compare the two options:

- Net present cost (NPC), i.e. the total lifetime cost of the project, discounted over the lifetime with a set discount rate of 3.5%. This includes all CAPEX, OPEX and replacement expenditure (REPEX). In general, the lowest NPC is the most attractive project from an economic perspective
- Levelised cost of heat (LCOH), i.e. cost per unit of heat generated (kWh) over the lifetime of a system. In general, the lower the LCOH, the lower the cost to construct and operate the system
- Carbon emitted, i.e. the lifetime carbon emissions (tonnes of $CO_2e$) associated with the different technologies over the lifetime of the project

The economic performance of each network underwent sensitivity analysis to assess its resilience in response to variations of input parameters (e.g. variation in energy purchase tariffs). The sensitivity results are presented in the form of graphs, with the x-axis representing the percentage variation of the parameter being varied. The 0% variation is therefore the base case and is typically in either the centre of the graph or at one of the extremes. From the base case, the parameter is varied by a fixed percentage (usually -30%, -15%, +15% and +30%) and the effect on the project IRR is displayed.

If a graph were to display a horizontal line, this would indicate that the parameter being varied does not affect the performance of the heat network. On the other hand, a very steep line would indicate that the project is very sensitive to small changes in the parameter being varied, indicating a high risk.

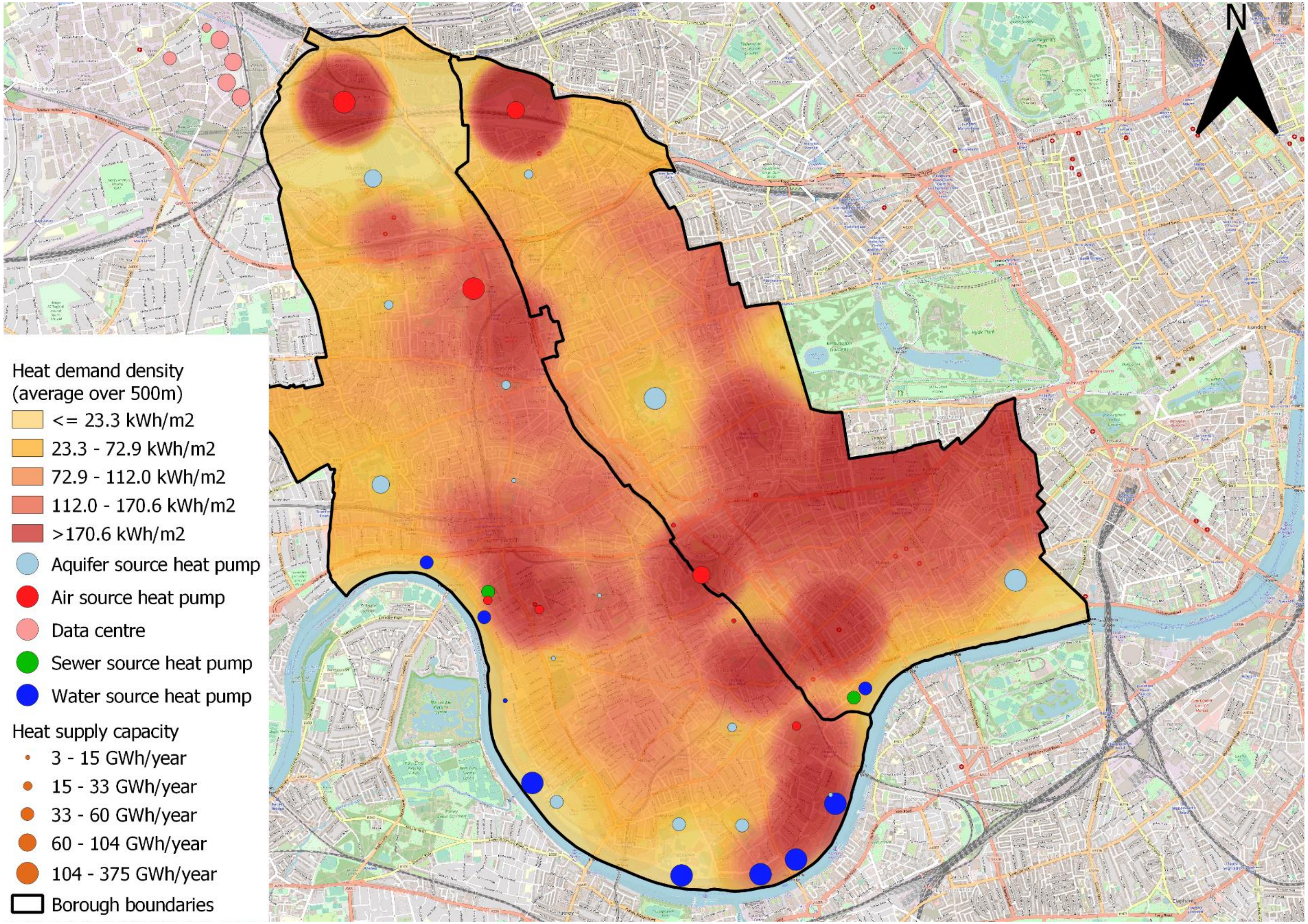
## 2.3. Mapping results

### 2.3.1. Existing and future demands and identified heat supplies

Map 2 shows the heat demand density across the study area, along with potential supply locations. The map only includes the heat sources that were known at the time of developing this masterplan, based on the data available and provided, however other potential supplies are likely available across the study area. The heat map demonstrates good heat density across the entirety of the study area. Darker reds indicate the densest areas of heat demand. The densest areas of demand are in the east of K&C, the south of H&F and by the boundary between the two boroughs. There is also another area of reasonable heat density around Hammersmith Town Centre.

There are areas of very high density in the north of the two boroughs, but these are relatively isolated. This likely occurs due to these points representing new developments, part of the Old Oak and Park Royal Development Corporation (OPDC) and Kensal Canalside. Because these developments are represented by a single heat demand figure for the entire site (as more detailed information on the distribution of buildings and their predicted individual heat demands is not available at this stage), their heat demand is concentrated at the centre of a large area. In reality, this would mean that the actual density is likely to be lower than shown on the single point and better spread across these sites.

Map 2: Heat density map for the cross-borough area showing supply capacity

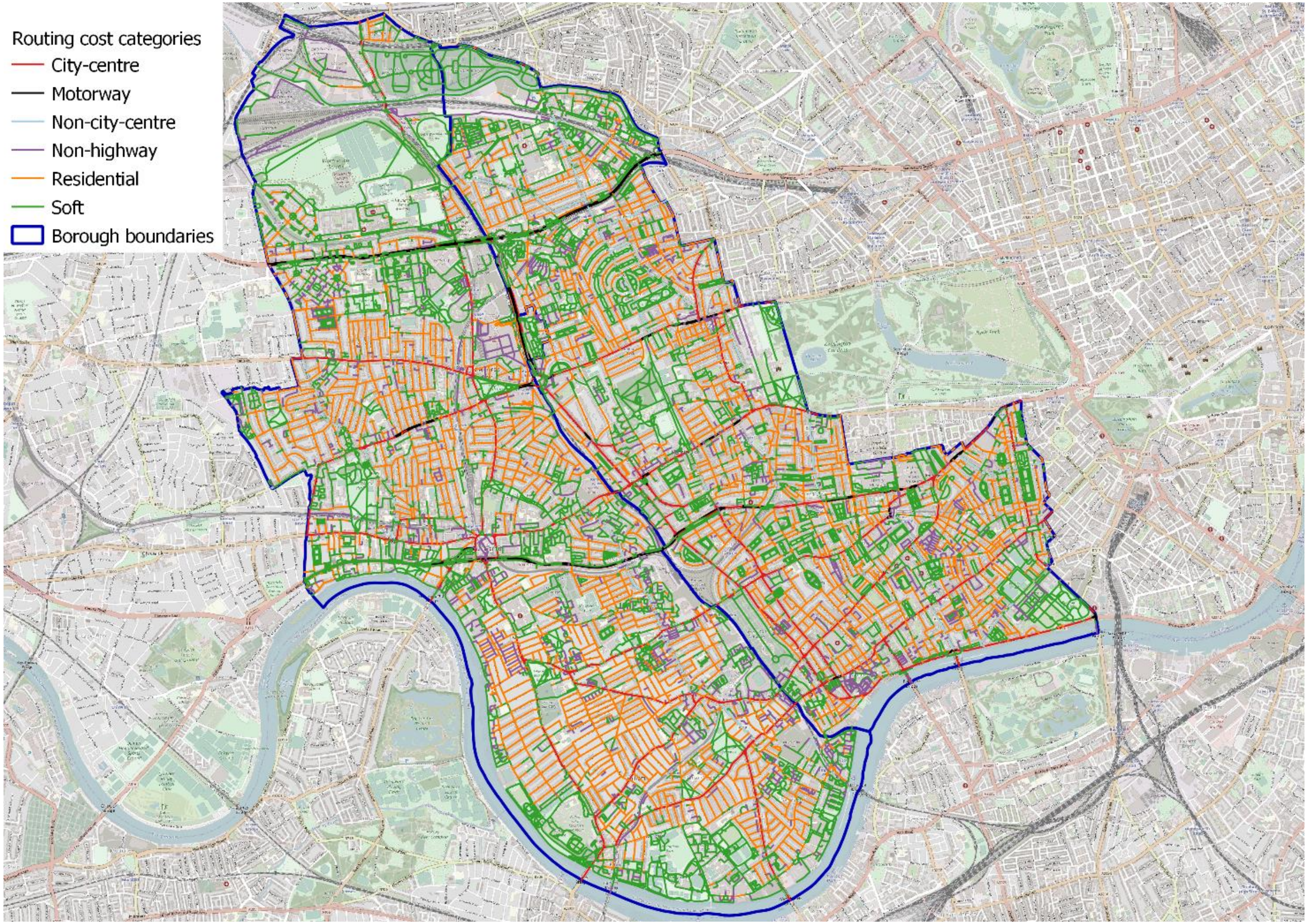


### 2.3.2. Route mapping

Map 3 shows the cost categories of different routes in the study area. These were mapped from the routes that are known to exist, with modifications based upon information received through stakeholder engagement.

There are a mix different route types across the study area. Soft dig routes are present across large parts of the area. As these routes tend to be the cheapest to excavate for heat network piping, this suggests that there is good potential for lower-cost installation of heat networks. There is also a large proportion of residential roads, which are also relatively low-cost to excavate, being simpler than larger traffic corridors. There are some large traffic corridors in the study area, including partial motorway, which would generally be 3-4 times more expensive to dig than soft dig or residential roads and could pose a soft barrier to heat network piping.

Map 3: The cost categories of different routes in the study area



### 2.3.3. Utilities mapping

Primary substation data from UK Power Network's open data portal[18] regarding electricity distribution and demand headroom[19] is presented as a scale of red-amber-green, known as demand RAG, where:

- Red – the substation is already more than 5% overloaded
- Amber – the substation capacity is between 5% overloaded and 5% headroom available
- Green – the substation has over 5% headroom available

Substation capacity in the local area is the main utility constraint for heat networks, as it may not be able to accommodate additional connections. In order to decarbonise heating, most of it will need to be electrified. This could either be through the development of heat networks or through the installation of individual heat pumps for each building.

As heat networks achieve higher coefficients of performance than individual heating systems, they require less electricity to supply the same heat demand. This electricity is generally required in fewer places than for distributed heating, such as individual ASHPs. In addition, heat networks can have greater flexibility (i.e. ability to shift demand) than distributed heating systems, which is often enabled by large amounts of thermal storage within energy centres.

These factors mean that the scale of required grid upgrade and reinforcement is smaller than would be required for alternative heat decarbonisation solutions, such as individual systems. Understanding where grid constraints exist, or are likely to exist, during the development of a heat network can improve its design but also inform the investment plans of the Distribution Network Operator (DNO).

UK Power Networks is the DNO for the study area. Their 2023 DFES scenarios are:

1. Falling short: general progress is made towards decarbonisation; however, this is the only scenario world that does not meet net zero by 2050.

2. System transformation: the 2050 net zero target is met by relying on hydrogen to decarbonise the more difficult sectors of heat and heavy transport.

3. Consumer transformation: the 2050 net zero target is met by a high degree of societal change as well as deep electrification of transport and heat.

4. Leading the way: this is the fastest of the scenario worlds to achieve net zero, with the highest level of societal change, utilising both hydrogen and electric low carbon technologies."[20]

[18] https://ukpowernetworks.opendatasoft.com/pages/home/
[19] How much more electricity demand can be connected to a substation
[20] https://www.ukpowernetworks.co.uk/future-energy/dfes-2023 (p. 3)

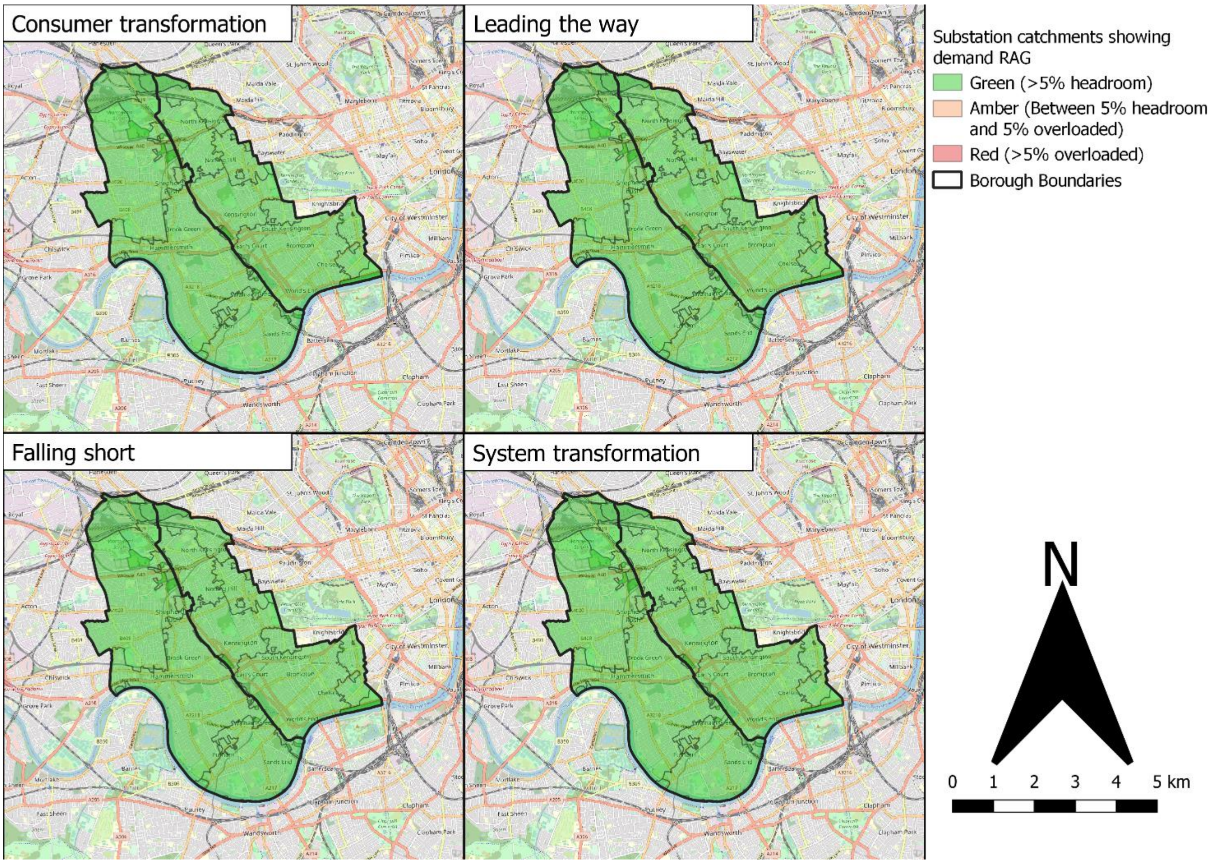
The “consumer transformation” scenario most closely resembles the uptake of electrified heat networks. However, all four scenarios were assessed for the development of this masterplan. These scenarios were compared at key years related to the phasing detailed in section 2.2.3:

- 2023 (Map 4): at present every substation in the study area has some spare capacity
- 2027 (Map 5): at completion of phase 1 of heat network development all substations are predicted to have available capacity except for the Kimberley Road substation. The Kimberley Road distribution area is shown to be at or around its maximum capacity. As a result, heat network development may require reinforcement of the distribution network in this area
- 2030 (Map 6): at completion of phase 2 of heat network development there is some evidence of constraint. In this year the Kimberley Road substation is shown overloaded in all scenarios, which makes it likely that heat network development in this area would require grid reinforcement
- 2033 (Map 7): at completion of phase 3 of heat network development the network constraints from 2030 are confirmed

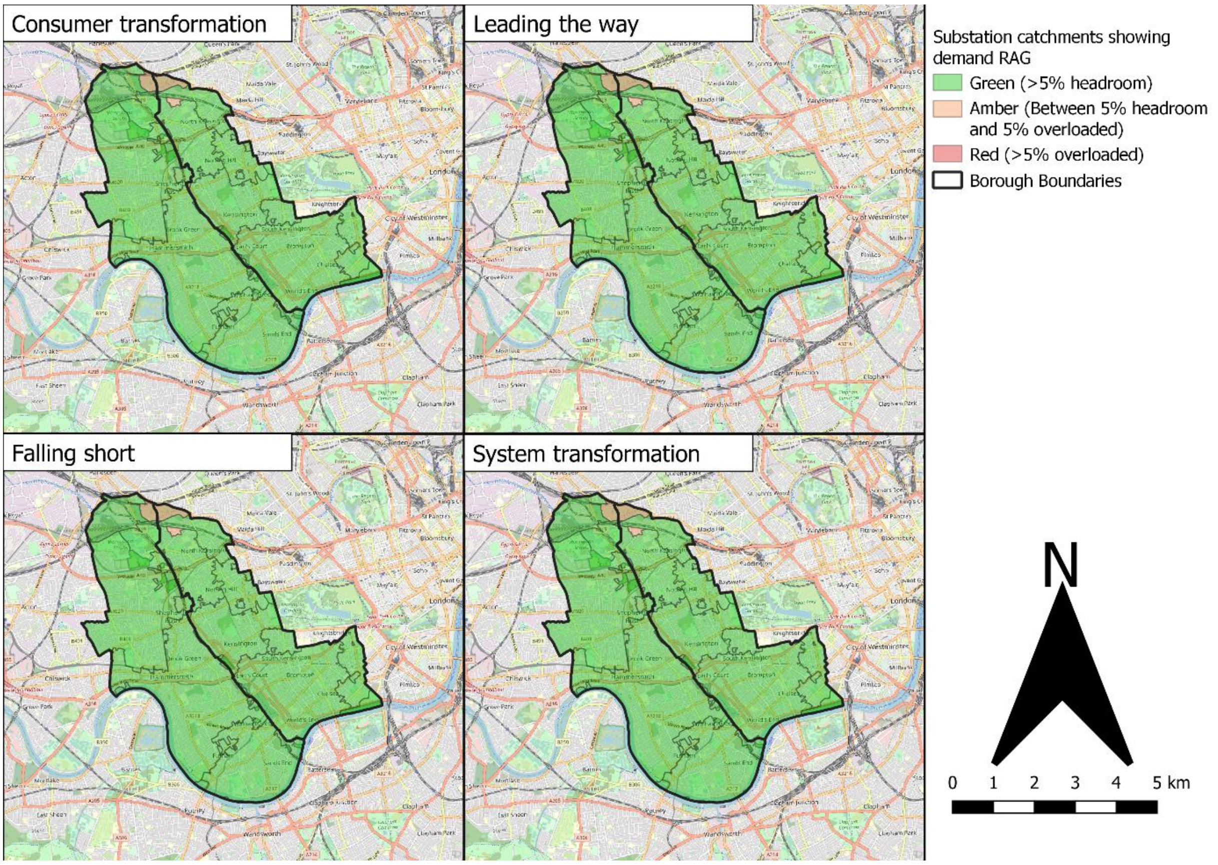
Any planned heat networks with energy centres in the study area would need to be discussed in detail with UK Power Networks to understand the effect on the power system and align with their future investment plans.

Early engagement with UK Power Networks is essential as it will ensure the network operator has advanced visibility of upcoming demand and generation on the network, giving them time to ensure there is sufficient electrical capacity in the right place, at the right time, at the lowest cost for customers. This could be through network reinforcement or innovative flexible solutions.

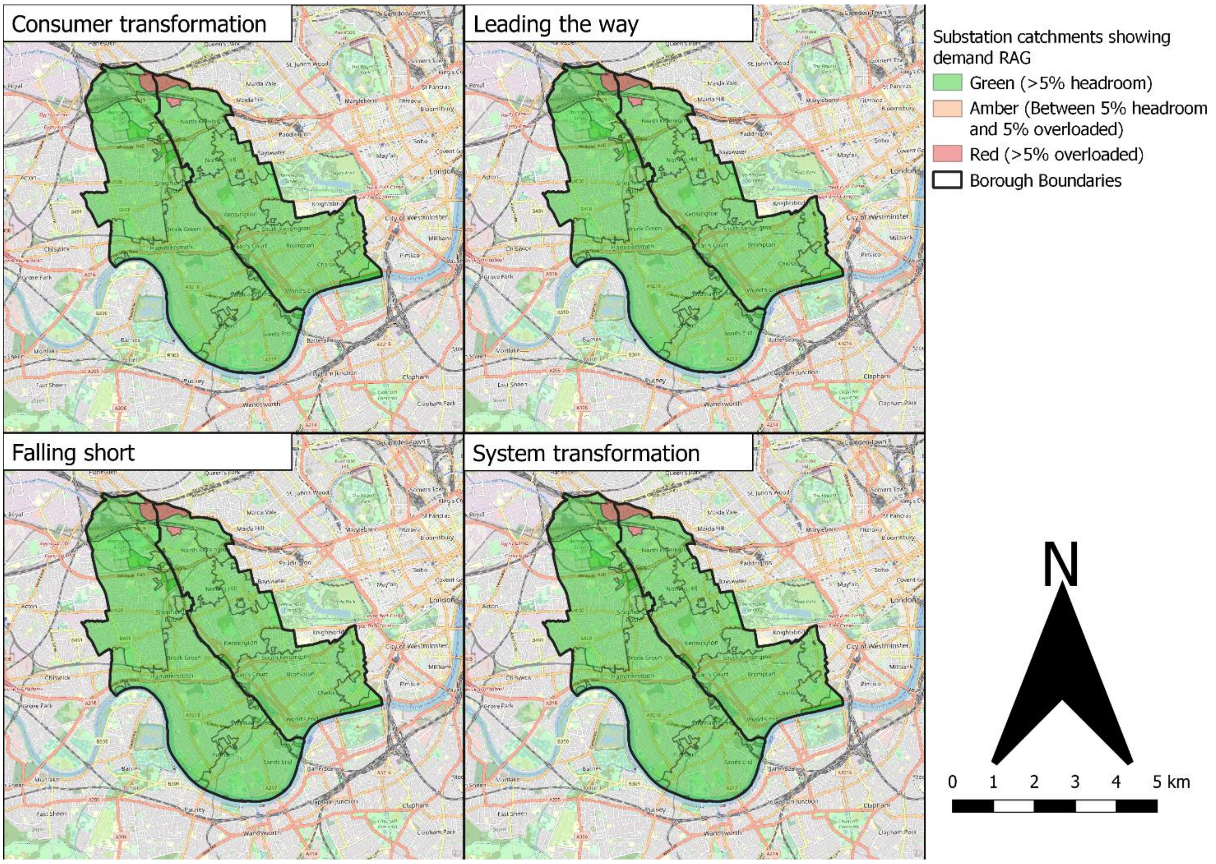
## Map 4: Demand RAG under different DFES scenarios in 2023



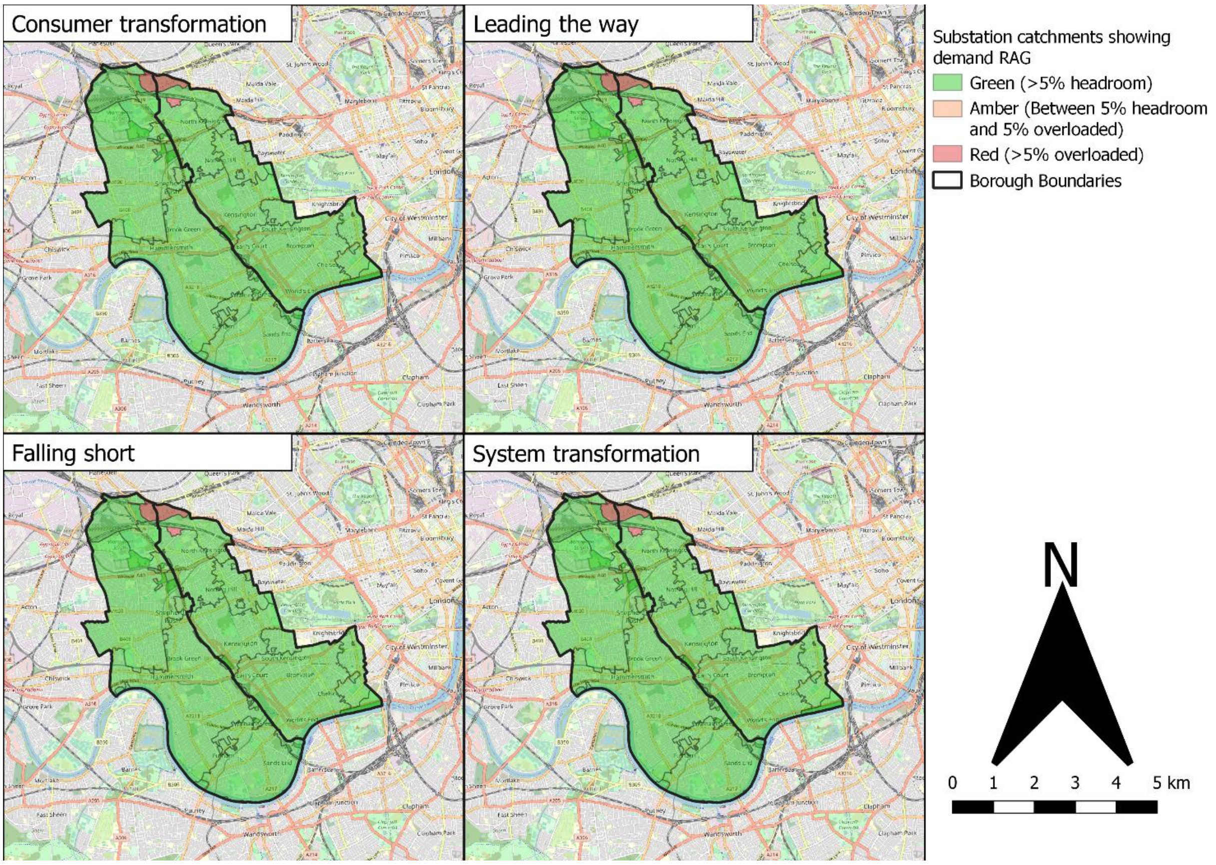

## Map 5: Demand RAG under different DFES scenarios in 2027



Map 6: Demand RAG under different DFES scenarios in 2030




Map 7: Demand RAG under different DFES scenarios in 2033

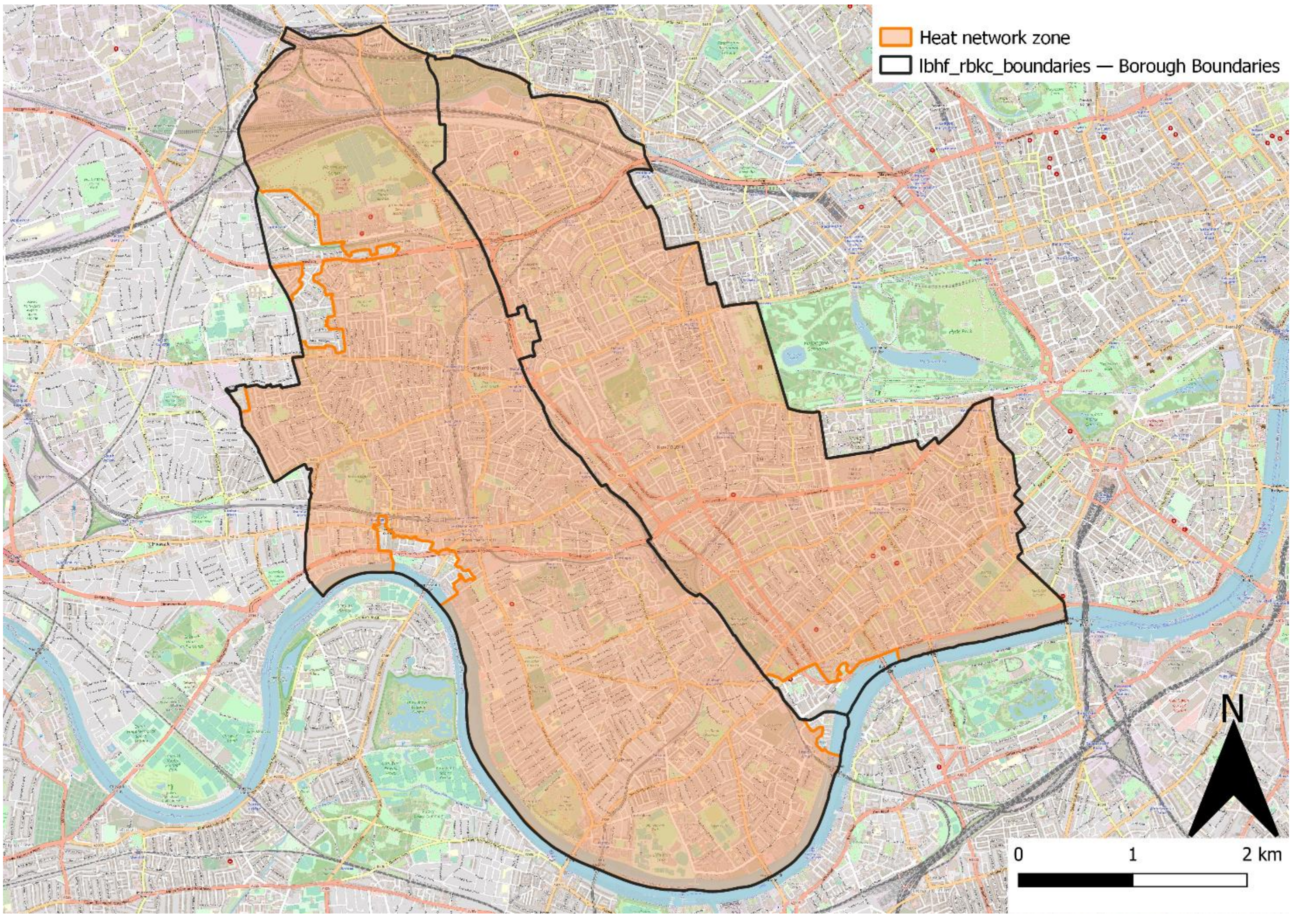


## 2.4. Zone modelling

CSE's zoning model produced a series of areas (zones) where heat networks are viable compared to the counterfactual of individual ASHPs, under various price assumptions. The counterfactual acts as a comparison against which heat networks can be assessed. To decarbonise heat, currently the main options suitable for buildings in a dense urban area are individual ASHPs or connections to heat networks. Therefore, assessing a heat network against an ASHP counterfactual provides the fairest comparison.

Map 8 shows the areas produced under a breakeven price, which means that a network operator would neither make a profit or loss on each unit of heat sold in this area. The map shows that in almost the entirety of the study area a heat network is considered the best option for decarbonising heat. This reflects the dense nature of heat demand in the study area, which renders both K&C and H&F very attractive to heat network development. Only two areas next to the River Thames and one on the west boundary of H&F seem less viable for heat network development according to the zoning model. This is likely due to the River Thames acting as an edge for heat networks at the proximity of the other areas to large green spaces.

Map 8: Zone modelling results at a distributed heat price of 0p/kwh



## 2.5. Detailed network modelling

Noting that almost the entire study area could be viable for heat networks, the modelling process identified twelve highly favourable clusters for heat network development, which are shown in Figure 67 and listed in Table 15. Based on outputs from the zone modelling and extensive stakeholder engagement, five areas were subsequently identified as priorities for heat network development. The priority areas are shown in Map 9 are:

A) Earl’s Court

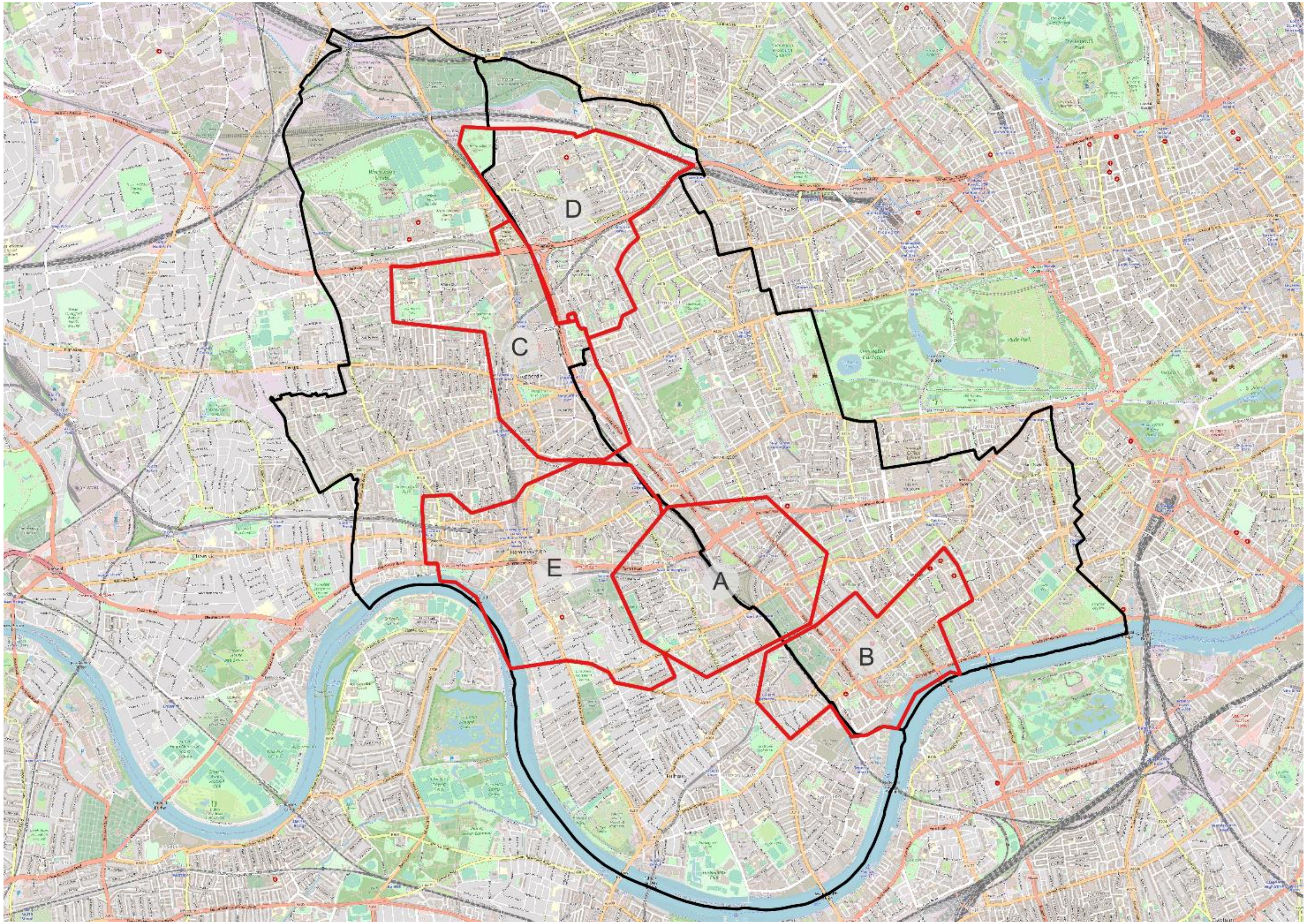
B) Chelsea & Westminster Hospital and World’s End

C) White City

D) Notting Dale and North Kensington

E) Hammersmith Town Centre and Olympia

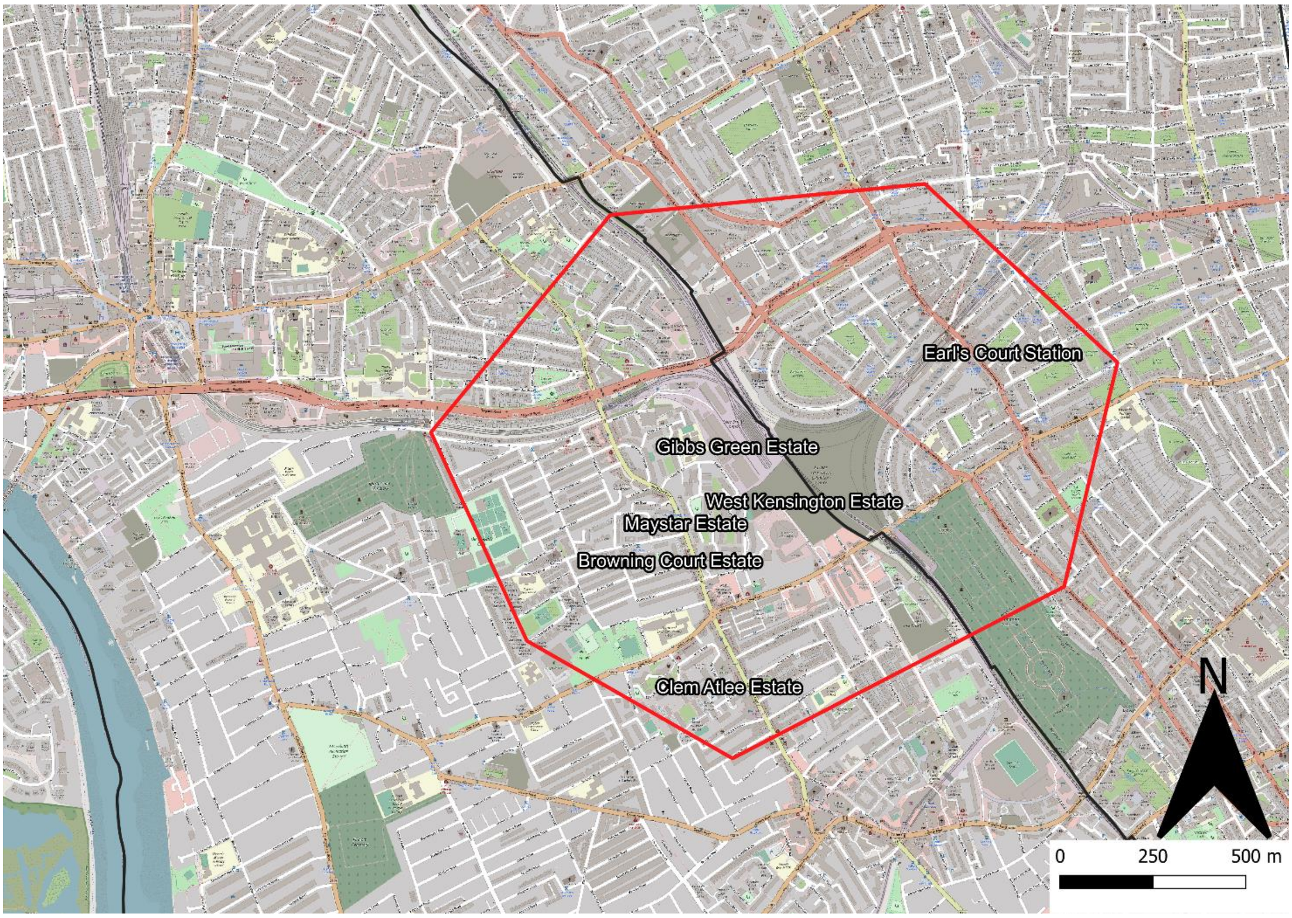
Map 9: The five priority areas selected for detailed network modelling



## 2.6. Earl's Court

Earl's Court, shown in Map 10, is relatively central to the cross-borough study area and approximately half of the priority area lies in each borough. The central section of the area is dominated by the planned Earl's Court development, for which an ambient loop heat network is proposed. During the initial phase of these proposals, this heat network is only designed to serve the planned development and therefore does not form part of the detailed network modelling undertaken for this masterplan. However, there is recognised potential for the ambient loop network to connect to emerging heat networks around the development in the future.

Map 10: Overview of Earl's Court priority area




### 2.6.1. Network design

The network design produced through THERMOS and the modelled phasing for this priority area is shown in Map 11. The Earl's Court priority area includes a total of 6,418 buildings with 302 GWh/year of heat demand. The modelled network, which is intended to be an illustration of the heat network development that could potentially be feasible in this area, supplies 55.4 GWh/year of this demand to 896 buildings. In terms of network development:

- Phase 1 could connect H&F housing (Maystar, West Kensington and Gibbs Green) to the west of the Earl's Court redevelopment area to a single heat supply (Hammersmith Pumping Station)
- Phase 2 could expand to larger loads to the south of the H&F housing, including the Clem Attlee Estate and a second heat supply would be connected (a large ASHP that is modelled to be installed at 20 Seagrave Road). The demand at this location would also be connected
- Phase 3 would expand outwards to the loads on the eastern side of the Earl's Court redevelopment area, including Earl's Court Station, backfill smaller loads along the established network and connects additional supplies

Map 11: Network design showing the different phases of the Earl's Court network

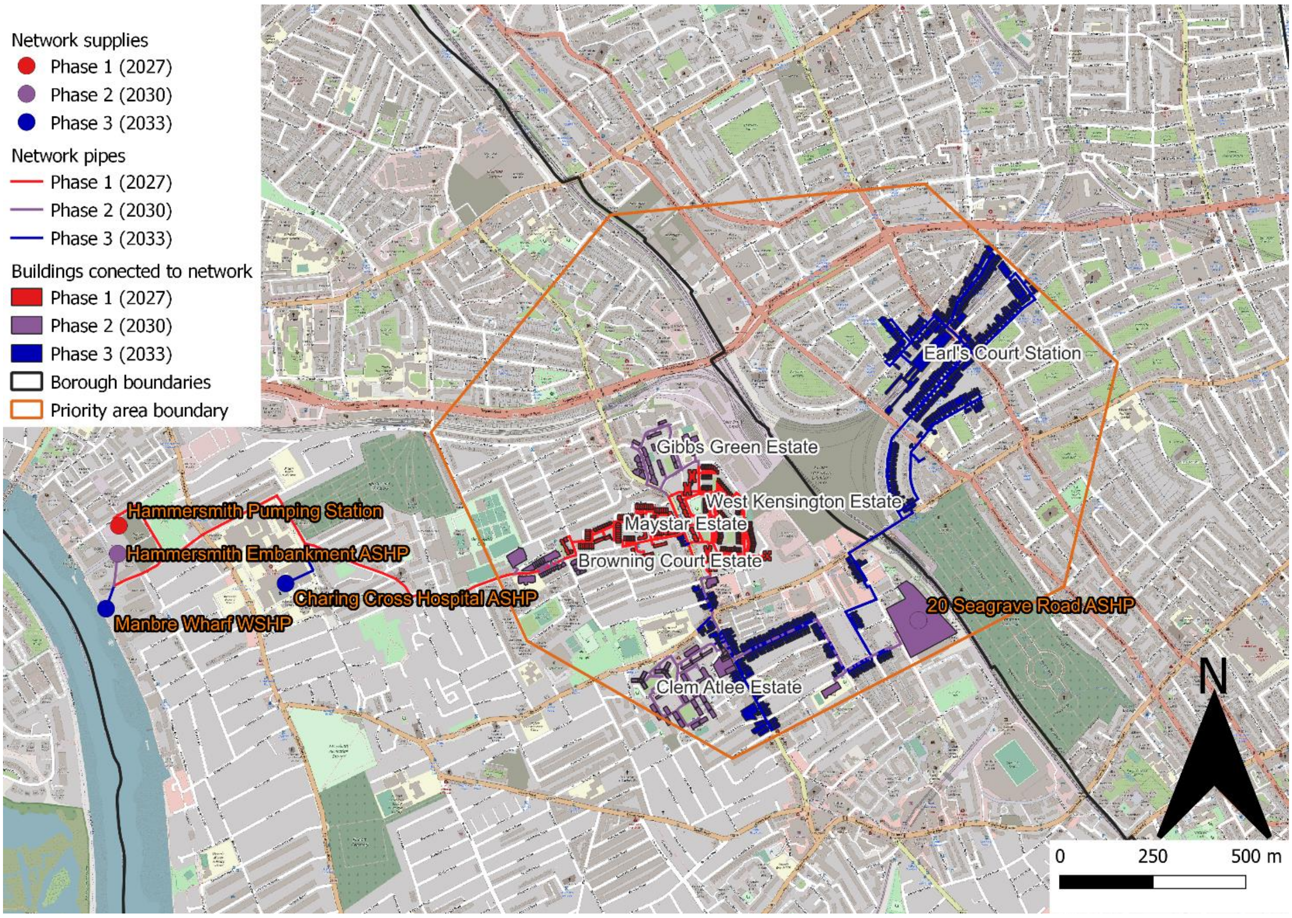



Figure 5 shows how the quantity of heat demand connected varies by phase, up to the maximum connected to the network.

Figure 5: Total heat demand connected to the network per phase in Earl's Court priority area

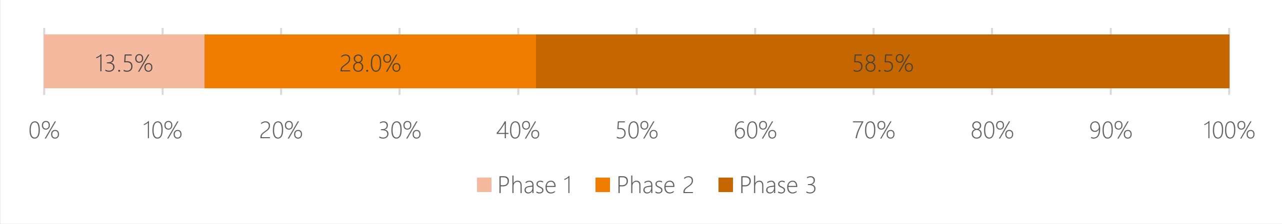



Figure 6 shows how many end connections there are on the network by key building type in each phase.

Figure 6: Number of end connections per phase by building type in Earl's Court priority area[21]

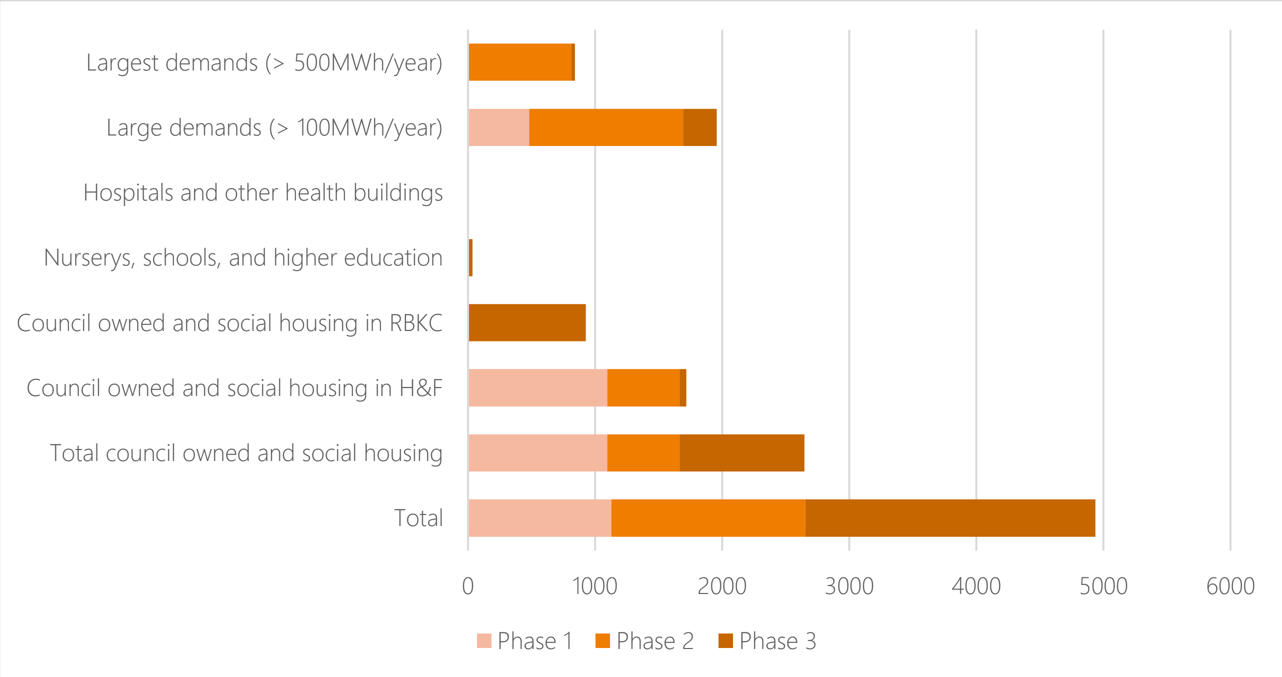



Figure 7 summarises the heat demand connected in each phase by type of key building.

[21] Note that these categories may overlap – for example, a hospital would also normally fall into the categories of a large and very large demand

Figure 7: Heat demand connected per phase by building type in Earl's Court priority area[21]

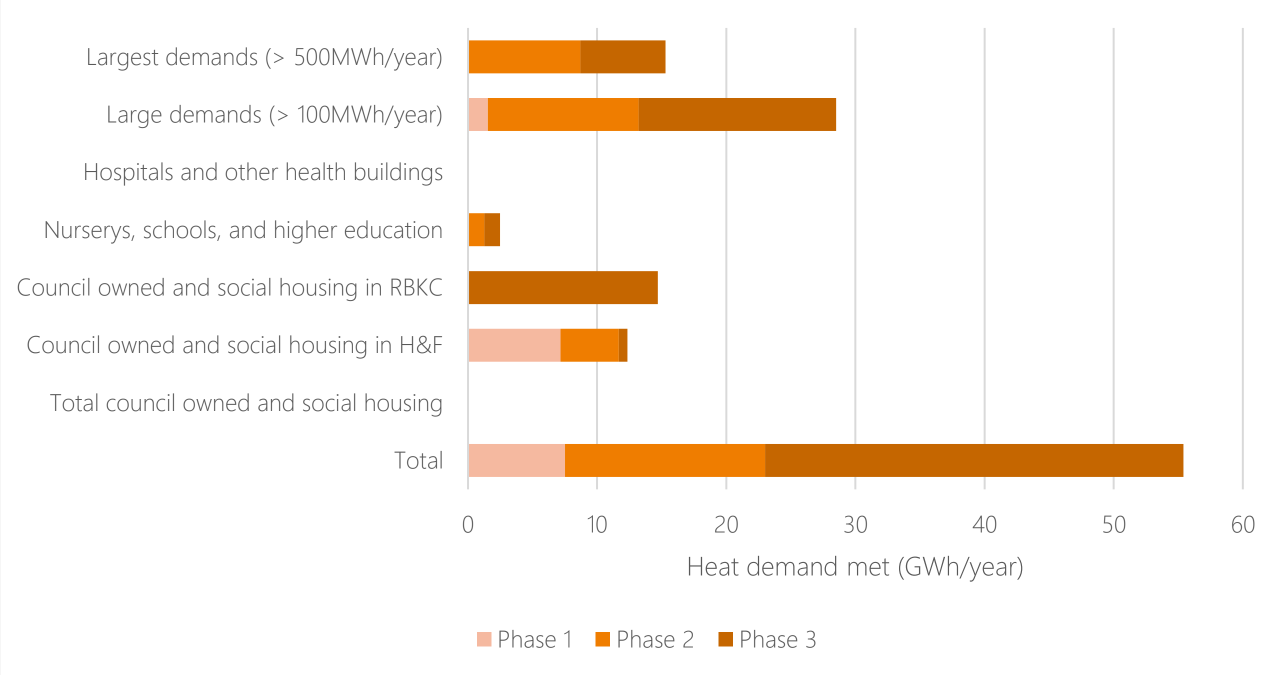
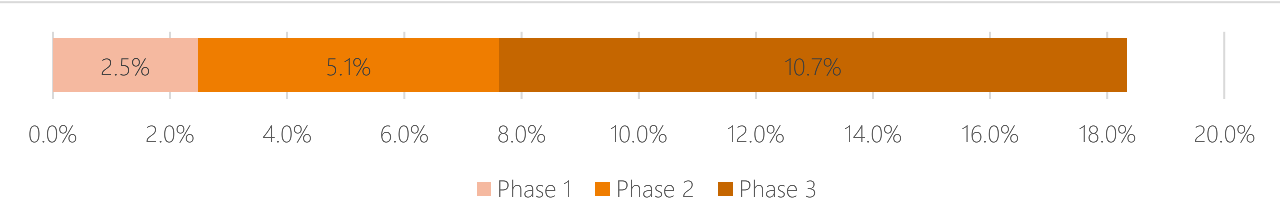



Figure 8 highlights how the heat demand connected to this network compares to the total heat demand of the priority area.

Figure 8: Total heat demand connected to the heat network per phase compared to total heat demand of the Earl's Court priority area




In total, 18.3% of the area's total heat demand is met by the heat network. This is relatively low due to the Earl's Court Development area dominating this priority area and accounting for much of the demand (41 GWh/year), but also because its location means that a new heat network in the area must route around it. However, the Earl's Court Development Company (ECDC) have indicated that it may be possible to later connect the two networks together. Potential connection points between the two networks are shown in Map 12. Several of the potential connection points to the ECDC network are in very close proximity to the modelled network for the priority areas, which ultimately would also allow for further expansion to large demands around the modelled network.

Map 12: Potential points of connection to the Earl's Court Development Corporation's heat network in reference to the planned network

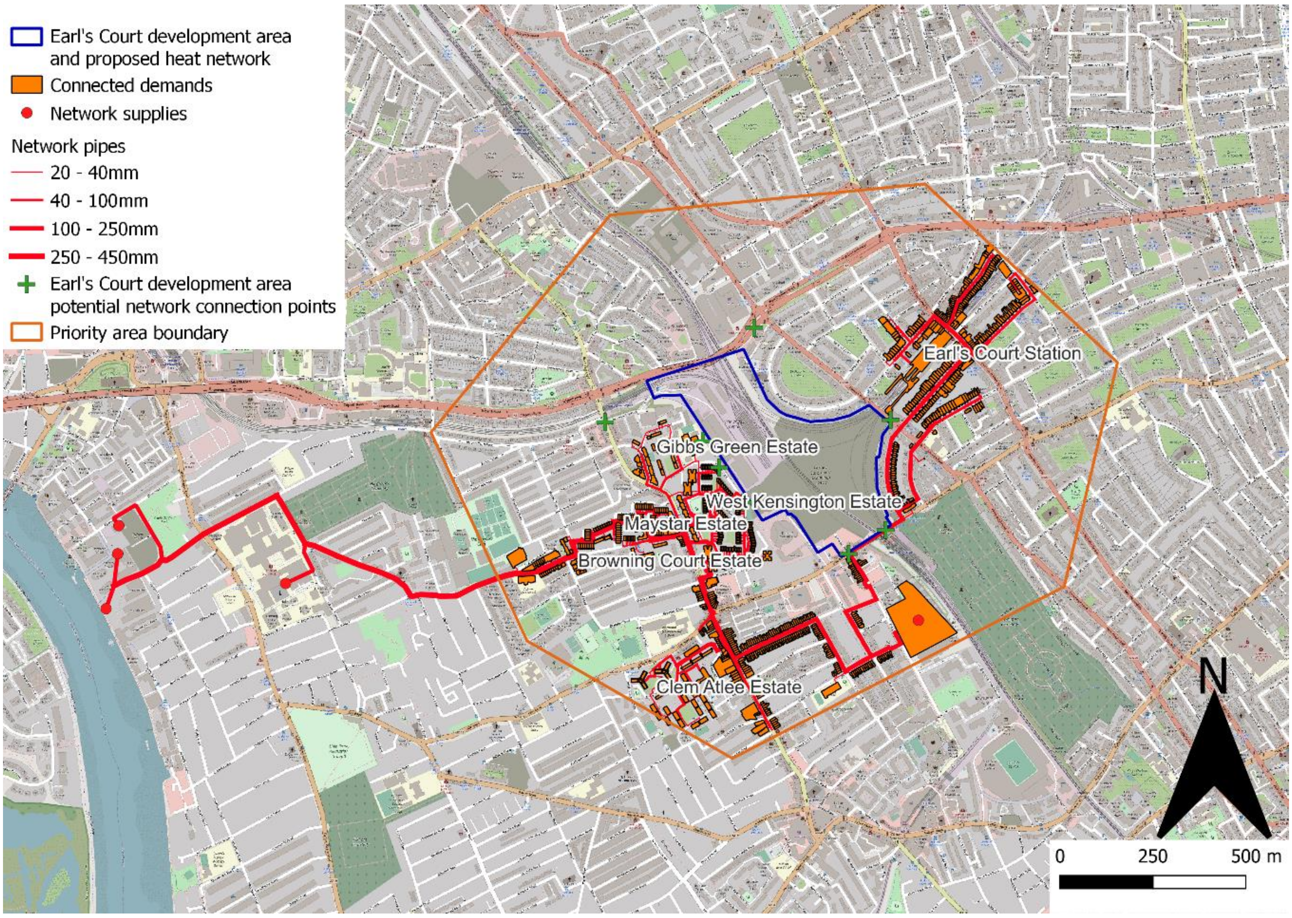



Table 1 shows the supplies modelled to be connected to the Earl's Court network and in what phase they will be connected.

Table 1: Supplies connected to the Earl's Court network

| Supply | Phase | Maximum heat output (GWh/year) | Maximum capacity (MW) |
|---|---|---|---|
| Hammersmith Pumping Station | 1 | 42.57 | 13.5 |
| 20 Seagrave Road ASHP | 2 | 11.58 | 3.67 |
| Hammersmith Embankment ASHP | 2 | 17.06 | 5.41 |
| Manbre Wharf WSHP | 3 | 54.75 | 17.36 |
| Charing Cross Hospital ASHP | 3 | 20.5 | 6.5 |
| Total | | 146.46 | 46.44 |

Figure 9 shows the yearly output from each heat supply connected to the Earl's Court network, both how much is utilised and how much remains unutilised.

Figure 9: Yearly heat output of heat supplies connected to the Earl's Court network

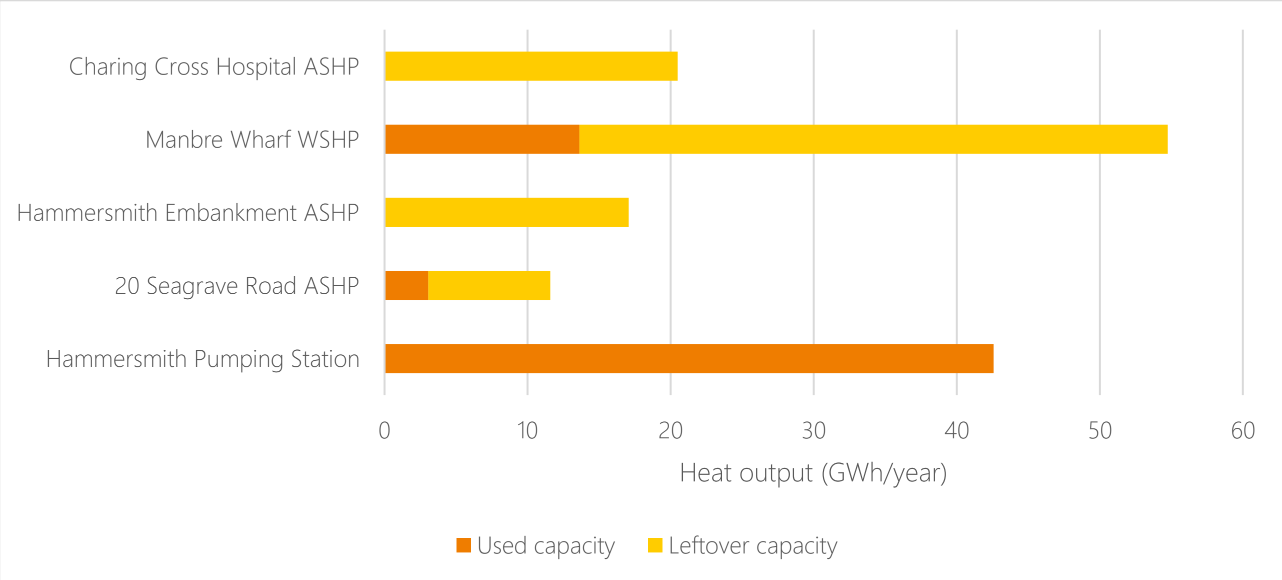
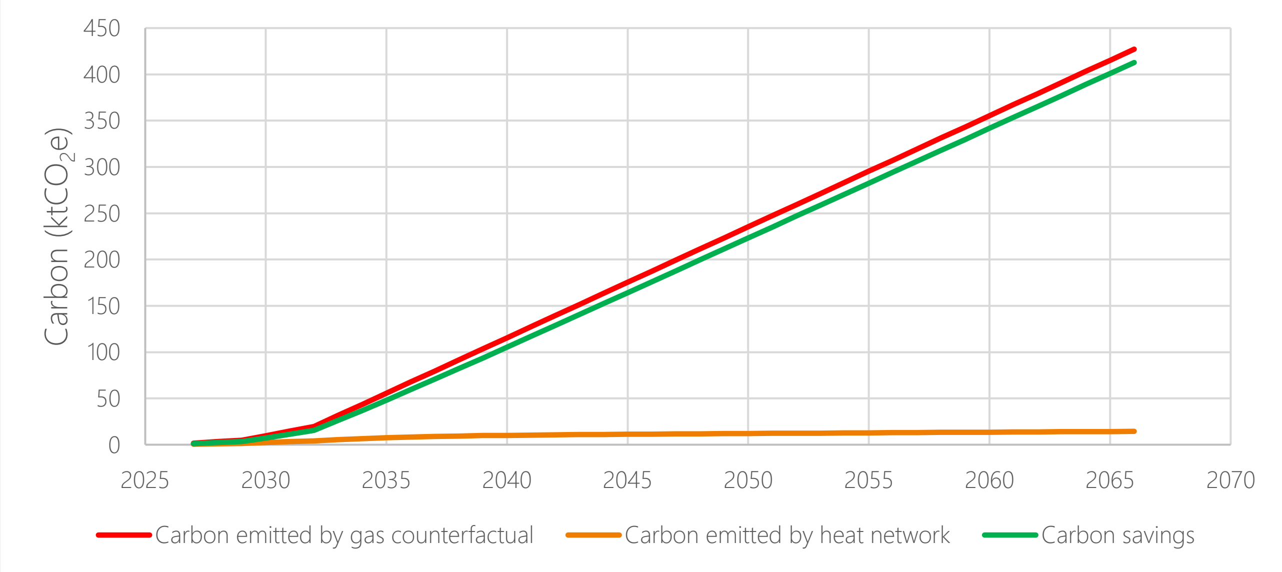



Figure 10 shows an overview of carbon savings related to this network. It highlights how much carbon would be emitted by the heat network over its lifetime and compares this to the emissions if the current heating systems were not replaced. The heat network represents a significant saving in carbon over maintaining today's heating systems. Key data assessed over 40 years from phase 1 completion (estimated network lifetime) :

- Total carbon emitted by network: 14.4 $ktCO_2e$

- Total carbon emitted by gas counterfactual: 427.2 $ktCO_2e$
- Total net carbon savings: 412.8 $ktCO_2e$

Figure 10: Cumulative carbon emissions and emission savings from the Earl's Court network




## 2.6.2. Economics

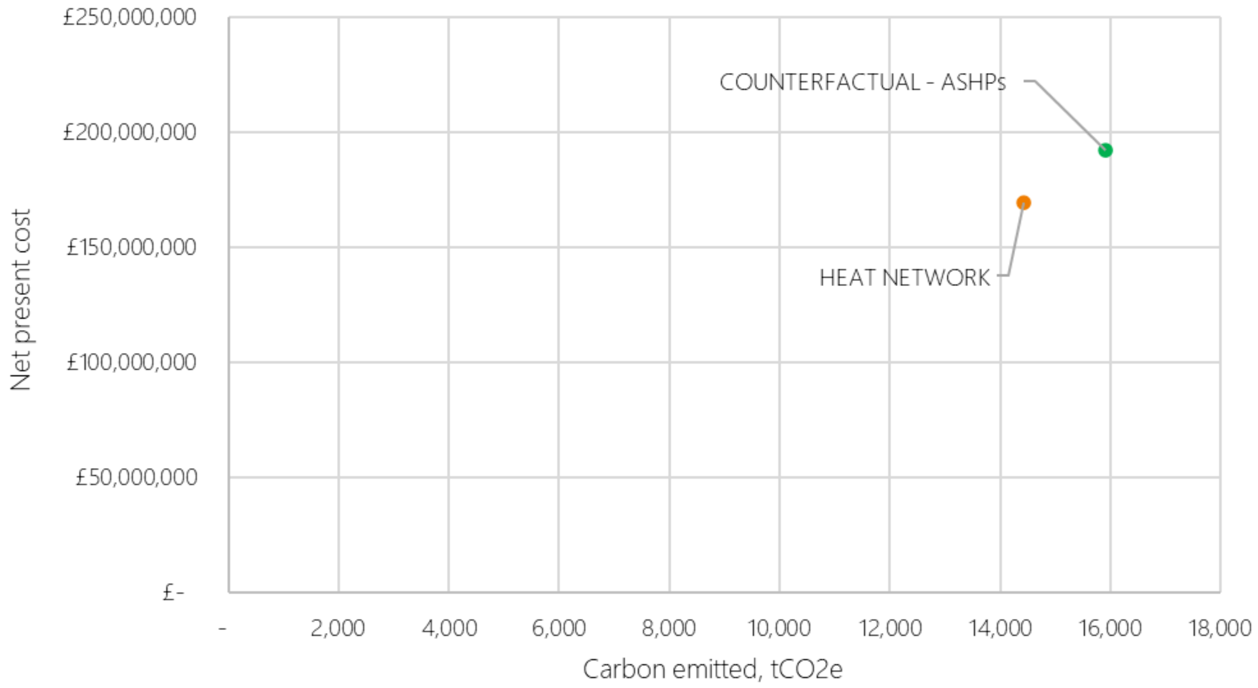
The summary of network economics and carbon emissions for Earl's Court is shown in Table 2.

Table 2: Earl's Court 40-year heat network economic summary – Full network

| Items | Heat Network | Counterfactual - ASHPs | Counterfactual – Gas boilers |
|---|---|---|---|
| Overall system COP | 2.98 | 2.4 | N/A |
| Heat sales tariff | 18.87 | N/A | |
| Capital cost, £ | £79,030,564 | £66,207,091 | £2,111,750 |
| Operating and replacement cost, £ | £210,392,845 | £328,157,691 | £112,430,591 |
| Net present cost, £ | £169,535,399 | £192,366,141 | £47,729,391 |
| Levelised cost of heat, p/kWh | 16.95 | 19.23 | 4.77 |
| Carbon emissions 40-years, $tCO_2e$ | 14,424 | 15,917 | 412,788 |
| Internal rate of return (IRR) | 3.5% | N/A | |

Whilst the net present cost of heat networks may seem higher than that of a gas counterfactual, this does not account for the cost of carbon emissions. Following the medium level prices set out by the Green Book, the additional cost of the emissions from the gas counterfactual would be £152.8 million.

Figure 11: NPC vs carbon emission – Earl's Court

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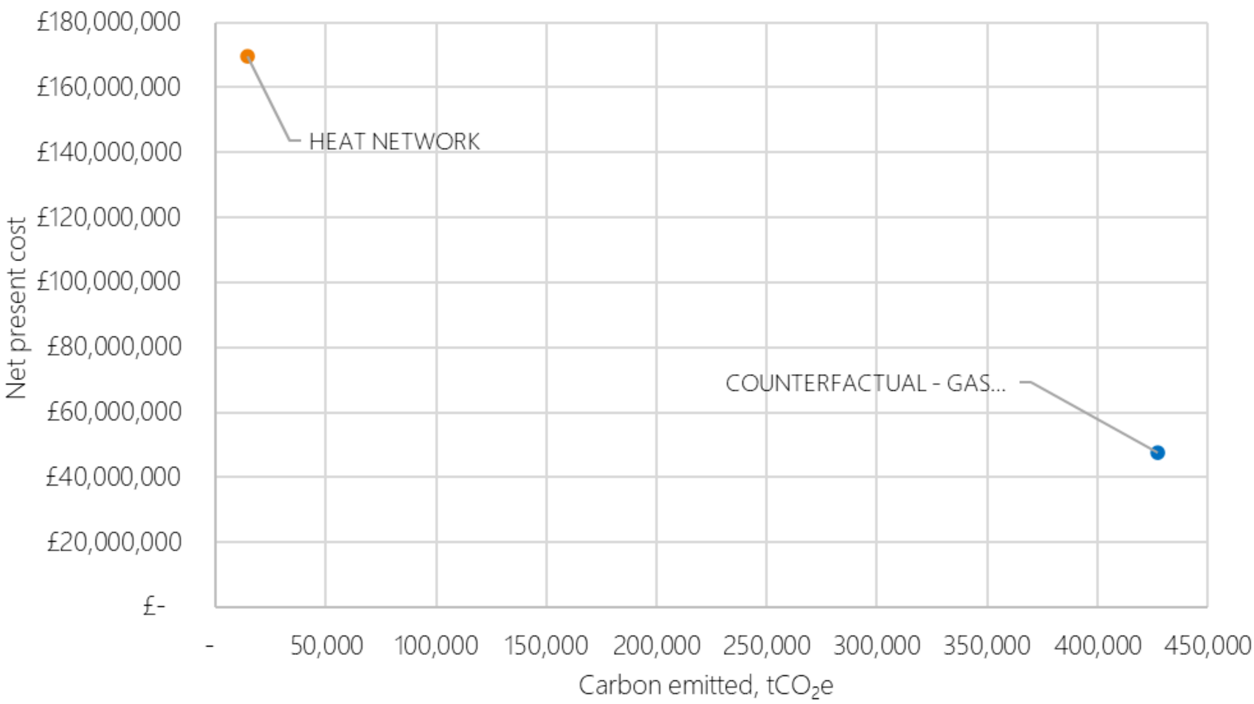
| Overall system COP | 2.98 | 2.4 | N/A |
| Heat sales tariff | 18.87 | N/A | |
| Capital cost, £ | £79,030,564 | £66,207,091 | £2,111,750 |
| Operating and replacement cost, £ | £210,392,845 | £328,157,691 | £112,430,591 |
| Net present cost, £ | £169,535,399 | £192,366,141 | £47,729,391 |
| Levelised cost of heat, p/kWh | 16.95 | 19.23 | 4.77 |

| | | | |
|---|---|---|---|
| Carbon emissions 40-years, $tCO_2e$ | 14,424 | 15,917 | 412,788 |
| Internal rate of return (IRR) | 3.5% | N/A | |

Whilst the net present cost of heat networks may seem higher than that of a gas counterfactual, this does not account for the cost of carbon emissions. Following the medium level prices set out by the Green Book, the additional cost of the emissions from the gas counterfactual would be £152.8 million.

Figure 11Figure 11 shows that the district heat option is cheaper and has a lower carbon footprint than the counterfactual of individual ASHPs. While individual gas boilers offer cost-effective heating, they come with several drawbacks, notably a higher carbon emission when compared to low-carbon heat networks. Moreover, reliance on individual gas boilers hinders local authorities from achieving their carbon targets. The UK Government's 2035 ban on new gas boiler sales will also mandate the adoption of alternative low carbon heating systems. As a result, district heating networks are the preferred low and zero-carbon solution for achieving heat decarbonisation in Earl's Court. The heat network NPC and carbon performance versus individual gas boilers counterfactuals is shown in Figure 12.

Figure 12: NPC vs carbon emission – Earl's Court (Gas boilers counterfactual)




## 2.6.3. Sensitivity

### 2.6.3.1. CAPEX sensitivity

Figure 13 demonstrates the impact of varying network CAPEX on the network economics. An increase in total network CAPEX will have a detrimental impact on the network's economic performance as it results in higher total network costs while network revenue remains unchanged.

If a grant funding of 30% is secured for the full network, this would increase the network IRR to 5%.

Figure 13: Variable element of CAPEX

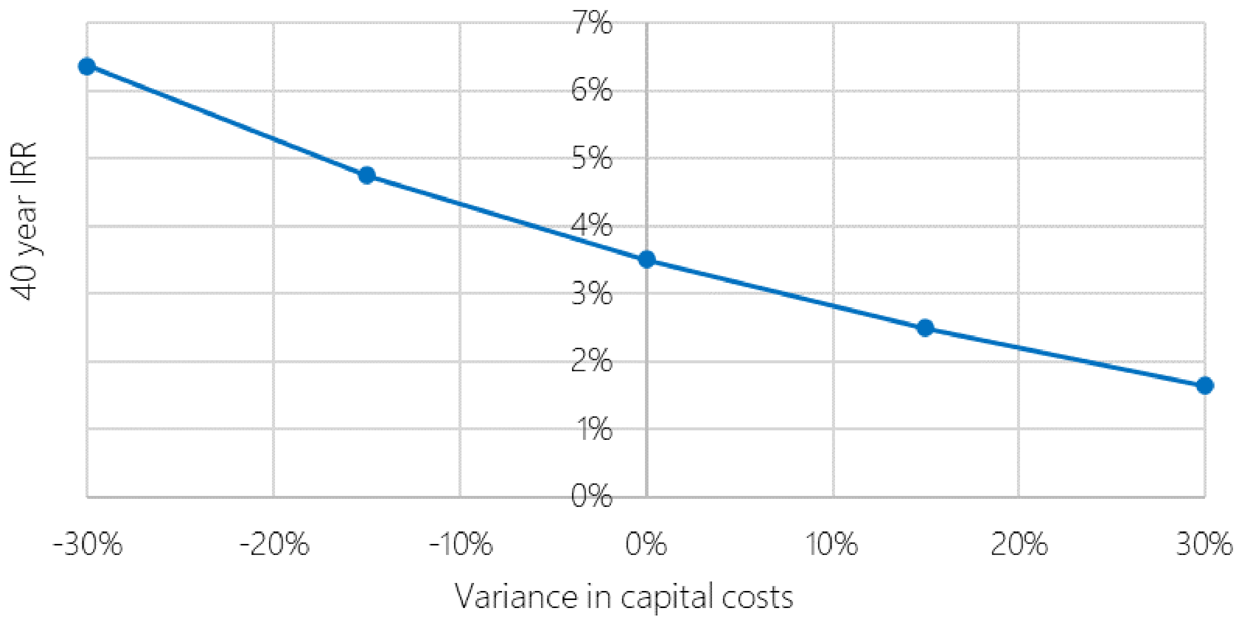
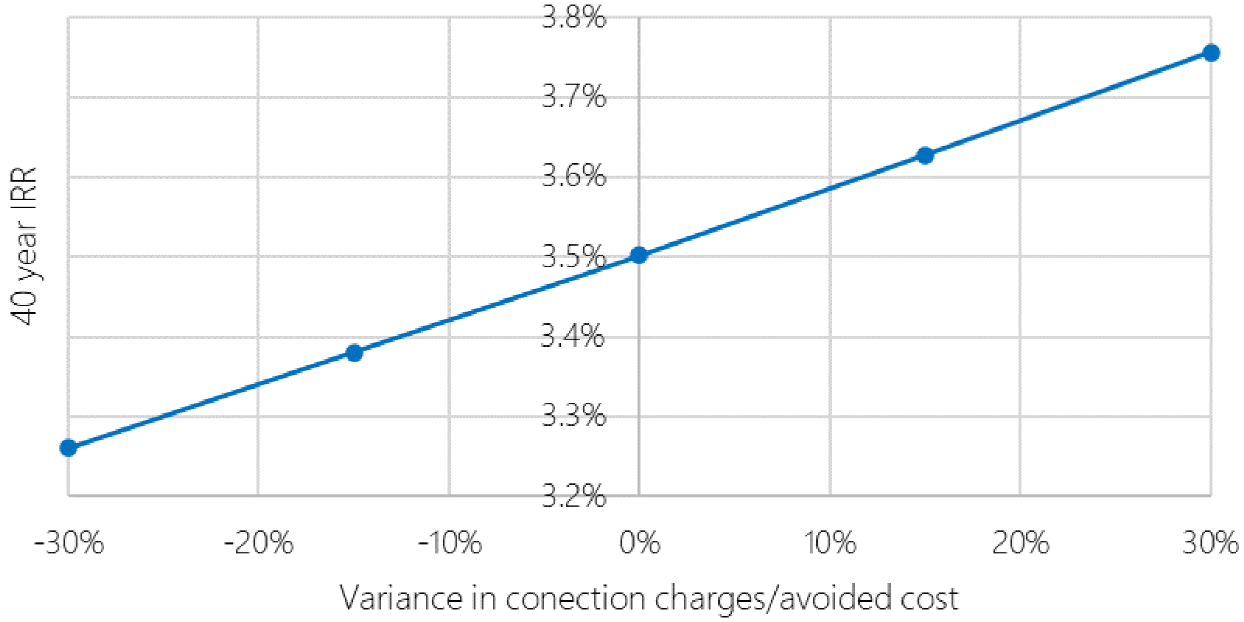



Figure 14 demonstrates the impact of varying connection charges/avoided cost on the network economics. A reduction in connection charges/avoided costs has a minor effect on the network performance as the cost reduction is not significant compared to total network costs. This suggests that charging customers less to connect to the heat network will only have a minor impact on the network's economics.

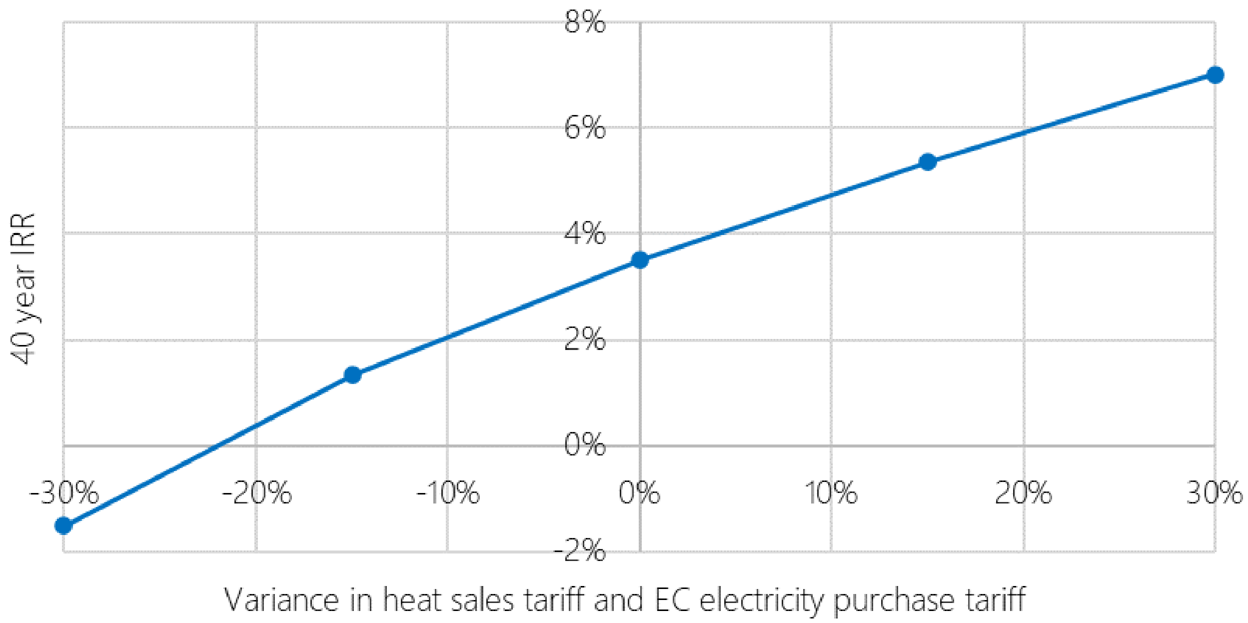
Figure 14: Variable element of connection charge/avoided cost




### 2.6.3.2. Energy tariff sensitivity

Figure 15 shows the impact of a variance in the energy and heat sales tariff and energy centre electricity purchase price on the network's economic performance. A positive IRR results from increasing both the heat sales tariff and energy centre electricity purchase price. This indicates that an increase in the heat sales tariff has a greater impact on network economic performance, as more revenue is generated than the increased costs when both parameters are increased simultaneously. This sensitivity has been carried out as it is likely that both these elements would vary with electricity prices.

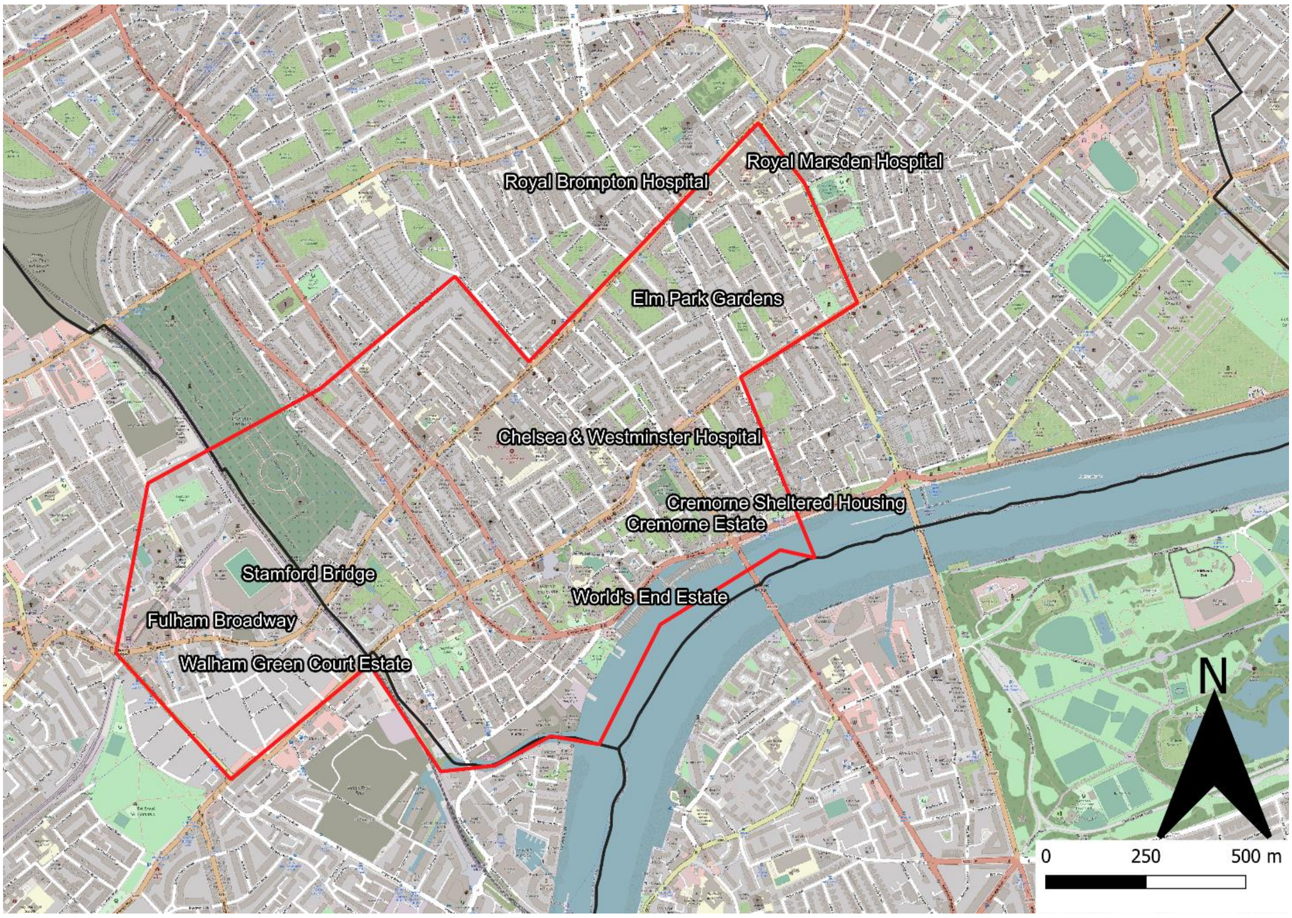
Figure 15: Variable element of heat sales tariff and electricity purchase tariff



## 2.7. Chelsea & Westminster Hospital and World's End

The Chelsea & Westminster Hospital and World's End priority area, shown in Map 13 lies mostly within K&C, centred on the hospital site and World's End estate, with a smaller H&F section around Stamford Bridge.

Map 13: Overview of Chelsea & Westminster Hospital and World's End priority area




### 2.7.1. Network design

The network design produced through THERMOS and the modelled phasing for this priority area is shown in Map 14. The Chelsea & Westminster Hospital and World's End priority area includes a total of 5,370 buildings with 296.7 GWh/year of heat demand. The modelled network, which is intended to be an illustration of the heat network development that could potentially be feasible in this area, supplies 158.4 GWh/year of this demand to 662 buildings. In terms of network development:

- Phase 1 could connect the World's End estate and be supplied by the Lots Road Pumping Station sewer source heat pump. The Chelsea Academy could also be connected, alongside the Lots Road development and another social housing estate

- Phase 2 would extend to the hospitals in the area: Chelsea & Westminster, Royal Brompton and Royal Marsden. Several of the larger demands in the area and a second heat supply (Royal Hospital AqSHP) would also be connected

- Phase 3 would extend to many of the smaller loads along the established network route in K&C and to Stamford Bridge Stadium, Fulham Broadway shopping centre and Walham Green Court in H&F, as well as other demands in the surrounding area. An additional modelled heat source could be added to this phase (Fulham Gasworks ASHP)

Map 14: Network design showing the different phases of the Chelsea & Westminster Hospital and World's End network

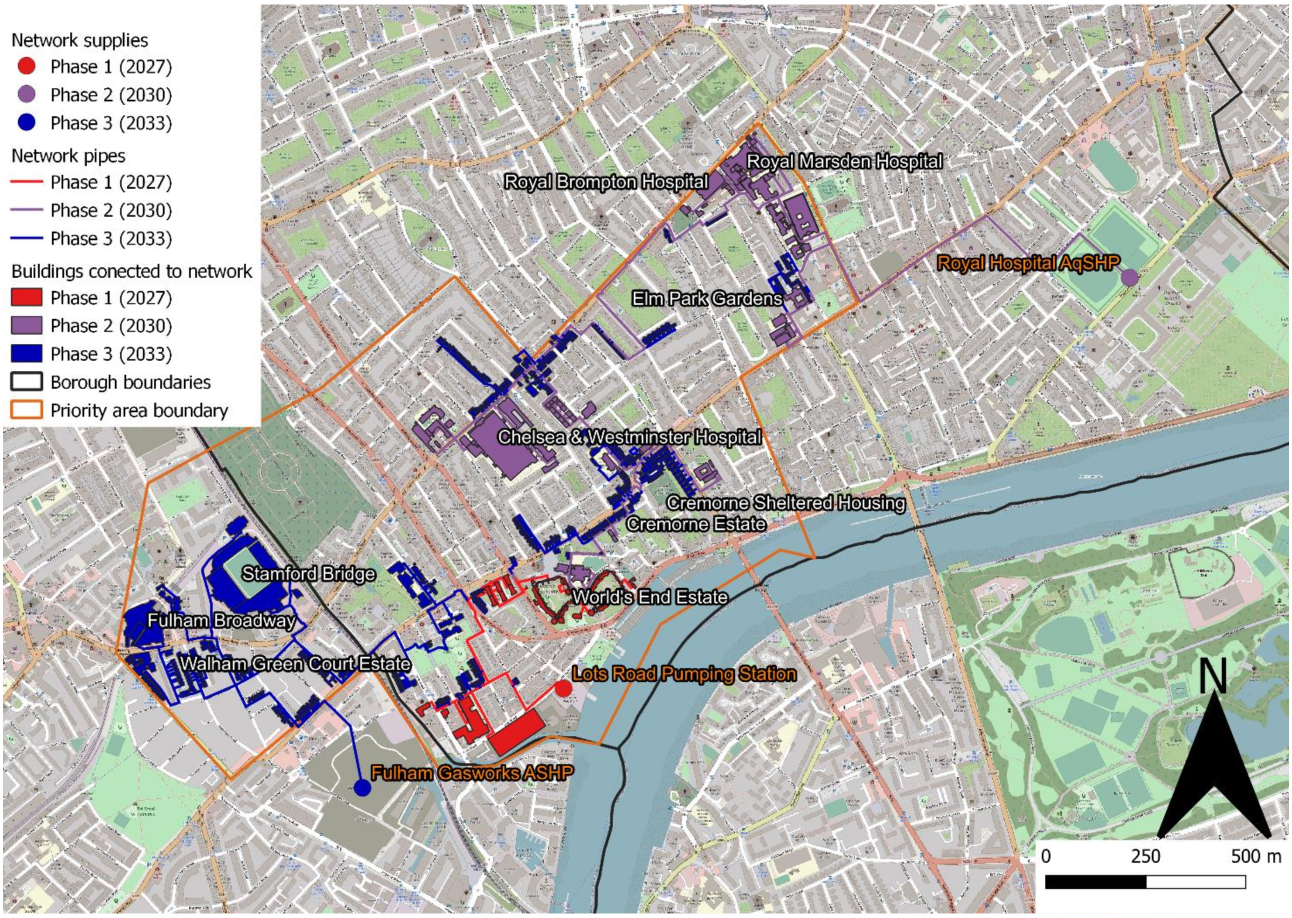



Figure 16 shows how the heat demand met by the network varies with phase, up to its maximum.

Figure 16: Total heat demand connected to the network per phase in Chelsea & Westminster Hospital and World's End priority area

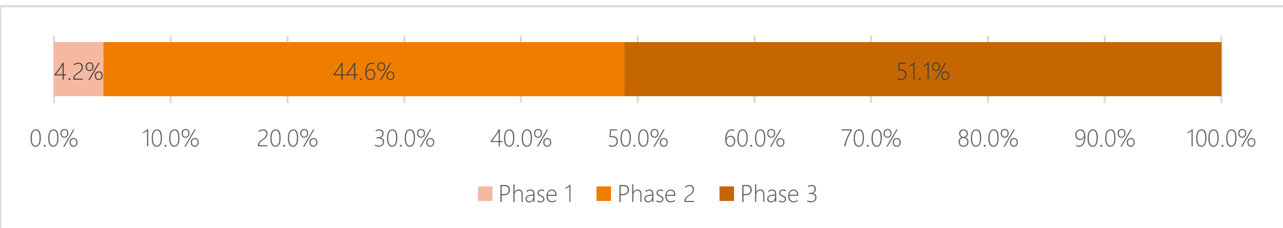


Figure 17 shows how many end connections are connected to the network by key building type in each phase.

Figure 17: Number of end connections per phase by building type in Chelsea & Westminster Hospital and World's End priority area

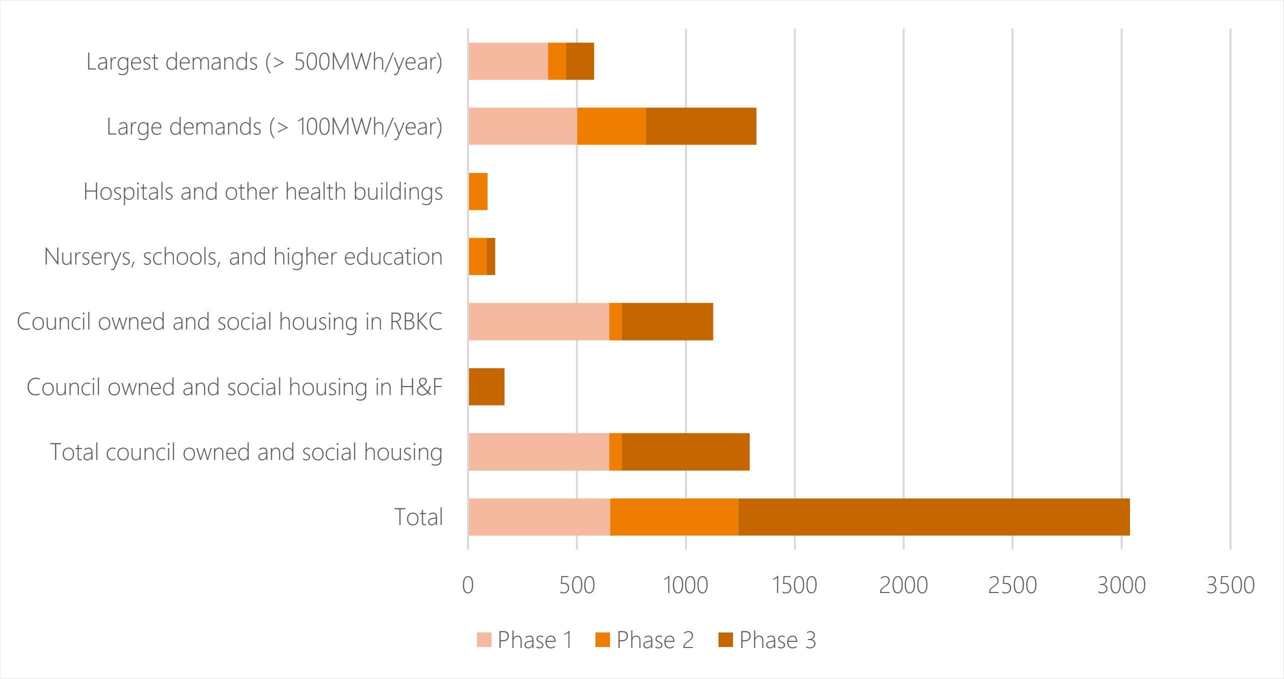



Figure 18 summarises the heat demand connected in each phase by the type of key building.

Figure 18: Heat demand connected per phase by building type in Chelsea & Westminster Hospital and World's End priority area

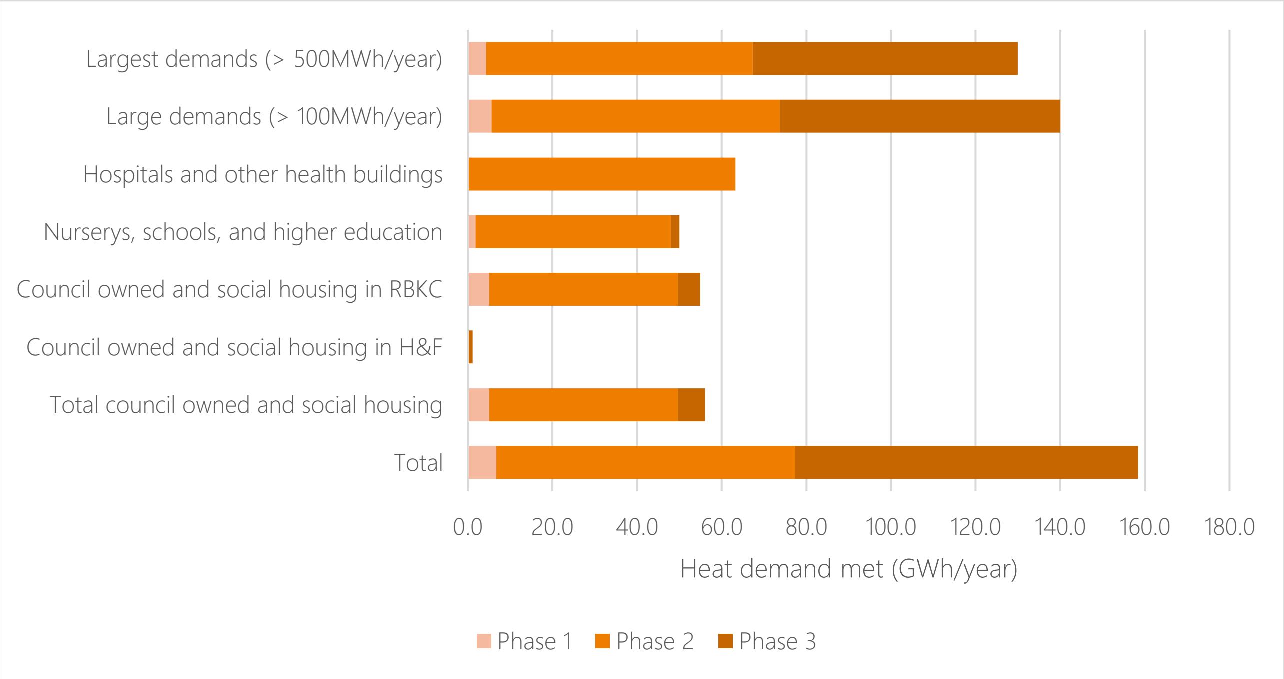
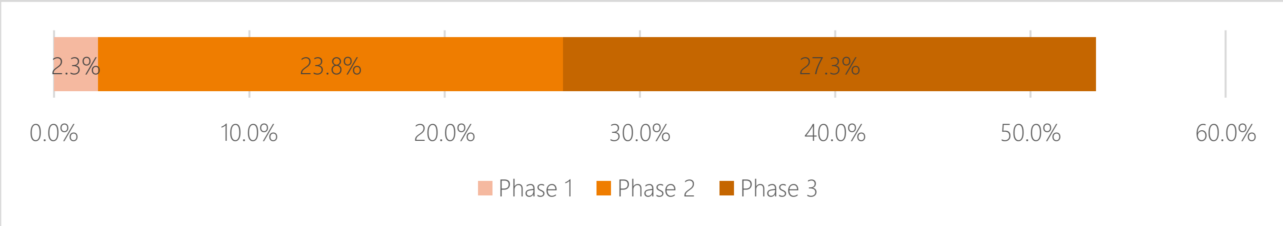


Figure 19 highlights how the heat demand connected to the network compares to the total heat demand of the area.

Figure 19: Total heat demand connected to the network per phase in Chelsea & Westminster Hospital and World's End priority area compared to total heat demand of the area




In total, 53.4% of the priority area's heat demand is connected to the heat network. This heat demand largely comes from the large demands in the area. Many smaller demands are not connected to the network at this stage, but potentially could be at a later date.

Table 3 shows the supplies connected to the Chelsea & Westminster Hospital and World's End network and in what phase they will be connected.

Table 3: Supplies connected to the Chelsea & Westminster Hospital and World's End network

| Supply | Phase | Maximum heat output (GWh/year) | Maximum capacity (MW) |
|---|---|---|---|
| Lots Road Pumping Station | 1 | 42.57 | 13.5 |
| Royal Hospital AqSHP | 2 | 117.3 | 37.2 |
| Fulham Gasworks ASHP | 3 | 31.54 | 10 |
| Total | | 191.41 | 60.7 |

Figure 20 shows the yearly output from each heat supply connected to the Chelsea & Westminster Hospital and World's End network, both how much is utilised and how much remains unutilised.

Figure 20: Yearly heat output of heat supplies connected to the Chelsea & Westminster Hospital and World's End network

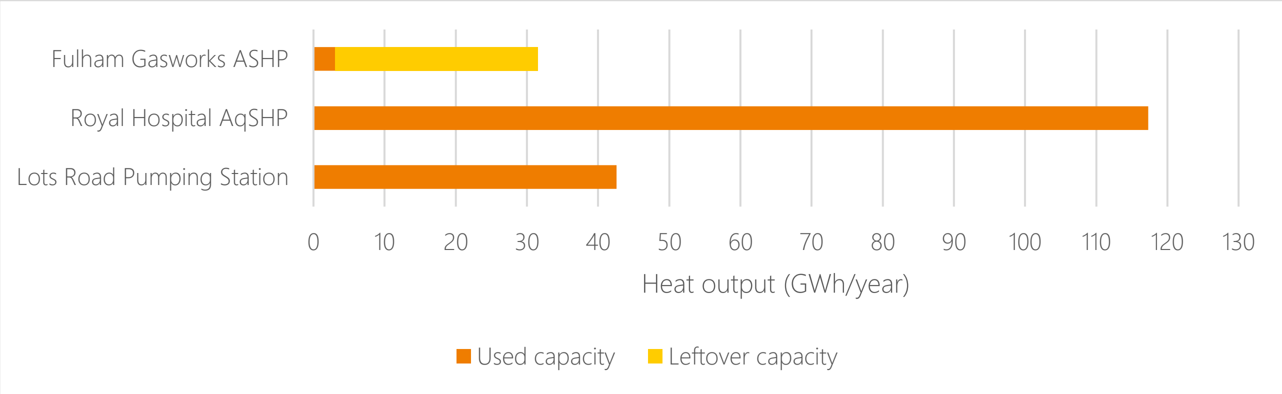
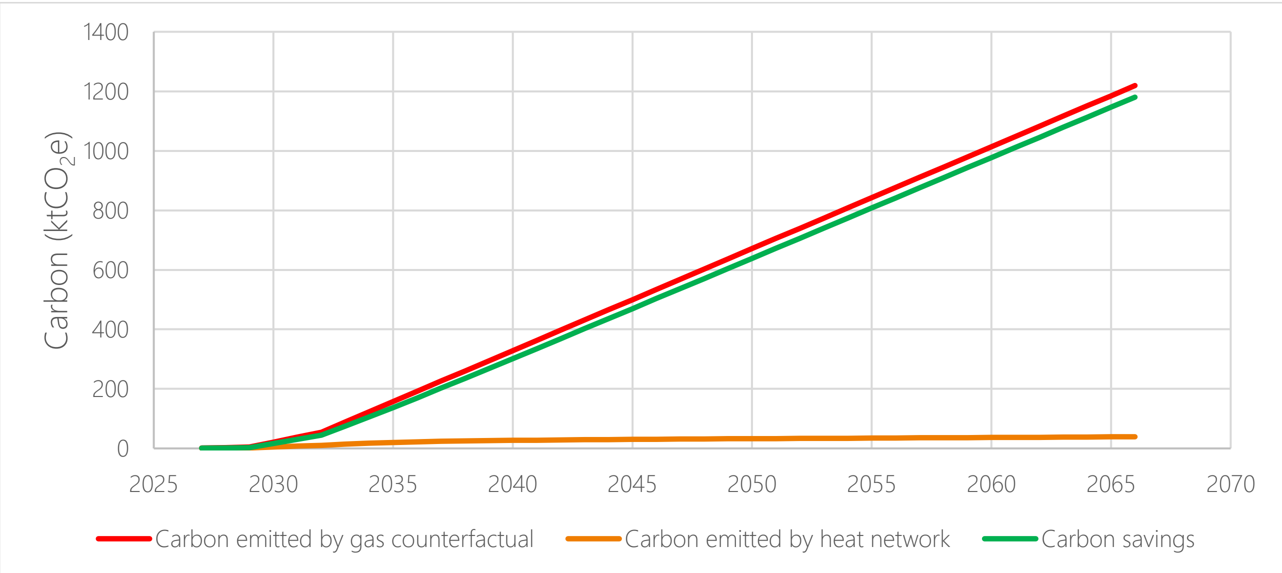



Figure 21 shows an overview of carbon savings related to this network. It highlights how much carbon would be emitted by the heat network over its lifetime and compares this to the emissions if the current heating systems were not replaced. The heat network represents a significant saving in carbon over maintaining today's heating systems. Key data assessed over 40 years from phase 1 completion (estimated network lifetime):

- Total carbon emitted by network: 39.0 kt$CO_2$e
- Total carbon emitted by gas counterfactual: 1,219.3 kt$CO_2$e
- Total net carbon savings: 1,180.3 kt$CO_2$e

Figure 21: Cumulative carbon emissions and emission savings from the Chelsea & Westminster Hospital and World's End network




## 2.7.2. Economics

The summary of network economics and carbon emissions for Chelsea & Westminster Hospital and World's End is shown in Table 4.

Table 4: Chelsea & Westminster Hospital and World's End 40-year heat network economic summary – Full network

| Items | Heat Network | Counterfactual - ASHPs | Counterfactual – Gas boilers |
|---|---|---|---|
| Overall system COP | 2.93 | 2.4 | N/A |
| Heat sales tariff, p/kWh | 11.97 | N/A | |
| Capital cost, £ | £101,948,713 | £102,341,371 | £4,932,731 |
| Operating and replacement costs, £ | £346,141,894 | £693,204,954 | £309,089,033 |
| Net Present Cost, £ | £251,525,622 | £367,855,569 | £130,071,280 |
| Levelised cost of heat, p/kWh | 8.83 | 12.91 | 4.57 |
| Carbon emissions 40-years, $tCO_2e$ | 39,026 | 44,917 | 1,180,275 |
| Internal rate of return (IRR) | 8.0% | N/A | |

Whilst the net present cost of heat networks may seem higher than that of a gas counterfactual, this does not account for the cost of carbon emissions. Following the medium level prices set out by the Green Book, the additional cost of the emissions from the gas counterfactual would be £437 million.

Figure 22: NPC vs carbon emission – Chelsea & Westminster Hospital and World's End network

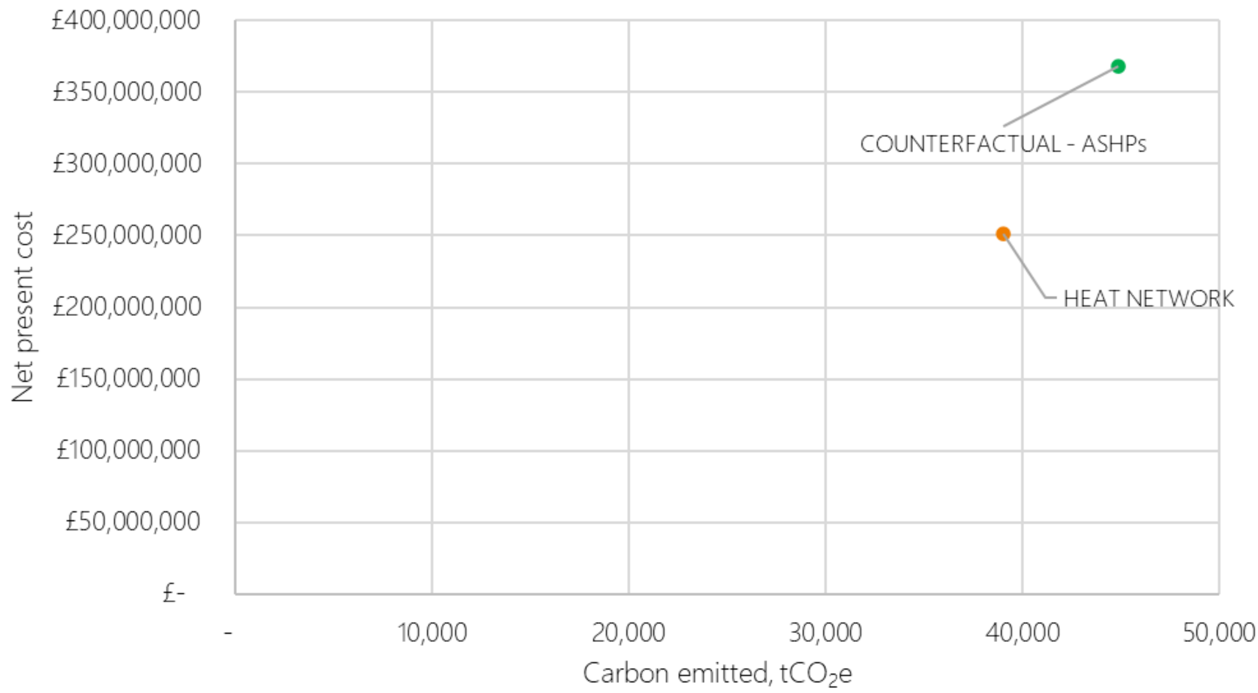
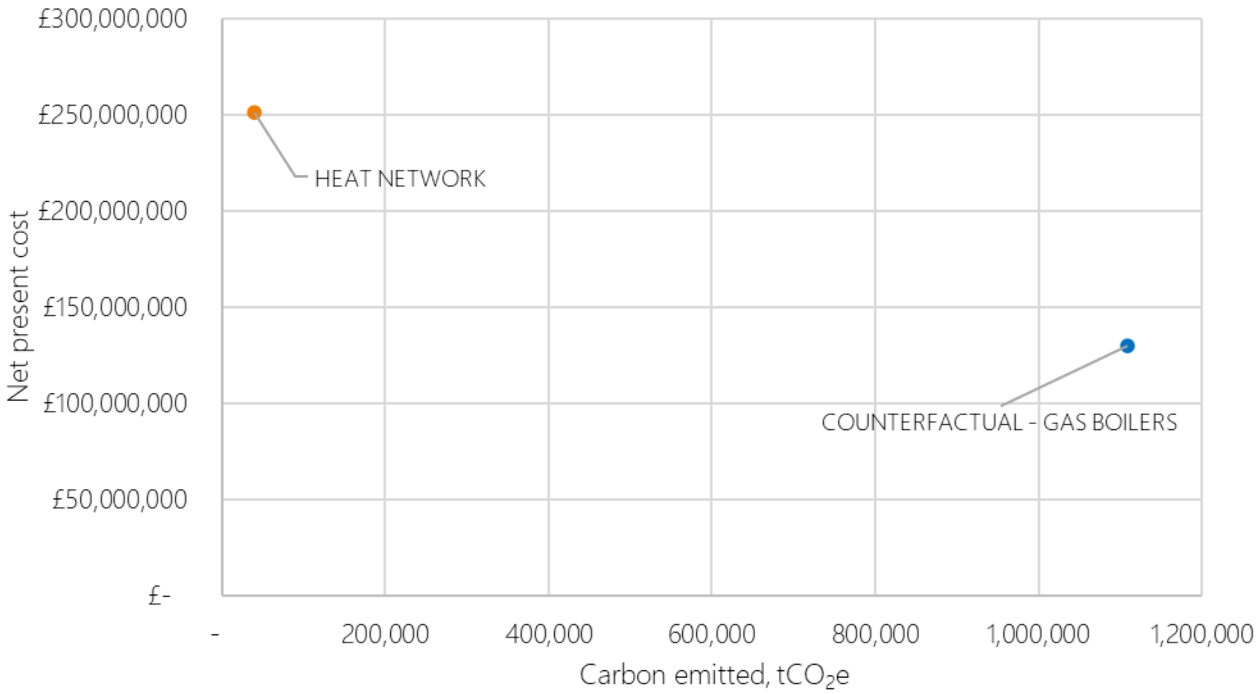



Figure 22 and Table 4 show that the district heat option is found to be cheaper and have a lower carbon footprint than the counterfactual of individual ASHPs. While individual gas boilers offer cost-effective heating, they come with several drawbacks, notably a higher carbon emission when compared to low-carbon heat networks. Moreover, reliance on individual gas boilers hinders local authorities from achieving their carbon targets. The UK Government's 2035 ban on new gas boiler sales will also mandate the adoption of alternative low carbon heating systems. As a result, district heating networks are the preferred low and zero-carbon solution for achieving heat decarbonisation in the Chelsea & Westminster Hospital and World's End area. The heat network NPC and carbon performance versus individual gas boilers counterfactuals is shown in Figure 23.

Figure 23: NPC vs carbon emission – Chelsea & Westminster Hospital and World's End (Gas boilers counterfactual)




## 2.7.3. Sensitivity

### 2.7.3.1. CAPEX sensitivity

Figure 24 demonstrates the impact of varying network CAPEX on the network economics. An increase in total network CAPEX will have a detrimental impact on the network economic performance as it results in higher total network costs, while the network revenue remains unchanged.

If a grant funding of 30% is secured for the full network, this would increase the network IRR to 10%.

Figure 24: Variable element of CAPEX

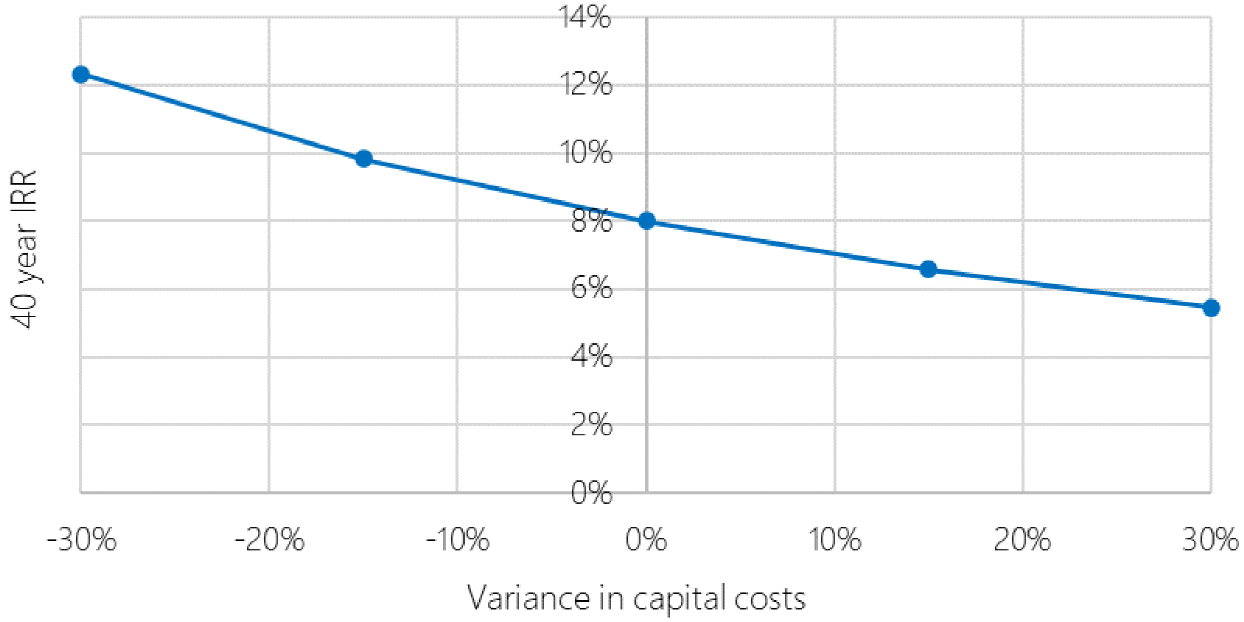
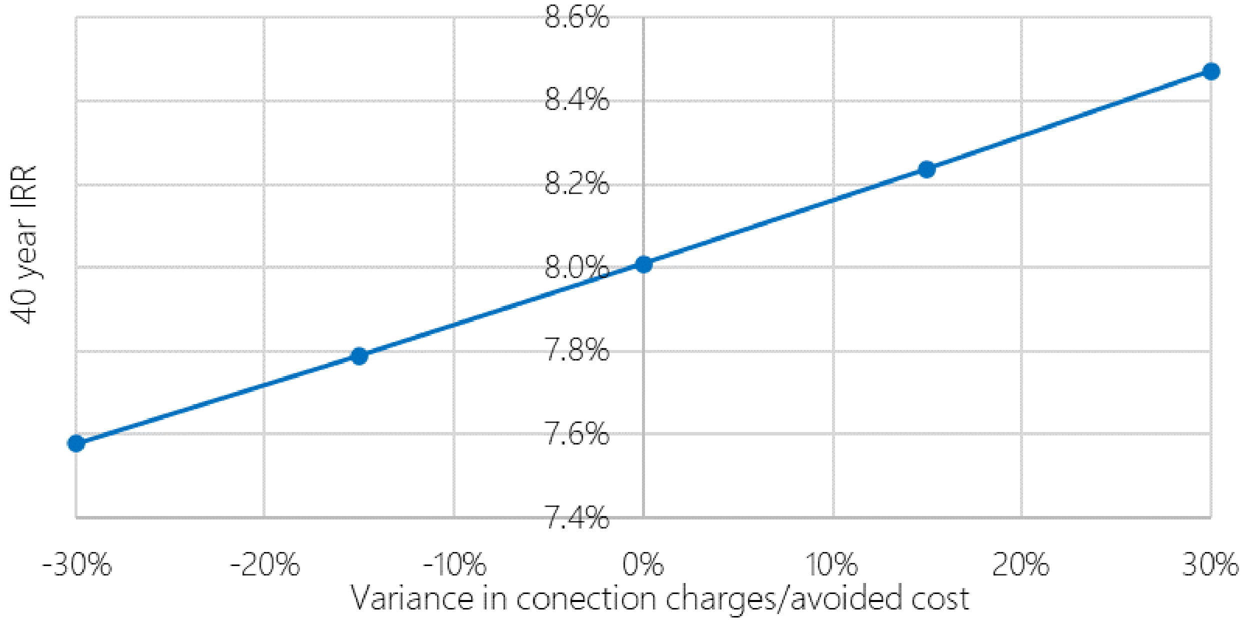



Figure 25 demonstrates the impact of varying connection charges/avoided costs on the network economics. A reduction in connection charges/avoided costs has a minor effect on the network performance as the cost reduction is not significant compared to the total network costs. This suggests that charging customers less to connect to the heat network will only have a minor impact on the network's economics.

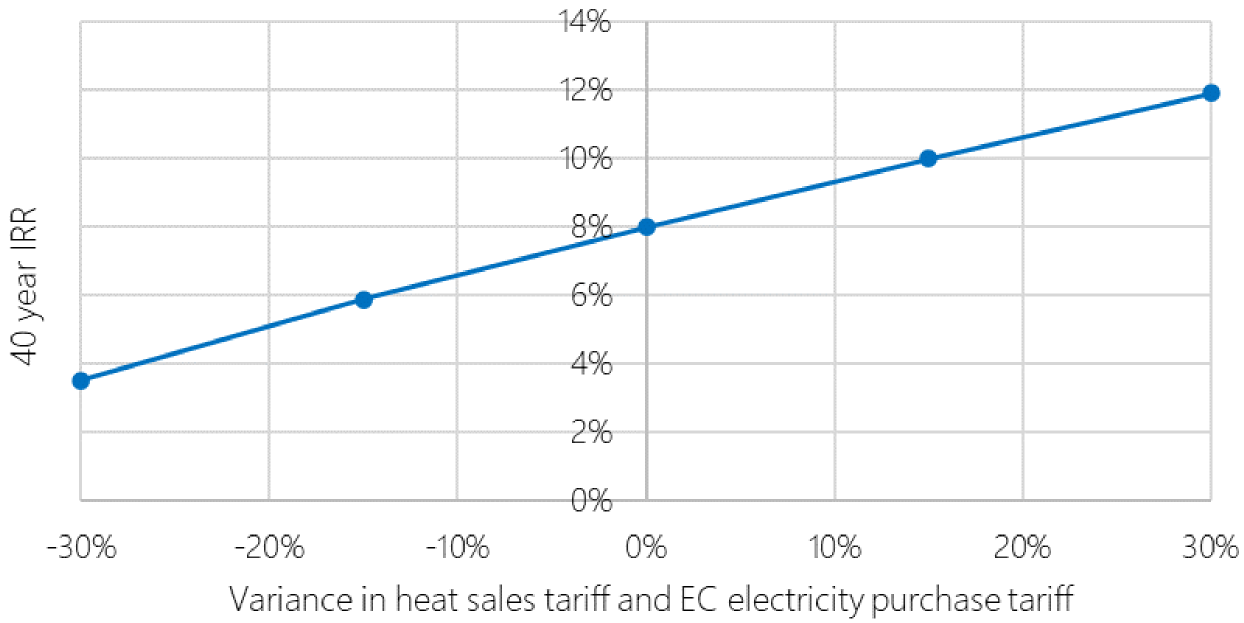
Figure 25: Variable element of connection charge/avoided cost




### 2.7.3.2. Energy tariff sensitivity

Figure 26 shows the impact of a variance in the energy and heat sales tariff and energy centre electricity purchase price on the network's economic performance. A positive IRR results from increasing both the heat sales tariff and energy centre electricity purchase price. This indicates that an increase in the heat sales tariff has a greater impact on the network economic performance, as more revenue is generated than the increased costs when both parameters are increased simultaneously. This sensitivity has been carried out as it is likely that both these elements would vary with electricity prices.

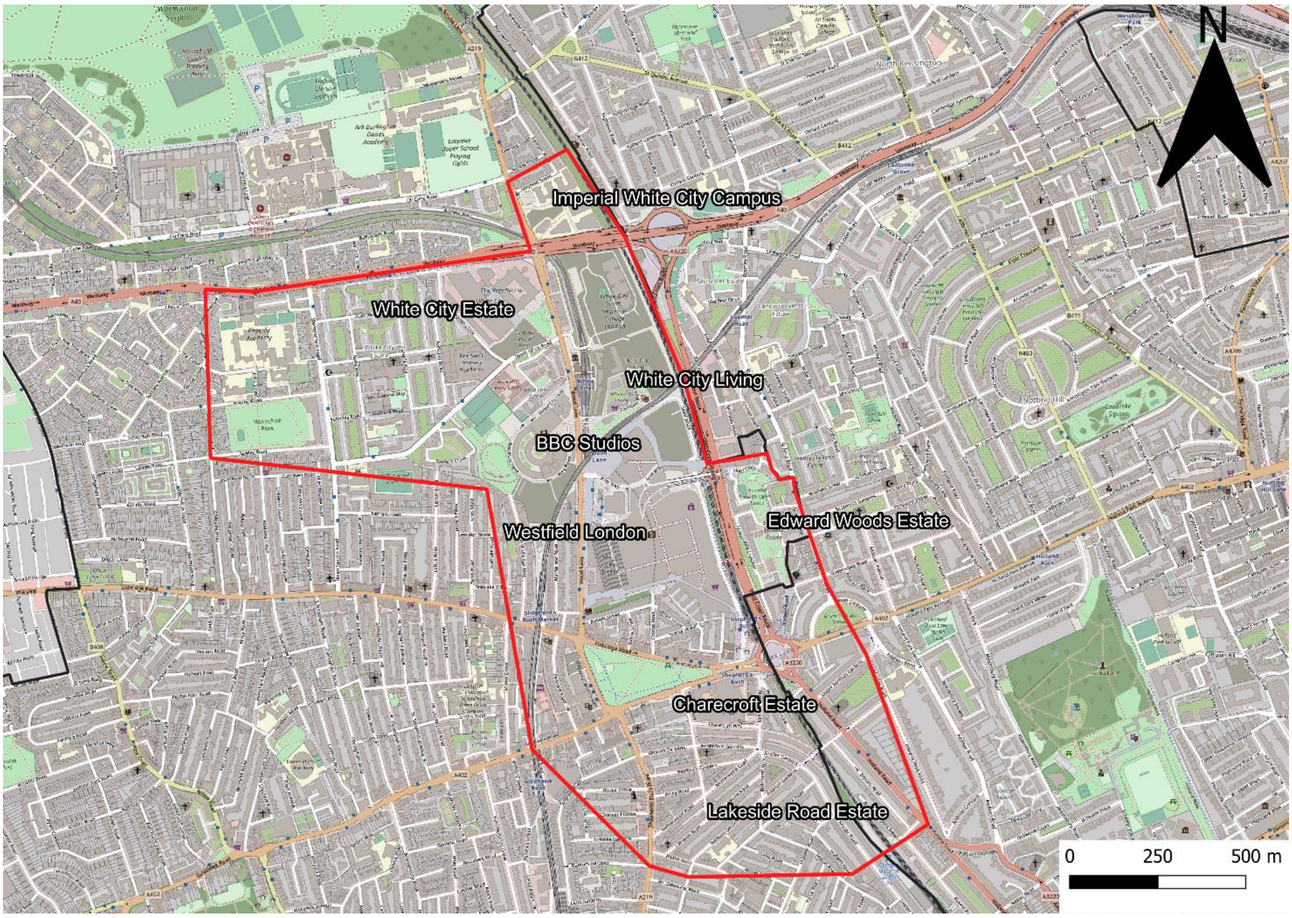
Figure 26: Variable element of heat sales tariff and electricity purchase tariff



## 2.8. White City

The White City priority area, shown in Map 15, lies mostly within H&F, with a smaller K&C section along the borough boundary to the south-east.

Map 15: Overview of White City priority area




### 2.8.1. Network design

The network design produced through THERMOS and the modelled phasing for this priority area is shown in Map 16. The White City priority area includes a total of 4,643 buildings with 283.3 GWh/year of heat demand. The modelled network, which is intended to be an illustration of the heat network development that could potentially be feasible in this area, supplies 174.6 GWh/year of this demand to 1,107 buildings. In terms of network development:

- Phase 1 would connect H&F White City estate. The heat source connected would be the modelled White City ASHP
- Phase 2 could expand to the large demands, including the former BBC television centre, Imperial College White City campus and Westfield. Other H&F estates in the area would also be connected, such as Charecroft and Edward Woods estates. Two additional AqSHPs could be connected to supply this phase (in Holland Park and Wormwood Scrubs)

- Phase 3 would connect smaller demands along the established routes, as well as the Lakeside Road Estate

Map 16: Network design showing the different phases of the White City network

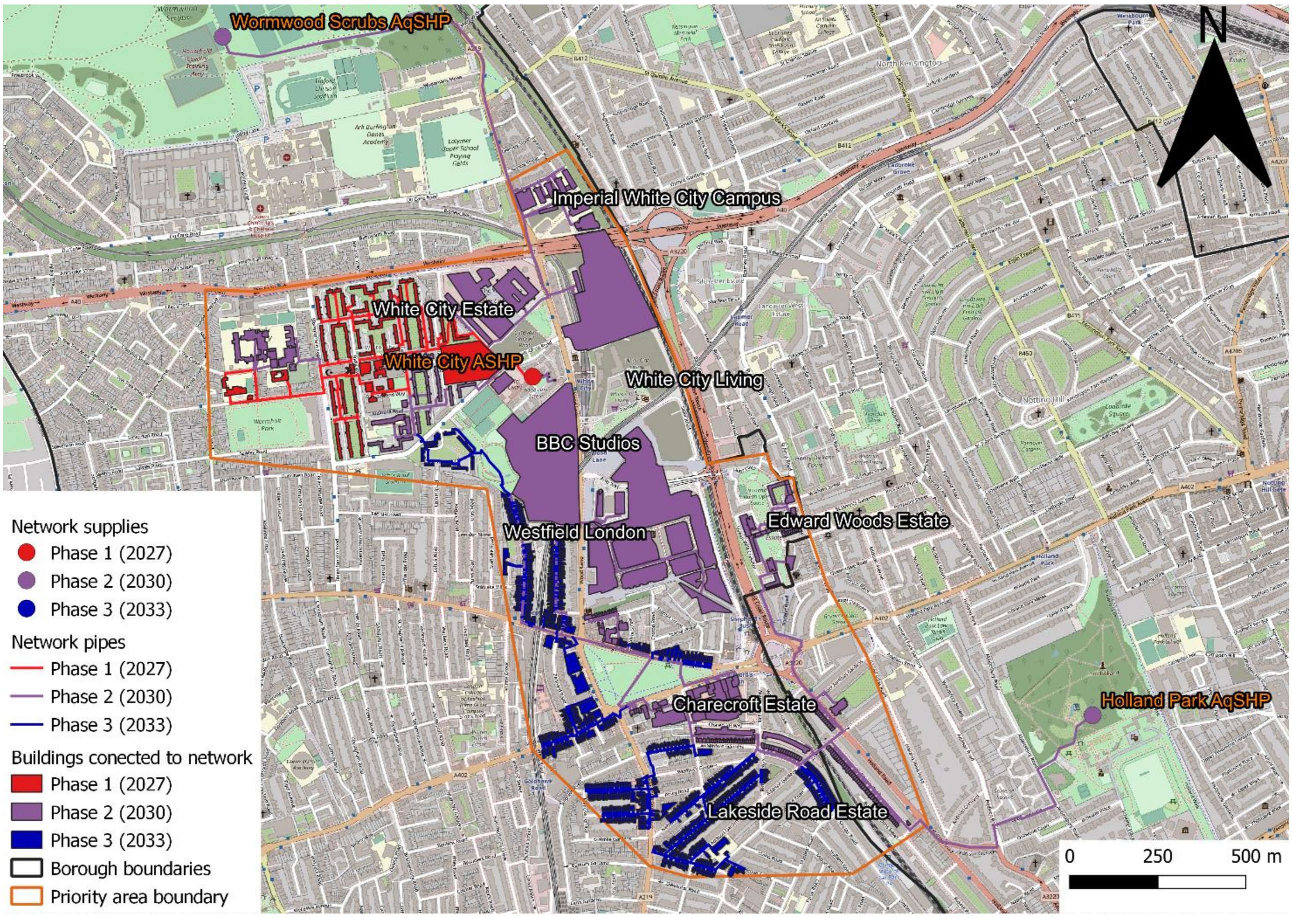



Figure 27 shows how the quantity of heat demand connected varies with phase, up to the maximum connected to the network.

Figure 27: Total heat demand connected to the network per phase in White City priority area

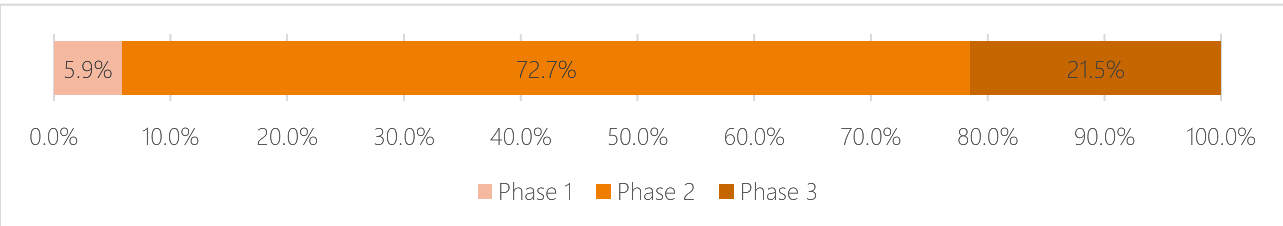



Figure 28 shows how many end connections are connected to the heat network by the key building type in each phase.

Figure 28: Number of end connections per phase by building type in White City priority area

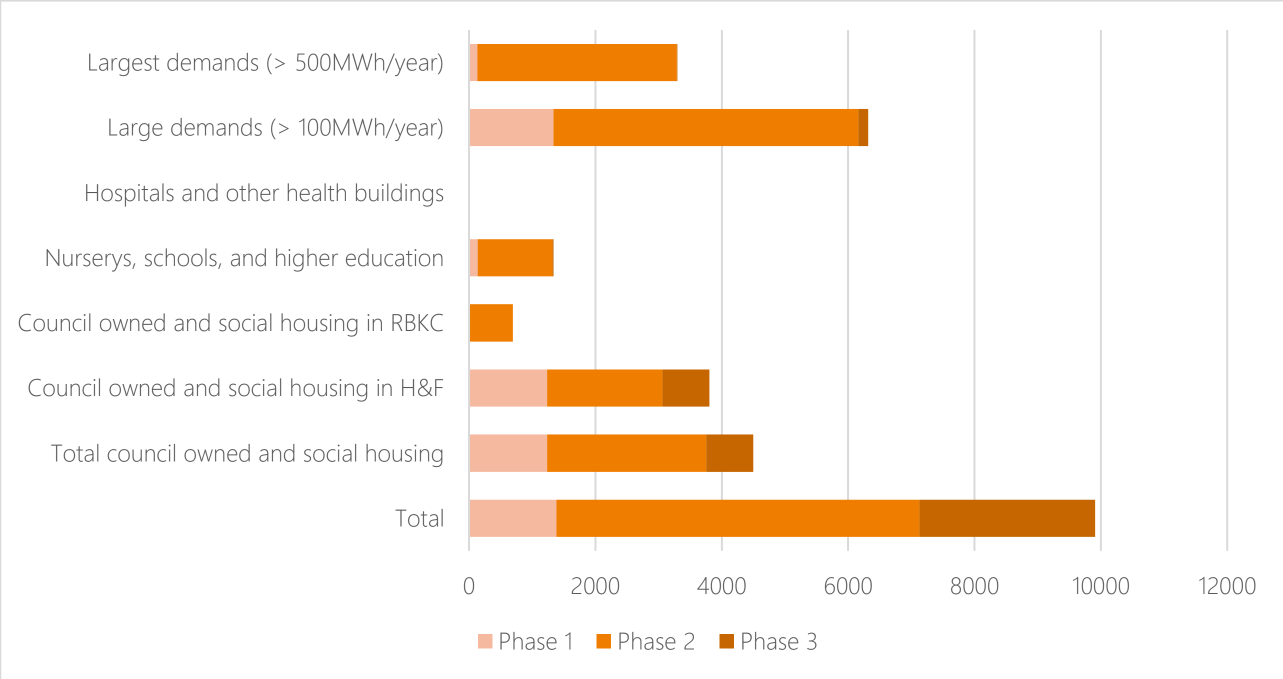



Figure 29 summarises the connected heat demand in each phase by the type of key building.

Figure 29: Heat demand connected per phase by building type in White City priority area

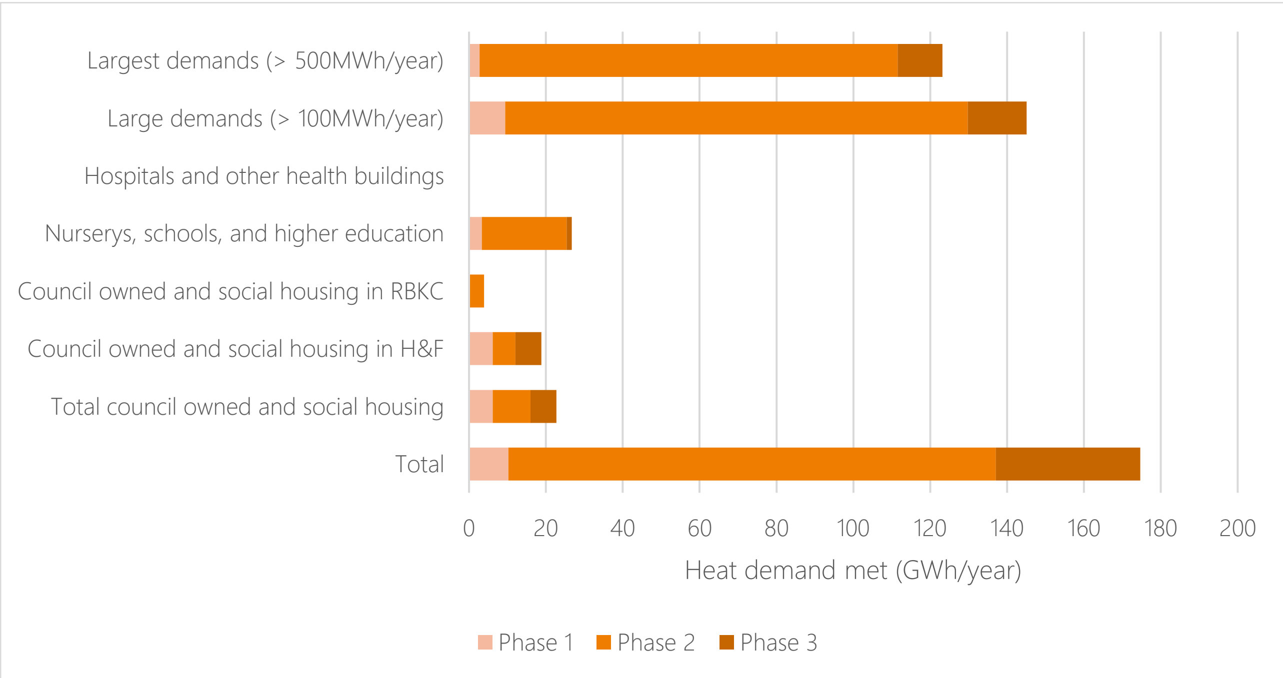
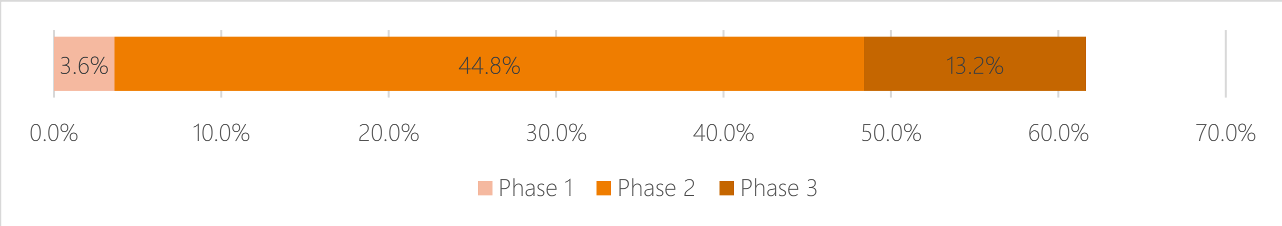



Figure 30 highlights how the heat demand connected to this network compares to the total heat demand of the priority area.

Figure 30: Total heat demand connected to the network per phase in White City priority area compared to total heat demand of the area




In total, 61.6% of the area's heat demand is met by the heat network. This is dominated by phase 2, where large demands are connected.

Table 5 shows the supplies connected to the White City network and in what phase they will be connected.

Table 5: Supplies connected to the White City network

| Supply | Phase | Maximum heat output (GWh/year) | Maximum capacity (MW) |
|---|---|---|---|
| White City ASHP | 1 | 143.57 | 45.53 |
| Wormwood Scrubs AqSHP | 2 | 91.3 | 28.95 |
| Holland Park AqSHP | 2 | 103.93 | 32.96 |
| Total | | 338.8 | 107.44 |

Figure 31 shows the yearly output from each heat supply connected to the White City network, both how much is utilised and how much remains unutilised.

Figure 31: Yearly heat output of heat supplies connected to the White City network

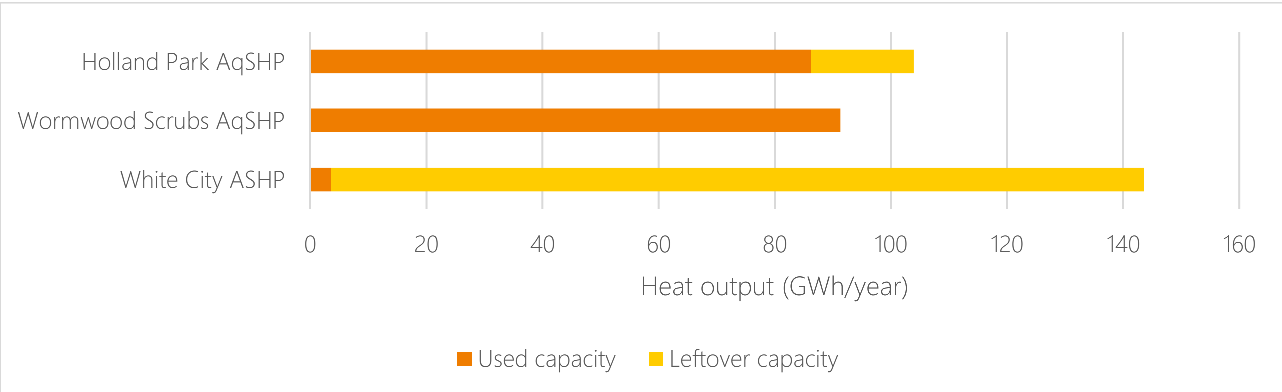
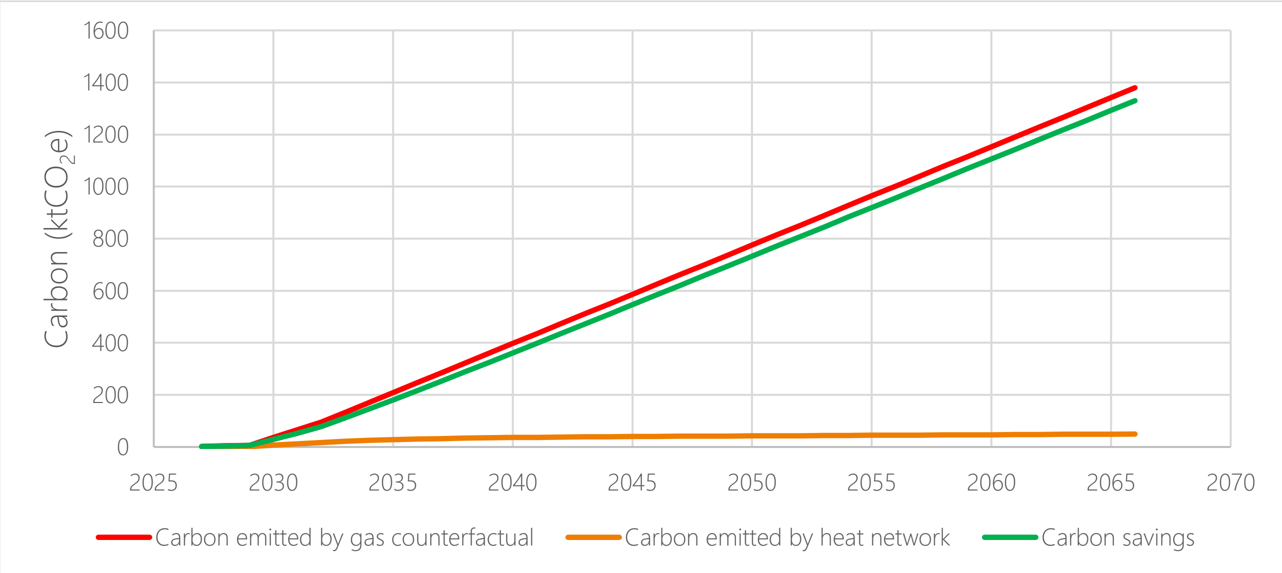



Figure 32 shows an overview of carbon savings related to this network. It highlights how much carbon would be emitted by the heat network over its lifetime and compares this to the emissions if the current heating systems were not replaced. The heat network represents a significant saving in carbon over maintaining today's heating systems. Key data assessed over 40 years from phase 1 completion (estimated network lifetime):

- Total carbon emitted by network: 49.8 kt$CO_2$e
- Total carbon emitted by gas counterfactual: 1,379.7 kt$CO_2$e
- Total net carbon savings: 1,329.9 kt$CO_2$e

Figure 32: Cumulative carbon emissions and emission savings from the White City network




## 2.8.2. Economics

A summary of the network economics and carbon emissions for White City is shown in Table 6.

Table 6: White City 40-year heat network economic summary – full network

| Items | Heat Network | Counterfactual - ASHPs | Counterfactual – Gas boilers |
|---|---|---|---|
| Overall system COP | 2.88 | 2.4 | N/A |
| Heat sales tariff, p/kWh | 15.03 | N/A | |
| Capital cost, £ | £153,524,048 | £170,972,997 | £6,772,034 |
| Operating and replacement cost, £ | £494,092,069 | £976,267,982 | £362,411,958 |
| Net Present Cost, £ | £387,733,457 | £551,116,782 | £157,981,896 |
| Levelised cost of heat, p/kWh | 11.83 | 16.81 | 4.82 |
| Carbon emissions 40-years, $tCO_2e$ | 49,760 | 57,847 | 1,329,901 |
| Internal rate of return (IRR) | 8.0% | N/A | |

Whilst the net present cost of heat networks may seem higher than that of a gas counterfactual, this does not account for the cost of carbon emissions. Following the medium level prices set out by the Green Book, the additional cost of the emissions from the gas counterfactual would be £489.9 million.

Figure 33: NPC VS Carbon emission – White City

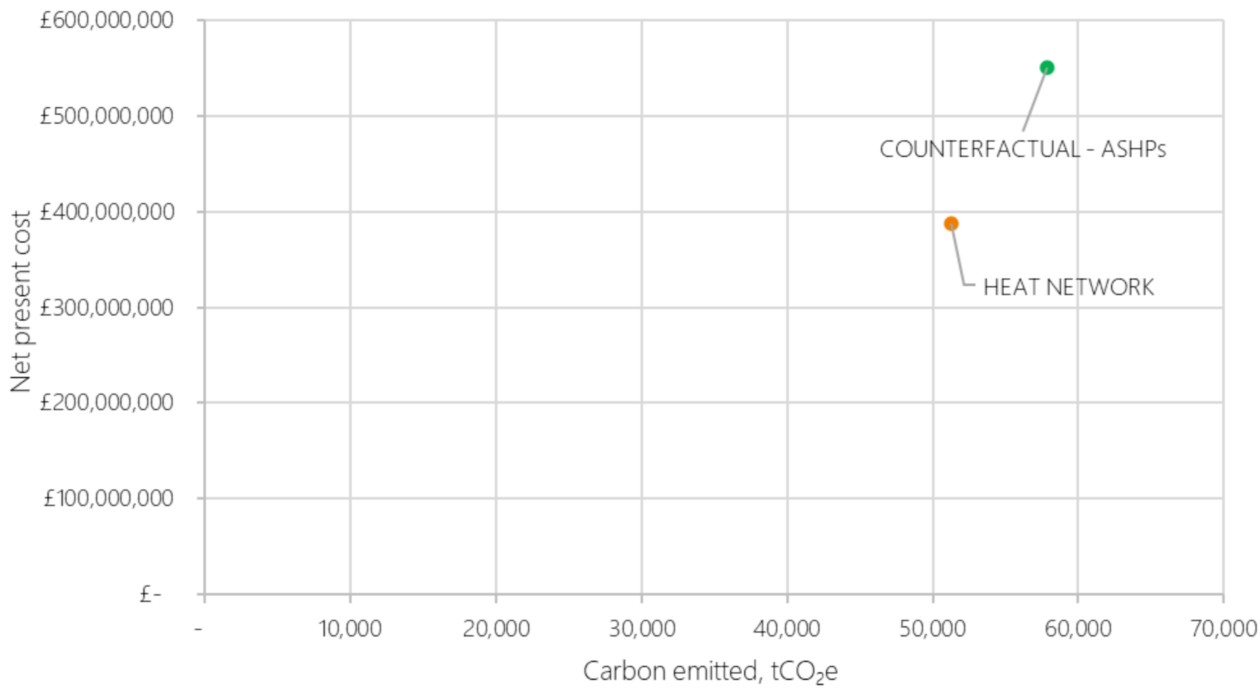
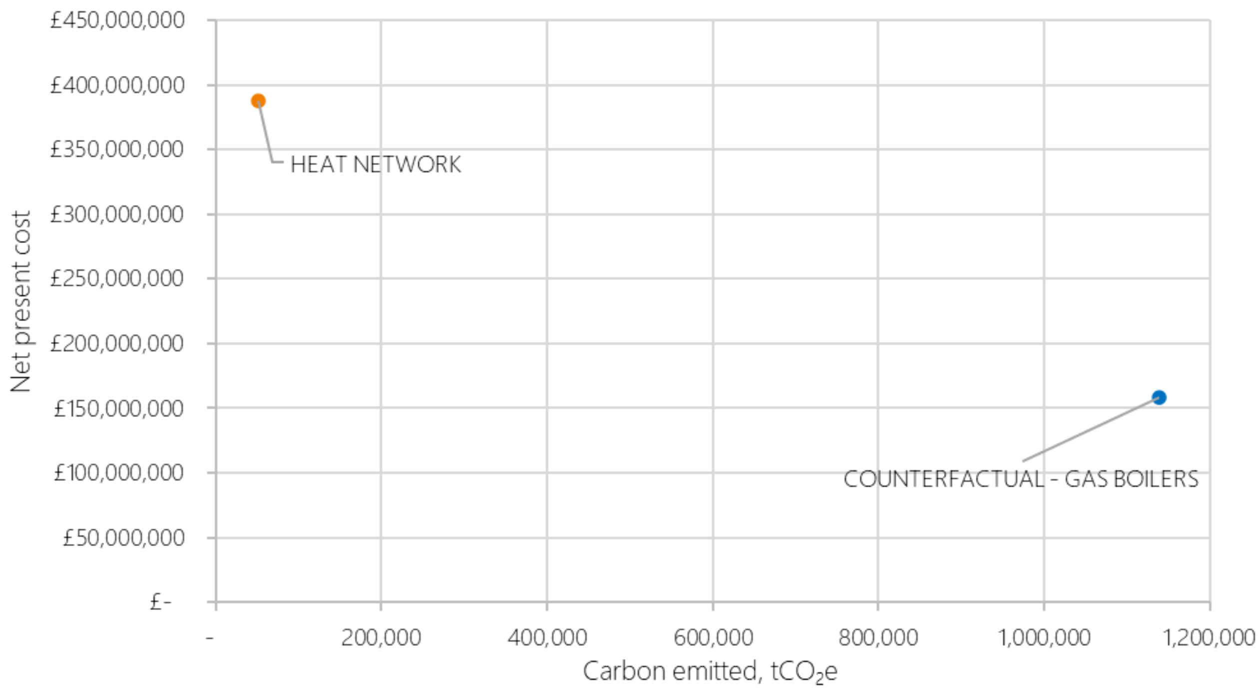



Figure 33 and Table 6 show that the district heat option is found to be cheaper and have a lower carbon footprint than the counterfactual of individual ASHPs. While individual gas boilers offer cost-effective heating, they come with several drawbacks, notably a higher carbon emission when compared to low-carbon heat networks. Moreover, reliance on individual gas boilers hinders local authorities from achieving their carbon targets. The UK Government's 2035 ban on new gas boiler sales will also mandate the adoption of alternative low carbon heating systems. As a result, district heating networks are the preferred low carbon solution for achieving heat decarbonisation in the White City area. The heat network NPC and carbon performance versus individual gas boilers counterfactuals are shown in Figure 34.

Figure 34: NPC vs carbon emission – White City (Gas boilers counterfactual)




## 2.8.3. Sensitivity

### 2.8.3.1. CAPEX sensitivity

Figure 35 demonstrates the impact of varying network CAPEX on the network economics. An increase in total network CAPEX will have a detrimental impact on the network's economic performance, as it results in higher total network costs while the network revenue remains unchanged.

If a grant funding of 30% is secured for the full network, this would increase the network IRR to 10%.

Figure 35: Variable element of CAPEX

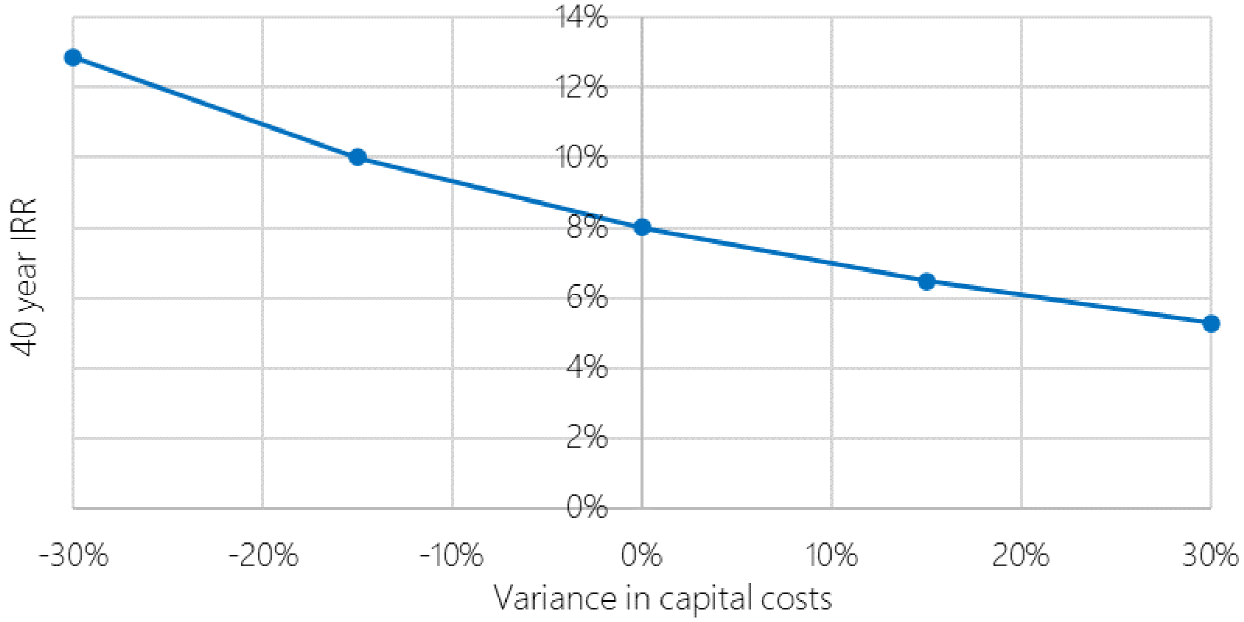
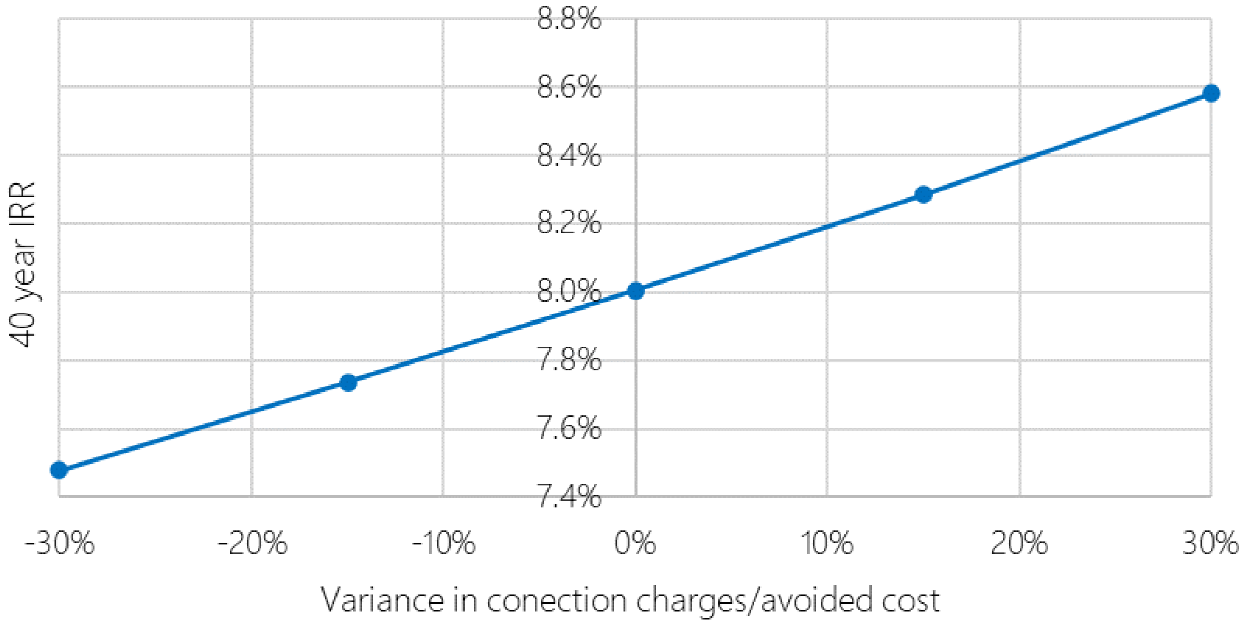



Figure 36 demonstrates the impact of varying connection charges/avoided costs on the network economics. A reduction in connection charges/avoided costs has a minor effect on the network performance as the cost reduction is not significant compared to total network costs. This suggests that charging customers less to connect to the heat network will only have a minor impact on the network's economics.

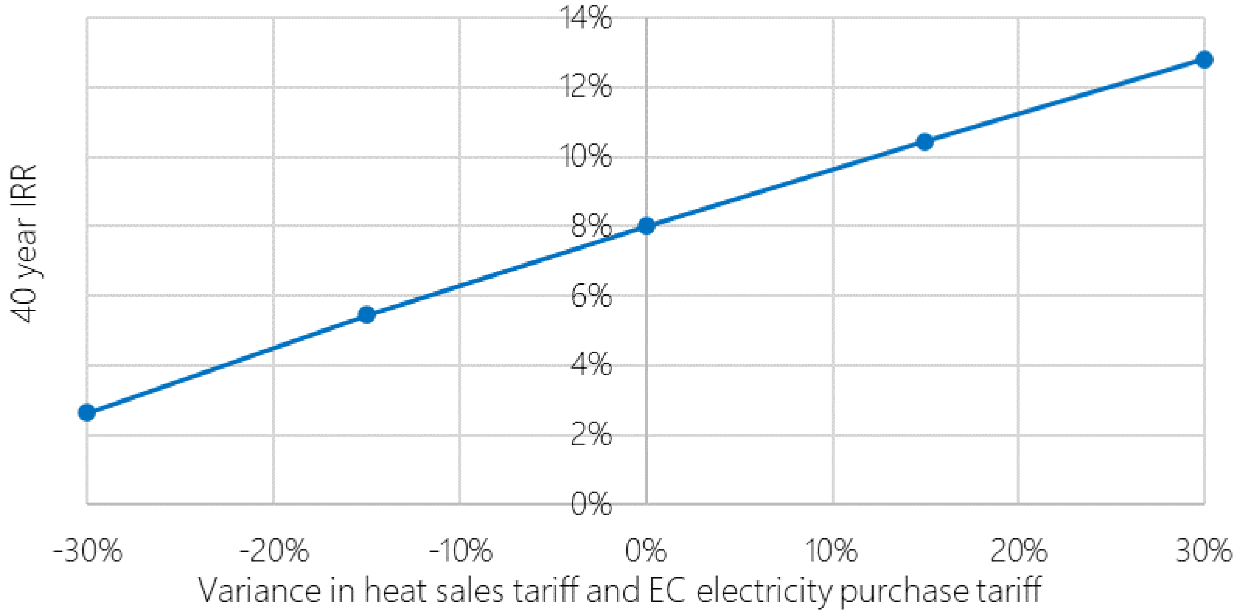
Figure 36: Variable element of connection charge/avoided cost




### 2.8.3.2. Energy tariff sensitivity

Figure 37 shows the impact of a variance in the energy and heat sales tariff and energy centre electricity purchase price on the network's economic performance. A positive IRR results from increasing both the heat sales tariff and energy centre electricity purchase price. This indicates that an increase in the heat sales tariff has a greater impact on network economic performance, as more revenue is generated than the increased costs when both parameters are increased simultaneously. This sensitivity has been carried out as it is likely that both these elements would vary with electricity prices.

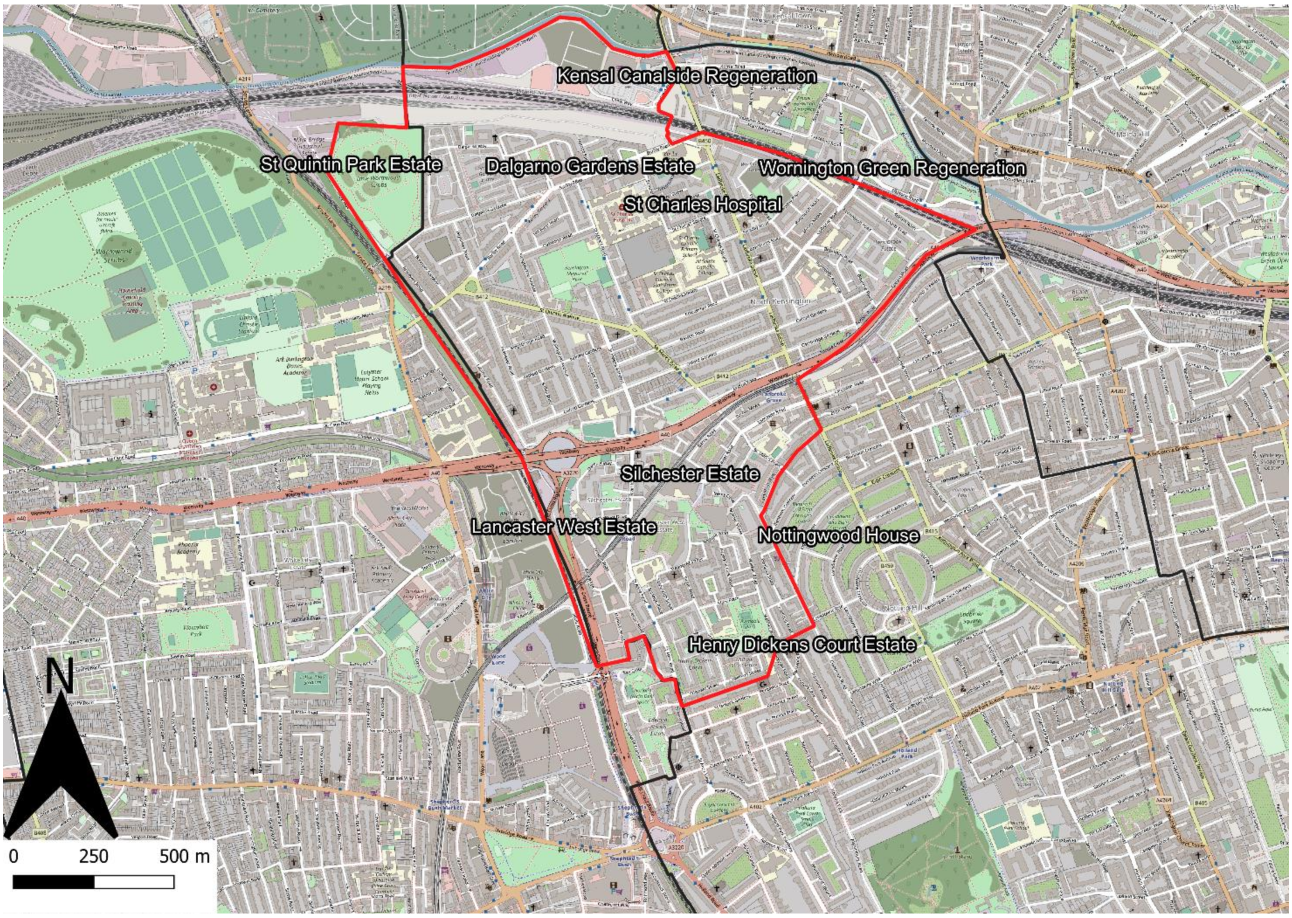
Figure 37: Variable element of heat sales tariff and electricity purchase tariff



## 2.9. Notting Dale and North Kensington

The Notting Dale and North Kensington priority area, shown in Map 17 lies entirely within K&C, in the north of the borough.

Map 17: Overview of Notting Dale and North Kensington priority area




### 2.9.1. Network design

The network design produced through THERMOS and the modelled phasing for this priority area is shown in Map 18 The Notting Dale and North Kensington priority area includes a total of 5,707 buildings with 168 GWh/year of heat demand. The modelled network, which is intended to be an illustration of the heat network development that could potentially be feasible in this area, supplies 88.4 GWh/year of this demand to 1,796 buildings. In terms of network development:

- Phase 1 of the network is the Lancaster West Estate, which is already a planned network. For the purposes of the modelling undertaken for this masterplan and due to data availability, a heat supply for this phase was not modelled. This phase is already planned to be supplied by a 1.5MW air source heat pump on the roof of Kensington Leisure Centre in the centre of Lancaster West Estate
- Phase 2 would expand to larger demands in the priority area, both north and south of the A40 Westway. A large housing estate in the north of the priority area would be connected

as well as the Wornington Green development area. Two larger heat supplies could be connected in this phase (White City ASHP and the Holland Park AqSHP)

- Phase 3 would connect smaller demands along the established routes

It is noted that an additional phase 4 could connect the planned new development at Kensal Canalside, to the north of the priority area. The depth of data required is currently unavailable for this development to be included in the detailed modelling for this masterplan. As such, it is not included in the techno-economic analysis for this priority area. Another expansion route for Phase 4 could be towards the east of the priority area, into Norland and Colville Wards, which were not modelled in this masterplan due to resource limitations. Both these and other options should be considered at a later stage.

Note that the modelled network deployment shown here follows a different methodology from the Notting Dale Heat Network proposals, therefore the modelled phasing shown does not match those.

Map 18: Network design showing the different phases of the Notting Dale and North Kensington network

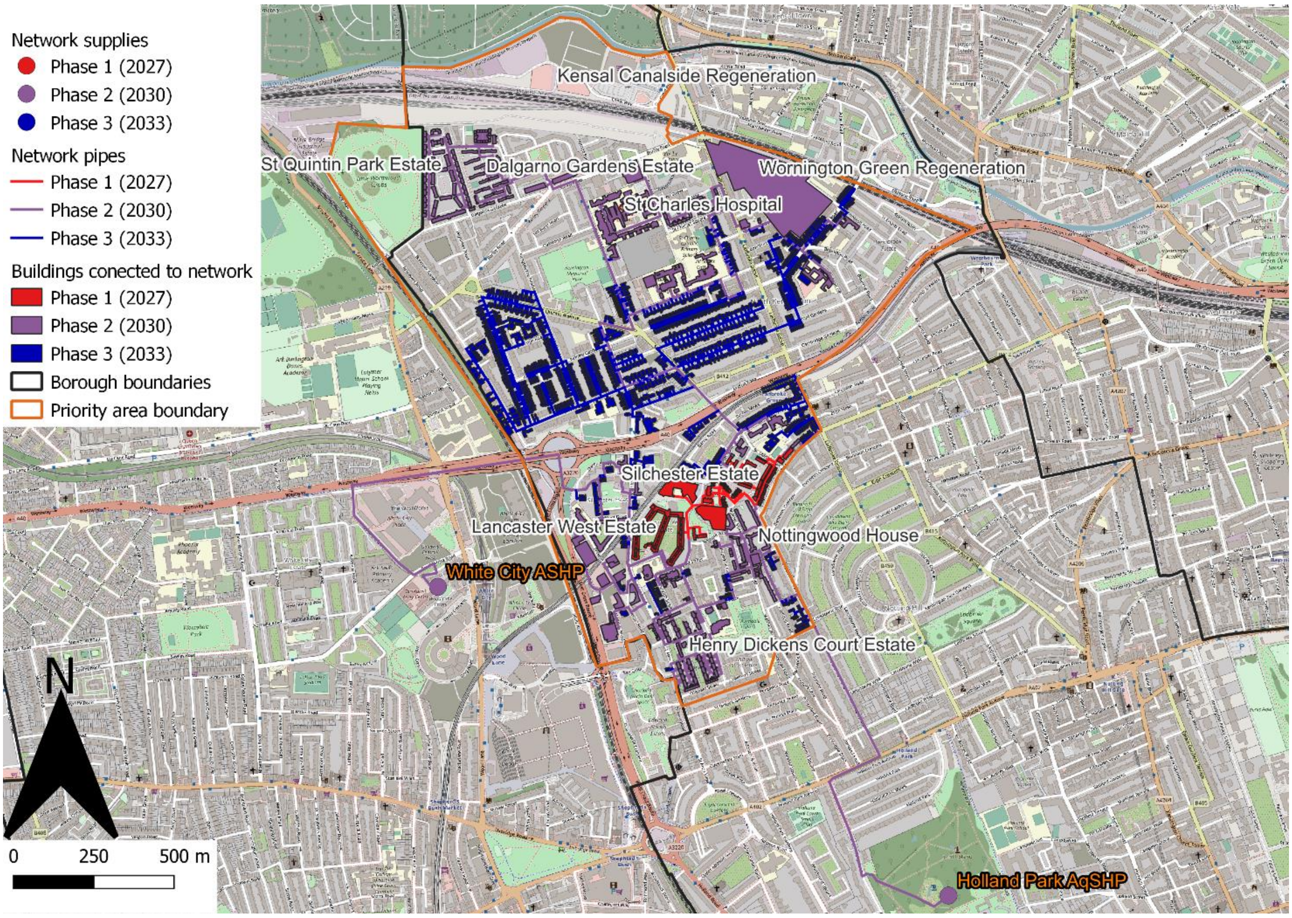



Figure 38 shows how the quantity of heat demand connected varies with phase, up to the maximum connected to the network.

Figure 38: Total heat demand connected to the network per phase in Notting Dale and North Kensington network

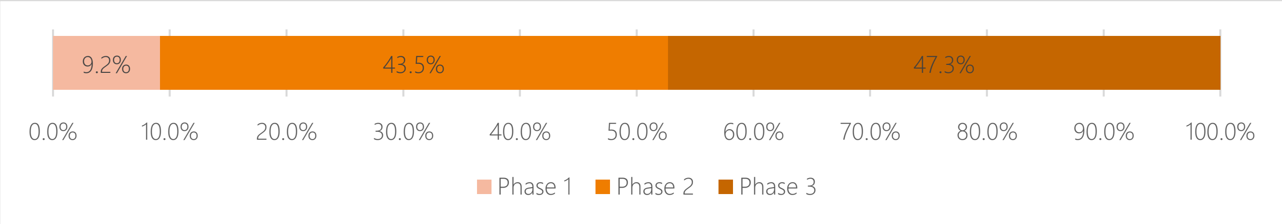



Figure 39 shows how many end connections are connected to the network by key building type in each phase.

Figure 39: Number of end connections per phase by building type in Notting Dale and North Kensington network

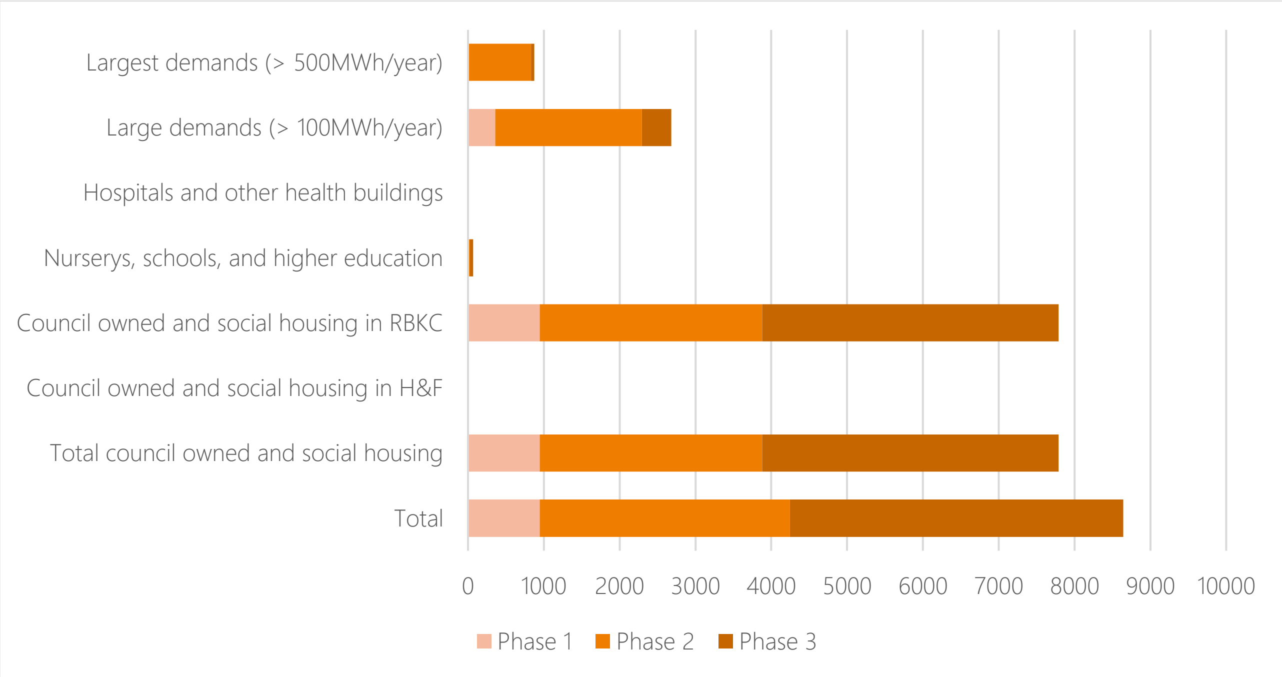



Figure 40 summarises the heat demand connected in each phase by type of key building.

Figure 40: Heat demand connected per phase by building type in Notting Dale and North Kensington priority area

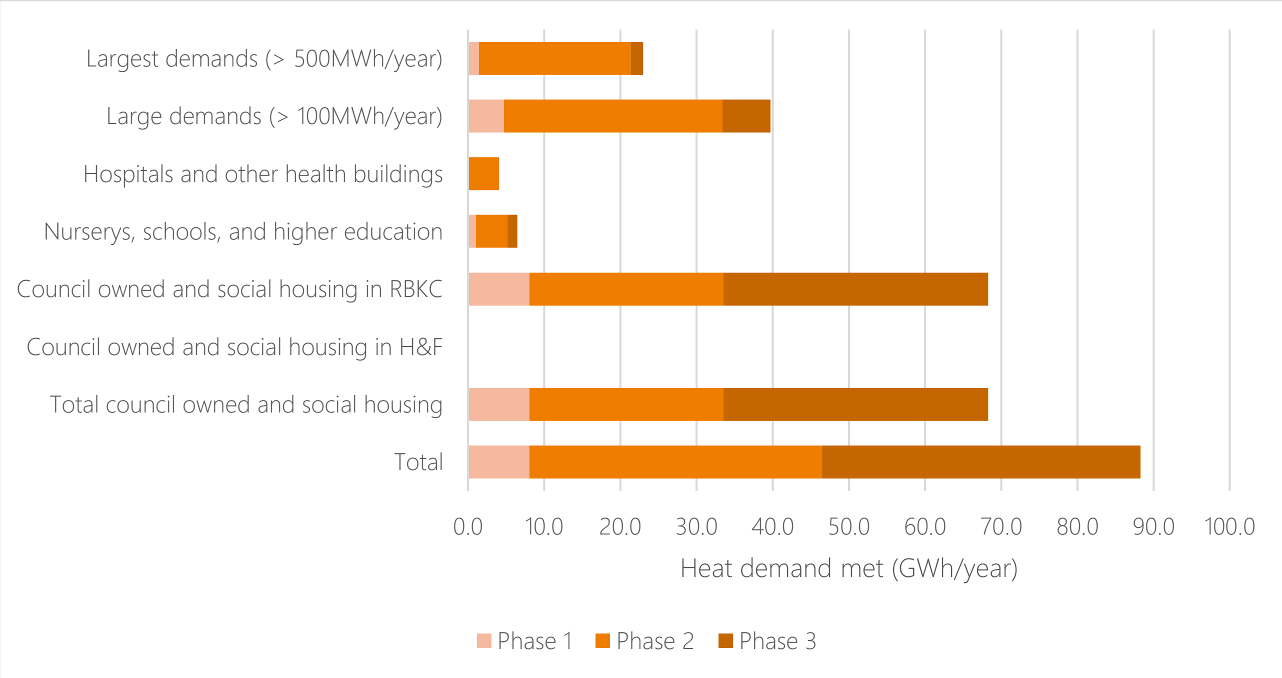
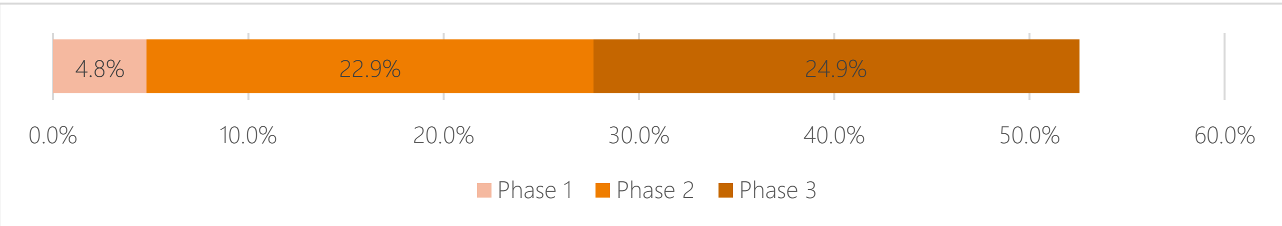



Figure 41 highlights how the heat demand connected to the network at each phase compares to the total heat demand of the priority area.

Figure 41: Total heat demand connected to the network per phase in Notting Dale and North Kensington network compared to total heat demand of the area




In total, 53% of the priority area's heat demand is met by the modelled heat network. This demand in centred around council-owned housing and social housing.

Table 7 shows the supplies connected to the Notting Dale and North Kensington network and in what phase they will be connected.

Table 7: Supplies connected to the Notting Dale and North Kensington network

| Supply | Phase | Maximum heat output (GWh/year) | Maximum capacity (MW) |
|---|---|---|---|
| White City ASHP | 2 | 143.57 | 45.53 |
| Holland Park ASHP | 2 | 103.93 | 32.96 |
| Total | | 247.5 | 78.49 |

Figure 42 shows the yearly output from each heat supply connected to the Notting Dale and North Kensington network, both how much is utilised and how much remains unutilised.

Figure 42: Yearly heat output of heat supplies connected to the Notting Dale and North Kensington network

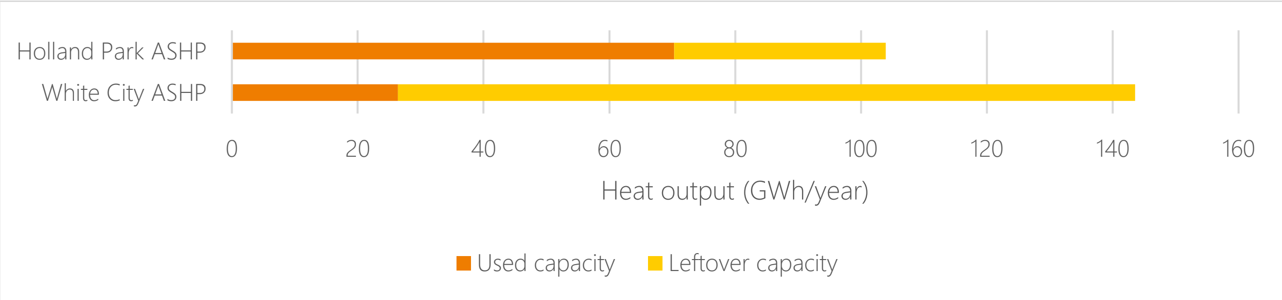
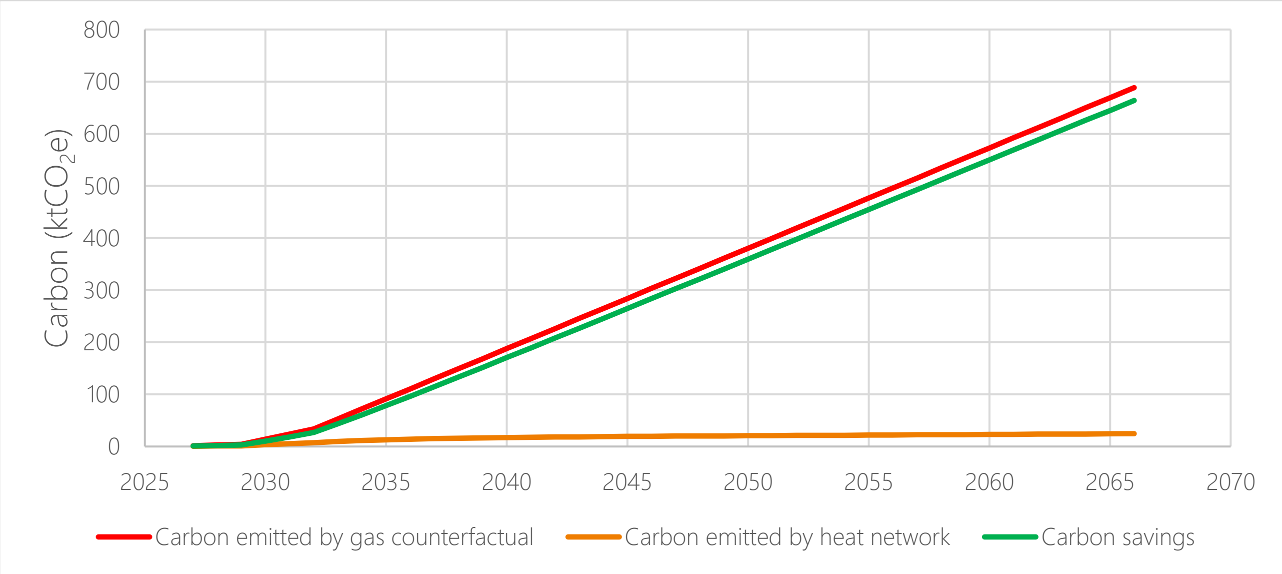



Figure 43 shows an overview of carbon savings related to this network. It highlights how much carbon would be emitted by the heat network over its lifetime and compares this to the emissions if the current heating systems were not replaced. The heat network represents a significant saving in carbon over maintaining today's heating systems. Key data assessed over 40 years from phase 1 completion (estimated network lifetime):

- Total carbon emitted by network: 24.6 kt$CO_2$e
- Total carbon emitted by gas counterfactual: 688.5 kt$CO_2$e
- Total net carbon savings: 663.9 kt$CO_2$e

Figure 43: Cumulative carbon emissions and emission savings from the Notting Dale and North Kensington network




### 2.9.2. Economics

The summary of network economics and carbon emissions for Notting Dale and North Kensington is shown in Table 8.

Table 8: Notting Dale and North Kensington heat network economic summary – Full network

| Items | Heat Network | Counterfactual - ASHPs | Counterfactual – Gas boilers |
|---|---|---|---|
| Overall system COP | 2.87 | 2.4 | N/A |
| Heat sales tariff, p/kWh | 17.30 | N/A | |
| Capital cost, £ | £133,985,945 | £118,186,093 | £9,123,782 |
| Operating and replacement cost, £ | £294,462,712 | £621,555,747 | £196,574,575 |
| Net Present Cost, £ | £250,842,162 | £350,980,448 | £88,491,119 |
| Levelised cost of heat, p/kWh | 15.54 | 21.75 | 5.48 |
| Carbon emissions 40-years, $tCO_2e$ | 24,649 | 28,128 | 688,524 |
| Internal rate of return (IRR) | 3.5% | N/A | |

Whilst the net present cost of heat networks may seem higher than that of a gas counterfactual, this does not account for the cost of carbon emissions. Following the medium level prices set out by the Green Book, the additional cost of the emissions from the gas counterfactual would be £245.7 million.

Figure 44: NPC vs carbon emission – Notting Dale and North Kensington

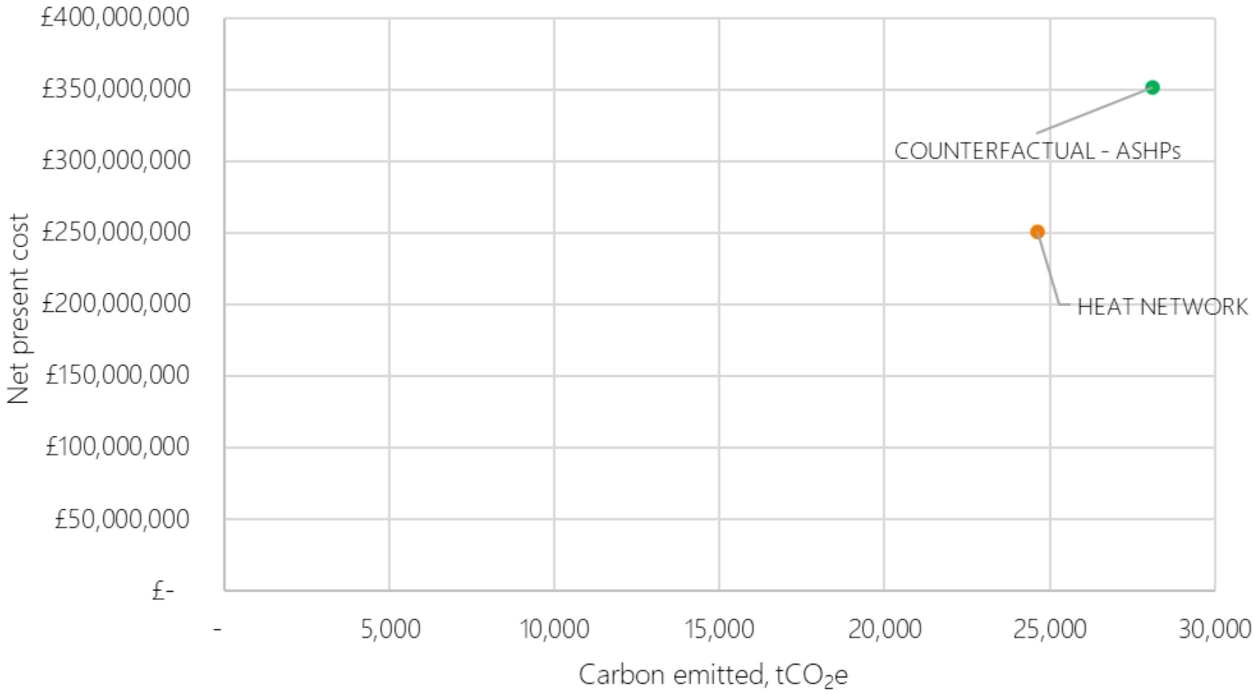
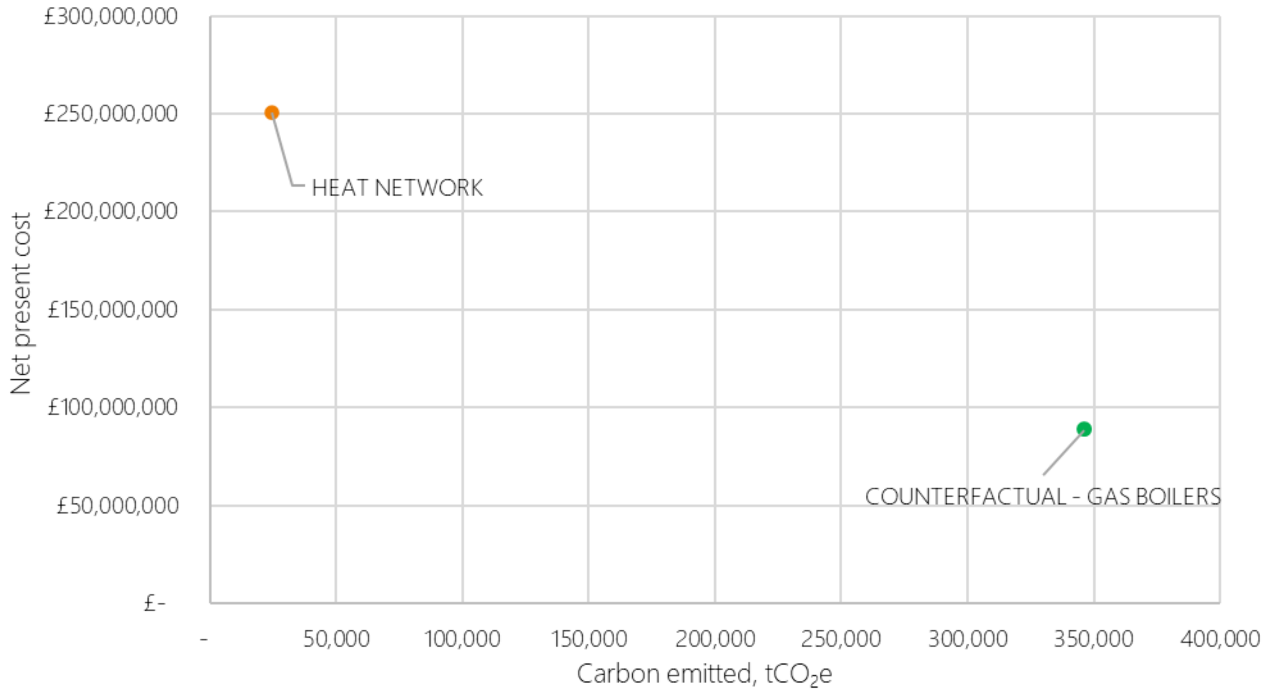



Figure 44 and Table 8 show that the district heat option is found to be cheaper and have a lower carbon footprint than the counterfactual of individual ASHPs. While individual gas boilers offer cost-effective heating, they come with several drawbacks, notably a higher carbon emission when compared to low-carbon heat networks. Moreover, reliance on individual gas boilers hinders local authorities from achieving their carbon targets. The UK Government's 2035 ban on new gas boiler sales will also mandate the adoption of alternative low carbon heating systems. As a result, district heating networks are the preferred low carbon solution for achieving heat decarbonisation in the Notting Dale and North Kensington area. The heat network NPC and carbon performance versus individual gas boilers counterfactuals are shown in Figure 45.

Figure 45: NPC VS Carbon emission – Notting Dale & Kensington (Gas boilers counterfactual)




## 2.9.3. Sensitivity

### 2.9.3.1. CAPEX sensitivity

Figure 46 demonstrates the impact of varying network CAPEX on the network economics. An increase in total the network CAPEX will have a detrimental impact on the network's economic performance as it results in higher total network costs while the network revenue remains unchanged.

If a grant funding of 30% is secured for the full network, this would increase the network IRR to 5%.

Figure 46: Variable element of CAPEX

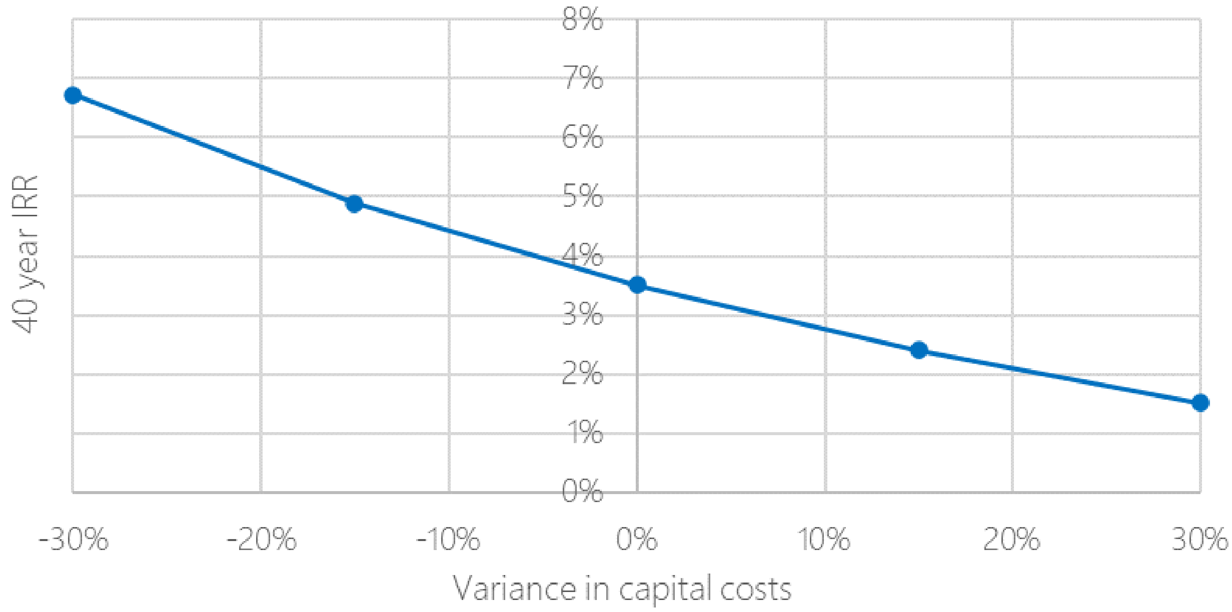
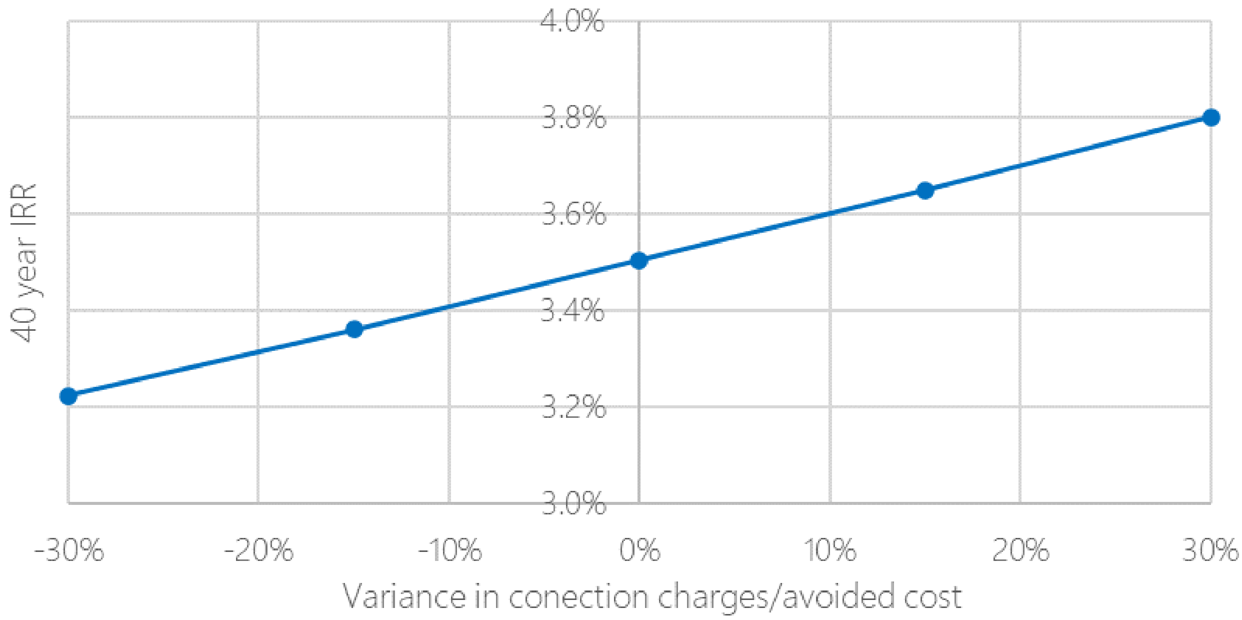



Figure 47 demonstrates the impact of varying connection charges/avoided costs on the network economics. A reduction in connection charges/avoided costs has a minor effect on the network performance as the cost reduction is not significant compared to total network costs.

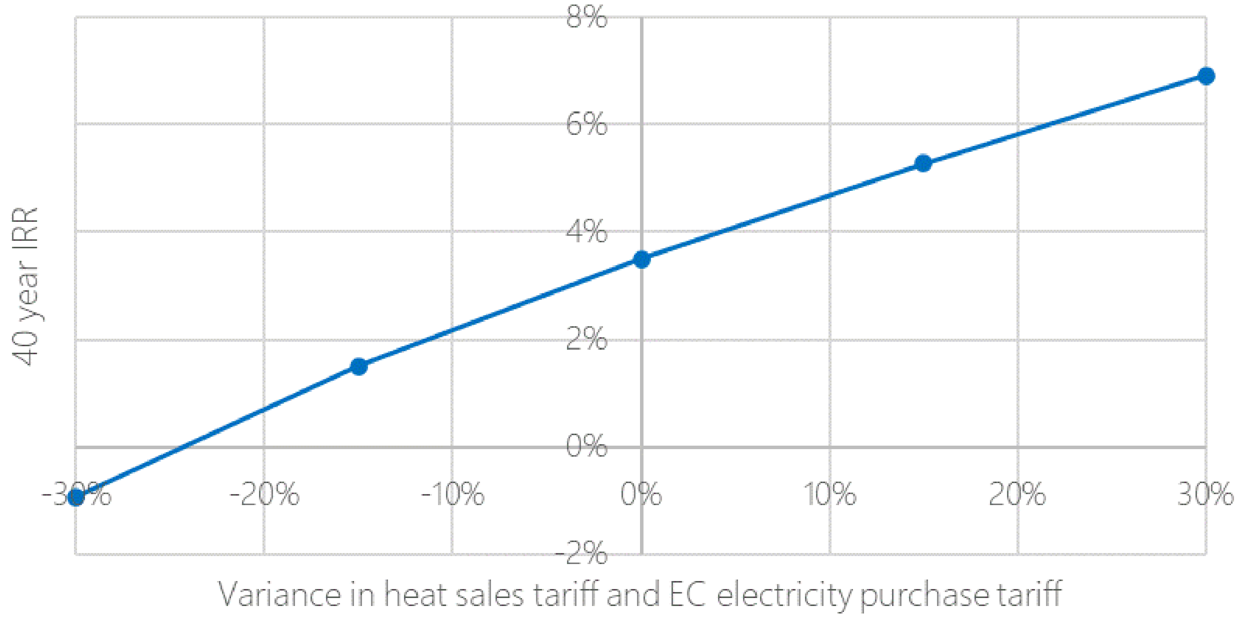
Figure 47: Variable element of connection charge/avoided cost




2.9.3.2. Energy tariff sensitivity

Figure 48 shows the impact of a variance in the energy and heat sales tariff and energy centre electricity purchase price on the network's economic performance. A positive IRR results from increasing both the heat sales tariff and energy centre electricity purchase price. This indicates that an increase in the heat sales tariff has a greater impact on network economic performance, as more revenue is generated than the increased costs when both parameters are increased simultaneously. This sensitivity has been carried out as it is likely that both these elements would vary with electricity prices.

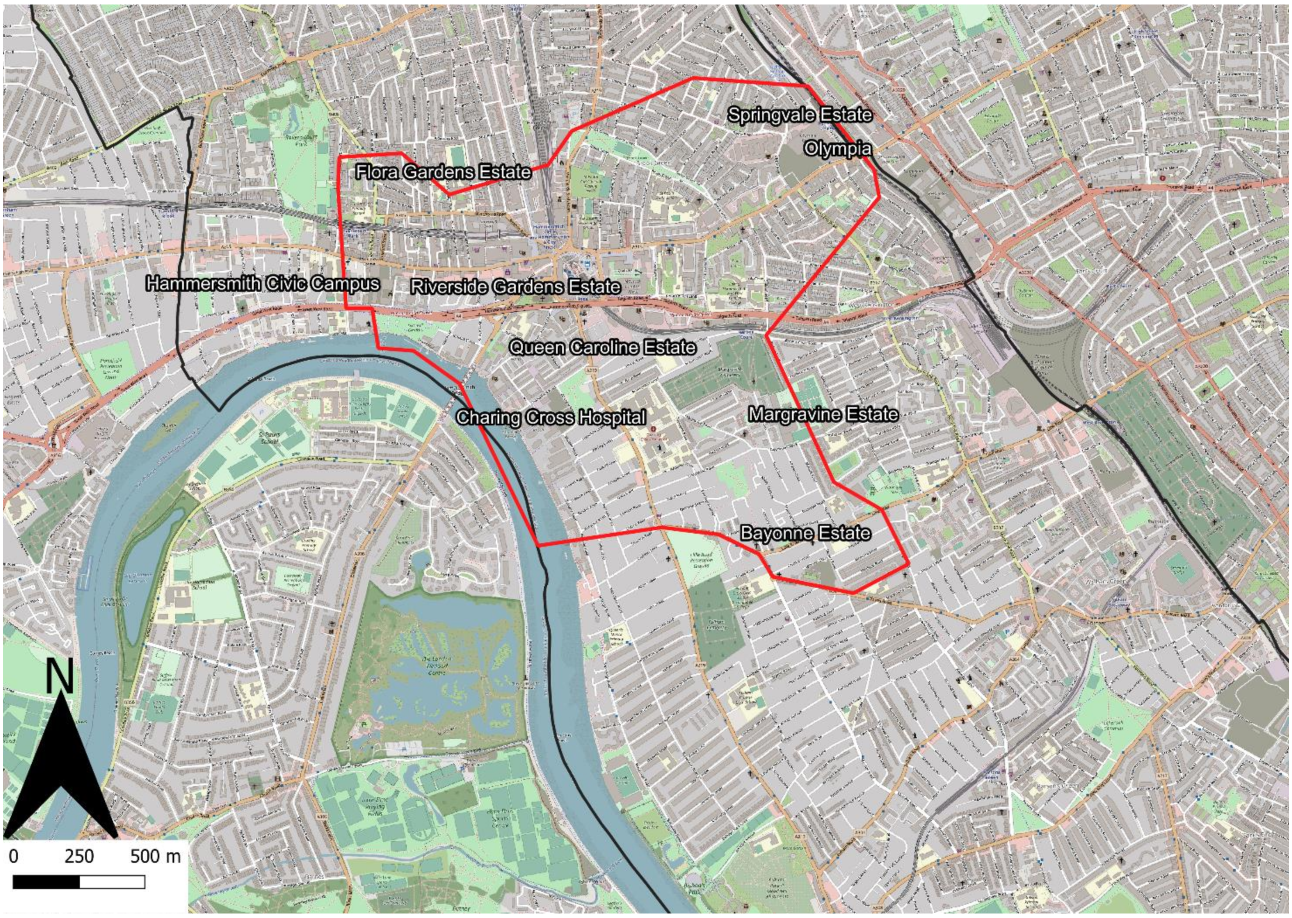
Figure 48: Variable element of heat sales tariff and electricity purchase tariff



## 2.10. Hammersmith Town Centre and Olympia

The Hammersmith Town Centre and Olympia priority area, shown in Map 19, lies entirely within the H&F boundary.

Map 19: Overview of Hammersmith Town Centre and Olympia priority area




### 2.10.1. Network design

The network design produced through THERMOS and the modelled phasing for this priority area is shown in Map 20. The Hammersmith Town Centre and Olympia priority area includes a total of 8,503 buildings with 402 GWh/year of heat demand. The modelled network, which is intended to be an illustration of the heat network development that could potentially be feasible in this area, supplies 247.5 GWh/year of this demand to 1,748 buildings. In terms of network development:

- Phase 1 would connect the Hammersmith Civic Campus currently under redevelopment, the Riverside Gardens estate, the Flora Gardens estate and a few larger buildings in the area. The heat supply modelled for this phase would be the Ravenscourt Park AqSHP. It is noted that there are plans for a GSHP at Hammersmith Civic Campus to power an internal heat network. Whilst this has not been modelled in this study because it is too small relative to the scale of the networks, if connected this would reduce supply strain and potentially allow for a slightly larger network

- Phase 2 could expand to many of the large demands in the priority area, including the Olympia redevelopment and Charing Cross Hospital. It could also extend south, connecting the Bayonne Estate and the Queen Caroline Estate. This phase is significant and could connect six additional modelled supplies (Lillie Road Rec AqSHP, Brook Green AqSHP, Hammersmith Embankment ASHP, Hammersmith Pumping Station, Bishop's Park WSHP and Charing Cross Hospital ASHP)

- Phase 3 would connect smaller demands along the established routes

Map 20: Network design showing the different phases of the Hammersmith Town Centre and Olympia network

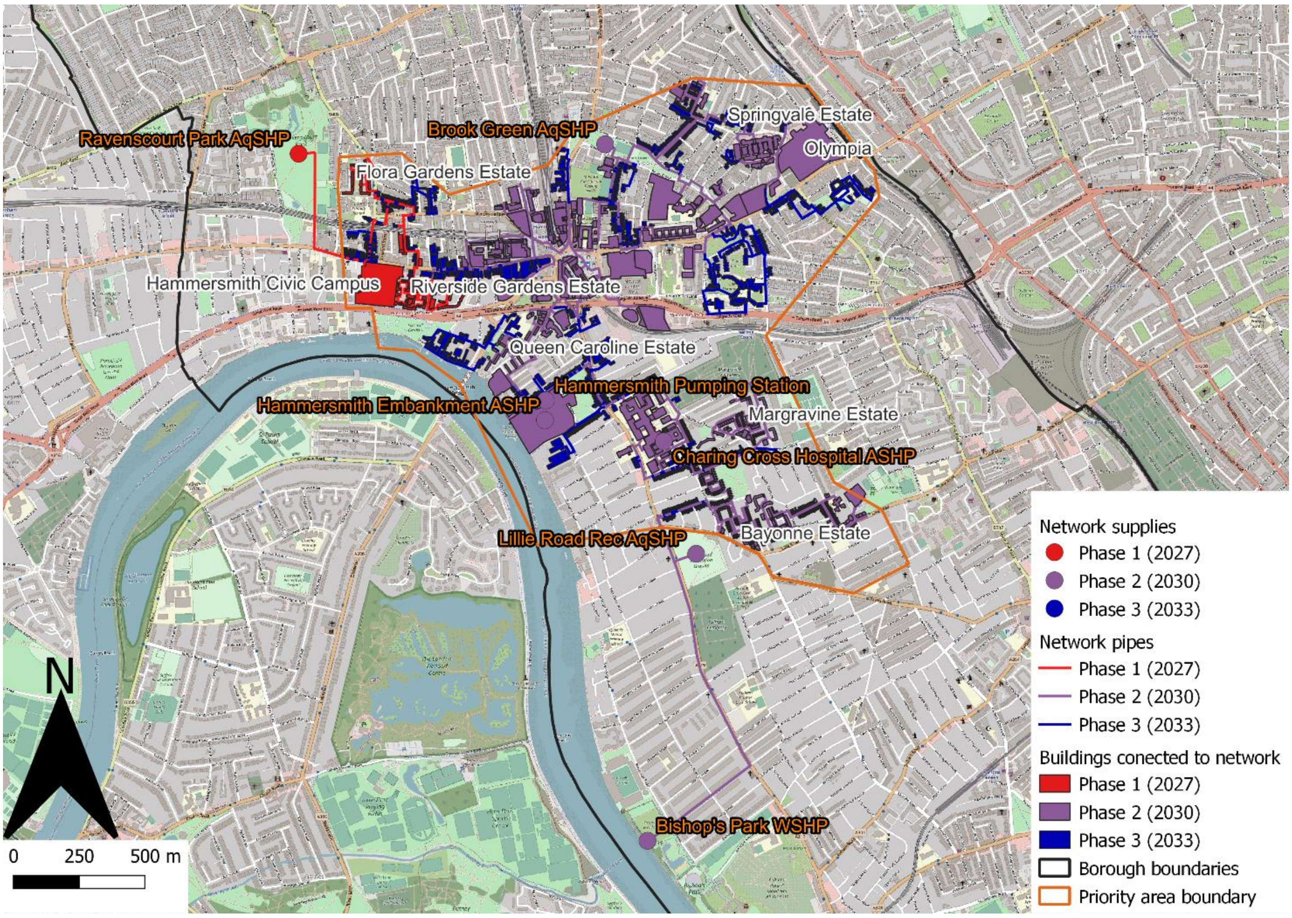



Figure 49 shows how the quantity of heat demand connected varies with phase, up to the maximum connected to the network

Figure 49: Total heat demand connected to the network per phase in Hammersmith Town Centre and Olympia priority area

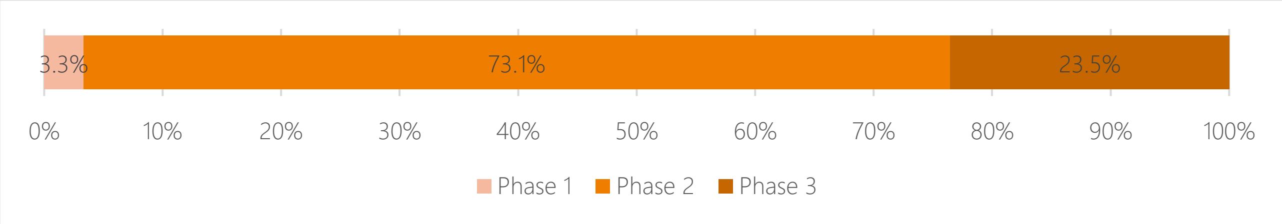



Figure 50 shows how many end connections are connected to the network by key building type in each phase.

Figure 50: Number of end connections per phase by building type in Hammersmith Town Centre and Olympia priority area

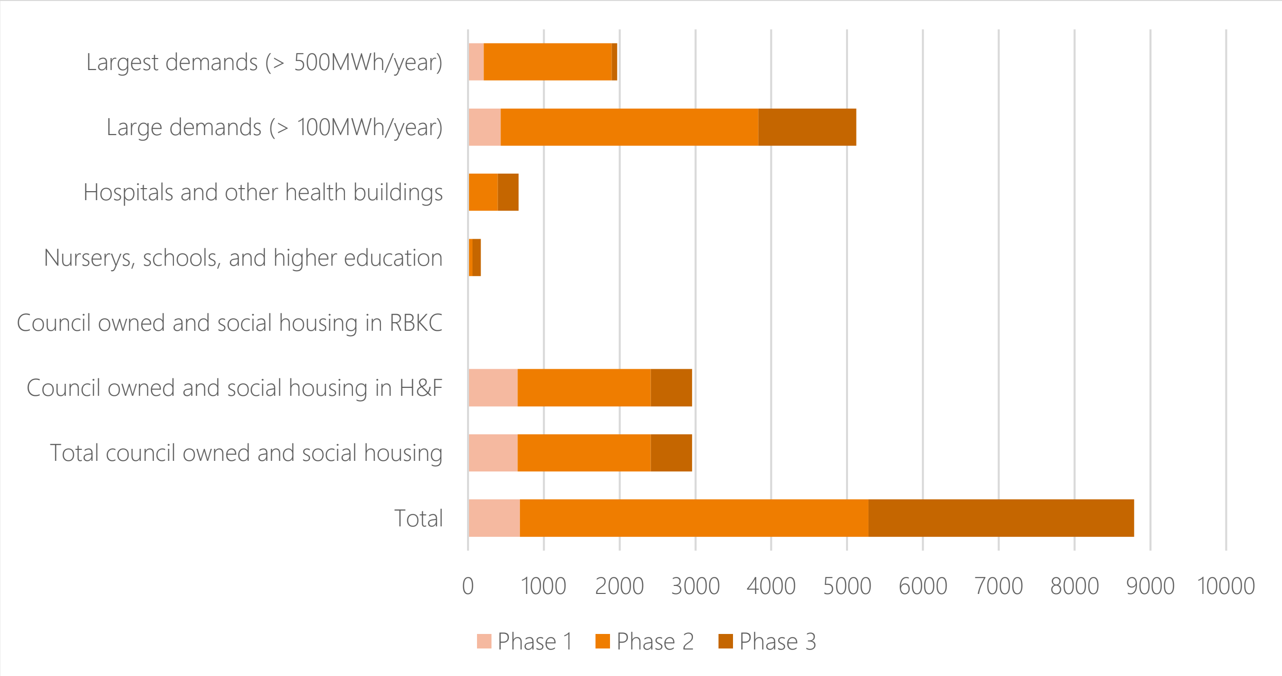



Figure 51 summarises the heat demand connected in each phase by type of key building.

Figure 51: Heat demand connected per phase by building type in Hammersmith Town Centre and Olympia priority area

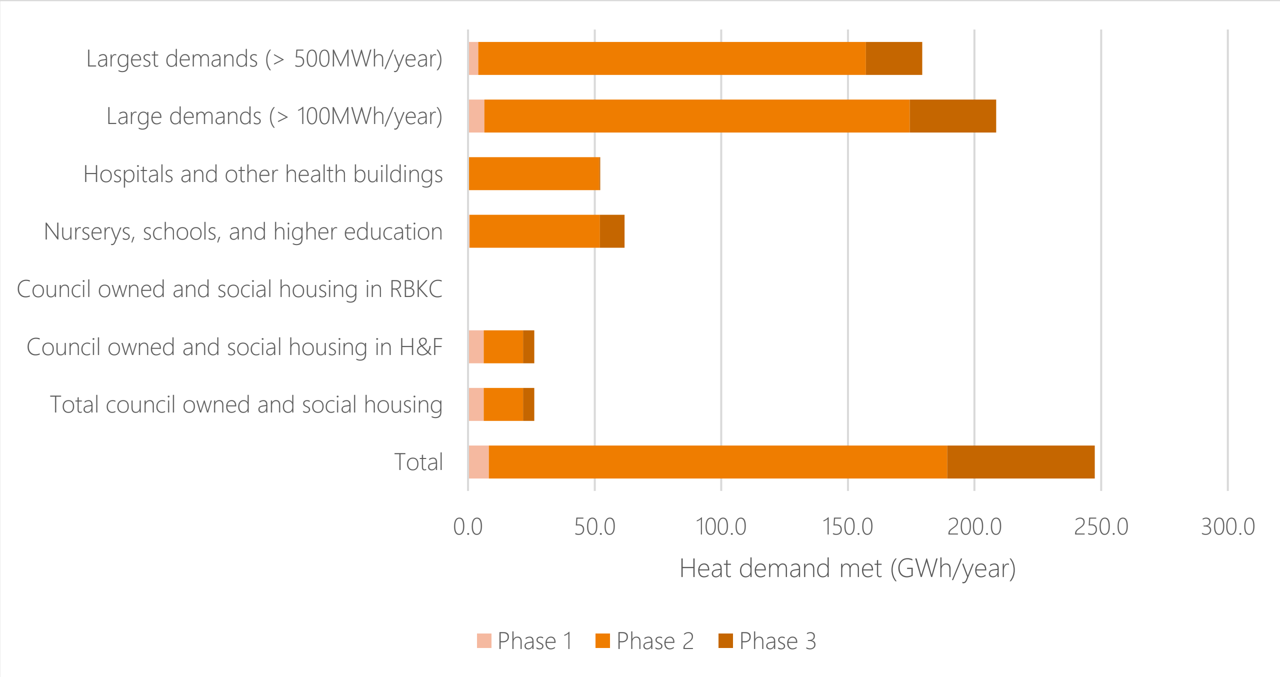
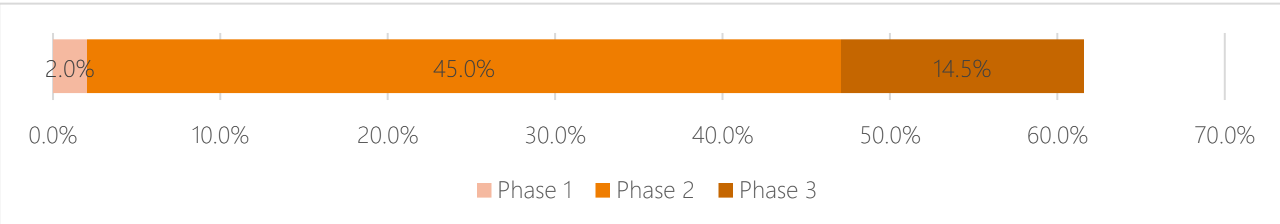



Figure 52 highlights how the heat demand connected to the network compares to the total heat demand of the priority area.

Figure 52: Total heat demand connected to the network per phase in Hammersmith Town Centre and Olympia priority area compared to total heat demand of the area




In total, 61.6% of the total heat demand in the priority area is met by the network, the majority of which is connected in Phase 2 where the network expands to the largest loads.

Table 9 shows the supplies connected to the Hammersmith Town Centre and Olympia network and in what phase they will be connected.

Table 9: Supplies connected to the Hammersmith Town Centre and Olympia network

| Supply | Phase | Maximum heat output (GWh/year) | Maximum capacity (MW) |
|---|---|---|---|
| Ravenscourt Park AqSHP | 1 | 63.77 | 20.22 |
| Lillie Road Rec AqSHP | 2 | 14.65 | 4.64 |
| Brook Green AqSHP | 2 | 13.42 | 4.25 |
| Hammersmith Embankment ASHP | 2 | 17.06 | 5.41 |
| Hammersmith Pumping Station | 2 | 42.57 | 13.5 |
| Bishop's Park WSHP | 2 | 325.41 | 103.19 |
| Charing Cross Hospital ASHP | 2 | 20.5 | 6.5 |
| Total | | 497.38 | 157.71 |

Figure 53 shows the yearly output from each heat supply connected to the Hammersmith Town Centre and Olympia network, both how much is utilised and how much remains unutilised.

Figure 53: Yearly heat output of heat supplies connected to the Hammersmith Town Centre and Olympia network

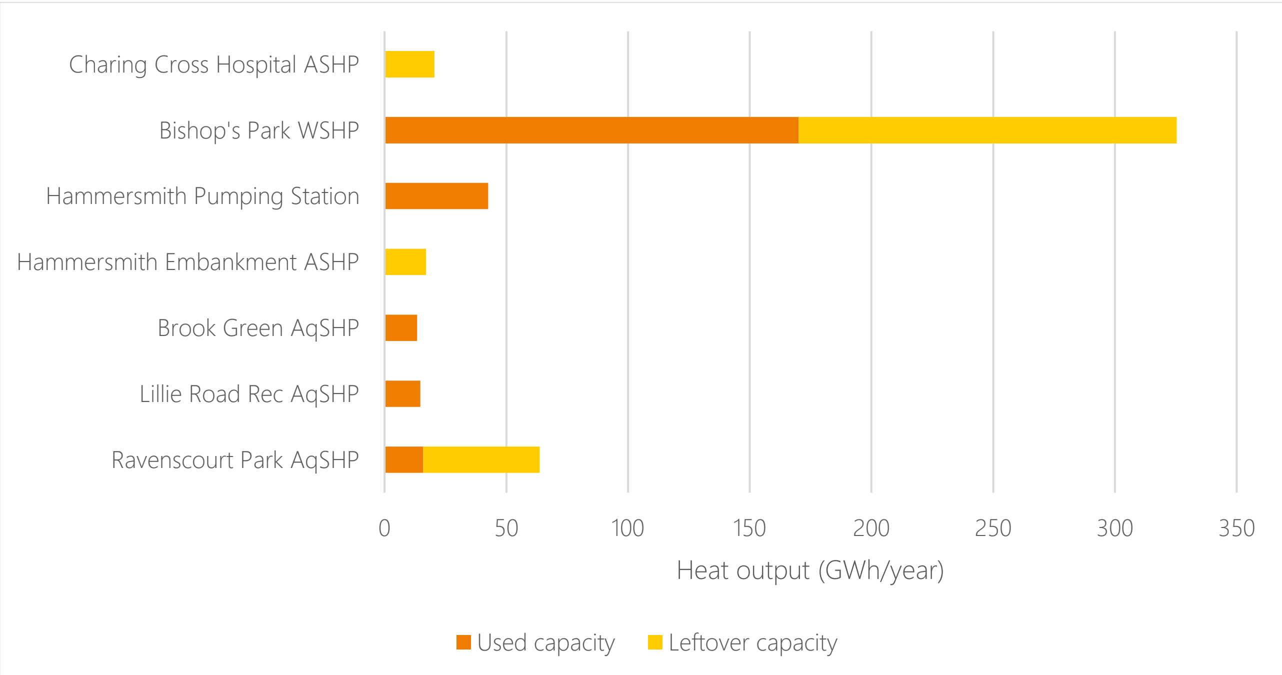
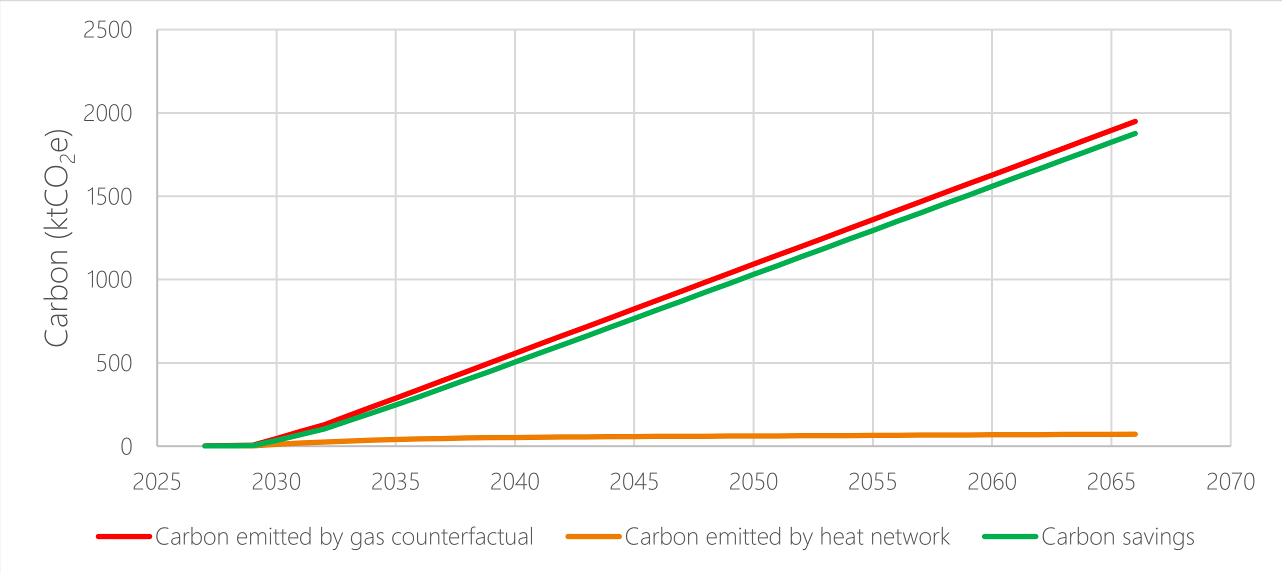


Figure 54 shows an overview of carbon savings related to this network. It highlights how much carbon would be emitted by the heat network over its lifetime and compares this to the emissions if the current heating systems were not replaced. The heat network represents a significant saving in carbon over maintaining today's heating systems. Key data assessed over 40 years from Phase 1 completion (estimated network lifetime):

- Total carbon emitted by network: 72.0 kt$CO_2$e
- Total carbon emitted by gas counterfactual: 1,948.6 kt$CO_2$e
- Total net carbon savings: 1,876.5 kt$CO_2$e

Figure 54: Cumulative carbon emissions and emission savings from the Hammersmith Town Centre and Olympia network




The heat network represents a significant saving in carbon over maintaining today's heating systems. In total, to 2050, the heat network would emit 48.4 kt$CO_2$e. Today's heating systems would emit 1,108.5 kt$CO_2$e. This means the network results in net carbon savings of 1,060.1 kt$CO_2$e.

## 2.10.2. Economics

The summary of network economics and carbon emissions for Hammersmith Town Centre and Olympia is shown in Table 10.

Table 10: Hammersmith Town Centre and Olympia heat network economic summary – Full network

| Items | Heat Network | Counterfactual - ASHPs | Counterfactual – Gas boilers |
|---|---|---|---|
| Overall system COP | 2.81 | 2.4 | N/A |
| Heat sales tariff, p/kWh | 15.13 | N/A | |
| Capital cost, £ | £228,673,049 | £237,504,431 | £10,135,846 |
| Operating and replacement cost, £ | £664,102,355 | £1,345,975,867 | £509,529,627 |
| Net Present Cost, £ | £512,135,572 | £758,775,702 | £221,186,359 |
| Levelised cost of heat, p/kWh | 11.09 | 16.43 | 4.79 |
| Carbon emissions 40-years, $tCO_2e$ | 72,032 | 79,211 | 1,948,576 |
| Internal rate of return (IRR) | 8.0% | N/A | |

Whilst the net present cost of heat networks may seem higher than that of a gas counterfactual, this does not account for the cost of carbon emissions. Following the medium level prices set out by the Green Book, the additional cost of the emissions from the gas counterfactual would be £692.0 million.

Figure 55: NPC vs carbon emission – Hammersmith Town Centre and Olympia

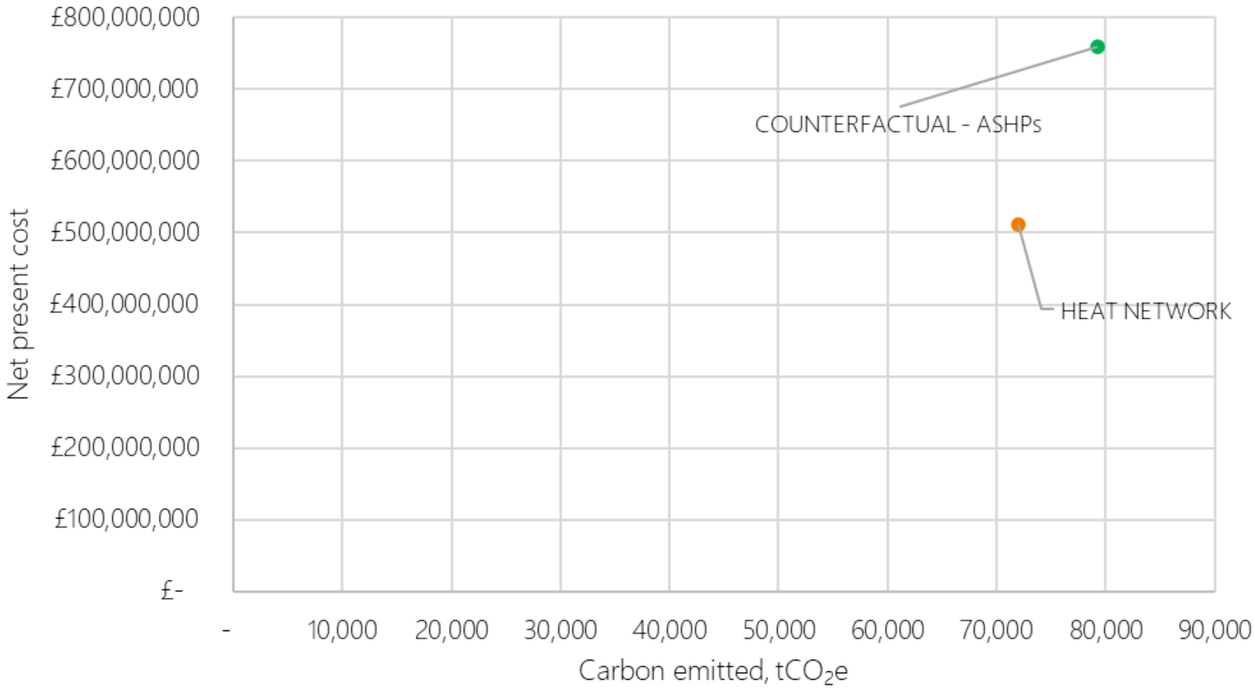
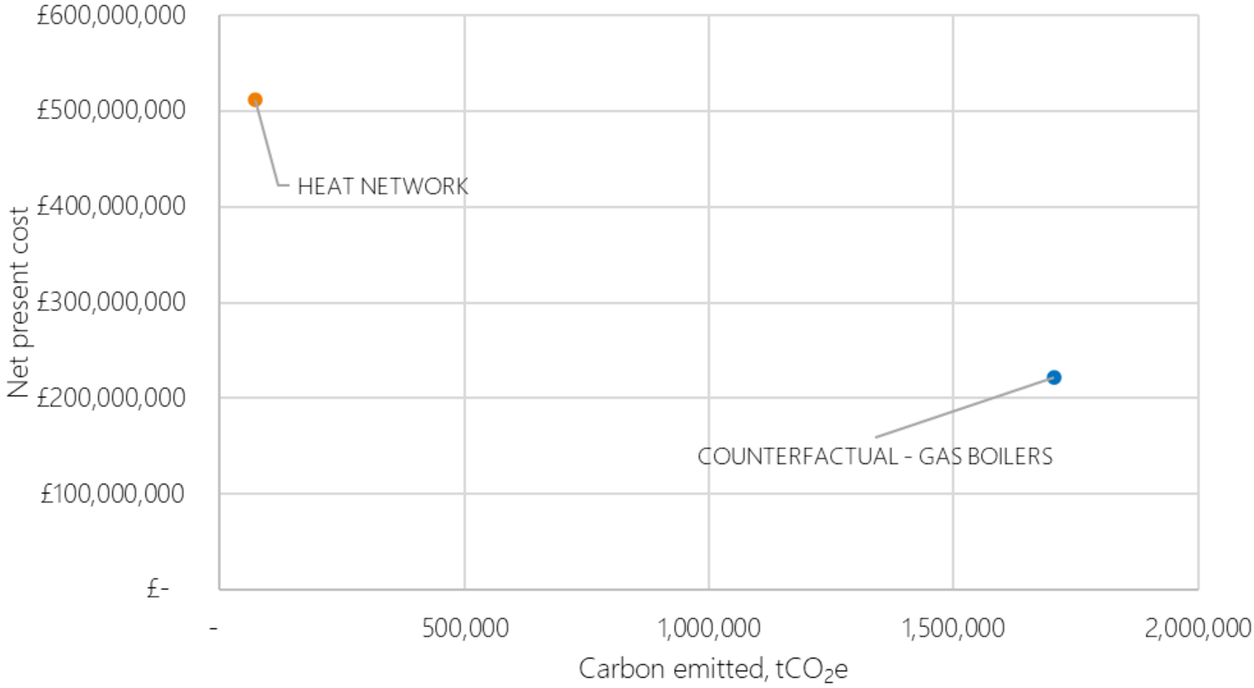



Figure 55 and Table 10 show that the district heat option is found to be cheaper and have a lower carbon footprint than the counterfactual of individual ASHPs. While individual gas boilers offer cost-effective heating, they come with several drawbacks, notably a higher carbon emission when compared to low-carbon heat networks. Moreover, reliance on individual gas boilers hinders local authorities from achieving their carbon targets. The UK Government's 2035 ban on new gas boiler sales will also mandate the adoption of alternative low carbon heating systems. As a result, district heating networks are the preferred low carbon solution for achieving heat decarbonisation in Hammersmith Town Centre and Olympia. The heat network NPC and carbon performance versus individual gas boilers counterfactuals is shown in Figure 56.

Figure 56: NPC vs carbon emission – Hammersmith Town Centre and Olympia (Gas boilers counterfactual)




## 2.10.3. Sensitivity

### 2.10.3.1. CAPEX sensitivity

Figure 57 demonstrates the impact of varying network CAPEX on the network economics. An increase in total network CAPEX will have a detrimental impact on the network's economic performance as it results in higher total network costs while network revenue remains unchanged.

If a grant funding of 30% is secured for the full network, this would increase the network IRR to 9.88%.

Figure 57: Variable element of CAPEX

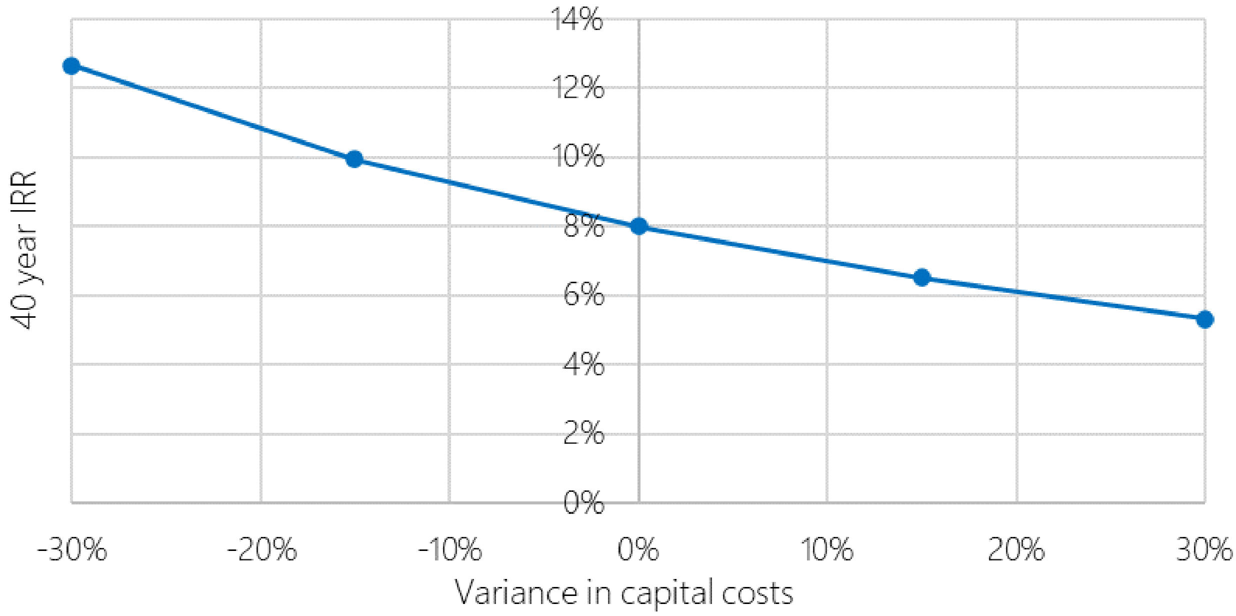
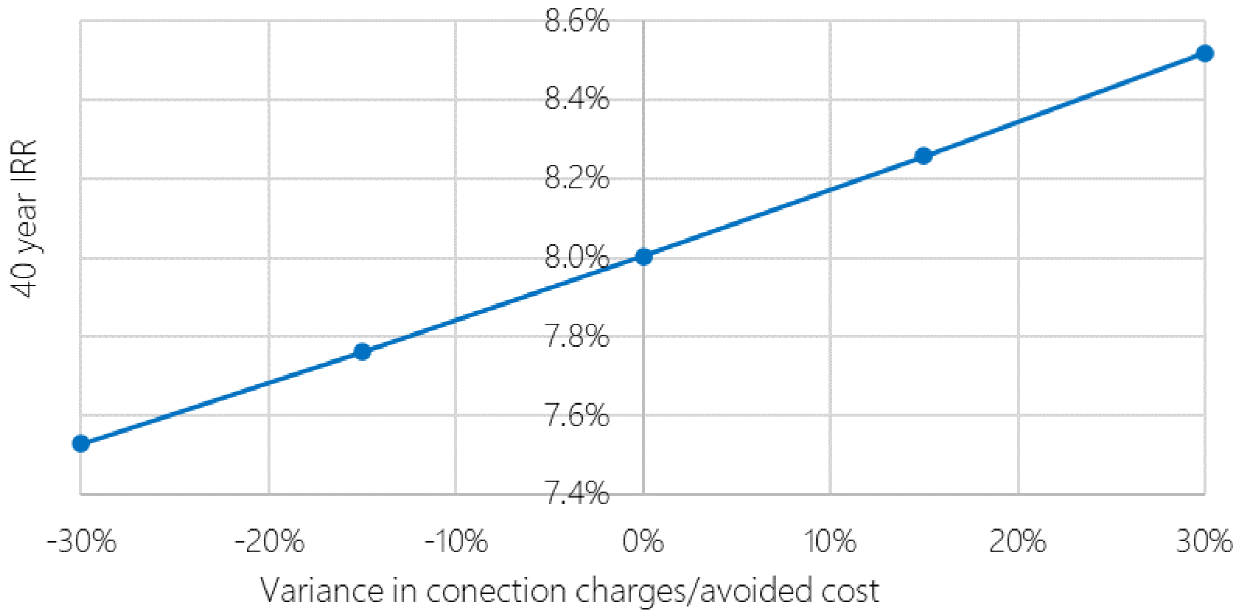



Figure 58 demonstrates the impact of varying connection charges/avoided cost on the network economics. A reduction in connection charges/avoided costs has a minor effect on the network performance as the cost reduction is not significant compared to total network costs. This suggests that charging customers less to connect to the heat network will only have a minor impact on the network's economics.

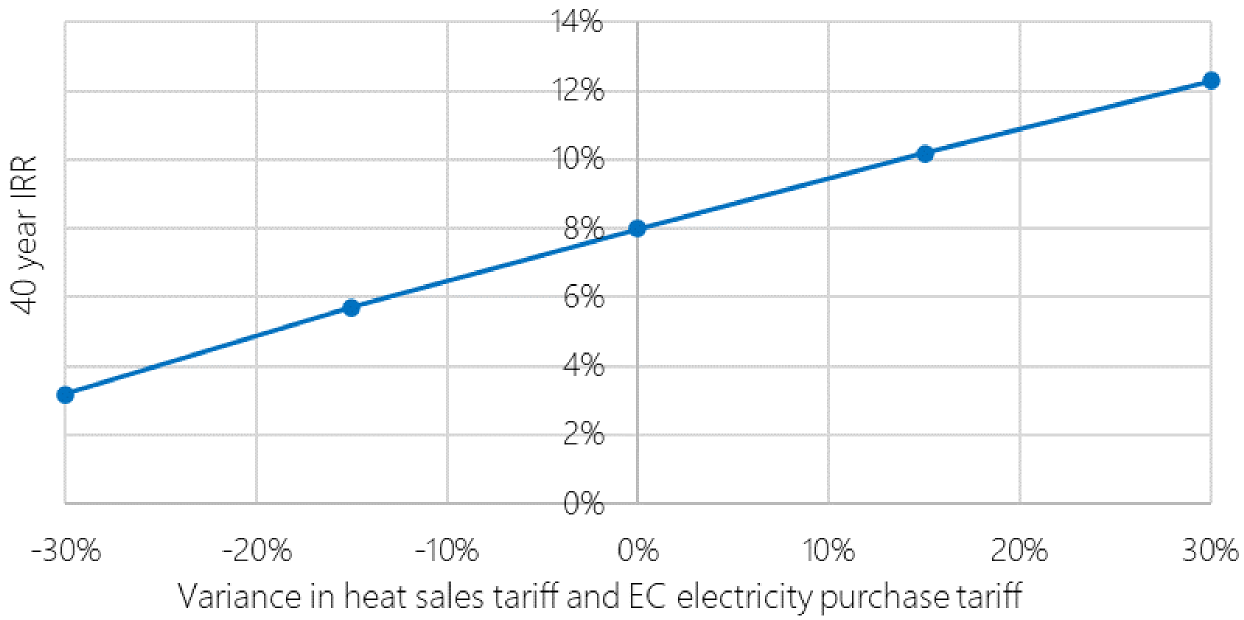
Figure 58: Variable element of connection charge/avoided cost




### 2.10.3.2. Energy tariff sensitivity

Figure 59 shows the impact of a variance in the energy and heat sales tariff and energy centre electricity purchase price on the network's economic performance. A positive IRR results from increasing both the heat sales tariff and energy centre electricity purchase price. This indicates that an increase in the heat sales tariff has a greater impact on network economic performance, as more revenue is generated than the increased costs when both parameters are increased simultaneously. This sensitivity has been carried out as it is likely that both these elements would vary with electricity prices.

Figure 59: Variable element of heat sales tariff and electricity purchase tariff




## 2.11. Technical and economic conclusions

As evidenced throughout this chapter, most of the boroughs are of sufficient density to prefer heat networks over non-networked ASHPs for decarbonising heat. There are also a range of heat supplies available to exploit, with little constraint from an electricity grid perspective. Additionally, there are many routes to choose from in laying heat network pipes.

Figure 60 compares the number of end connections per network. White City has the greatest number of end connections, likely reflecting the number of larger residential and commercial buildings in the area, including the Westfield shopping centre. The Chelsea & Westminster Hospital and World's End network has the least. This is likely because it is dominated by three large hospitals with fewer end connections.

Figure 60: Number of end connections per network

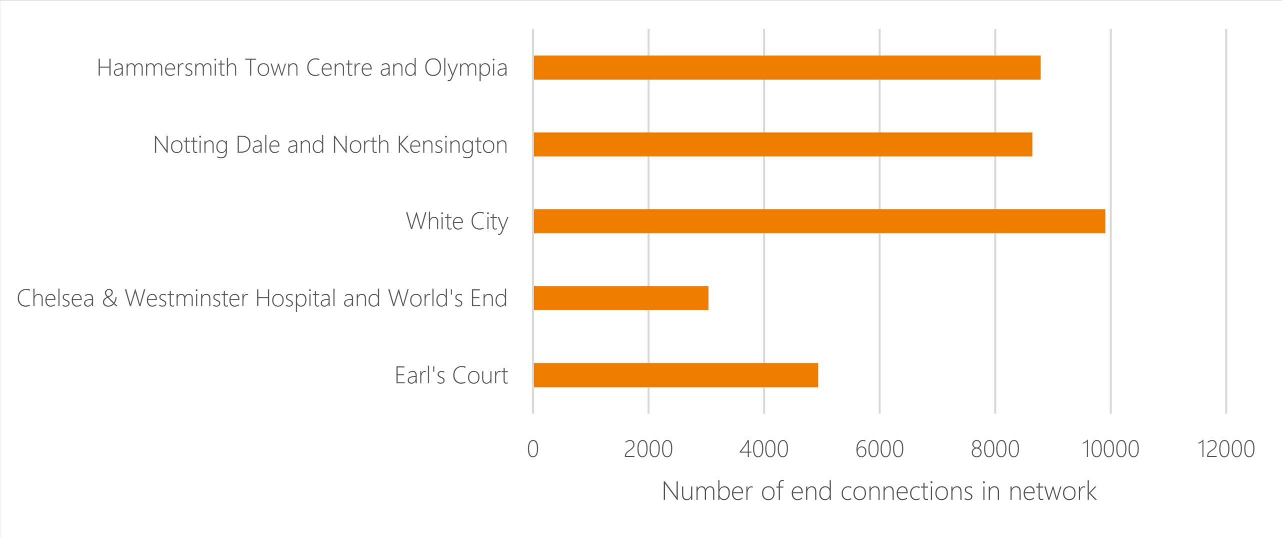



Figure 61 compares the total heat demand met by each network. In this case the Hammersmith Town Centre and Olympia network meets the greatest heat demand, followed by White City and then Chelsea & Westminster Hospital and World's End.

Figure 61: Total heat demand met by network (GWh/year)

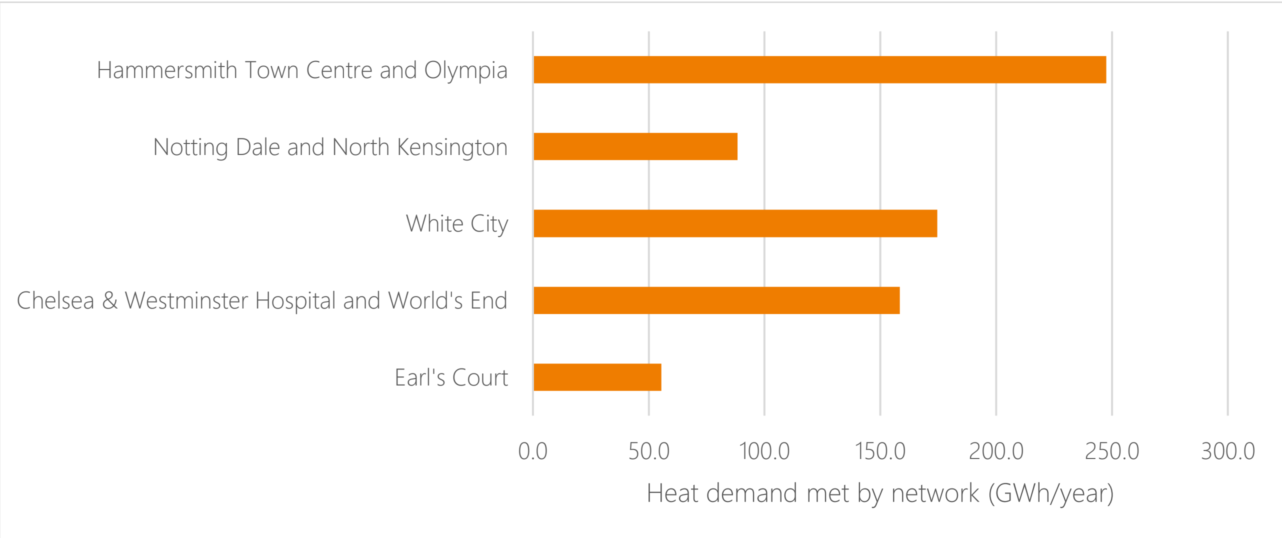
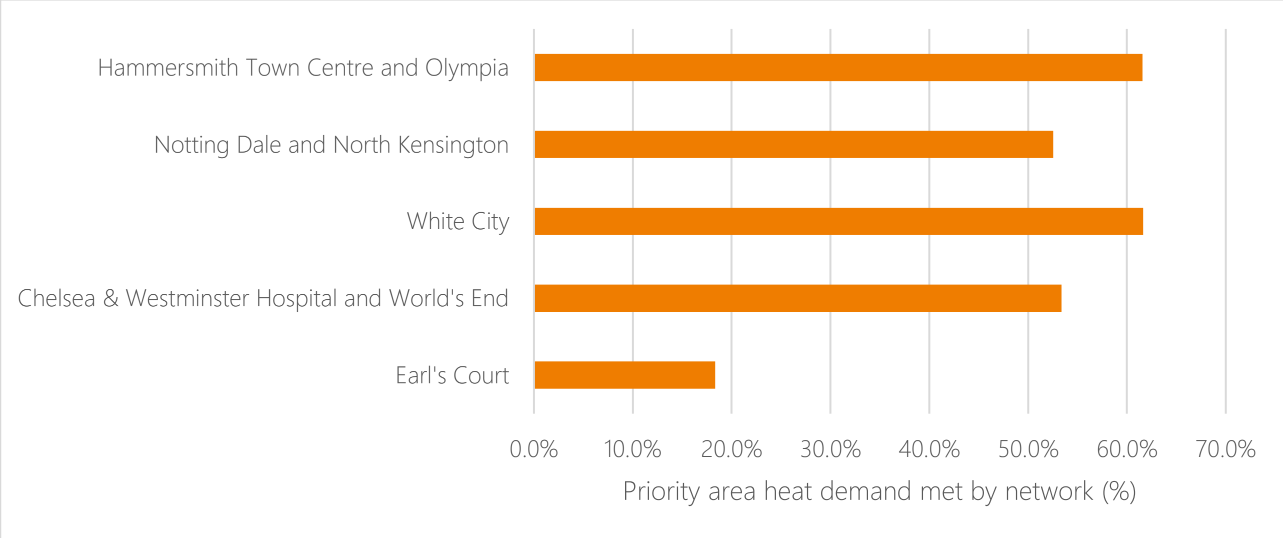


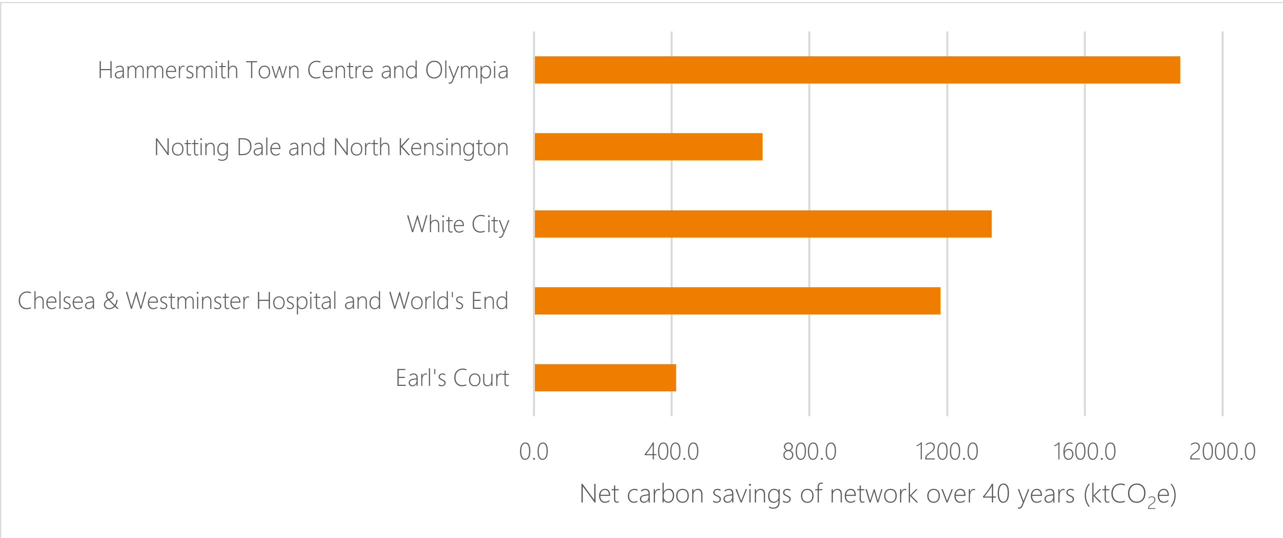

Figure 62 highlights the percentage of heat demand in each priority area met by the heat network in that area. All modelled networks except Earl's Court meet more than 50% of the heat demand of the priority area they are in. The lower amount in Earl's Court is likely because the ECDC development site, when operational, would cover a significant portion of the area's heat demand, which could then be added to the modelled networks outputs.

Figure 62: Percentage of heat demand in the priority area met by the networks




Finally, Figure 63 shows the carbon savings made by each network over the heating systems that each building has today. All the networks offer significant carbon savings compared to the status quo. In general, carbon savings are proportional to the amount of heat demand met by the network, therefore connecting more demand to networks will lead to greater carbon savings.

Figure 63: Carbon savings for each network compared to current heating systems




The charts above highlight the potential of each network for meeting significant portions of the heat demand of each area with great net carbon savings.

From a techno-economic perspective, Table 11 shows the 40-year Net Present Cost and carbon emissions for all prioritised network areas.

Table 11: TEMs summary

| | Earl's Court | C & WH & WE | White City | ND & NK | HTC & O |
|---|---|---|---|---|---|
| 40-year Net Present Cost, £ | £169,535,399 | £251,525,622 | £387,733,457 | £250,842,162 | £512,135,572 |
| CAPEX, £ | £79,030,564 | £101,948,713 | £153,524,048 | £133,985,945 | £228,673,049 |
| Operating and replacement, £ | £210,392,845 | £346,141,894 | £494,092,069 | £294,462,712 | £664,102,355 |
| ASHPs counterfactual NPC, £ | £192,366,141 | £367,855,569 | £551,116,782 | £361,874,237 | £758,775,702 |
| Gas boiler counterfactual NPC | £47,729,391 | £130,071,280 | £157,981,896 | £88,456,656 | £221,186,359 |
| Carbon emissions 40-years, $tCO_2e$ | 14,424 | 39,026 | 49,760 | 24,649 | 72,032 |

In all assessed cases, the network is shown to be a cheaper solution than the counterfactual of individual ASHPs and emits significantly less carbon than both the individual ASHPs and the gas boilers counterfactuals. Despite gas boilers delivering the lowest heat cost, several drawbacks are associated with them. These include significantly higher carbon emissions compared to a low-carbon heat network. Furthermore, the use of gas boilers will not enable local authorities to meet their carbon targets.

Heat networks are therefore expected to be the heating solution which delivers the lowest cost of heat to customers. It is also expected that a heat network would offer other technical benefits compared to individual ASHPs such as:

- Reduced building-level disruption to customers from decarbonisation compared to the installation of ASHPs
- Reduced visual disruption in comparison with individual ASHPs in dense urban areas
- Reduced strain on the local electrical grid – heat networks typically require a lower electrical connection capacity than the counterfactual of individual ASHPs
- Ability to benefit from financial incentives from electricity grid operators through thermal storage and time of use tariffs

- Ability to benefit from Government grants aimed at developing heat networks
- Resilience to future changes in the energy landscape – for example, hydrogen fuel cells could be installed on the network, should this technology prove to be cost-competitive in the future

An overview of the heat networks across the two boroughs, as well as additional heat network-related activity is shown in Map 21. Key statistics of each network are summarised in Table 12. The map shows that the networks are all in relatively close proximity to one another, they largely cross or run along the borough boundary and in some cases use the same heat supply.

Map 21: Overview of the heat networks within the study area

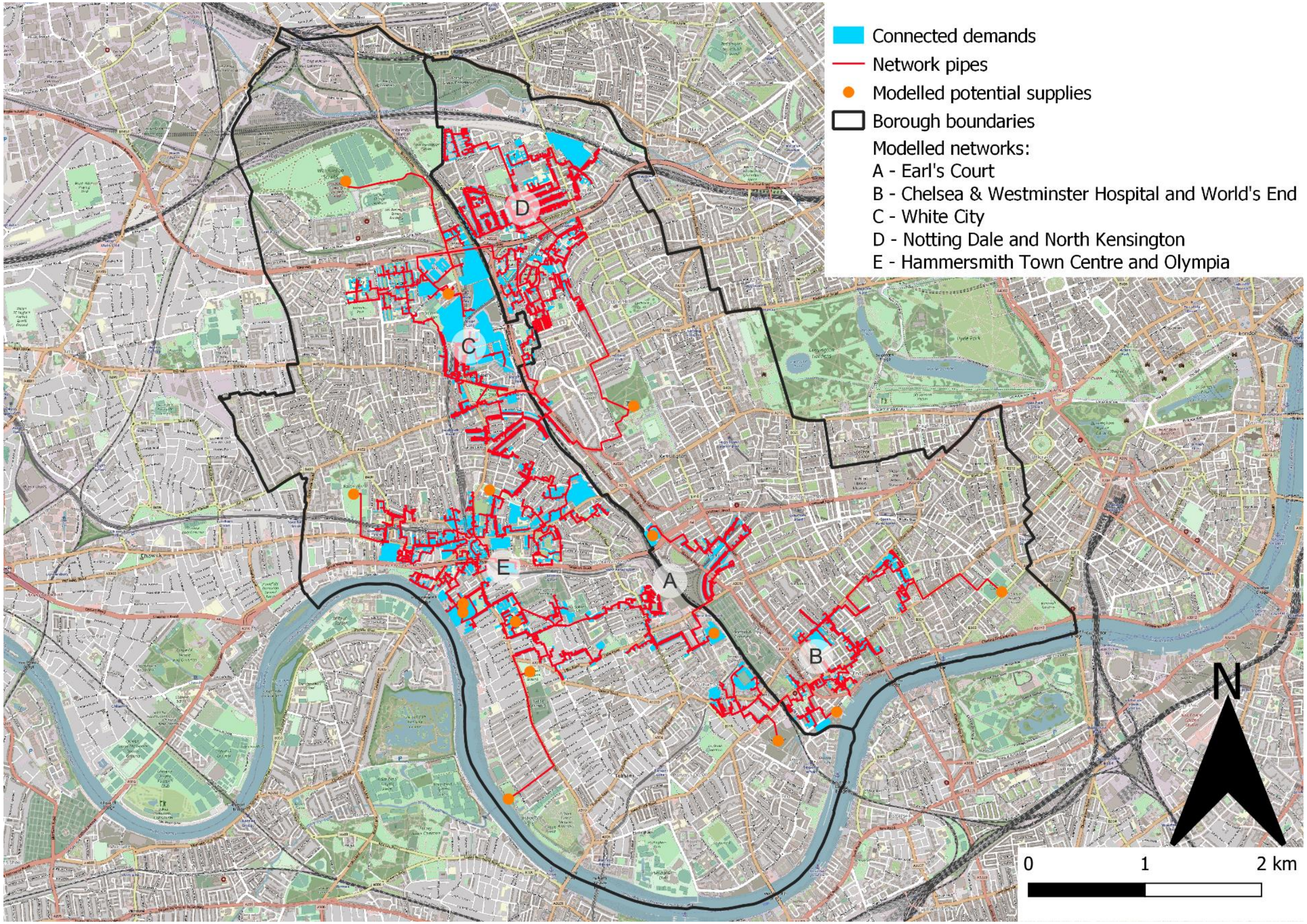


Table 12: Key statistics of the five networks

| | Total heat demand connected (GWh/year) | Priority area heat demand connected (%) | Total heat supply potential (GWh/year) | Leftover heat supply potential (GWh/year) | Net carbon savings over 40 years ($ktCO_2e$) |
|---|---|---|---|---|---|
| Earl's Court | 55.4 | 18.3% | 59.3 | 87.1 | 412.8 |
| Chelsea & Westminster Hospital and World's End | 158.4 | 53.4% | 162.9 | 28.5 | 1,180.3 |
| White City | 174.6 | 61.6% | 181.0 | 157.8 | 1,329.9 |
| Notting Dale and North Kensington | 88.3 | 52.5% | 96.7 | 150.8 | 663.9 |
| Hammersmith Town Centre and Olympia | 247.5 | 61.6% | 257.0 | 240.4 | 1,876.5 |

From an overarching view of all these networks, there are some clear opportunities that can be capitalised on:

- Sharing of a heat supply could pose an opportunity for the networks to be joined at the shared supply, if the difficulties of competition for heat could be resolved, e.g. through flexibility or adding other supplies to the network. This would allow synergy between the networks, leading to better returns and performance for both networks involved. This combination of smaller networks is how Copenhagen's city-wide network grew over time

- Through the stakeholder engagement process, the idea for a north-south "heat spine" which could run along the boundary between the two boroughs was presented. The geographic position of the networks shown in Map 21 reveals that they all lie near or adjacent to the shared boundary between the two boroughs. This could support proposals for a north-south heat main that the networks could draw heat from, however no modelling has been done to establish the viability of this idea

- There is much more heat network activity ongoing in the study area that did not fall within the scope of the detailed modelling undertaken for this masterplan. This includes:

- o Plans for the OPDC redevelopment to pursue a heat network with heat supplied by a number of data centres, as shown in Map 21 and to expand this heat network down to Wormwood Scrubs Hospital
- o Plans for the historical and cultural quarter in South Kensington by the organisation South Ken ZEN+, who are working to establish a zero-emissions heat network around the museums in the area

• Both areas of heat network activity show that the development of heat networks in the area is well under way. In the longer term, it may be possible to interconnect these heat networks to some or all the networks modelled in this report

There are also a couple of technical considerations that will need further attention when implementing this masterplan:

- Having two networks sharing a heat supply means that it may not be possible for both to be viable on the modelled supply. In some cases, there is some capacity on the supply to partially meet the yearly heat requirements of more than one network, but there could be issues with instantaneous capacity
- There is greater supply potential in Hammersmith and Fulham, which could cause issues with ideas of supply and demand where there is not cross-borough cooperation

The techno-economic modelling and analysis presented in this chapter clearly shows that the study area is extremely well placed for the development of low and zero-carbon heat networks in and across the two boroughs. Progressing the modelled heat networks to the next stage will allow the potential benefits identified to be realised.

# 3. Social processes

## 3.1. Approach

Whilst technical analysis is crucial in the identification of viable heat network opportunities, the successful delivery of the opportunities highlighted through this masterplan will ultimately rely on the involvement and endorsement of a broad range of local, regional and national stakeholders.

Like all large infrastructure initiatives, the development of heat networks across the two boroughs will be an iterative process, with each new stage building from the work done in the previous one. There are stakeholders within each authority and the wider area that are best placed to build the foundations and enabling environment required to support the proliferation of heat networks in the coming years. Assuming that this energy masterplan is stage 1, the social process and approach used in its development have prioritised the identification of, and engagement with, these stakeholders.

Building on the Design Council's Double Diamond[22], the general project approach used in the development of this masterplan has comprised of two defined modelling stages, each bounded by engagement periods at their start and end. This approach was selected specifically to build buy-in to the outputs of the masterplan, with a broad range of stakeholders engaged from an early stage and involved in the selection of the priority networks.

For a visualisation of the full engagement approach, see Appendix C: Full project process.

To further embed the work within the local context and identify those opportunities most likely to be progressed in the coming years, the engagement carried out through the development of this masterplan has adhered to the following three principles:

- Listen, learn and build from what is happening already
- Explore and capitalise upon shared interest
- Always look to build capacity and relationships that last into the future

In the following sections, the engagement activities and outputs carried out through this project will be outlined in chronological order and include:

1. Local area characterisation and engagement strategy development
2. Key stakeholder conversations
3. The prioritisation and selection of priority heat networks for further analysis
4. Non-technical analysis and route mapping

[22] https://www.designcouncil.org.uk/our-resources/the-double-diamond/

## 3.2. Local area characterisation and engagement strategy development

Following on from the project inception meeting, CSE and SEL carried out a desk-based review of local and regional projects, strategies and initiatives that had potential synergy with the development of a Cross-Borough Energy Masterplan. Through identification of the stakeholders involved in or leading these initiatives a baseline was built for the broader stakeholder mapping process outlined in Workshop 1 below.

### 3.2.1. Workshop 1: Local area characterisation and mapping

The first workshop was held on 26th January 2023 at Kensington Town Hall, with those present on the day including representatives from both Hammersmith and Fulham and Kensington and Chelsea Councils, as well the Centre for Sustainable Energy and Sustainable Energy Ltd. A full list of attendees of all project workshops can be found in Appendix D: Stakeholder involvement.

Figure 64: Workshop 1 participants

As the first key step in the project, this workshop focussed on establishing key project processes, building a shared understanding of the local context, identifying key stakeholders and agreeing governance and delivery mechanisms.

To kick this off, participants were invited to co-explore:

- The moving parts in the local area that will impact the delivery of the project and future implementation of heat networks across the two boroughs
- The decisions that might need to be made within and between the local authorities and how they would be made
- The realistic 'starting point' for the project in light of previous work done and the ambition and buy-in of the respective local authorities

In the next part of the workshop participants were led through a dynamic stakeholder mapping activity, with key steps as follows:

- Participants were asked to independently spend some time considering the most important potential project stakeholders 'not in the room' and write these onto sheets of paper. Where possible, participants were asked to name individual stakeholders (for example [name] instead of [organisation])
- An 'interest-influence' axis was created on one wall of the room, with Low-to-High Interest on the x-axis and Low-to-High Influence on the y-axis. To represent those stakeholders that may be actively opposed to the project, a 'Negative Interest' label was added to the left of the origin on the x-axis
- Participants were asked to place each of their stakeholders on the axis in the place that they felt most appropriate for that stakeholder, given their knowledge or perceived understanding of both how influential that stakeholder could be in the development of heat networks in the area and how interested that stakeholder might be in being involved in the development of heat networks in the area
- Once all stakeholders were placed, participants were asked to suggest stakeholders they felt had been incorrectly placed and for each one a discussion in the room was had about why they felt they were wrongly placed and where they should be on the axis. When agreement was reached, the stakeholders were adjusted to the position agreed in the room
- After several rounds of discussion, the group was asked to collectively suggest any key stakeholders that were still missing from the picture. These were added one by one until the group felt all key stakeholders were represented on the axis
- Participants were then asked to suggest the 10-15 stakeholders that they deemed to be the most crucial to the project and these were recorded
- As a final task, a discussion was had about key stakeholder groupings and those that need to be prioritised within the development of the Cross-Borough Energy Masterplan

The workshop closed with a discussion about appropriate project governance mechanisms, decision making pathways and an analysis of project risks. The project plan was updated and agreed and next steps identified.

Figure 65: Stakeholder mapping


## 3.2.2. Workshop 1: key outputs and outcomes

- A shared understanding across the project team of the project purpose, starting point and opportunity
- A prioritised list of potential key project stakeholders and an understanding of the key groups to be targeted through the development of the masterplan, which were:
    - Stakeholders currently running or developing district heating schemes
    - Potential heat supplies
    - Major heat demands and anchor heat loads
    - Strategic stakeholders and those leading parallel workstreams
    - Those with a responsibility for updating policy and plans
- Agreement that engagement with internal local authority teams would be handled by the respective local authority leads
- Agreement that engagement with external partners would be handled by CSE and SEL, within appropriate project resource
- A shared understanding of immediate next steps and consent to the broader project programme
- An agreed approach to data collection and an established request for information (RFI) process

## 3.2.3. Engagement strategy and stakeholder tracker

Following the workshop, the outputs from the stakeholder mapping activity were used to develop the engagement strategy followed for this project, with key tasks identified and named leads for engagement with specific stakeholder groupings. This was submitted to and agreed by representatives from the two boroughs on the 17th February 2023.

Alongside the engagement strategy, the first iteration of a stakeholder tracker was developed. In line with the approach to social process outlined in Approach, the tracker was updated and reviewed regularly alongside representatives from the two boroughs with the aim of building understanding and knowledge that would enable them to continue to identify the key stakeholders required following the end of this project.

In the development of this masterplan extensive stakeholder engagement has been undertaken and at the time of writing this report there are 337 identified stakeholders from 131 distinct organisations and networks listed in the tracker.

## 3.3. Key stakeholder conversations

In agreement with the two local authorities, key stakeholder conversations were planned and held with the aims of:

- Identifying existing and planned heat networks across the two boroughs
- Identifying upcoming large developments
- Identifying potential supplies and demands that could be used to develop a heat network, as well as building stakeholder interest and buy-in to the process
- Building an understanding of the non-technical enablers and challenges that would need to be navigated going forwards in the delivery of an energy masterplan

As agreed in Workshop 1, conversations with external stakeholders were carried out by CSE and SEL, with internal conversations covered by the respective local authorities. Conversations were held as shown in Table 13.

Table 13: Key conversations carried out following Workshop 1

| Date | Organisation |
|---|---|
| 6th March | UK Power Networks |
| 9th March | Future Neighbourhoods (Kensington and Chelsea Council) |
| 9th March | Councillor Kim Taylor-Smith, Deputy Leader, Grenfell Housing, Housing and Social Investment, Kensington and Chelsea Council |
| 10th March | West London Chambers of Commerce (via telephone) |
| 22nd March | Thames Water |
| 23rd March | Cadogan Estates |
| 23rd March | OPDC, Ealing Council, Brent Council |
| 24th March | Transport for London |
| 26th March | Eclipse Power (IDNO for Kensington Olympia) (via telephone) |
| 29th March | Cadent Gas |

| Date | Organisation |
| --- | --- |
| 30th March | South Ken Zen+ (including V&A, Natural History Museum and Imperial College) |
| 30th March | SSE |
| 4th April | West London LAEP (via Arup) |
| 4th April | Environment Agency (via email) |
| 13th April | West London NHS Trust |
| 13th April | Councillor Wesley Harcourt, Cabinet Member for Climate Change and Ecology, Hammersmith and Fulham Council |
| 17th April | North-West London ICB |
| 20th April | Earl's Court Development Company |
| 2nd June | Imperial College White City Campus |

## 3.4. The prioritisation and selection of priority heat networks for further analysis

To ensure a robust selection process for the five priority networks identified in this masterplan, it was agreed that a longlist of potential networks developed through the modelling process would be prioritised alongside local stakeholders through Workshop 2. Five of these would be subsequently selected by an Advisory Group of senior stakeholders from teams across both local authorities.

To capitalise on this opportunity, it was further agreed that Workshop 2 would serve as a public launch of the Cross-Borough Energy Masterplan, with local, regional and national stakeholders invited to help build interest and momentum around the potential collaboration.

### 3.4.1. Workshop 2: Cross-Borough Energy Masterplan launch and heat zone selection

The second workshop was held on 10th May 2023 at Kensington Town Hall with 154 stakeholders from 63 organisations invited to help prioritise the heat network opportunities for further analysis through the masterplan. On the day, 72 stakeholders from 30 organisations attended, with broad representation from existing district heating schemes, major potential supplies and large developments as well as senior level representation from both borough authorities, the GLA and the Department for Energy Security and Net Zero (a full list of the organisations represented can be found in Appendix D: Stakeholder involvement).

For the morning session, a number of stakeholders gave presentations on their respective work areas. These presentations were split into four sections and covered the local context, existing local authority schemes, the regional and national policy and funding context and commercial district heating schemes. See below for further information on the topics and speakers.

Figure 66: K&C Deputy Leader Cllr Kim Taylor Smith and H&F Climate Commissioner Helen Dell


In between each section there was a Q&A panel, with workshop participants able to ask questions directly of the speakers. The 'Policy and funding context' section in particular was an area of interest for participants, with questions focussing on Heat Network Zoning and how to access funding opportunities.

Table 14: Presentation topics and speakers at Workshop 2

| Section | Topic | Speaker |
|---|---|---|
| Local context | Why this conversation matters to the two boroughs | Cllr Kim Taylor Smith, Deputy Leader of Kensington and Chelsea Council<br>Helen Dell, Climate Change Commissioner for Hammersmith and Fulham |
| | The Cross-Borough Energy Masterplan | Kat Drake, Cross-Borough Energy Masterplan Programme Manager at Kensington and Chelsea Council<br>Tim Pryce, Climate Emergency Energy Lead at Hammersmith and Fulham Council |
| Local Authority District Heating Schemes | Lancaster West & Notting Dale Heat | James Caspell, Neighbourhood Director (Lancaster West & Grenfell Housing Services)<br>Jeff Laidler, Heat Network Programme Manager for the Notting Dale Heat Network |
| | Existing Kensington & Chelsea District Heating Schemes | Doug Goldring, Director of Housing Management at Kensington and Chelsea Council<br>Dr FeiFei Sun, Energy and Sustainability Project Manager at Kensington and Chelsea Council |
| | Hammersmith and Fulham | Hinesh Mehta, Assistant Director of Climate Change at Hammersmith and Fulham Council |

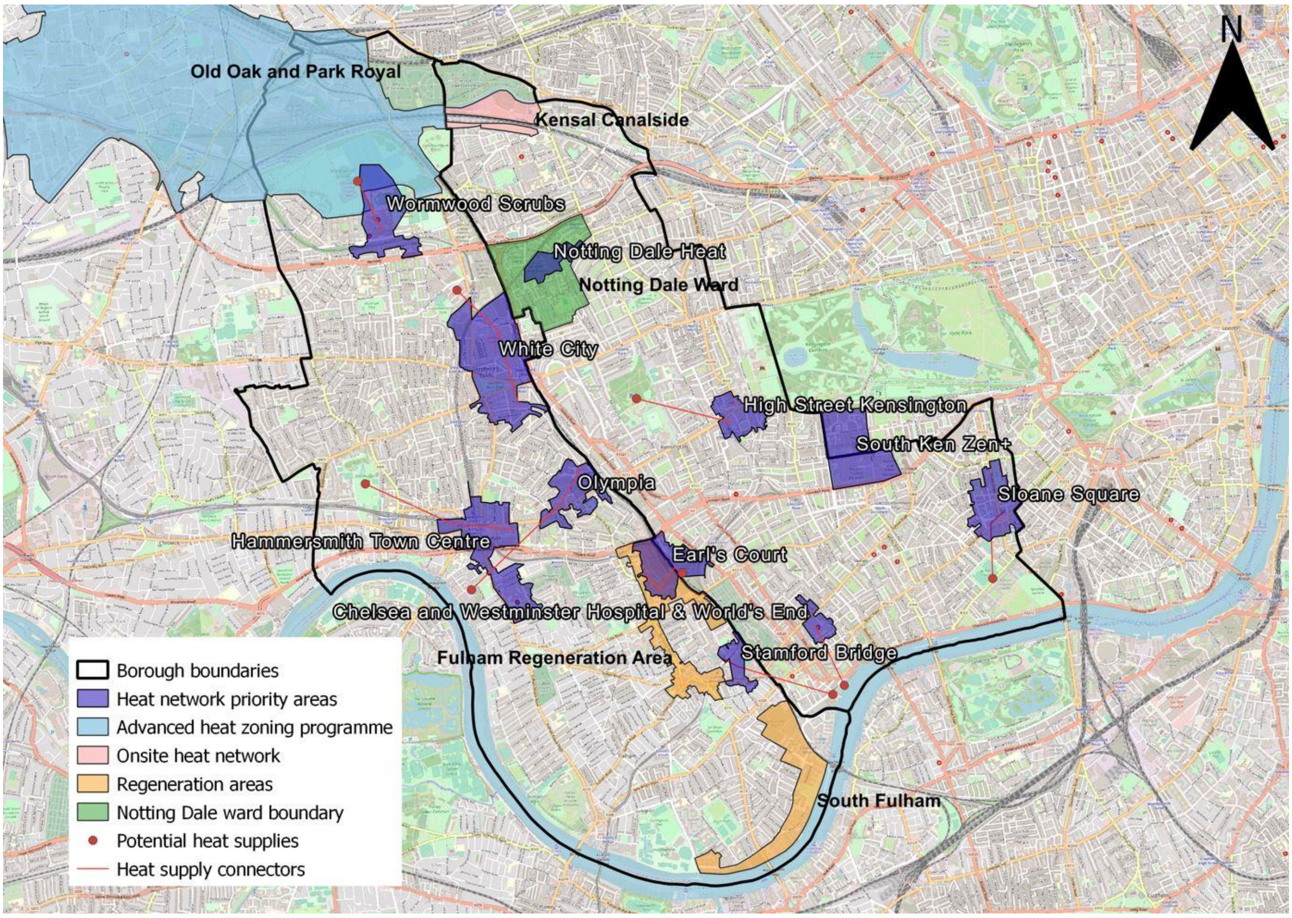
| Section | Topic | Speaker |
| --- | --- | --- |
| | Hammersmith Town Centre & West Kings Street Heat Network | Matt Sealby, Director at QODA |
| | Existing Hammersmith & Fulham District Heating Schemes | Rob Kyle, Sustainability Asset Manager at Hammersmith and Fulham Council |
| Policy and funding context | Heat Network Zoning | Cantor Mocke, Head of Market Growth for Heat Networks at DESNZ |
| | London Policy Background and Context | Stephen de-Souza, Strategic Programme Manager (Energy) at GLA |
| | Partnering with Government to deliver low carbon heat network market growth | Ken Hunnisett, Head of Public Sector at Triple Point Investment Management |
| Commercial district heating schemes | Earl’s Court Development Company (ECDC) | Peter Runacres, Head of Urban Futures at ECDC |
| | Old Oak and Park Royal Development Corporation (OPDC) | Phillippa Illingworth, Head of Infrastructure at OPDC |
| | SSE (White City and Television Centre) | Jody Pittaway, Head of Project Development at SSE Plc |
| | South Ken Zen+ | Melissa Painter, Head of Sustainability at Victoria and Albert Museum |

To start the afternoon session, participants were given a brief presentation on the modelling process, with an explanation of the following:

- The scope of the modelling
- The input datasets used
- How the THERMOS model works
- An explanation of what will be done in the next modelling phase following the selection of five priority networks

Participants were then presented with the outputs of the initial modelling in the form of the following map (Figure 67).

Figure 67: The longlist of potential networks




After an explanation of the map and its key, the room was divided into eleven sub-groups, with a detailed map of a different 'Heat network priority area' (purple) on each table. Each table was assigned a letter for clarity, with networks split as per Table 15 below.

Table 15: Workshop 2 afternoon activity sub-groups

| | |
|---|---|
| Table A – Wormwood Scrubs<br>Table B – White City<br>Table C – Hammersmith Town Centre<br>Table D – Olympia<br>Table E – Earl's Court<br>Table F – Stamford Bridge | Table G – Chelsea & Westminster Hospital & World's End Estate<br>Table H – Sloane Square<br>Table I – South Ken Zen+<br>Table J – High Street Kensington<br>Table K – Notting Dale Heat |

Participants were asked to go to the group with the network that was of most interest to their organisation, with the understanding that there were likely multiple networks of interest and that they could move between tables at any point throughout the following activities. A facilitator was allocated to each table and participants were then led through two activities with the aim of drawing out key information and ascertaining the level of interest in each network.

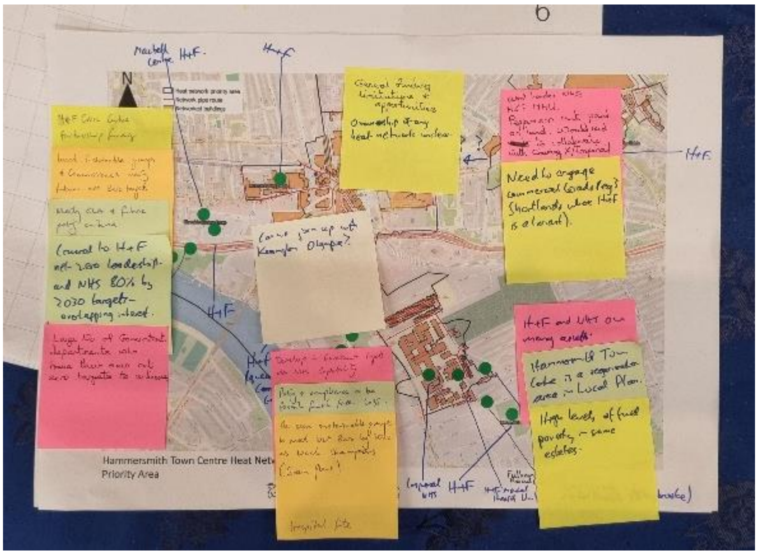
For the first activity, participants were asked to place a green dot on any assets that are owned by their organisation. As this activity developed, participants were asked, where possible, to identify the ownership of other key assets on the map, regardless of whether they were owned by their organisation.

For the second activity, participants were asked to identify non-technical conditions and factors that they believed may either enable or hinder the development of heat networks in the respective priority areas, using the following categories:

- Policy & regulatory conditions (green post-it notes)
- Commercial conditions (yellow post-it notes)
- Socio-cultural conditions (orange post-it notes)
- Capabilities & initiative taking (pink post-it notes)

To explain this in more detail, examples of enabling or hindering conditions and factors were given for each of these four categories and participants were given the opportunity to clarify their understanding before beginning the task.

Figure 63: Output from green dot and non-technical activities for Hammersmith Town Centre Network



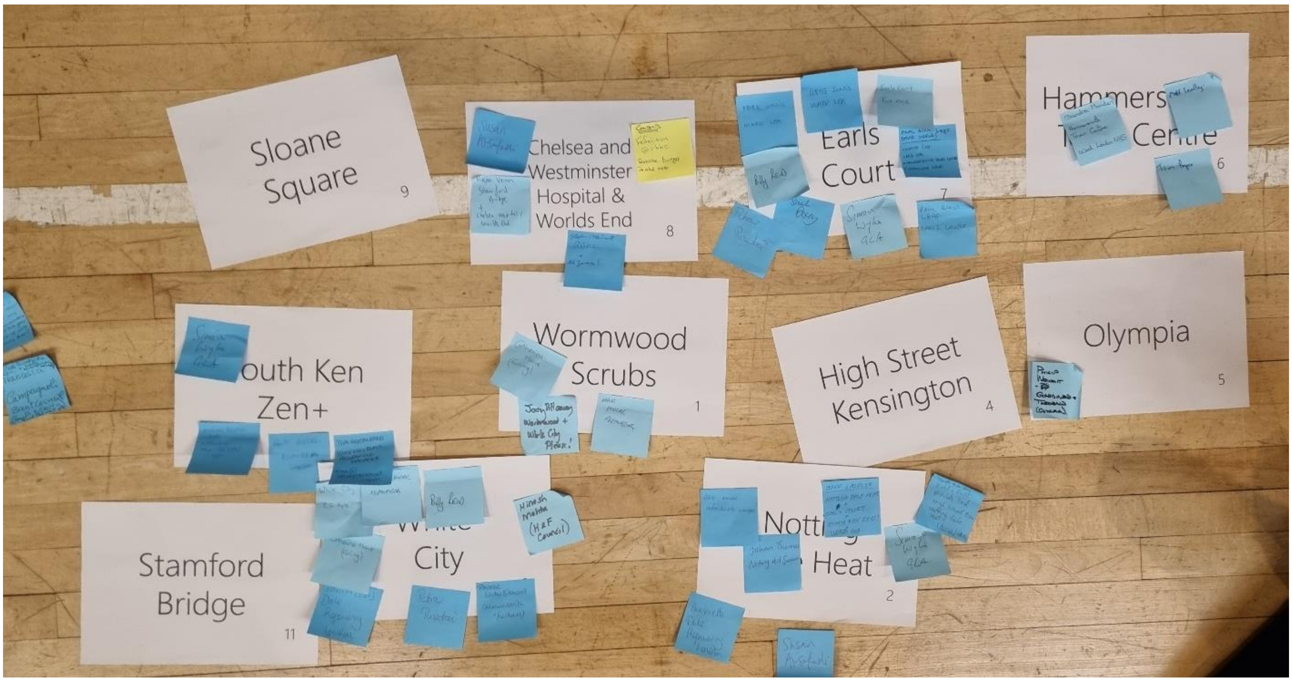

A third activity was planned to explore potential co-benefits of developing heat networks in each area, however, following a collective discussion with the facilitators it was agreed that this was already happening through the second activity and wouldn't offer any additional value.

At the end of the two activities, facilitators from each table were asked to feed key points back to the room. Whole group discussion was encouraged if there were similarities or synergies between the networks, as well as clear and important differences.

To close the session, participants were thanked for their inputs and each given a number of blue post-it notes. As they left, they were asked to indicate which networks they would be most interested in 'starting work on tomorrow', with the outputs from this activity in Figure 68 below.

Please note: whilst recognising that not all areas were represented by stakeholders at the event, attendance and interest have been valued through the development of this plan as an indication of a will and agency to implement heat networks that can be capitalised upon in the near term. To this end, this vote was considered within the area prioritisation in section 3.4.3 below and explained further in Appendix E: Full ranking and scoring criteria for the network prioritisation matrix.

Figure 68: Outputs from participant indication of interest




## 3.4.2. Workshop 2: Key outputs and outcomes

- Demonstrated stakeholder interest in, and mandate for, the significant heat network opportunities at hand, with a broad range of stakeholders engaged from across both boroughs, as well as from the GLA and national government
- An understanding of which networks are a strategic priority for key stakeholders
- The identification of a broad range of non-technical enablers and challenges for each network (output)
- A better understanding amongst the stakeholders present of the conditions that need to be navigated to make these opportunities a reality (outcome)

Figure 69: Workshop 2 participants

### 3.4.3. Heat network prioritisation

Using the outputs from the key conversations, Workshop 2 and elements of the technical analysis, a prioritised list of the 11 networks was developed (Table 16), with each network receiving scores for each of the following fields:

- A score of 1-5 for the proximity of the network opportunity to local authority-owned assets (a)
- A score of 1-5 based on the expressed interest and engagement from key stakeholders in the process to date (b)
- A score of 1-5 based on an assessment of the balanced of potential enablers and challenges and how easy the network could be to deliver in the short term (c)

These scores were totalled for each network and the following ranked list was produced, with the most preferable networks to be pursued by the local authorities receiving the highest scores.

For a full list of ranking and scoring criteria, see Appendix E: Full ranking and scoring criteria for the network prioritisation matrix.

Table 16: Network prioritisation matrix

| Rank | Heat Network Priority Identifier | Borough | Proximity to local authority assets (a) | Stakeholder prioritisation: Criteria 1 Interest and engagement from key stakeholders at workshop (b) | Stakeholder prioritisation: Criteria 2 Enablers & challenges (c) | Aggregate weighting (a + b + c) |
|---|---|---|---|---|---|---|
| 1 | B - White City | H&F | 5 | 5 | 4 | 14 |
| 2 | C - Hammersmith Town Centre | H&F | 5 | 5 | 4 | 14 |
| 3 | E – Earl's Court | H&F / K&C | 5 | 4 | 5 | 14 |
| 4 | G - Chelsea & Westminster Hospital and World's End | K&C | 5 | 5 | 4 | 14 |
| 5 | K - Notting Dale Heat | K&C | 5 | 5 | 4 | 14 |
| 6 | D - Olympia | H&F | 4 | 5 | 4 | 13 |
| 7 | I - South Ken Zen+ | K&C | 2 | 5 | 5 | 12 |
| 8 | A - Wormwood Scrubs | H&F | 4 | 4 | 3 | 11 |
| 9 | J - High Street Kensington | K&C | 4 | 4 | 3 | 11 |
| 10 | F - Stamford Bridge | H&F | 4 | 3 | 3 | 10 |
| 11 | H - Sloane Square | K&C | 3 | 3 | 2 | 8 |

## 3.4.4. First Advisory Group meeting

To select the five priority networks for further analysis through the project, an Advisory Group of senior stakeholders from teams across both local authorities was convened in an online meeting on 16th May 2023. For oversight and wider integration, representatives from the GLA and UK Power Networks were also present (for a full list of attendees, see Appendix D: Stakeholder involvement).

An update was given on the project so far, including the technical modelling and engagement activities. The network prioritisation matrix and scoring approach was presented to the group and discussed in detail.

Following the discussion, it was agreed that the five networks to be pursued would be, in alphabetical order:

- Chelsea & Westminster Hospital and World's End Estate (combined with Stamford Bridge)
- Earl's Court
- Hammersmith Town Centre (combined with Olympia)
- Notting Dale Heat (expanded to include the wider North Kensington area)
- White City

It is important to note that of the other networks that were not selected through this activity, South Ken Zen+ in particular was considered by both authorities to be an important strategic network. However, there is a lack of local authority assets in the area and a feasibility study is already being undertaken and funded by the Exhibition Road Cultural Group (ERGG), a partnership of 22 science and arts institutions including the museums and other internationally renowned cultural organisations in and around the South Kensington area. As a result, whilst not considered a Priority Area for this study, it is recognised that the South Ken Zen+ is an important heat network project and part of Kensington and Chelsea Council's route to net-zero, where the local authority has an important enabling role.

It was also recognised by the two boroughs that Old Oak and Park Royal Development Corporation (OPDC) are planning to develop heat networks utilising waste heat from several existing and planned data centres. This will offer considerable opportunities for collaboration going forwards, with clear potential for expansion into the surrounding boroughs. In particular this will have an impact on heat network development in the north of the study area and, to this end, it was agreed that the Wormwood Scrubs network should explored separately alongside OPDC as more detail emerges on the amount of waste heat available.

It was agreed within the Advisory Group that further action and engagement would be required to define the boundaries of each study area. Contacts for this were agreed for each network and the meeting was closed.

### 3.4.5. Subsequent engagement

Following the Advisory Group, stakeholders were engaged to help define the areas as agreed in the meeting. Conversations were also held with a number of additional stakeholders to identify additional data sets to support the detailed modelling. Further information and a list of these stakeholders can be found in Appendix D: Stakeholder involvement.

# 3.5. Non-technical analysis and route mapping

## 3.5.1. Workshop 3: Non-technical analysis and route mapping

On 11th July 2023 a mixture of stakeholders from the project delivery team and Advisory Group were convened for the final project workshop. This workshop was offered as a hybrid, with 13 in-person participants meeting at the Clockwork building in H&F and 15 participants joining online. For a full list of attendees, see Appendix D: Stakeholder involvement.

In the first workshop session, participants were given a presentation on the priority networks and techno-economic modelling undertaken through the project. This included:

- A recap of the first modelling phase and the five priority areas selected
- The heat network modelling methodology and process used
- Drawings and key statistics for each priority network
- Techno-economic modelling methodology and outputs

Some discussion was had for each network, with some additional local-authority owned priority housing estates identified for inclusion in the Earl's Court network (West Kensington Estate) and the White City network (White City Estate and Edward Woods Estate). The area to the east of Notting Dale ward was also further highlighted as a potential opportunity for future expansion of the Notting Dale and North Kensington network.

The challenge of networks being developed around the same heat supply was raised and it was agreed that to avoid issues arising a co-ordinated cross-borough approach to prioritisation and network phasing is required.

The potential for cross-borough collaboration around developing a spine network or north-south heat main was also discussed, with the proximity of each network to the borough boundary providing a "golden opportunity" that should not be missed.

For the second session, participants were led through a similar non-technical analysis activity to the one used in Workshop 2, with the aim of drawing out the enabling factors to be capitalised on and the challenges to be addressed or mitigated against in the development of heat networks across the two boroughs in the coming years.

As in Workshop 2, the categories were:

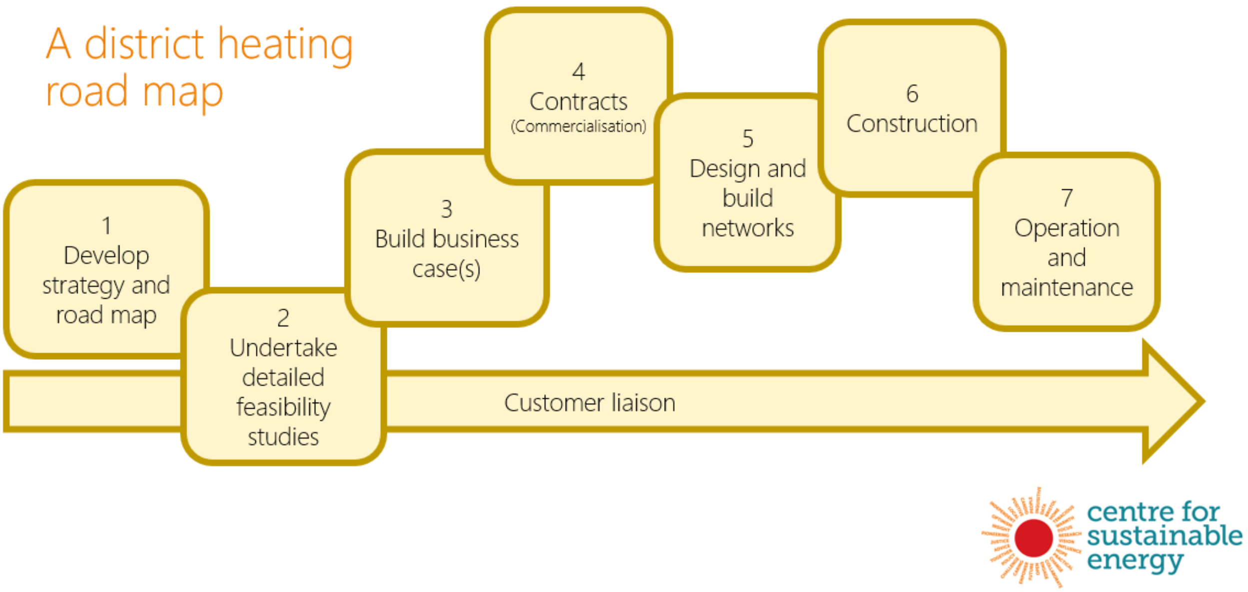
- Local, regional and national plans and policies (blue post-its)
- Funding and commercial factors (green post-its)
- Capabilities and initiative taking (pink post-its)
- Building consent and buy-in (yellow/orange post-its)

Whilst the activity in Workshop 2 had focussed on the individual priority networks, this activity was broader, with participants asked to identify factors and conditions at a borough, cross-borough and national level in addition to those for specific networks. Participants were split into three groups (two in-person and one online) and asked to suggest factors and conditions for each of the above categories and plot them onto a flipchart or Jam board with 'Hinder-Help' on the x-axis and 'Local-National' on the y-axis. Outputs from this activity have been included in the non-technical analysis outlined in chapter four of this masterplan.

The final session focussed on the route mapping element, with the aim of identifying the route mapping approach to be used, as well as building a shared understanding within the group of how best to frame the respective borough and cross-borough elements of the recommendations.

To initiate discussion, a general route map for developing a district heating network was presented, with the key stages and steps that need to be undertaken outlined. The route map used in the session is included in Figure 70, however a more detailed version can be found in Figure 74.

Figure 70: General route map for developing a district heating route map used in Workshop 3




Participants agreed that the work undertaken through the development of this masterplan so far sat within the first stage (develop strategy and road map) and that stages two to seven were specific to individual heat networks.

With this in mind, participants were led through a route mapping activity with the aim of identifying the tasks that will need to be undertaken in the coming months and years. It had been envisioned that participants would be split into groups for this activity, however due to the importance of having a shared understanding of the process required as well as the opportunities and challenges to be navigated it was felt that there was value to holding this discussion as a whole group.

Participants were asked to suggest the tasks that they felt needed to happen in the short term (6-months), medium term (7-24 months) and longer term (2-5 years), as well as which of these should happen at a borough, cross-borough and individual priority network level. These tasks were categorised as per the non-technical analysis used earlier in the workshop.

Key observations and learnings from this activity included:

- The majority of tasks and actions suggested by participants were at a borough level and focussed on the short term. The lack of medium and longer-term actions is indicative of the reliance of latter stages on conversations and actions that need to happen in the next few months about general direction of travel and prioritisation of opportunities within each borough
- There is a clear need to take action to build consent and buy-in amongst different departments at both local authorities for the opportunity (evidenced by the majority of actions relating to building consent and buy-in) as well as ascertaining the appetite for, and form of, future cross-borough collaboration
- Updating local planning policy is key, with both boroughs at different stages of their local planning process and therefore requiring different approaches to this

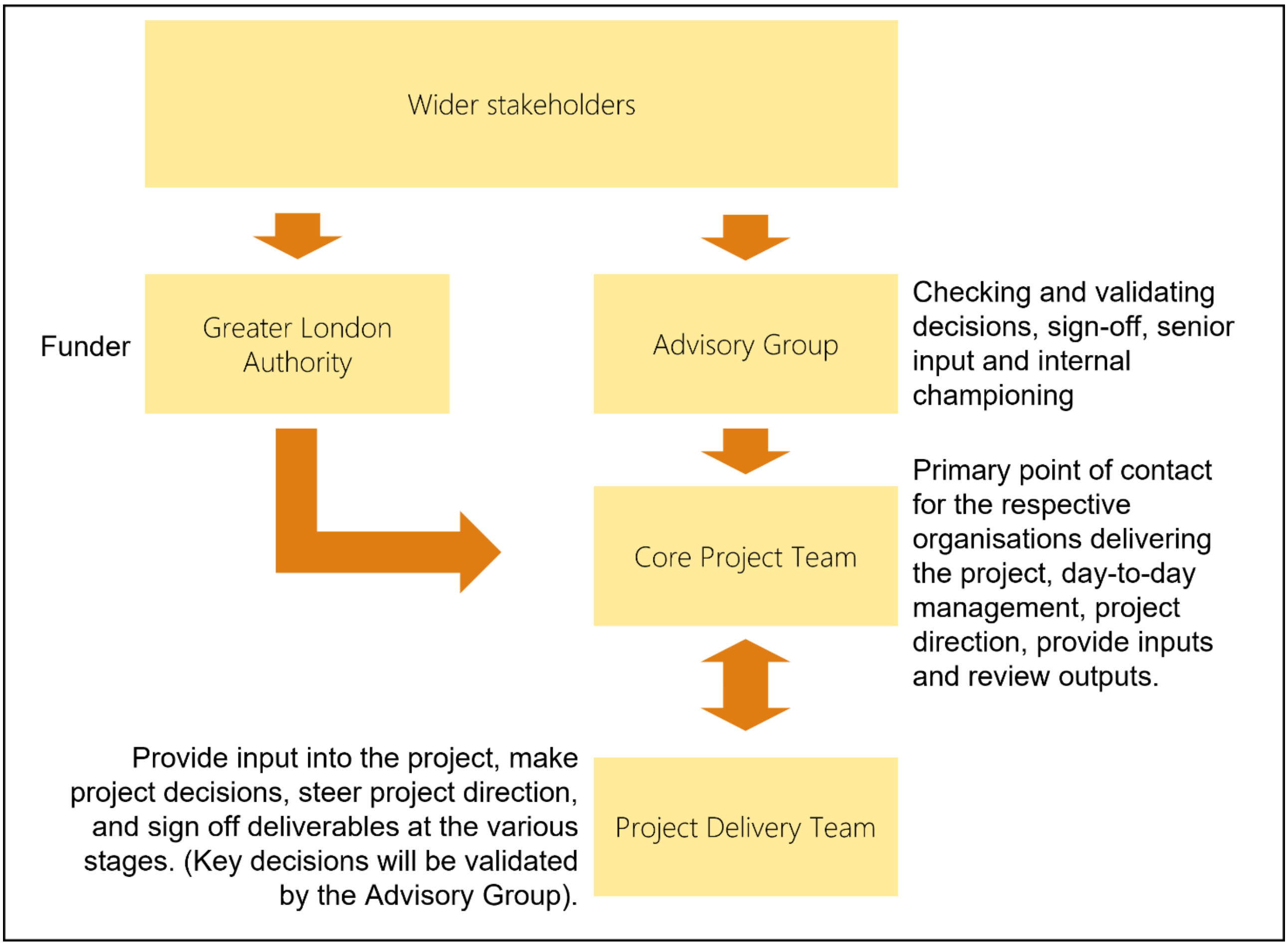
### 3.5.2. Workshop 3: Key outputs and outcomes

- Agreement and consent to a route mapping approach that splits recommendations and task between those required for individual networks and the wider actions required at a borough and cross-borough to create an enabling environment in the coming months and years
- An understanding amongst participants of the tasks and activities required to develop an individual heat network
- A clearer understanding for all present of the respective ambitions and priorities of each borough, both in terms of the individual networks, phasing and their approach to a cross-borough collaboration going forward
- Identification of non-technical enablers and challenges to help development of the route maps (output) as well as a better shared understanding of the potential amongst those present (outcome)

## 3.6. Overall project governance

The governance structure for the Cross-Borough Energy Masterplan project comprised of three key stakeholder groups, each with separate roles and levels of involvement in the project, as illustrated in Figure 71 below.

Figure 71: Cross-Borough Energy Masterplan governance structure




Membership of each group was as follows (in alphabetical order):

## Core project team members

- Julia Oggioni – Senior Project Manager (Research & Analysis), CSE
- Kat Drake – Cross-Borough Energy Masterplan Lead, K&C
- Tim Pryce – Clean Energy Lead, H&F

## Project delivery team members

- Adrien Grubb – Senior Consulting Engineer, SEL
- Alex North – Stakeholder Engagement Lead, CSE
- Elin Pain – Senior Consultant, Turner & Townsend (GLA PDU)
- Feifei Sun – Sustainability & Energy Manager, Housing Management, K&C
- Gabriel Gallagher – Managing Director, SEL
- Hinesh Mehta – Head of Climate Change, H&F
- Jeff Laidler – Heat Network Programme Manager, Lancaster West Neighbourhood Team (K&C)
- Keith Hempshall – Director of Local and Community Empowerment, CSE
- Lewis McNamee – Project Officer, CSE
- Martin Holley – Head of Consultancy, CSE

- Michael King – Strategic Stakeholder Engagement Manager, Lancaster West Neighbourhood Team (K&C)
- Neil Smillie – Principal Consultant, Turner & Townsend (GLA PDU)
- Paul Baker – Environmental Policy Planner, H&F
- Petra Pusztai – Graduate, H&F
- Rob Kyle – Housing Sustainability Lead, H&F
- Sarah Dixey – Planning & Economic Development, H&F
- Stephen McKinnell – Energy Manager, Corporate Property, K&C
- Tom Hinton – Head of Modelling & Software, CSE

Advisory Group members

- Bram Kainth – Strategic Director of Environment, H&F
- Billy Reid – Head of M&E, H&F
- David Gawthorpe – Planning and Economic Development, H&F
- Ezgi Kelleher – Senior Project Officer, Energy Systems GLA
- James Caspell – Neighbourhood Director, LWNT (K&C)
- Jeremy Plester – Lead for Sustainability, K&C
- Joe Ash – Net Zero Associate, UKPN
- Jon Skaife – Corporate and Innovation Director, H&F
- Keith Hempshall – Non-Technical Lead, CSE
- Lynne MacDonald – LAEP Manager, UKPN
- Martin Holley – Technical Lead, CSE
- Matt Patterson – Head of Spatial Planning, H&F
- Preeti Gulati Tyagi – Spatial Planning Policy Team Leader, K&C
- Richard Buckley – Assistant Director, Residents and Buildings Safety, H&F
- Shaun Haden – Head of Strategic Projects & Innovation, LWNT (K&C)
- Terry Oliver – Director of Cleaner, Greener & Cultural Services, K&C

# 4. Non-technical considerations

## 4.1. Introduction

Whilst it is essential to understand the nature and scale of the technological changes required to decarbonise heat and deploy heat networks across the two boroughs, it is equally as important to understand the practical, real-life context where these changes need to happen. There are non-technical factors that will influence and determine the successful implementation of the required technical solutions, some of which have unique local dimensions. In the case of this masterplan, there are also added cross-borough non-technical considerations that can play a key role in the development of the proposed city-scale heat network solutions.

This chapter presents an analysis to help understand this range of non-technical dependencies. The analysis was developed from the outcomes of the engagement activities described in the section Non-technical analysis and route mapping of the Social processes chapter and it follows CSE's 'Walking around the issues' framework, which was developed around achieving energy system transition[23]. In line with this, the analysis considers non-technical dependencies in the following four dimensions that complement the technical results:

- Local, regional and national plans and policies: existing and emerging plans, strategies and targets that might support or hinder heat network deployment in the study area
- Funding and commercial factors: financial and commercial factors that could help or hinder the development of heat networks in and across the two boroughs
- Capabilities and initiative taking: experience and capabilities available, or lacking, in the two boroughs that are needed to develop heat networks
- Building consent and buy-in: considerations that might help or hinder the appetite for the delivery and the wider uptake of the heat network offer

For each of these four dimensions the analysis provides considerations categorised as follows:

- Enablers: opportunities and factors that can be capitalised on for successful deployment of heat networks across the two boroughs
- Challenges: barriers and risks that need to be understood and addressed to ensure they do not hinder efforts towards decarbonisation and heat network development

Recommendations on how many of the challenges identified can be overcome by capitalising on existing enablers and opportunities are detailed in Appendix F: Detailed recommendations.

[23] https://www.cse.org.uk/research-consultancy/consultancy-projects/local-area-energy-planning/

## 4.2. Local, regional and national plans and policies

### Enablers

- Upcoming national gas boiler ban on new homes means that new developments will need low carbon heating options
- Upcoming heat network zoning framework is designed to catalyse district heating across the country by designating heat network zones, where heat networks would need to meet low carbon requirements and certain buildings and heat sources would be mandated to connect to them
- Emerging heat networks regulation seek to ensure consumers receive a fair price and reliable supply of heat in the transition to net zero
- London Plan policies on minimising greenhouse gas emissions (SI 2) and energy infrastructure (SI 3) and GLA's Assessment Guidance for planning applications
- Setting ambitious local EPC targets helps to promote the long-term decarbonisation of heat
- GLA currently collating data to identify potential waste heat sites and their waste heat potential in London, with the aim to map waste heat opportunities in London comprehensively (to be included in London Heat Map)
- H&F Local Plan Policy CC1 requires major developments to implement energy conservation measures, including assessing the feasibility to connect to or integrate new decentralised energy systems
- Earl's Court, West Kensington and White City are identified as Opportunity/Regeneration areas which require developers to explore opportunities for provision of/connection to decentralised energy networks
- Future H&F Local Plan review to consider incorporating district heating policies
- Draft K&C Local Plan (Policy GB4) supplements the London Plan and requires major developments to design in the ability to connect to future or proposed heat networks in accordance with the London Plan heat hierarchy and be accompanied by energy masterplans
- K&C emerging Local Plan Policy PLV3 identifies Lancaster West Estate and Notting Dale as an area with potential for positive change and requires delivery of a heat network by 2030, with future opportunities for other estates and properties in the Ward to connect
- Kensal Canalside and Earl's Court Opportunity Areas are identified as new opportunities for sustainable development
- The emerging K&C Local Listed Building Consent Order on solar PVs will help reduce obstacles to low carbon solutions
- Opportunity to use the Local Plan to stimulate heat decarbonisation in the private sector
- Conservation areas and listed building requirements in east of K&C may make heat networks a preferable option for decarbonisation to other individual approaches that can have a visual impact on to the historic asset (i.e. individual ASHP)
- Lots of new developments and opportunity areas in both boroughs mean there is a real opportunity to influence change through updated planning policy. New Supplementary Planning Documents (SPDs) could be used to supplement the Local Plans and provide additional guidance
- Decarbonising buildings cost effectively by combining renewable heat networks with energy retrofit projects (as with the Notting Dale Heat Network and H&F Civic Campus)

### Challenges

- Uncertainty around emerging hydrogen policies and the unlikely future role of hydrogen in domestic heating
- K&C new Local Plan at examination and it is therefore too late for the cross-borough energy masterplan to influence its heat decarbonisation policies
- H&F Local Plan review has not yet commenced and is therefore not ready to influence imminent opportunities (e.g. South Fulham) beyond the high level polices contained in the adopted 2018 Local Plan
- Uncertainty of what the potentially significant changes
- Some uncertainty about national energy security and net zero policy as it progresses through Parliament
- A current lack of a Local Area Energy Plan or similar decarbonisation study at either local authority means that there is no coherent strategy to maximising grid capacity (for example, competing priorities for maximising electric vehicle infrastructure, rooftop solar and decarbonising heating may lead to challenges in the near to medium-term)
- Conservation areas and listed buildings (e.g. those in east of K&C) may make enabling works and retrofit more challenging due to their visual impacts
- Building plans around regional strategies and ambitions could result in delays to progress (for example, waiting for an investment case to be developed for a north-south heat main is reliant on other stakeholders such as OPDC and Network Rail)
- Current lack of clarity as to when Heat Network Zoning policy will come into force and what exactly it will entail
- Short borough decarbonisation targets may increase pressure on council departments to implement quicker solutions, for example via the Public Sector Decarbonisation Scheme (PSDS) that prioritises solutions such as ASHP on individual building, which are quicker to implement than heat networks

## 4.3. Funding and commercial factors

### Enablers

- UK Infrastructure Bank interested in piloting collaboration with local authorities in heat network development (e.g. City Leap with Bristol City Council)
- New capital works programme in H&F provides funding for public investment in housing stock, including district heating
- Funding available for supporting development of heat networks through the Green Heat Network Fund (GHNF)
- Cost of new connections to electricity grid are reduced as a result of charging connections reform
- Densely populated areas and associated high number of potential connections in both boroughs presents opportunity for economies of scale for city-scale district heating
- LEA funding programme available until 2024 to support delivery of projects including low and zero carbon heat networks
- District heating projects are eligible for applying to loans available from the Mayor of London's Green Finance Fund
- Low carbon heat networks are eligible for funding applications to the Social Housing Decarbonisation Fund (SHDF) Wave 2.1
- The scale of the cross-borough and city-scale heat network opportunity is of an appropriate size to be of interest to institutional investors (e.g. pension funds) with lower rates of return and therefore better customer tariffs than conventional energy service companies (ESCOs)
- Scale of cross-borough opportunity improves ability to achieve economies of scale in supply chain, as well as co-ordination and other associated administration elements
- There are opportunities to set up a range of public/private partnerships, including joint ventures

### Challenges

- Big fluctuation in UK energy market makes it difficult to accurately estimate the financials of heat networks and build an investment case
- Competitive nature of Government funding makes it more difficult to access (both for heat networks themselves but also energy efficiency works to help enable them)
- Political differences between two boroughs may be viewed as a risk by potential investors for any large-scale cross-borough initiatives
- High cost of enabling works such as retrofit works in older buildings may have a detrimental impact on the business case for heat networks in some areas of each borough
- There is a need to demonstrate tangible benefit to both boroughs to proceed with collaboration
- There is funding available to support heat network development and delivery but no central map, list of opportunities or designated lead to pursue them

## 4.4. Capabilities and initiative taking

| Enablers | Challenges |
|---|---|
| • The two boroughs have already taken the first steps towards heat decarbonisation and are ahead of many other local authorities, which means they are better placed to access resources and funding<br>• H&F investment in new capital works programme for own housing stock incentivises decarbonisation schemes<br>• There is available capacity in the electricity grid for new connections<br>• Retrofit programmes for corporate buildings in both councils to make them district heating ready<br>• London Heat Map provides consolidated information that is regularly updated to support the decarbonisation of heat<br>• LEA programme provides free technical support to local authorities from the Programme Delivery Unit<br>• Council-owned special purpose vehicle (SPV), Notting Dale Heat, will enable the delivery and operation of the Notting Dale heat network. This demonstrates feasibility of model (proof of concept) and there could be opportunities to build on this and scale up across K&C and cross-borough<br>• Scale of cross-borough opportunity and ability to achieve economies of scale makes potential proposition more interesting to large-scale investment, infrastructure and construction organisations<br>• Imminent need for a replacement heat network in World's End estate (K&C) means there is an initiative taking opportunity in this location<br>• The potential for large-scale schemes and investment through the opportunities identified makes it easier to make a case for additional resource and capacity at each local authority | • Limited technical resource available in the supply chain to meet demand for low carbon solutions such as heat networks<br>• Limited legal expertise available to resolve legal issues with heat networks (e.g. liaisons with leaseholders)<br>• Contrasting political landscape across the two councils could impact initiative taking and delivery of heat decarbonisation<br>• Lack of capacity and capability at both H&F and K&C councils respectively to co-ordinate and support the development of both borough level and cross-borough wide district heating initiatives<br>• Changing electricity use means there are competing needs for grid capacity (for example rising uptake of Electric Vehicles and subsequent charging point installation)<br>• Lack of capacity or experience of delivering large-scale infrastructure schemes at either local authority<br>• Where the priority networks include stakeholders already developing networks there could be challenges in integrating these plans (for example ECDC's existing plans to develop an ambient loop network in the priority area) |

## 4.5. Building consent and buy-in

| Enablers | Challenges |
|---|---|
| • Current focus on waste heat from potential suppliers (e.g. data centres, Thames Water[24], etc.)<br>• Strategic interest and focus on decarbonisation of H&F housing evidenced by capital works programme<br>• London-wide focus on heat networks normalises their role in heat decarbonisation and generate interests across Council departments<br>• This masterplan is an opportunity to continue collaboration across borough boundaries<br>• The imminent need for a replacement for the heat networks in the World's End Estate (K&C) and Bayonne Estate (H&F) could provide a catalyst for wider buy-in to heat networks across the councils<br>• The concept of a north-south or east-west heat main has currency with regional stakeholders and could bring in resource from neighbouring authorities such as OPDC, Westminster City Council and Ealing Council | • Government funding for individual heat pumps means district heating solutions become more complex in comparison and lose some public interest<br>• Availability of individual heating options within owner's control (e.g. ASHPs) presents a faster route to decarbonisation for those seeking to do that<br>• Public concern that connecting to a monopoly heat network supplier will lead to higher heating costs in light of fluctuating energy prices<br>• The nature and set-up of local government makes it challenging to build momentum across teams for large-scale infrastructure projects<br>• There is currently no project sponsor lined up at either local authority to drive forward the next stages of the project<br>• Current lack of coherent vision for heat networks and city-scale collaboration<br>• Current lack of structure within each local authority to deliver city-scale heat networks as well as a lack of clarity as to where initiatives like this sit within their respective hierarchies<br>• Work and action from planning departments in both councils is required<br>• Political differences cross-borough may make collaboration challenging<br>• Past challenges (and failures) with cross-borough infrastructure initiatives may influence perspectives at each local authority<br>• Disruption from the build phase in Notting Dale could give rise to negative narratives about heat networks across the borough (and wider)<br>• Low uptake of Government grant schemes nationally could be indicative of public's reluctance for disruptive works (e.g. Home Upgrade Grant Scheme 2 and Boiler Upgrade Scheme)<br>• It takes a long time to implement a network from inception to completion, which could be off-putting to other council departments who require more immediate decarbonisation solutions |

[24] https://assets.kpmg.com/content/dam/kpmg/uk/pdf/2023/01/waste-heat-beneath-our-feet.pdf

# 5. A route map to decarbonising heat across the two boroughs

## 5.1. Introduction

The following sections outline core recommendations for Hammersmith and Fulham and Kensington and Chelsea Councils to take forward, either separately or collaboratively, to increase heat network implementation across the two boroughs in the coming years.

These recommendations are the result of the robust technical analysis, social process and assessment of wider non-technical factors outlined through previous sections of the report. Taken together the recommendations offer an ambitious but pragmatic plan to build on the trailblazing approach taken by the two boroughs, capitalise on the opportunity at hand and build local capacity and a clear sense of agency within and across the two boroughs in the process.

It is crucial that, whilst the five networks outlined through this masterplan should be considered a priority for the local authorities and can be pursued in isolation, the opportunity to collaborate and develop city-scale heat networks is not missed. Achieving this will involve a co-ordinated effort across both authorities and a clear plan to simultaneously address the challenges of capacity, funding, regulation and social consent to collaboration and change.

It is also essential to acknowledge that there are a range of technical, socio-political and economic factors, which are outside of the ability of this study to fully predict, that will ultimately influence which network opportunities are pursued and the order in which these are implemented.

To ensure the recommendations are robust and can be implemented in a range of different scenarios (e.g. business as usual; work focused on borough level; collaborative work at cross-borough level; etc.), the recommendations have been categorised into three distinct focus areas:

- Building the enabling environment: a 'done well' checklist and suggested actions for the next 6-months that can be pursued both separately and collaboratively by the two boroughs to establish capacity and support the strategic development and implementation of heat network opportunities in the cross-borough study area
- Strategic aims: medium to long-term recommendations applicable to both boroughs
- Developing priority heat networks: general practice recommendations for developing a heat network and a suggested phasing option for each of the five priority networks identified, selected and modelled through the development of this energy masterplan

In addition to the recommendations outlined in the following sections, a summary table of all recommendations with borough-specific detail can be found in Appendix F: Detailed recommendations.

## 5.2. Building the enabling environment

To effectively support the borough and cross-borough wide delivery of heat networks in the coming years, immediate action is needed to build capacity within both councils. Clarity is required in terms of where the leadership for this work sits within the structures of each council, as well as how they should practically collaborate on the significant heat network opportunity going forwards.

Outside of the council structures and the five priority networks identified through this report, there are also a range of different heat network opportunities being explored by other stakeholders in the two boroughs. To the east of K&C the Exhibition Road Cultural Group (ERGG), a partnership of 22 science and arts institutions have commissioned a feasibility study into the development of a heat network that links them all up as part of their South Ken Zen+ initiative. To the north of both boroughs, OPDC's exploration of heat network opportunities will have considerable implications for the development of schemes in the surrounding area. The Cadogan Group, the main landlord in Chelsea and Knightsbridge has commissioned similar feasibility studies into their estate and across both H&F and K&C large private developers such as the Berkeley Group are increasingly including district heating schemes in their development proposals.

With their ability to convene and their statutory responsibilities for place-shaping, both local authorities are well placed to enable these opportunities in parallel with their own priorities, be that directly through the development of robust support offers for third-parties or indirectly via the implementation of new policies through the local planning process.

### 5.2.1. Next steps for stakeholder engagement

Engagement through this master planning process has largely focussed on the development of strategic relationships. However, to ensure the network opportunities identified are implemented both efficiently and in a way that is sensitive to the needs of local communities, a co-ordinated approach to communications and stakeholder engagement will be crucial.

Pro-active effort must be made in the early stages of any priority network development to implement a communication and engagement strategy that reaches both those directly affected by planned changes and those able to support the delivery of opportunities. In addition to the stakeholders engaged through this project, essential groups who have as of yet not been engaged include:

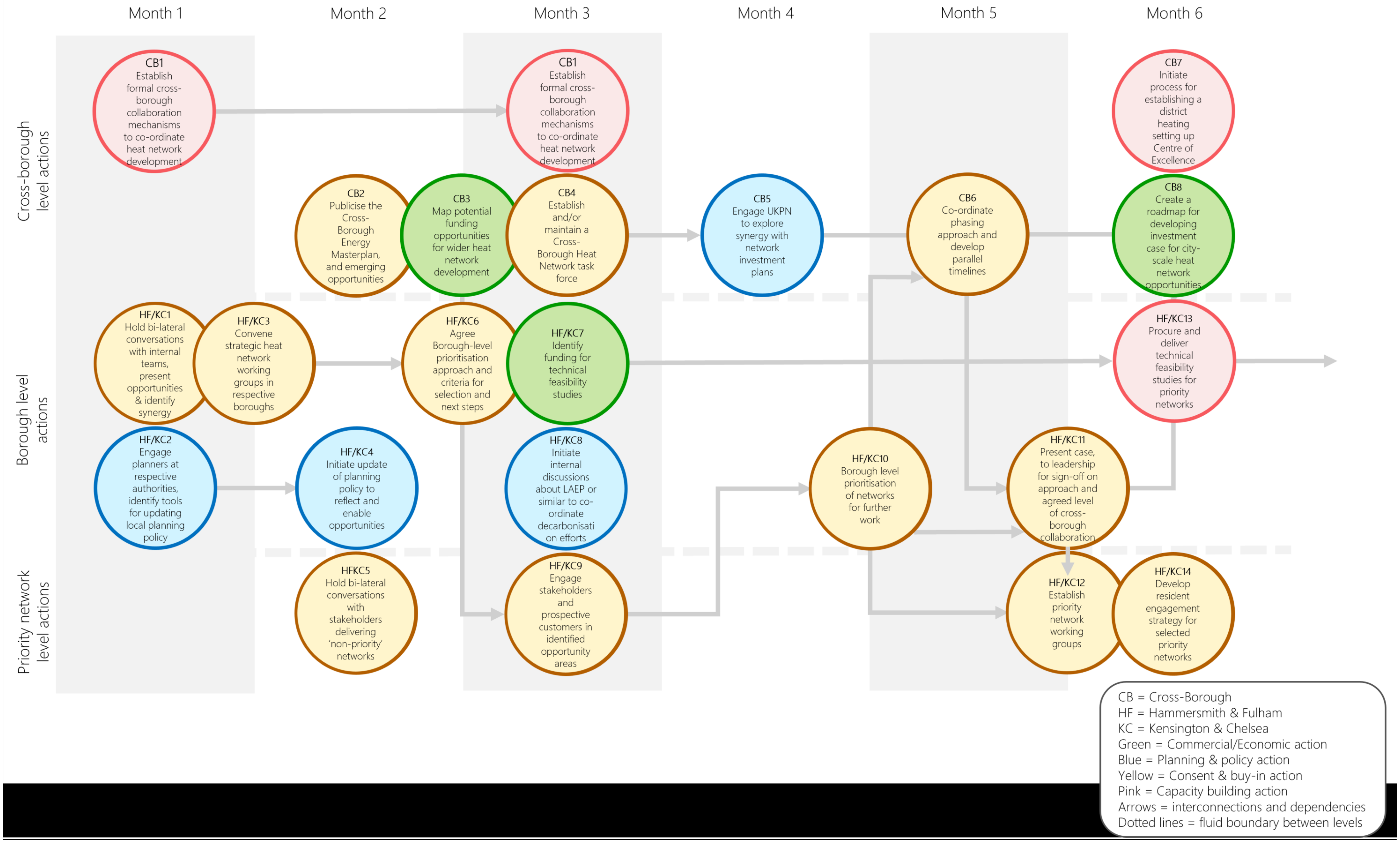
- Local residents living in priority areas. Whilst less disruptive to individual householders than the installation of direct measures into the home (such as insulation and air source heat pumps), the development of heat networks will have implications to householders that should be communicated ahead of any works being undertaken. Alongside the direct disruption caused by capital works, consumers should also be made aware of regulatory differences between heat networks and their current situation and how this may affect them
- The retrofit supply chain. As well as ensuring that heat network opportunities are designed around existing retrofit initiatives and capitalise upon opportunities to both improve energy efficiency and minimise disruption, there is a key opportunity to build skills and capacity that can be called upon in other decarbonisation initiatives going forwards. To this end, engagement with the supply chain should involve existing suppliers and skills colleges and academies

For both groups learning from the comprehensive resident engagement and co-design approach taken in the development of Notting Dale Heat can be drawn upon. Further to this, as the statutory representative for domestic and microbusiness energy consumers across Great Britain, Citizens Advice should be consulted in the design of any resident engagement strategy to ensure that consumer voice is suitably considered and represented in the development process.

### 5.2.2. A done-well checklist: what success looks like in the first 6 months

- Both boroughs have a prioritised list of heat network opportunities that are consistent with their corporate plan objectives and have been agreed by their leadership
- There is a clear understanding within each authority as to where responsibility and leadership for the development and delivery of heat networks at a borough level sits, including which department leads the work and whose portfolio it falls under
- Both boroughs have integrated, or are in the process of integrating, outputs from the masterplan into their local planning framework. This may be through Supplementary Planning Documents, Local Development Orders or through the Local Plan review process
- There is dedicated capacity within each local authority, or at a cross-borough level, to co-ordinate heat network development in each or both boroughs. Ideally this will be new capacity in the form of at least 1 FTE per borough
- There is a clear delineation between borough and cross-borough functions and a shared understanding of how to proceed with both cross-borough opportunities and priority networks that straddle the border (for example, Earl's Court)
- Working groups have been established for the highest priority opportunity networks, with a mixture of heat supplies, large asset owners, business and community representatives and relevant internal authority teams involved (planning, housing, corporate estate, communications etc)
- One or more new heat network feasibility studies have been commissioned, or are in the process of being commissioned, in each borough

Figure 72: A 6-month route map to success



### 5.2.3. A summary of suggested actions for the 6-month route map to success

Month 1

CB1: Establish formal cross-borough collaboration mechanisms to co-ordinate heat network development.

HF/KC1: Hold bi-lateral conversations with internal teams, present opportunities, identify synergies and build buy-in.

HF/KC2: Engage the planning policy team, development and landscape officers to identify appropriate policy tools to integrate outputs from this energy masterplan into local planning policy.

Month 2

HF/KC3: Convene strategic heat network working group in respective boroughs.

CB2: Publicise the Cross-Borough Energy Masterplan, its findings and suggested next steps to both existing stakeholders that were engaged as part of the Cross-Borough Energy Masterplan and a wider group of local, regional and national stakeholders. This is key to maintaining momentum and interest from the GLA, government, delivery partners and potential funders.

HF/KC4: Initiate update of planning policy to reflect and enable opportunities.

HF/KC5: Hold bi-lateral conversations with stakeholders developing heat networks outside of the five priority networks to establish ambition and explore support needs.

Month 3

CB3: Map potential funding opportunities for heat network development.

HF/KC6: Agree borough level prioritisation approach and criteria for selection and next steps.

CB4: Establish and/or maintain a Cross-Borough Heat Network task force to drive forward actions.

HF/KC7: Identify funding for technical feasibility studies for priority networks.

HF/KC8: Initiate internal discussions about LAEP or similar to co-ordinate decarbonisation efforts.

HF/KC9: Engage stakeholders and prospective customers in identified and opportunity areas to ascertain interest and inform borough level prioritisation activity.

Month 4

CB5: Engage UKPN to explore synergy with network investment plans.

Month 5

HF/KC10: Carry out borough level prioritisation activity and develop prioritised list.

CB6: Co-ordinate phasing approach and develop parallel timelines.

Month 6

HF/KC11: Present case to respective borough-leadership teams for sign-off on approach and agreed level of cross-borough collaboration.

HF/KC12: Establish priority network working groups.

CB7: Initiate the process for establishing a District Heating Centre for Excellence across the two boroughs.

CB8: Create a route map to develop an investment case for city-scale heat network opportunities, including links to OPDC as a significant source of low carbon waste heat.

HF/KC13: Procure and deliver technical feasibility studies for priority networks.

HF/KC14: Develop a resident engagement and communications strategy for selected priority networks.

Please note: In addition to the recommendations above, it is crucial that both boroughs keep up to date with heat network zoning policy as further detail emerges. The work done through the development of this masterplan has gone some way in identifying areas across both boroughs that are suitable for the development of heat networks, however without specific detail on the zoning process and associated policies at this stage it has not been possible to include a defined action within the 6-month timeline. A recommendation has been included in the following section (ML4) however this in recognition that announcements made in the short-term may result in changes to the 6-month actions proposed.

## 5.3. Strategic aims

The recommendations that follow provide longer-term focal points around which to build strategies and programmes. These are also represented in diagrammatic form in Figure 73.

Medium-Long (ML) 1: Build significant staff capacity across boroughs to be able to deliver heat networks at scale, either through the development of a standalone cross-borough heat network unit, the development of heat network specialists within each local authority or by embedding heat network roles across a number of relevant teams (for example, housing, sustainability, corporate estate teams).

ML2: Capitalise on the first mover opportunity and apply for regional and national funding to accelerate progress in one or more priority network areas.

ML3: Build consumer awareness of, and demand for, heat networks through local public, community and corporate engagement.

ML4: Keep up to date with developments to the national heat network zoning policy and adapt timelines and workplans as appropriate to capitalise on the opportunity that presents.

ML5: Pro-actively engage with other early-mover local authority actors across the country (and potentially Europe) to share and gain learning and insights.

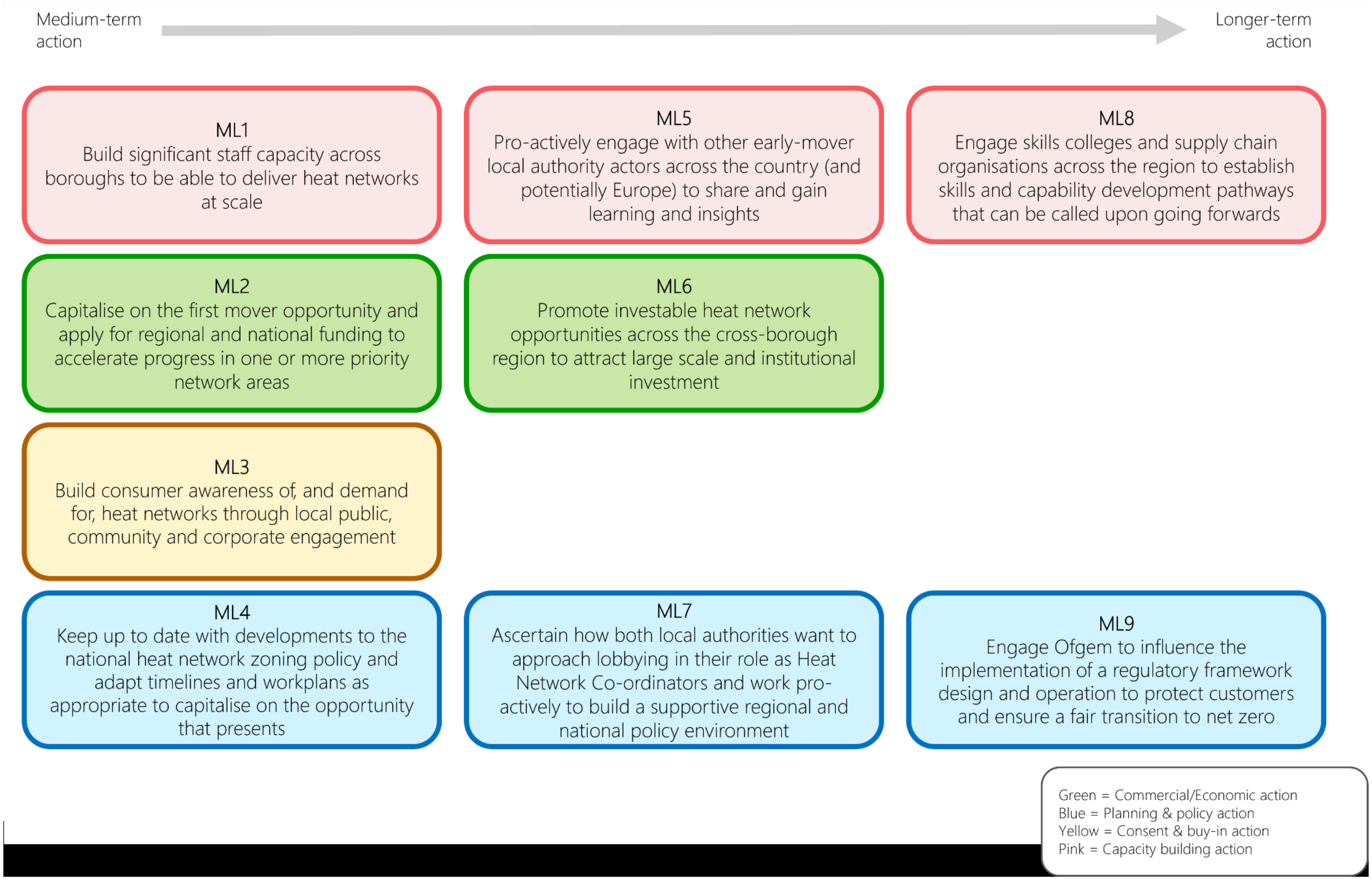
ML6: Promote investable heat network opportunities across the cross-borough region to attract large-scale and institutional investment. This could be done via linking the opportunities identified through this masterplan and developing an investment case for a north-south heat main along the border between the two boroughs utilising waste heat from OPDC and the River Thames, or alternatively an East-West Heat main linking Hammersmith Town Centre, Olympia Earl's Court, South Ken ZEN and potentially the City of Westminster.

ML7: Ascertain how both local authorities want to approach lobbying in their role as Heat Network Co-ordinators and work pro-actively to build a supportive regional and national policy environment, engaging with the GLA and central Government to ensure the London Plan and current and emerging national policy accurately reflects and effectively enables the emerging opportunities on the ground.

ML8: Engage skills colleges and supply chain organisations across the region to establish skills and capability development pathways that can be called upon going forwards.

ML9: Engage Ofgem to influence the implementation of a regulatory framework design and operation to protect customers and ensure a fair transition to net zero.

Figure 73: Medium to long-term actions



## 5.4. Developing priority heat networks

Once each local authority has developed a prioritised list of network opportunities and taken action to update local planning policy, there is guidance and a widely accepted approach to developing individual heat networks that can be used in the development of these opportunities.

The below diagram (Figure 74) outlines the key stages and sub-steps that need to be followed and builds on the CIBSE Code of Practice CP1[25] and District Heating Journey: Overview for Local Authority Project Sponsors (2017) produced by the Scottish Futures Trust[26].

[25] https://www.cibse.org/knowledge-research/knowledge-portal/cp1-heat-networks-code-of-practice-for-the-uk-2020-pdf

[26] https://www.heatnetworksupport.scot/wp-content/uploads/2015/10/DH-Sponsors-project-guide-v1.8.pdf

Figure 74: Key stages and steps in developing an individual heat network

| | |
| --- | --- |
| 1<br>Carry out detailed feasibility studies on priority networks | • Undertake detailed technical options appraisal<br>• Assess financial viability and social/environmental impacts<br>• Consider delivery models<br>• Undertake engagement with prospective customers |
| 2<br>Develop business case | • Weigh up feasibility with strategic, socio economic, commercial and governance interests<br>• Develop investment-grade business case |
| 3<br>Contracts and procurement | • Develop design spec<br>• Obtain consents, including utility connections<br>• Produce tender documents<br>• Negotiate heat supply, purchasing and finance agreements<br>• Conduct procurement exercise<br>• Update business case |
| 4<br>Heat network design and construction | • Arrange contract/project management<br>• Agree programme of works<br>• Grant consents (planning and wayleaves)<br>• Undertake enabling works |
| 5<br>Commissioning | • Enact commissioning plan<br>• Ensure efficient operation of plant and network<br>• Ensure customer demand is met<br>• Ensure effective metering and billing systems in operation<br>• Handover training for network operator |
| 6<br>Operation and maintenance | • Ensure network reliability through effective plant maintenance regime<br>• Minimise heat loss and environmental impact<br>• Ensure Health & Safety requirements are met<br>• Undertake necessary training<br>• Ensure metering & billing process is fit for purpose |

In the development of the route maps in the following sections, it has been assumed that the local authorities will follow and adhere to this best practice guidance in the delivery of each heat network opportunity. To this end, the route maps are not a step-by-step process outlining how to assess, commission, construct and run each heat network but instead present the key information required to identify opportunities, support prioritisation activities and build interest with key internal and external stakeholders.

Each route map is split into three 3-year phases, with a simple breakdown of the total network demand covered, proportion of social and council-owned assets included and key steps for each. The current situation for each network is represented through a simple characterisation of the starting point and, to build on this and progress the Phase 1 opportunities, we have suggested key stakeholders to be engaged in their early development. Whilst this is not an exhaustive list, proceeding without engaging these stakeholders early in the process will likely mean that the networks become unfeasible in the current proposed form (particularly in the case of heat supplies or large demands). In addition to these, there are a general set of stakeholders that will need to be engaged in the development of every network opportunity. These include, but are not limited to:

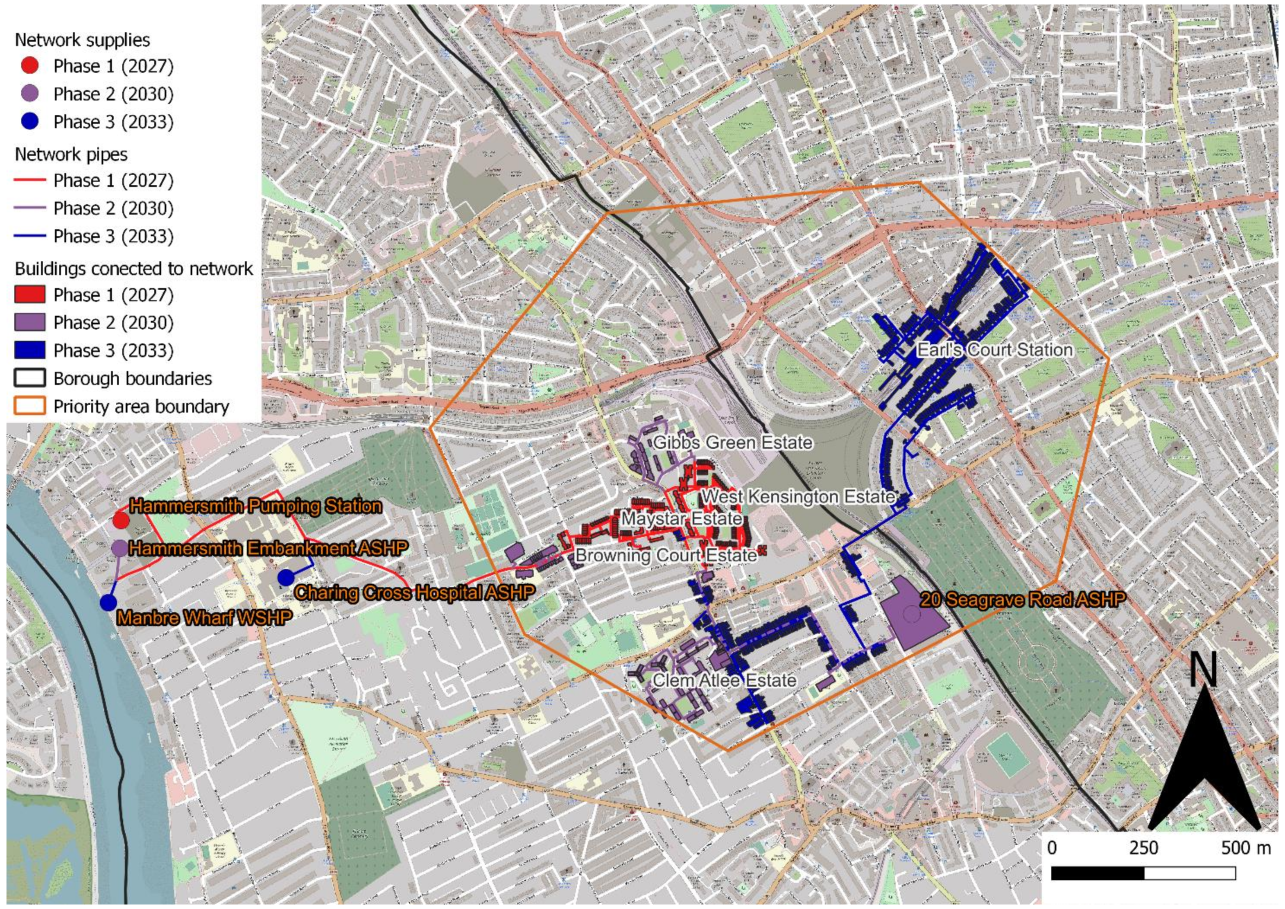
- The Local Authority Planning Policy team – to ensure that the proposed network is compliant with local planning policy and identify parallel processes that could be dovetailed (for example utility plans)
- Local Authority Highways department – pipe runs have largely been modelled on road networks. To be compliant with the New Roads and Street Works Act 1991 (NRSWA) co-ordination is required to minimise disruption and there may be pre-planned opportunities to capitalise upon that could influence phase planning
- UPKN – to ensure that the proposed network is compliant with current and proposed grid reinforcement plans

It is important that a detailed process of stakeholder mapping is carried out and an engagement plan developed early on for each network. This could take place alongside the working group suggested in recommendation HF/KC13 and should include a robust and comprehensive resident communication strategy as per recommendation HF/KC14.

Please note: the phasing options outlined in the following sections are indicative and suggest one potential version of a heat network per priority area, consistent with the method and approach outlined in section 2.2.3. Both boroughs present considerable opportunities for the development of heat networks in the coming years and the selection of projects and the exact order in which they are delivered will ultimately depend on local priorities and the ability to capitalise on emerging social, political and economic opportunities as they become evident.

Currently all network opportunities have been modelled independently. To this end in some instances two networks have been modelled using the same supply. Whilst a cross-borough collaboration going forwards provides many strategic opportunities, as a minimum dialogue will have to happen early in the process to co-ordinate phasing approach and respective timelines (as suggested through recommendation CB6). Where this has implications to a network, we have referred to it in the relevant route map.

## 5.5. Earl's Court




Map 22: Network design showing the different phases of Earl's Court network

The starting point: Earl's Court Development Company (ECDC) has proposed the development of an ambient loop network within their regeneration site and conversations have been held with them to explore the potential of future connections to this proposed network. H&F has a number of priority housing estates in the immediate vicinity to the regeneration area and is keen to ensure work on these dovetails with existing and proposed retrofit initiatives.

Phase 1: A small network designed around three council-owned housing estates, limiting the number of stakeholders involved and making it more manageable as a Phase 1 network. Due to the long Phase 1 pipe run it is important to explore how this can dovetail with existing transport and utility plans to find efficiencies and minimise disruption.

Phase 1 lead: Hammersmith and Fulham Council.

Key phase 1 stakeholders:

- ECDC to ensure that opportunities to build complementary networks are not missed as progress is made
- H&F Housing and Sustainable Assets teams regarding plans and connection for Browning Court, Maystar and West Kensington Estates
- H&F Highways Department regarding the long Phase 1 pipe run and how this can dovetail with existing infrastructure plans in the short-term
- Resident and neighbourhood groups for local estates such as West Kensington and Gibbs Green Community Homes (WKGGCH) and Browning Court and Maystar TRAs to build local consent and explore opportunities for network co-design
- Thames Water regarding the development of a heat supply at Hammersmith Pumping Station

Cross-borough considerations: Earl's Court is a priority area for both local authorities and discussions will need to be had to ensure both boroughs support this suggested phasing approach. Within this model there is network expansion across the borough boundary but not until Phase 3.

### Phase 1

2024-2027

13.5% network demand connected
97% connections in phase are social housing

- Establish sewer source heat pump at Hammersmith Pumping Station
- Connect Browning Court estate
- Connect Maystar estate
- Connect West Kensington estate

### Phase 2

2027-2030

41.5% network demand connected
37% connections in phase are social housing

- Establish large ASHP at 20 Seagrave Road and connect local demand in immediate vicinity
- Establish ASHP at Hammersmith Embankment
- Connect Clement Atlee and Gibbs Green estates
- Connect 200 Greyhound Road and residential buildings in the immediate vicinity

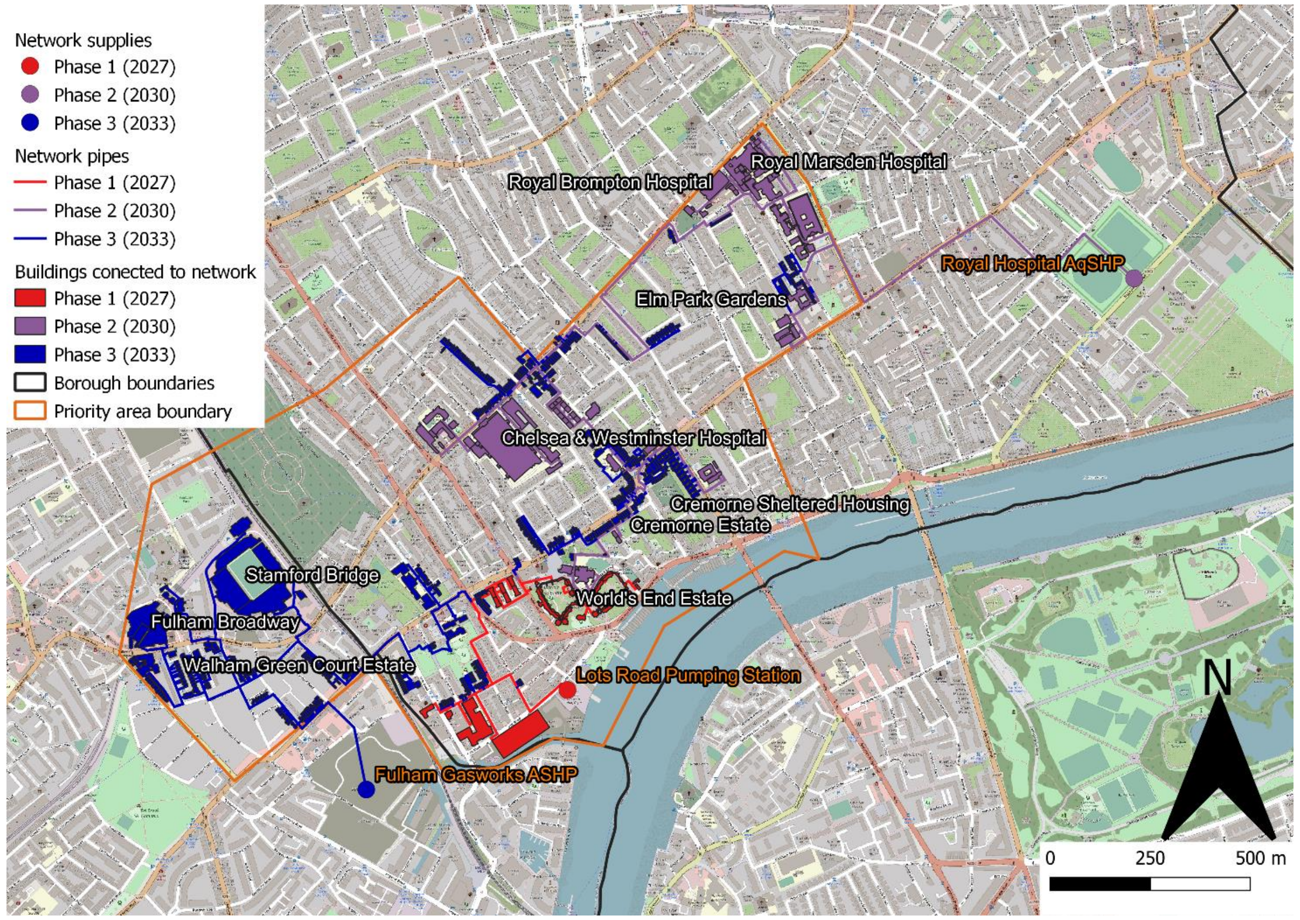
### Phase 3

2030-2033

100% network demand connected
54% total connections are social housing

- Establish ASHP at Charing Cross Hospital
- Establish WSHP at Manbre Wharf
- Extend north-east across borough boundary into K&C and connect Earl's Court Station
- Some backfill of smaller loads on existing route

## 5.6. Chelsea & Westminster Hospital and World's End




Map 23: Network design showing the different phases of the Chelsea & Westminster Hospital and World's End network, with Stamford Bridge connected

The starting point: World's End Estate is a priority area for Kensington and Chelsea Council with an imminent need to replace an existing heat network with a failing boiler. Engagement with the K&C housing team, North West London ICB and Thames Water (all of whom own assets in the area) has indicated that this is a network with a mandate from key stakeholders who can facilitate action.

Phase 1: With a relatively small network in Phase 1 and the majority of assets within the control of the local authority, this is a manageable network to develop in the short-term.

Phase 1 lead: Kensington and Chelsea Council.

Key Phase 1 stakeholders:

- Chelsea Academy regarding Phase 1 connection
- Guinness Partnership, the registered social landlord and owner of Iveagh House and estate on Kings Road regarding Phase 1 connection
- K&C Housing Team regarding proposed works at World's End estate and connections to a heat network.
- Resident and neighbourhood groups for local estates such as World's End Resident's Association (WERA) to build local consent and explore opportunities for network co-design
- Thames Water regarding the sewer source heat pump at Lots Road Pumping Station

Cross-borough considerations: Network expansion within this model crosses the borough boundary into H&F in Phase 3, with both heat sources and demands identified in H&F. To ensure that business cases can be built, these stakeholders will need to be engaged in the medium term to ensure confidence in the opportunity. With its position on the river and proximity to borough boundary, this network may also be key in the development of an investment case for a north-south heat main.

### Phase 1

2024-2027

4.2% total network demand connected

99% connections in phase are council-owned & social housing

- Establish sewer source heat pump at Lots Road Pumping Station
- Connect Chelsea Academy
- Connect Iveagh House (Guinness)
- Connect World's End estate

### Phase 2

2027-2030

48.8% total network demand connected

10% connections in phase are council-owned & social housing

- Establish AqSHP at Royal Hospital
- Connect Chelsea & Westminster Hospital, Royal Brompton and Royal Marsden Hospitals and assets
- Connect Elm Park Gardens
- Connect Servite RC Primary School, Tesco and other commercial sites in the near proximity

### Phase 3

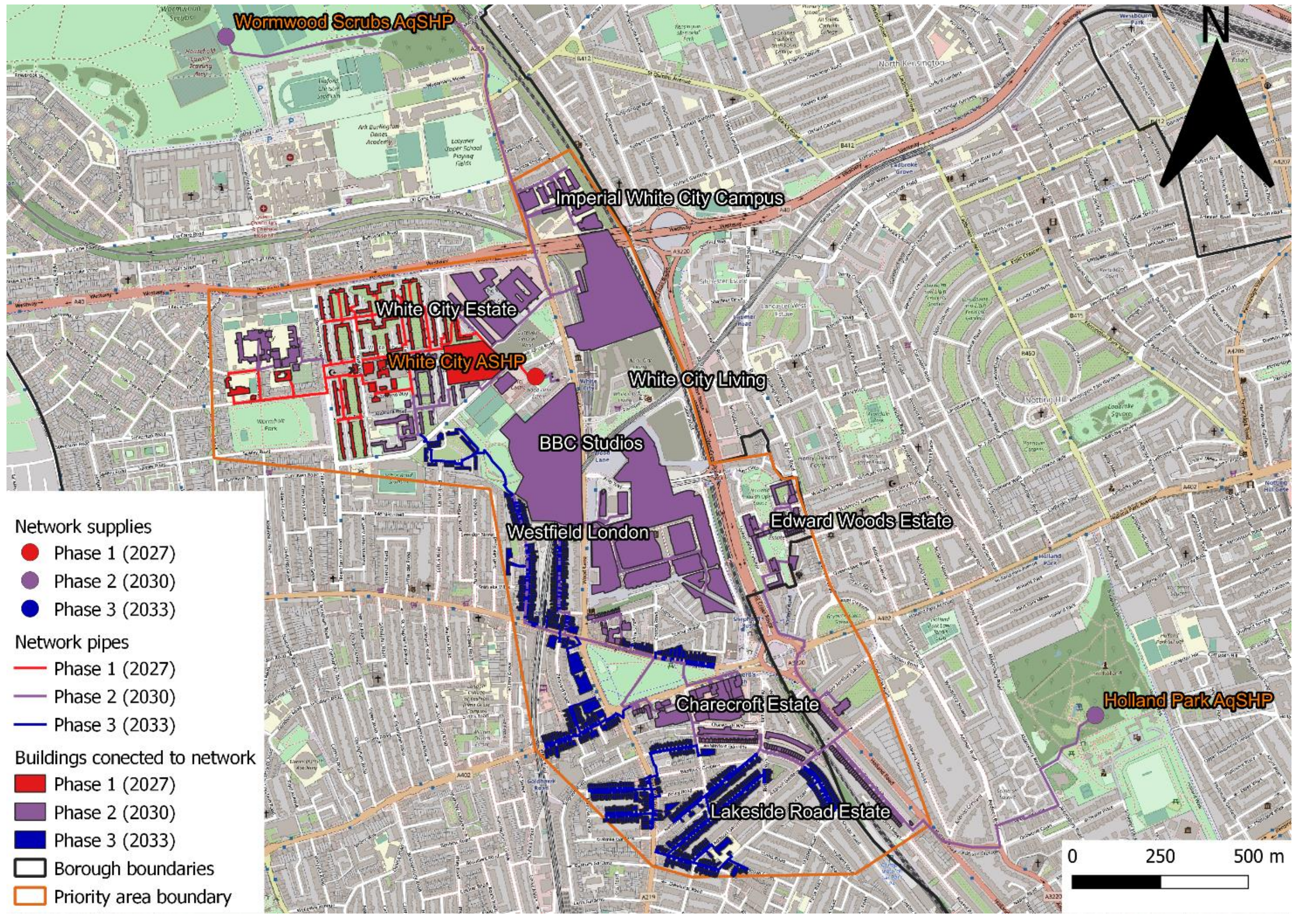
2030-2033

100% total demand connected

43% total connections are council-owned or social housing

- Establish ASHP at Fulham Gasworks, extending west across borough boundary into H&F
- Connect Cremorne estate and Sheltered Housing scheme
- Connect Fulham Broadway Shopping Centre
- Connect Stamford Bridge Stadium
- Connect Walham Green Court estate

## 5.7. White City




Map 24: Network design showing the different phase of White City network

The starting point: A number of large private and public sector organisations in the area are either already operating heat networks or have plans to explore and implement them in the near to medium term, including SSE. To the north Old Oak and Park Royal Development Corporation (OPDC) are exploring significant opportunities to utilise waste heat from data centres which could support both future iterations of this network post-Phase 3 as well as others through the development of a north-south heat main.

Phase 1: Phase 1 largely centres on the White City Estate, aligning this network with corporate housing decarbonisation objectives. Given that the local authority owns the majority of the buildings in Phase 1 this presents a manageable opportunity in the short term.

Phase 1 lead: Hammersmith and Fulham Council.

Key Phase 1 stakeholders:

- H&F Housing and Sustainable Assets teams regarding plans and connection for West Kensington Estate
- H&F Corporate Property team regarding plans and connections for Wormholt Primary School and Cambridge School
- OPDC regarding their future plans and the significant opportunity for collaboration
- Resident and neighbourhood groups for local estates such as the White City Residents Association (WCRA) or Wormholt TRA to build local consent and explore opportunities for network co-design
- SSE regarding future plans, the concession zone, connections and the development of the White City ASHP

Cross-borough considerations: On the border of the two boroughs, Phase 2 of this network is designed around an AqSHP in Holland Park which sits within K&C, whilst Phase 2 of the Notting Dale and North Kensington Network is designed around using the AqSHP in Holland Park and ASHP at White City Living. The Notting Dale network is a key strategic priority for K&C, as well as having timelines slightly ahead of the phase proposals suggested here due to progress already made on Phase 1. Early engagement around these two networks and how to develop parallel timelines will be crucial in the success of both networks.

### Phase 1

2024-2027

5.9% total network demand connected

89% connections in phase are council-owned & social housing

- Establish ASHP at White City
- Connect Cambridge School
- Connect White City estate
- Connect Wormholt Park Primary School

### Phase 2

2027-2030

78.6% total network demand connected

44% connections in phase are council-owned & social housing

- Establish AqSHP at Wormwood Scrubs and Holland Park (in K&C)
- Connect BBC Broadcast Centre
- Connect Charecroft and Edward Woods estates
- Connect Imperial College White City Campus
- Connect Westfield Shopping Centre

### Phase 3

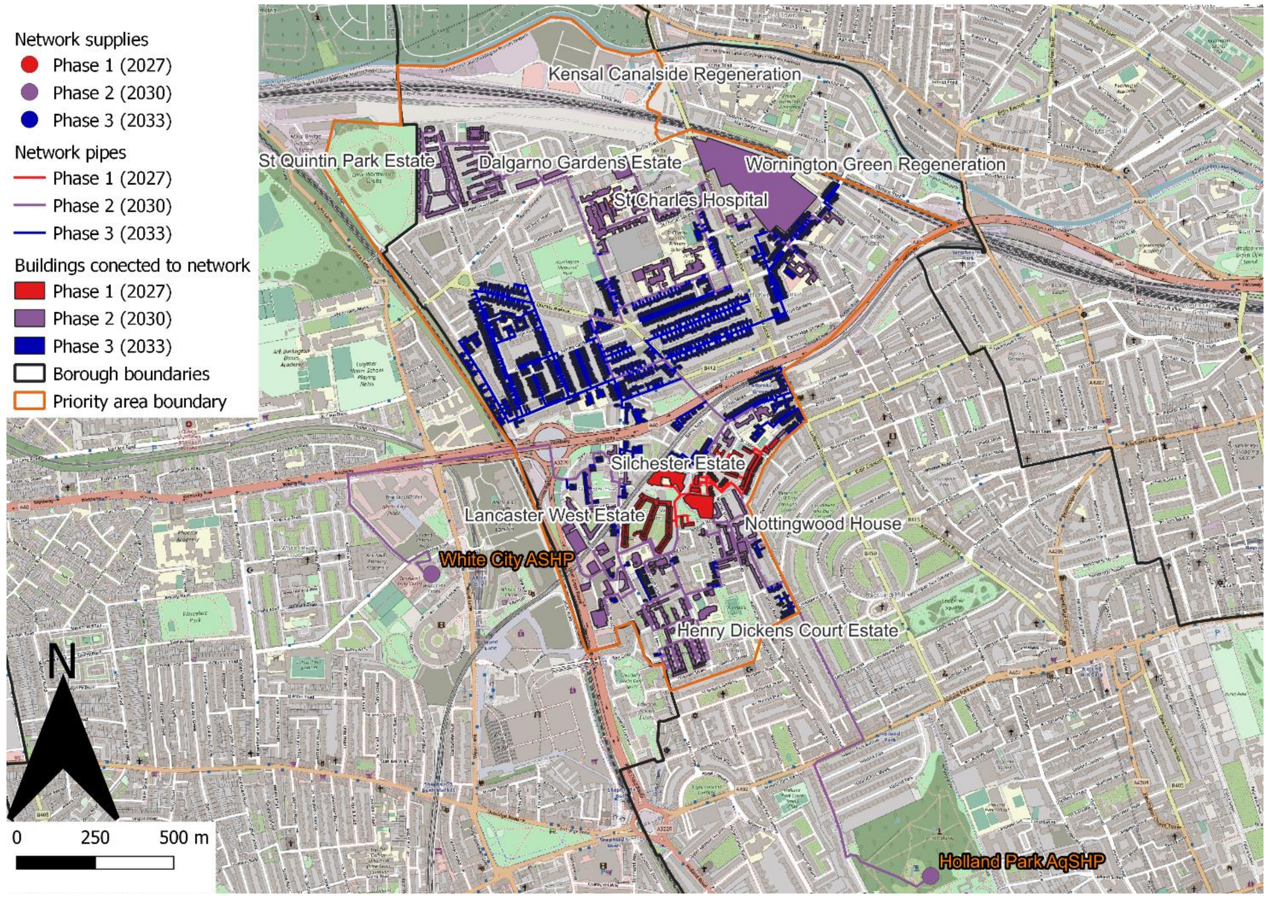
2030-2033

100% total network demand connected

45% total connections are council-owned or social housing

- Connect Lakeside Road estate
- Connect smaller demands along existing routing including areas around Batman Close, Frithville Gardens and Pennard Road

## 5.8. Notting Dale and North Kensington




Map 25: Network design showing the different phases of the Notting Dale and North Kensington network

**The starting point:** Phase 1 is already in progress, having reached Final Investment Decision in July 2023. This will connect 9% of the total modelled demand for this network. Almost all the connections within Phase 1 are council-owned and social housing, with the network focussing on the Lancaster West Estate. To supply this network a 1.5MWh ASHP is being established on the roof of Kensington Leisure Centre. Similar to the White City network, opportunities to collaborate with OPDC could provide additional waste heat that could support further network expansion north into Kensal Canalside.

**Phases 1 & 2:** Both phases focus primarily on social housing and schools, with Phase 1 nearing development and Phase 2 currently at Outline Business Case. Phase 2 is considerably larger in terms of heat demand but connects larger individual loads and therefore presents a manageable stakeholder process for a shorter-term network development.

**Phase 1 & 2 lead:** Kensington and Chelsea Council.

**Key Phase 1 & 2 stakeholders:**

- Central and North-West London NHS Foundation Trust regarding St Charles Hospital
- H&F Council regarding co-ordination of network phasing and practicalities relating to connecting to the ASHP in H&F
- K&C Housing Team regarding proposed works to connect Dalgarno Gardens estate, Henry Dickens Court estate, St. Quintin Park estate and Nottingwood House to the developing heat network
- K&C Planning Policy team regarding plans for Wornington Green
- OPDC regarding their future plans and the significant opportunity for collaboration
- Resident groups for estates such as St Helen's Residents Association to build local consent and explore opportunities for network co-design, capitalising on learning from the positive customer experience with Notting Dale Heat
- SSE regarding the White City ASHP

**Cross-borough considerations:** Modelling for Phase 2 currently utilises an ASHP in White City (in H&F), which is also the identified heat supply for Phase 1 of the White City network. Due to timeline differences this will need to be discussed with H&F as soon as feasible.

### Phase 1

2024-2027

9.2% total network demand connected

100% connections in phase are council assets or social housing

- Establish ASHP at Kensington Leisure Centre
- Connect Lancaster West estate
- Connect Silchester estate

### Phase 2

2027-2030

52.7% total network demand connected

89% connections in phase are council assets or social housing

- Establish an AqSHP at Holland Park and an ASHP at White City (in H&F)
- Connect Dalgarno Gardens, Henry Dickens Court and St. Quintin Park estates
- Connect Nottingwood House
- Connect St. Charles Hospital
- Connect Wornington Green regeneration

### Phase 3

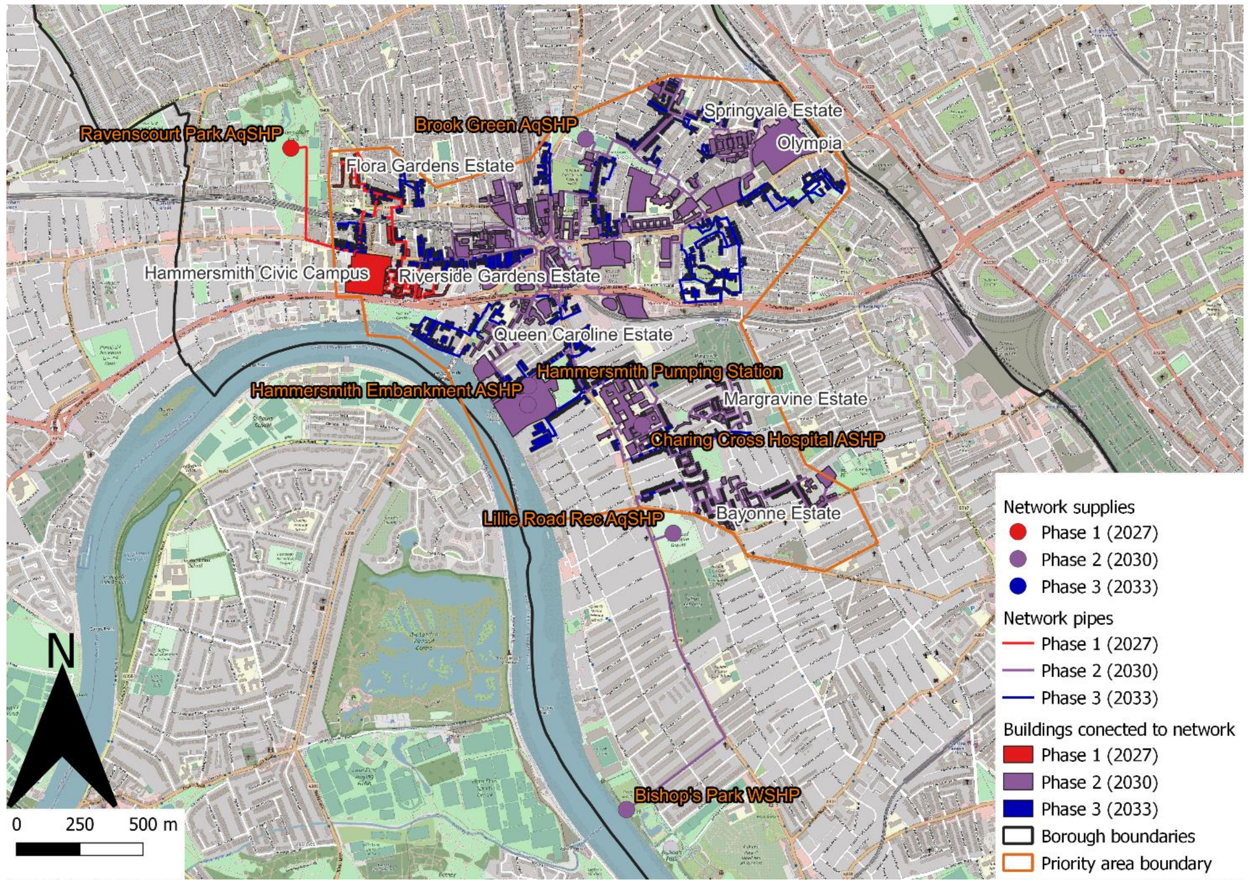
2030-2033

100% total network demand connected

90% total connections are council assets or social housing

- Connect residential and commercial demands in the area to the north-west of the A40
- Backfill small demands around Phase 1 and Phase 2 pipe runs

## 5.9. Hammersmith Town Centre and Olympia




Map 26: Network design showing the different phases of the Hammersmith Town Centre and Olympia network

The starting point: The Hammersmith Civic Campus is currently under redevelopment as part of the West Kings Street initiative. Included in this is the development of a heat network that will heat both the Civic Campus and neighbouring residential properties. At the east end of this priority area, Kensington Olympia are exploring options to develop a heat network within their own site and have expressed interest in wider collaboration through the development of this masterplan. H&F Council have also identified GLA Local Energy Accelerator funding that could support the delivery of a Phase 1 network. Unlike the illustrative modelled networks, this would start with Phase 1 in the Bayonne Estate (this proposal was developed after the modelling for the masterplan was completed).

Phase 1: The proposed Phase 1 is built around a high proportion of council-owned assets, making it achievable in the short term. Other phasing is possible and due to opportunities arising there may also be interest in incorporating other H&F assets in Phase 1, subject to further exploration. It is important to note here that Phases 2 and 3 are larger and involve high proportions of assets outside of the direct control of the local authority.

Phase 1 lead: Hammersmith and Fulham Council.

Key Phase 1 stakeholders:

- Civic Campus Team and QODA consultants to ensure that plans for Phase 1 are incorporated into the redevelopment of the civic campus and vice-versa
- H&F Environment and Parks Teams regarding the establishment of an AqSHP in Ravenscourt Park
- H&F Housing and Sustainable Assets teams regarding plans and connection for Riverside Gardens and Flora Gardens
- Resident and neighbourhood groups for local estates such as Flora Gardens or Riverside Gardens TRA to build local consent and explore opportunities for network co-design

Cross-borough considerations: This network is entirely within H&F and does not require any cross-borough collaboration outside of the wider strategic capacity building outlined in the recommendations.

### Phase 1

2024-2027

3.3% total network demand connected

96% connections in phase are council assets or social housing

- Establish AqSHP at Ravenscourt Park
- Connect Hammersmith Civic Campus
- Connect Flora Gardens estate
- Connect Riverside Gardens estate

### Phase 2

2027-2030

76.4% total network demand connected

38% connections in phase are council assets or social housing

- Establish AqSHPs at Lillie Road Rec and Brook Green, ASHPs at Hammersmith Embankment and Charing Cross Hospital, a sewer source heat pump at Hammersmith Pumping Station and a WSHP at Bishop's Park
- Connect Charing Cross Hospital
- Connect Bayonne, Flora Gardens, Margravine, Queen Caroline, Riverside Gardens and Springvale Estates
- Connect Olympia development

### Phase 3

2030-2033

100% total network demand connected

34% total connections are council assets or social housing

- Connect commercial properties east from the Civic Campus along King Street
- Connect properties in the area around Mall Road
- Connect properties in the area around West London College
- Connect other smaller demands along existing routing

# Appendix A: Zone modelling method

Please see separate document.

# Appendix B: Techno-economic assumptions

Please see separate document.

# Appendix C: Full project process

Please see separate document.

# Appendix D: Stakeholder involvement

Please see separate document.

# Appendix E: Full ranking and scoring criteria for the network prioritisation matrix

Please see separate document.

# Appendix F: Detailed recommendations

Please see separate document.