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0043514 Lewisham Energy Masterplan

ENERGY MASTERPLAN

10 JUNE 2020

Revision	Description	Issued by	Date	Checked
00	Energy masterplan report – draft issue	IH / BA	03.04.20	BW
01	Energy masterplan report – final issue	IH	10.06.20	BW

Lewisham Energy Masterplan

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Glossary

Term	Definition
ASHP	Air source heat pump
BEIS	Department of Business, Energy and Industrial Strategy
BLE	Bakerloo Line extension
Caoex	Capital expenditure
CHP	Combined heat and power
DE	Decentralised energy
DEC	Display Energy Certificate
DHN	District heat network
DHW	Domestic hot water
EC	Energy centre
ECO	Energy Company Obligation
EPC	Energy Performance Certificate
GLA	Greater London Authority
GSHP	Ground source heat pump
HIU	Heat interface unit
HNDU	Heat Networks Delivery Unit
HNIP	Heat Networks Investment Project
LBL	London Borough of Lewisham
LDD	London development database
LTHW	Low temperature hot water
LZC	Low and zero carbon
Opex	Operational expenditure
Repex	Replacement expenditure
RHI	Renewable heat incentive
TEM	Techno-economic model
TfL	Transport for London
WSHP	Water source heat pump

1 Executive Summary

This Lewisham Energy Masterplan has assessed and identified the potential for district energy to contribute to decarbonisation of the Borough. High level techno-economic assessment suggests that heat network clusters at Lewisham Town Centre and Catford could provide ~£30m of investible propositions with funding support whilst delivering long term carbon savings to the borough, supplying ~9,500 homes and saving an average of ~7,900 tonnes of CO_2 annually. The extension of the SELCHP Energy from Waste network to Deptford is also strongly recommended for further investigation.

1.1 Role of district heating in Lewisham

Lewisham Council (LBL) declared a Climate Emergency in April 2019, with the aim of making the borough carbon neutral by 2030. Around 30% of Lewisham's carbon emissions originates from the burning of natural gas in domestic boilers for heating and hot water production . Heating is therefore likely the largest single contributor to carbon emissions in the borough.

In March 2020 LBL published the Lewisham Climate Emergency Strategic Action Plan which sees district heating networks as having a key role to play in support of the Borough's target to reduce the its greenhouse gas emissions to net zero. The UK government has also re-iterated its support for heat networks in the March 2020 budget with announcements for further funding support and extension of the Renewable Heat Incentive.

Lewisham already has several operational heat networks and benefits from a large low carbon heat source through the South East London Combined Heat and Power (SELCHP) energy from waste plant with surplus capacity.

The key aim of this document is to explore the potential of district heat networks in Lewisham, identifying the key opportunity areas for district heating and developing a longer-term vision to support Lewisham's growth and low carbon transition using decentralised energy. It will provide an evidence base for the development of district heating network schemes in Lewisham, informing both policy and delivery.

1.2 Process

A number of strategic district heat network (DHN) opportunities have been identified within Lewisham based on the outcomes of this energy masterplan (Figure 1.1). Of the eight clusters identified, the following three are explored in more detail within this report to develop initial technical schemes and high-level economic performance:

- Deptford
- Lewisham Town
- Catford.

These three core network schemes represent ~£30m of investment and could serve lower carbon heat over 9,500 homes and a range of LBL owned and private commercial assets. Together, a saving of over 236,000 tCO_2e could be achieved over the lifetime of these schemes compared to the counterfactual technologies.

Despite the other clusters not being analysed in detail, there may still be opportunities in these areas – and low carbon energy projects in each will still need to be investigated if Lewisham is to meet its net zero carbon goal. In particular the New Cross and Bermondsey clusters also presented a good opportunity for heat network development however, these were omitted from further analysis in this study as they are already being pursued in parallel studies.

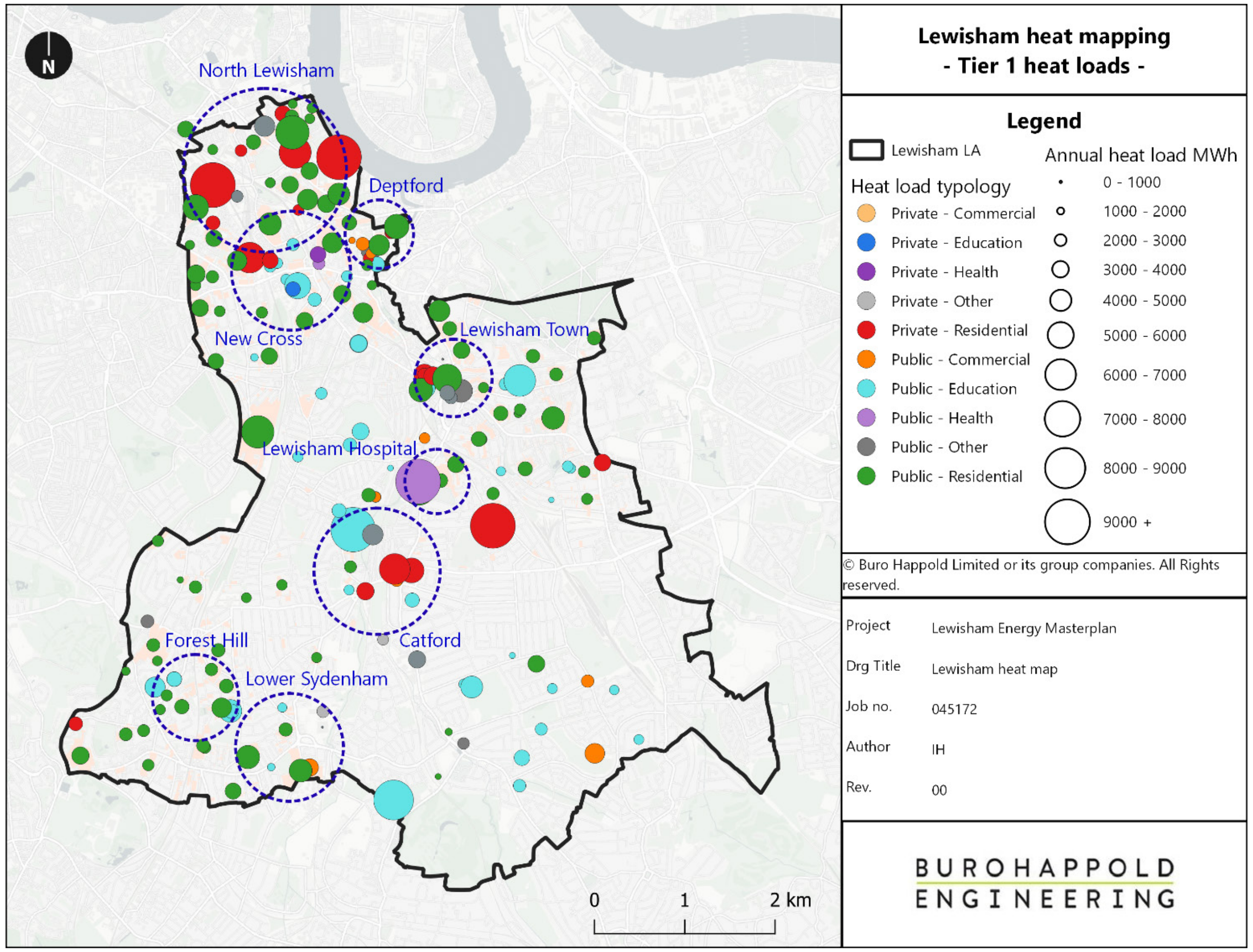


Figure 1.1: District heating clusters – all clusters

1.3 Prioritised cluster summaries

Table 1.1: High Priority Cluster summary

	Deptford		Lewisham Town	Catford
Annual heat demand (MWh/yr)	12,100		23,600	14,890
Heat line density (MWh/m)	7.2		9.4	9.8
No residential units on core network	1,620		4,570	3,640
Percentage tier 1 heat (%)	80%		75%	60%
Percentage public owned	40%		23%	50%
Capex (£m)	11.5		9.3	
LZC technology	ASHP	SELCHP	ASHP	GSHP
IRR @ 30 yrs (%) – no funding or RHI	N/A	3.1%	2.3%	4.9%
IRR @ 30 yrs (%) – with RHI	N/A	N/A	7.6%	10.3%
DH emissions saving @ year 1 (%)	59%	86%	61%	29%
DH emissions saving – 30-year total (tCO_2e)	50,720	68,440	157,490	11,640

Deptford

The Deptford area has undergone significant development in recent years in both the residential and commercial sectors. Many of the developments have been installed with CHP and have limited carbon futureproofing in their existing design. The CHPs will be approaching end of life by 2030. A heat network with a heat pump or connecting into SELCHP could provide infrastructure to help them decarbonise as well decarbonising a number of LBL's estates.

The proximity to the SELCHP waste incineration plant means it could benefit from the largest low carbon waste heat source in the borough. If this heat source can be utilised this could reduce carbon emissions in the Deptford cluster by up to 98% - a significant contribution to tackling the climate emergency and improving air-quality in the area.

The financial performance of the network is challenging, largely due to the costs of retrofitting Crossfield Estate. If these retrofit costs can be sourced from another capital budget and the SELCHP connection can be secured, high-level modelling suggests that the network could achieve an IRR within likely Lewisham hurdle rates over the 30 years modelled.

SELCHP have funding to extend the network to the Convoys Wharf development this year which may not currently be futureproofed to extend to Deptford. Further feasibility and early engagement is recommended with Veolia to discuss the connection and ensure that the network is futureproofed for extension to the Deptford area before installation (if further feasibility work proves it to be viable).

Lewisham Town

Lewisham Town Centre has seen rapid growth in recent years which is set to continue as new residents are attracted to the area's improving transport links to the City. The large-scale redevelopment of the Riverdale Shopping Centre could see an additional 2,000 homes to the already high heat dense area.

Existing CHP networks are operating at Lewisham Gateway and Loampit Vale. Due to the decarbonisation of the grid, gas CHP networks can no longer deliver long term carbon savings and therefore a transition plan is required to futureproof the existing networks for decarbonisation.

The redevelopment of the shopping centre, if realised, provides a catalyst to develop a future electrified heat network that will decarbonise and extend the existing networks in the area. Early engagement with the shopping centre is recommended to ensure this is captured within the masterplan. Heat supply opportunities include heat pumps (air source or the river) as well as heat recovery from cooling systems at the commercial areas and the Riverdale data centre.

Catford

The Catford Masterplan is due to be published later this year. In it is a plan for large scale redevelopment of a currently under-utilised area, including around 3,000 new homes, retail and a new civic suite. A ground-source heat pump scheme at the large St Dunstan's College green space could provide low carbon heat (and cooling) to the area.

The recently published Climate Emergency Action Plan sets seeks to embed the aspiration to be carbon neutral into the Catford Regeneration Masterplan. It is therefore critical for a low carbon infrastructure implementation plan to be designed into the masterplan from the outset to ensure a futureproofed approach to heating and cooling emissions. The heat network proposed in this report is estimated to see a carbon saving of 38% at year 30 compared to if no such plan was enforced (i.e. following latest GLA energy policy on an individual building basis).

The timing is critical as works on the South Circular re-routing are due to begin after 2020. If the DHN trenching can be coordinated it will save LBL significant disruption. In addition, some development sites are already coming forward in advance of the formalisation of the masterplan and these should be futureproofed for any energy scheme.

The techno-economic modelling results suggest Catford performs positively without any additional funding (~5% IRR). If RHI can be secured then IRR increases to ~10%, indicating a strong potential to attract third party investors.

1.4 Next steps

The following actions are recommended for the three identified clusters:

- Detailed feasibility
- A consolidated roadmap
- Incorporate findings into updates to local policy, including the Local Plan and any local area action plans
- Explore opportunities for LBL to integrate findings into GIS system.

Table 1.2: Key actions and interdependencies for individual clusters:

Cluster	Key action
Deptford	■ Consider a detailed feasibility study of extending the SELCHP network into Deptford – including investigation of connecting additional loads along the route ■ Engagement with Veolia SELCHP in advance of Convoys Wharf network installation ■ Identify alternative capital budget for retrofit costs of LBL estates ■ Maintain contact with Greenwich Council to ensure opportunity for inter-borough heat sharing is not lost
Lewisham Town	■ Early engagement with Landsec so this opportunity for wider decarbonisation is not missed at the Riverdale Shopping Centre redeveloped ■ Reach out to E.On to understand their long term plan for decarbonisation and present findings of study as a potential future ESCo
Catford	■ Incorporate findings into the Catford Masterplan and carry out further energy strategy work to determine best solution e.g. low temperature heat network or ambient loop option for cooling integration ■ Further discussions with St Dunstan’s College on GSHP installation at the Jubilee Ground ■ Coordination of possible network installation with the South-Circular re-routing team

Borough wide heat decarbonisation

A key challenge across the borough is decarbonising existing LBL housing estates which are spread across the borough. In many cases these are in densely populated areas which are typically favourable for heat networks. However, many flats are individually heated with gas boilers which presents a more complex solution in order to retrofit for heat network connection. If Lewisham is to meet its 2030 target, then interventions will be required to these sites to decarbonise – if these can come from separate capital budgets then this may improve network performance in some areas.

A separate study is also being undertaken in parallel addressing borough wide heat decarbonisation – including for those building typologies not suitable for heat networks

2 Understanding the Aims and Objectives

2.1 Context of energy in Lewisham

Lewisham Council (LBL) declared a Climate Emergency in April 2019, with the aim of making the borough carbon neutral by 2030.

Half of Lewisham's carbon emissions come from energy used in people's home, a significantly higher proportion than both the London and UK averages (Figure 2.1). The majority of this (31.5%) originates from the burning of natural gas in domestic boilers for heating and hot water production (Figure 2.2). This is the largest single contributor to carbon emissions in the borough and highlights the importance of decarbonising heating and hot water production in Lewisham to meet carbon targets.

In March 2020 LBL published the Lewisham Climate Emergency Strategic Action Plan . This document (detailed in Section 3.2.1) sets out the path for the borough to be carbon neutral by 2030 and to ensure Lewisham will be greener and better for future generations.

The investment required for this is huge, an estimated minimum of £1.6bn over 10 years. This action and investment could prevent a much higher social and economic cost later down the line and also have the power to create thousands of jobs and wider benefits for health and wellbeing of the borough's residents.

Investment in low carbon heat networks plays an important part of the Climate Emergency Strategic Action Plan. Objective 2.1 Sustainable Housing states a new strategic approach to decarbonising heat across the housing stock will be developed, with the aim of centralising plant and creating opportunities for heat networks.

In a large step towards this objective, Veolia (who own and operate the SELCHP heat network) won £5.5m funding in 2020 through the Heat Network Investment Programme (HNIP) to initiate a connection to 3,500 new homes in the North of Lewisham borough.

LBL are now working to establish a strategic heat network for the borough and to identify heat network opportunity areas. This Energy Masterplan report feeds directly into this work and will inform planning guidance.

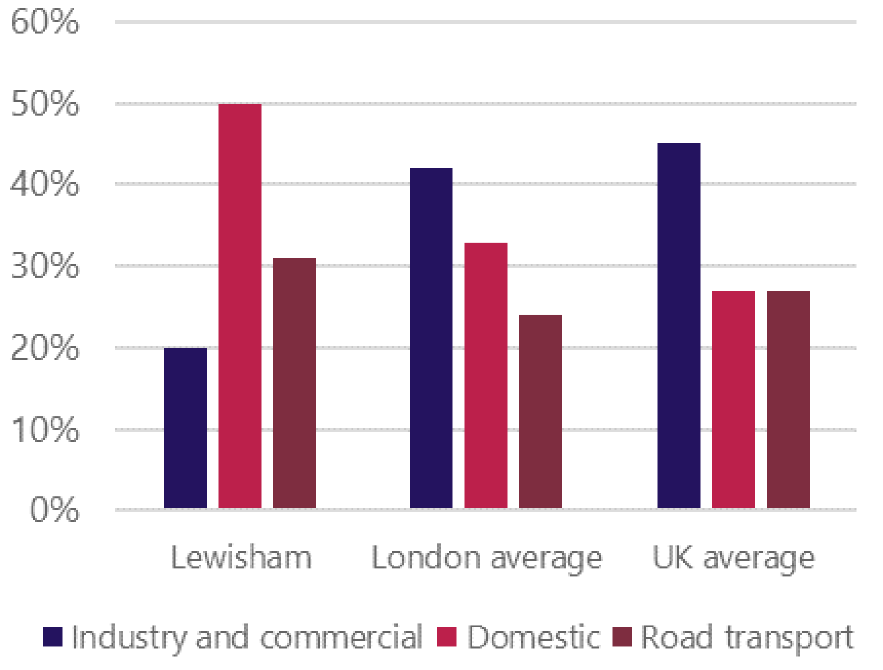


Figure 2.1: Carbon emissions by sector

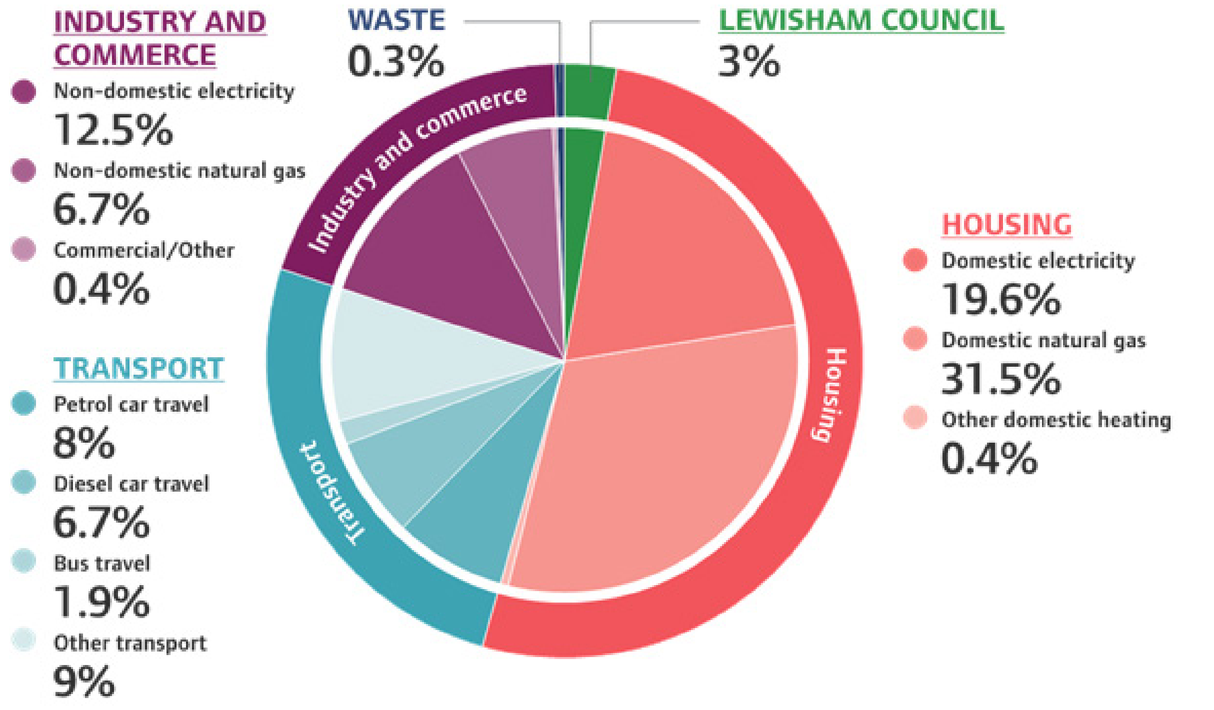


Figure 2.2: Lewisham carbon emissions baseline

2.2 Project scope

The London Borough of Lewisham (LBL) secured GLA Decentralised Energy Enabling Project (DEEP) funding to complete an update of the Decentralised Energy Masterplan for the borough with the aim of identifying opportunity areas for district heat network (DHN) development.

The approach to delivering this as documented in this report is split into these four areas:

- Update of the borough wide heat demand map: current and projected mapping of domestic and non-domestic heat demands to provide an update to the previous 2010 study. Buro Happold have engaged with LBL and relevant third parties to ensure all major new developments since 2010 have been captured and heat loads of existing buildings are up to date
- Determination of potential locations for secondary heat supply sources: desktop borough-wide study of secondary heat sources in Lewisham. Where secondary heat sources are found in areas identified under the heat mapping exercise as having potential for DHN growth, investigate the viability of each from a technical and economic perspective
- Identification of key opportunity areas: taking into account the above heat demand and supply mapping, identify, prioritise and recommend opportunity areas in the borough with potential for DHN development. Provide a strategic incremental heat network delivery plan based on identified clusters
- Techno-economic appraisal of three selected opportunity areas: network routes, plant sizing and economic and carbon modelling of the three prioritised areas:
    - Deptford
    - Lewisham Town
    - Catford

This study is limited to the high-level appraisal of DHN opportunities within LBL. Identified clusters should be subject to a subsequent detailed feasibility and techno-economic analysis to validate assumptions on energy demands, physical and commercial constraints and project finances.

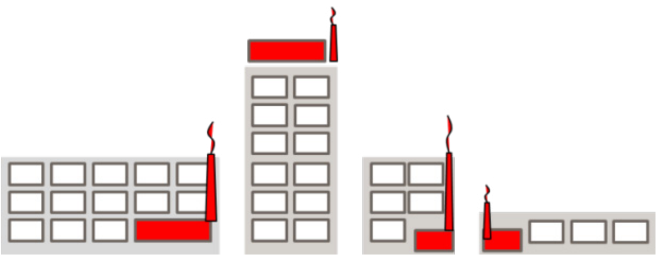


Figure 2.3: Without heat network

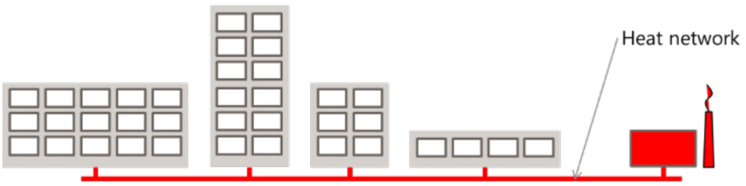


Figure 2.4: With heat network

2.3 Introduction to district heating

In a district heating network, buildings are served with hot water through an insulated pipe network from a centralised energy centre, remote from the point of supply, generating heat (and sometimes cooling and/or electricity).

Where the heat demand density is low, for example in Lewisham's areas of low-rise housing, an individual building approach to heating tends to be most suitable – to address this Buro Happold are carrying out an additional low carbon options appraisal of the existing and future building stock in LBL. Where heat demand density is high, district heating can be more energy efficient, reducing costs and enabling technologies with lower CO2 emissions to be connected, such as gas CHP and heat pumps, or utilisation of waste heat sources.

District heating infrastructure enables a wide spectrum of opportunity for low carbon heat by facilitating the ability to change future heat sources, without modifying building design. It allows the integration of some large heat sources that require a minimum heat output to be cost-effective. District heating can provide cost-effective and technically feasible means of achieving significant CO2 emissions savings for urban areas. However, care is needed to optimise the commercial and technical aspects of the network to minimise losses and maximise operational efficiency.

Specific benefits of district heating networks include:

- Introduction of wider range of energy efficient technology can result in lower carbon and lower costs to consumers if implemented at scale
- Future proofing to ensure continued carbon savings without altering individual buildings. As newer, more energy efficient heating plant becomes commercially available, the plant within the energy centre can be replaced at the end of its commercial lifecycle
- Energy security – an energy centre can provide fuel flexibility, as multiple types of heat generating plant can be used to deliver heat to a network. This can be based on the most efficient and cost-effective technology depending on the dynamic carbon factor of grid electricity or spark gap price between gas and electricity
- District heating can support building compliance and local authority targets for new and existing buildings, whilst also supporting the aim to decarbonise the UK heat supply through the Climate Change Act 2008
- Mitigating against rising energy costs and potentially providing long term returns on investment
    - Reducing developers' cost of compliance with Building Regulations
    - Reducing labour and maintenance costs compared with individual systems
    - Reducing or eliminating the need to reinforce utility networks
    - Providing Local Authorities with an opportunity to address fuel poverty for vulnerable residential and businesses by providing lower, more affordable and stable prices.

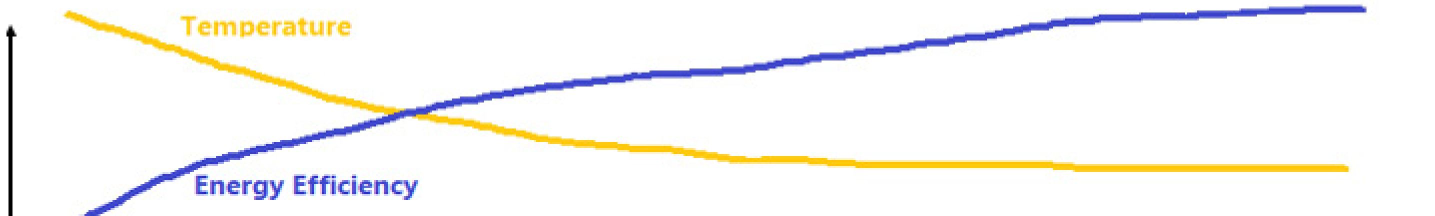
2.3.1 5th Generation district heating / Ambient loops

District heat networks have evolved over time as the technology and practical experience has grown. Below is a summary of 3rd – 5th generation district heating (GDH) topologies:

- 3GDH – traditional DH topology with heat only being supplied from an energy centre at ~70/40oC. Any cooling is supplied through a separate system
- 4GDH – traditional DH topology with heat only being supplied from an energy centre at ~50/30oC. Any cooling is supplied through a separate system. Becoming the most well-established heat distribution system
- 5GDH – 2 pipe warm and cool headers ~30/15oC heating only acting as a source/sink for distributed heat pumps to provide both heating & cooling and allowing an interchange between the two. Usually with balancing technology on the spine, including seasonal storage (also known as ambient loops)

The aggregation and interconnection of heat loads can create an opportunity for low carbon technologies to be deployed at scale to share benefits and generate revenue.

A well-established heat distribution system, DHN is currently evolving to what is known as "4th Generation District Heating" (4GDH). Buildings using 5GDH require high levels of insulation or larger heat emitters (such as underfloor heating) to operate with heating temperatures of 45oC. This temperature allows water source active cooling to reject heat straight back into the network, thus improving efficiency. Due to the low network temperature, DHW boosters are required in the dwellings. 5GDH therefore typically works best where simultaneous heating and cooling occur e.g. retail spaces typically have year round cooling whilst residential have year round hot water demand. Figure 2.5 provides an illustration of the concept of 4GDH in comparison to the previous two generations.



	3GDH	4GDH	5GDH
Topology	Standard – single EC supply heat outwards	Standard – single EC supply heat outwards	New – decentralised plant supplying spine
Temps	Supply: 60-70°C Return: 40-50°C	Supply: 45-55°C Return: 15-25°C	Supply: <45°C Return: 15-25°C
Pipework	Well insulated pipework (steel)	Well insulated pipework (steel or plastic)	Little to no insulated required (plastic)
Storage	Significant thermal storage	Significant thermal storage	A small amount of short term thermal storage
DHW	Can supply DHW directly	May need booster	Will need booster for DHW
Cooling	Separate system	Separate system	Built in cooling in 2-pipe system
Heat exchange	No exchange of heat between buildings	No exchange of heat between buildings	Interchange of heat and coolth with balancing mechanism
+ve		Reduced operating costs and carbon emissions Lower heat losses Greater plant efficiencies More opportunity for waste/renewable heat	Even lower operating costs and carbon emissions Supplies both heating and cooling Heat recovery between buildings Easier to expand network in future Even lower heat losses in pipes
-ve		Larger pipework and pumping costs Requires DHW boost Less storage density No heat exchange between buildings	Larger pipework but somewhat offset by reduced insulation Larger pumping costs Requires DHW boost

Figure 2.5: Illustration of 5th generation district heating (5GDH) compared to previous two generations

3 Relevant Studies and Polices

3.1 Previous heat mapping studies

3.1.1 Ramboll heat map 2010

The Ramboll Heat Map Study (2010) collected heat load data for priority buildings across the borough. It identified 5 opportunity areas for future heat networks:

- Deptford / New Cross
- Central Lewisham
- Hither Green
- Catford /Lewisham Hospital
- Sydenham.

Deptford / New Cross and Central Lewisham were listed as the highest priority due to their scheduled major redevelopments. Catford, Lewisham Hospital and Hither Green were classified as medium priority as these areas are more low density, residential areas. However, Lewisham Hospital was identified as a large anchor load for a potential network.

3.1.2 New Cross and north Lewisham heat network feasibility study

In 2015/16 WSP undertook two feasibility studies of a heat network supply Goldsmiths, University of London and a number of other new developments in the north Lewisham area with heat from the SELCHP waste incineration plant .

The original study focused on connection to Goldsmiths and a number of smaller adjacent loads. It concluded that this would not be economically attractive. It did however identify the potential for the network to extend north to several large new developments in the area.

Following on from this, WSP carried out a second, more detailed feasibility study into the north Lewisham area. The study concludes that the most economically beneficial scheme would connect Goldsmiths University, The Surrey Canal Triangle, Convoy's Wharf and a number of smaller loads. With an estimated capital cost of £4.7m for the pipework alone (Figure 3.2), the network would reach payback in 10 years.

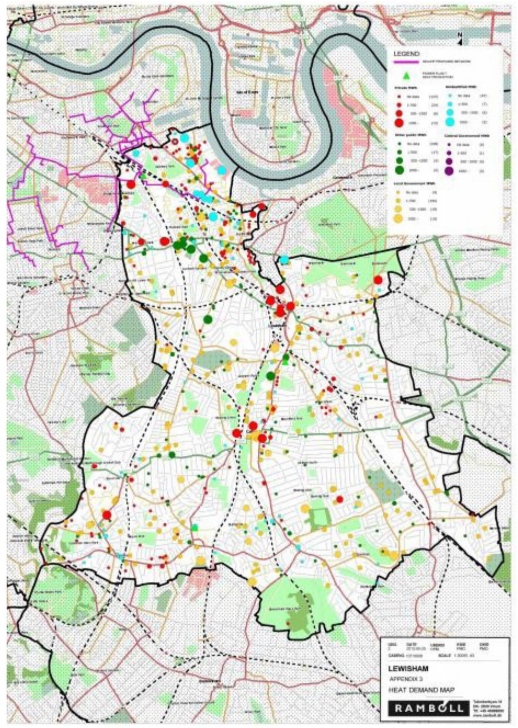


Figure 3.1: Ramboll 2010 heat map

Figure 3.2: WSP 2016 north Lewisham proposed network route

3.2 Policy

This chapter describes some of the national, regional and local policy context that will shape the future of district heating and decentralised energy within Lewisham.

3.2.1 Local policy

Lewisham Draft Local Plan

The main objective of the new Local Plan is to achieve 'An Open Lewisham as part of an Open London'. Underpinning this philosophy is the concept of 'Good Growth' that The Mayor of London recently introduced in the draft London Plan. Good Growth is growth that is socially and economically inclusive and environmentally sustainable.

This is particularly pertinent as the rapid population growth experienced in Lewisham in recent years is expected to continue, with projections estimating a 19% population growth between 2017 and 2040 . This will likely put further pressure on local services and infrastructure and may exacerbate issues around access to high quality housing and affordability. Over the next 15 years, there is an estimated demand for approximately 14,500 net additional square metres of retail floorspace and 15,000 net additional square metres of employment floorspace.

The significant investment in recent years has been concentrated in the north of the borough. This has improved overall levels of deprivation however Lewisham still remains within the 20% most deprived local authorities in England and is the 10th most deprived London Borough. It has the highest proportion of children and older people in economic deprivation in the country.

To ensure this Good Growth reaches all with equal opportunity, the draft Local Plan sets out the following objectives relevant to heat network development:

- Housing tailored to the community with genuinely affordable homes: Ensure Lewisham's existing and future residents benefit from good access to a wide range and mix of high quality housing, including genuinely affordable housing that is tailored to meeting the varying needs of the community, including the needs of those from all age groups at different stages of life, families and those with specialist housing requirements.
- A thriving local economy that tackles inequalities: Increase the number and variety of local jobs and business opportunities, by making the best use of employment land and providing suitable space to support businesses of all sizes, along with securing affordable workspace and workplace training programmes. through investment to secure Lewisham centre's future role as a regionally important Metropolitan centre, to deliver regeneration in Catford Major centre and to support the vitality of town centres elsewhere.
- A greener Borough
- Climate change resilience: Reducing carbon emissions through new development, 100% of all development to provide on-site carbon emission reductions of at least 35% compared to Building Regulations 2013, each year
- Healthy and safe communities
- Securing the timely delivery of infrastructure: Delivery of all forms of infrastructure (transport, community, health, education, cultural, green etc), Amount of financial contributions secured through section 106 and CIL
- Proposals for new residential and non-residential of 500m² gross floorspace or more, will be required to achieve an 'Excellent' rating under the BREEAM scheme or equivalent
- Sustainable retrofitting measures to existing buildings and other development will be supported where they comply with other Local Plan policies
- All major and minor development proposals should be designed for future connection to a heat network, having regard to Heat Network Priority Areas of the London Heat Map and other local area opportunities.

Lewisham Climate Emergency Strategic Action Plan

In March 2020 LBL published the Lewisham Climate Emergency Strategic Action Plan . This document sets out the path for the borough to be carbon neutral by 2030.

Investment in low carbon infrastructure and heat networks plays an important part of this plan. The following objectives are relevant to energy in Lewisham:

- Objective 1.5.4: Explore partnerships with finders for new carbon reduction infrastructure projects that deliver local value and potential return on investment
- Objective 1.5.5: use the Council's corporate energy procurement to support renewable energy, develop an energy procurement strategy that aligns with our Climate Emergency ambitions with the way we procure energy contracts
- Objective 1.2.3: embed the aspiration to be carbon neutral into the Catford Regeneration Masterplan with an aim for the Council's main corporate centre to achieve a DEC A rating
- Objective 2.1.2: develop a new strategic approach to decarbonising heat across the building stock with the aim of centralising plant and creating opportunities for heat networks.
  - Assess the opportunities and risks of technologies such as heat pumps
  - Improvements to existing electric heating systems and storage heaters
  - Identify the optimum approach to boiler replacements.

3.2.2 Regional policy

The GLA have issued new Energy Planning Guidance applicable from January 2019. In this update planning applicants are encouraged to use updated (SAP 10) carbon emission factors to assess the expected carbon performance of a new development, ahead of their adoption into Building Regulations in 2020. The implication of this will be that gas-fired Combined Heat and Power (CHP) will not be able to provide the required savings to achieve compliance. All major developments in LBH will be referable to the GLA.

Updates to the Draft New London Plan have been published as of July 2018 following public consultation. The new hierarchy continues to promote heat networks but, as with the above, the focus shifting to lower emission heat sources such as heat pumps (rather than CHP which was previously favourable) if a building cannot connect to local existing or planned heat networks.

The London Environment Strategy 2018 (LES) is an integrated environmental strategy for London, commissioned by the Mayor of London. It states that although predominantly gas-based CHP engines have been used in new developments across London, the carbon savings from these systems is declining as a result of the national grid electricity decarbonisation. This increasing evidence of adverse air quality impacts from CHP systems has led the Mayor to recognise the need for alternative approaches.

3.2.3 Updates to SAP factors

The Standard Assessment Procedure (SAP) is the methodology used by the Government to assess and compare the energy and environmental performance of dwellings. SAP 2012 guidance was followed by Building Regulations 2013.

An updated version, SAP 10.0 , was published for consultation in July 2018. More recently, a further updated version, SAP 10.1, has been published in October 2019 to coincide with the publication of the Government's Future Homes Standard consultation, which discusses proposed changes to Building Regulations Approved Document L1, which makes reference to SAP.

It should be noted that both SAP 10.0 and SAP 10.1 are consultation versions only and are not used for any official purpose. SAP 2012 continues to be the version used for all official purposes. The Building Research Establishment (BRE) expects a further update to SAP, SAP 10.2, to be published before it is brought into official use . Building Regulations Part L is currently under consultation and is usually updated once every four years, meaning that SAP 10 could be in use in 2020.

Amongst other changes within these new versions of SAP, carbon emissions factors have been updated for a number of key fuels including grid electricity, waste heat from power stations and heat from waste combustion boilers. These carbon factors are summarised in Table 3.1 and Figure 3.3.

Table 3.1: Carbon factor by version of SAP

	SAP 2012 version 9.92	SAP 2016	SAP 10	SAP 10.1
Mains gas	0.216	0.208	0.210	0.210
Electricity, any tariff	0.519	0.398	0.233	0.136

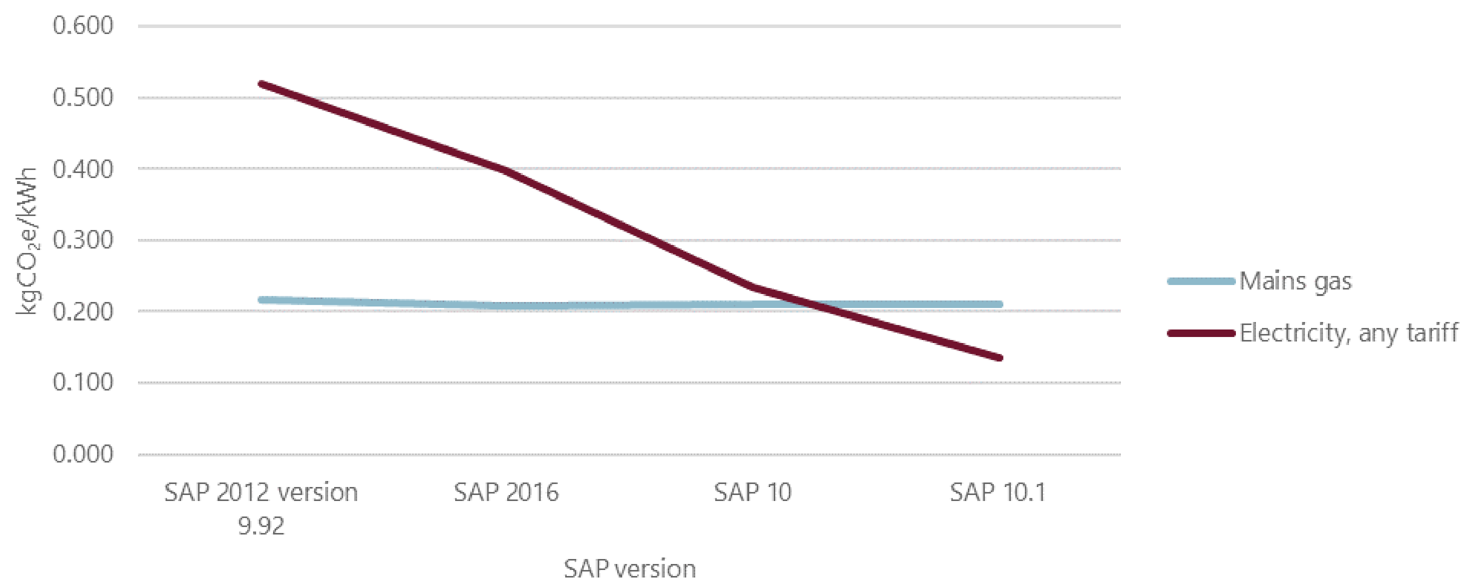


Figure 3.3: Carbon factor by version of SAP

4 Heat Clustering Method

4.1 Overview

The methodology of this study follows the development stages summarised in Figure 4—1 below.

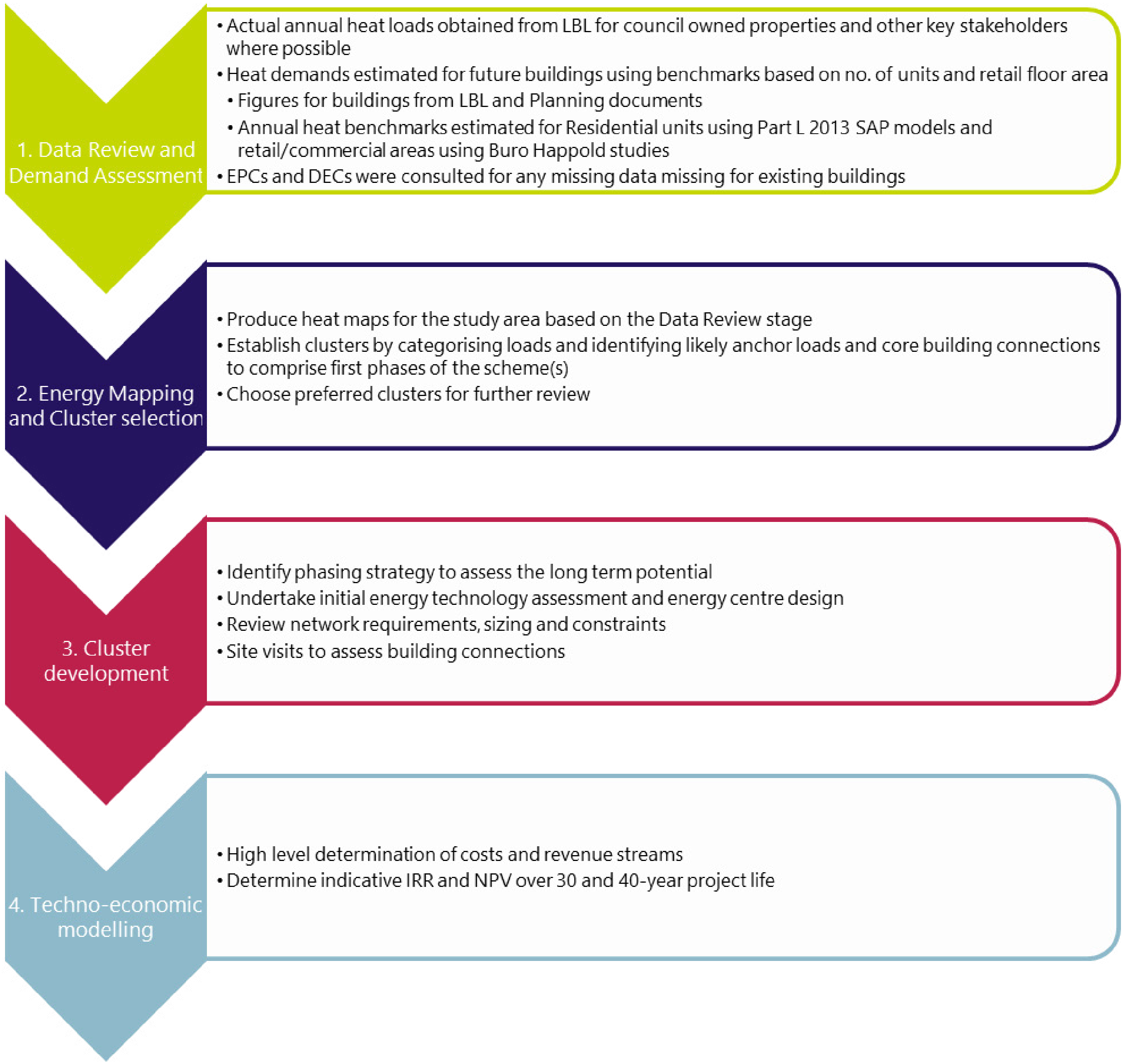


Figure 4.1: Methodology flow diagram

4.2 Data sources

A load schedule was developed for each identified heat load within the borough. The load schedule focusses on existing and planned developments over 50 residential units or 10,000m² GIA. The datasets consulted to consolidate this information include:

- Council owned buildings (resi and non-resi)
- Planning applications – Energy Statements
- Pre-planning applications database
- Stakeholder engagement
- London Development Database (LDD)
- Display Energy Certifications (DECs) (with duplicates from above removed)
- Energy Performance Certificates (EPCs) (over 1,000MWh/a) & not listed in the DECs.

Where heat load data was not available, heat loads have been estimated based on in-house typology based benchmarks.

4.3 Clustering approach

Each development mapped in the borough has been given a tier, based on the criteria set out in the table below. The tier assigned depends on the building's annual heat demand, typology, ownership and development status.

New builds have been more favourably tiered due to LBL's ability to influence energy strategy and their higher probability of connection readiness to a DHN. LBL and other publicly owned buildings have an improved tier compared to privately owned to reflect LBL's influence over refurbishment and plant replacement strategies.

The tiering descriptions for the table are as follows:

- Tier 1: High heat demand and potential anchor load.
- Tier 2: Lower heat demands but potential to contribute to an established network.
- Tier 3: Small heat demand unlikely to facilitate DHN development.

Table 4.1: Heat demand tiering criteria

New development	Building ownership	Building typology	Annual heat demand (MWh/year)						
			Unknown	<100	100-500	500-1000	1000-2000	2000-5000	5000+
No	Private	All typologies	Tier 3	Tier 3	Tier 3	Tier 2	Tier 1	Tier 1	Tier 1
	Local government	All typologies	Tier 3	Tier 3	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1
	Other public	All typologies	Tier 3	Tier 3	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1
Yes	Private	All typologies	Tier 3	Tier 3	Tier 2	Tier 1	Tier 1	Tier 1	Tier 1
	Local government	All typologies	Tier 3	Tier 3	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1
	Other public	All typologies	Tier 3	Tier 3	Tier 1	Tier 1	Tier 1	Tier 1	Tier 1

5 Heat Supply

5.1 Low carbon technology review

For each identified cluster, a central low carbon technology has been identified for technical modelling. Table 5.1 describes a range of possible low carbon technologies, explaining which have been considered as options in the cluster development.

- Green shaded cells indicate a positive impact, opportunity of advantage of using the technology
- Amber indicates a medium or neutral impact
- Red indicates potential large challenges and considerations of using the particular technology.

Table 5.1: Low carbon technologies review

Technology	Capital costs	Operational costs	Future energy prices	Future decarbonisation	Technology risk	Local environmental impact	Space and access	Security of supply	Further comments	Selected?
Natural gas CHP									Widely utilised technology considered mature and attractive. Considered a transition technology to bridge between natural gas and long-term electrification.	N – no longer 'future-proofed' solution due to the rising cost of carbon compared to the future grid electricity price.
Natural gas boiler									Mature, economic technology, offering a high level of flexibility and rapid heat generation.	Y – will be considered as a backup option or to meet peak demand
WSHP									Likely to become more attractive for large scale schemes as the grid decarbonises	Y – potential within the Ravensbourne River, River Quaggy or combined flow of both, downstream the Ravensbourne.
ASHP									Varying performance with ambient conditions, infinite supply, becoming a widely used low carbon technology	Y – particularly suitable for clusters where ground space is limited.
GSHP									More attractive as the grid decarbonises. Open loop requiring detailed ground survey but reliable, closed loop offering compact installation	Y – possible solution at St Dunstan's Enterprises (College grounds) and close to the Catford Redevelopment site.
Sewage Recovery									Emerging technology, utilising waste heat that is otherwise disposed of.	N – no suitable opportunities within the selected clusters.

Technology	Capital costs	Operational costs	Future energy prices	Future decarbonisation	Technology risk	Local environmental impact	Space and access	Security of supply	Further comments	Selected?
Biomass boiler									Responds slowly to fluctuating demand, so operate more efficiently under a more constant load.	N – does not meet air quality requirements in London.
Biomass CHP									Small-scale biomass CHP is relatively low efficiency. Well-established at a larger scale (>10MWe).	N – high cost and fuel storage presents major constraints.
Biogas CHP									No active authorised landfill sites or sewerage treatment plants in the study area.	N – high cost and supply of fuel is not certain for the scale of the project.
Energy from Waste - SELCHP									Fossil fuel and electricity price uncertainty may make EfW a more convincing proposition in the future	Y – SELCHP is a currently underutilised futureproofed waste heat resource
Sewage heat recovery									Thames Tideway Sewer runs through Lewisham. Successful projects in operation in Europe and other parts of the UK	Y – Sewage heat recovery possible in specific locations subject to further exploration with Thames Water
Hydrogen network									Pilot projects on-going. Potential solution for retrofitting. Not recommended trialling for this scale of deployment.	N – Technology in pilot testing (see later)

With ongoing decarbonisation of the national electricity grid, gas CHP is no longer considered a low carbon technology for district heating. Heat pumps are therefore likely to play an important role in the development of district heating going forward. Figure 5.1 shows carbon factor modelling until the year 2055; the counterfactual option representing individual gas boilers in each home/building. This modelling assumes that CHP electricity is used on-site. It demonstrates how CHP is expected to become a less attractive option in terms of CO2 emissions than the counterfactual option in the year 2032.

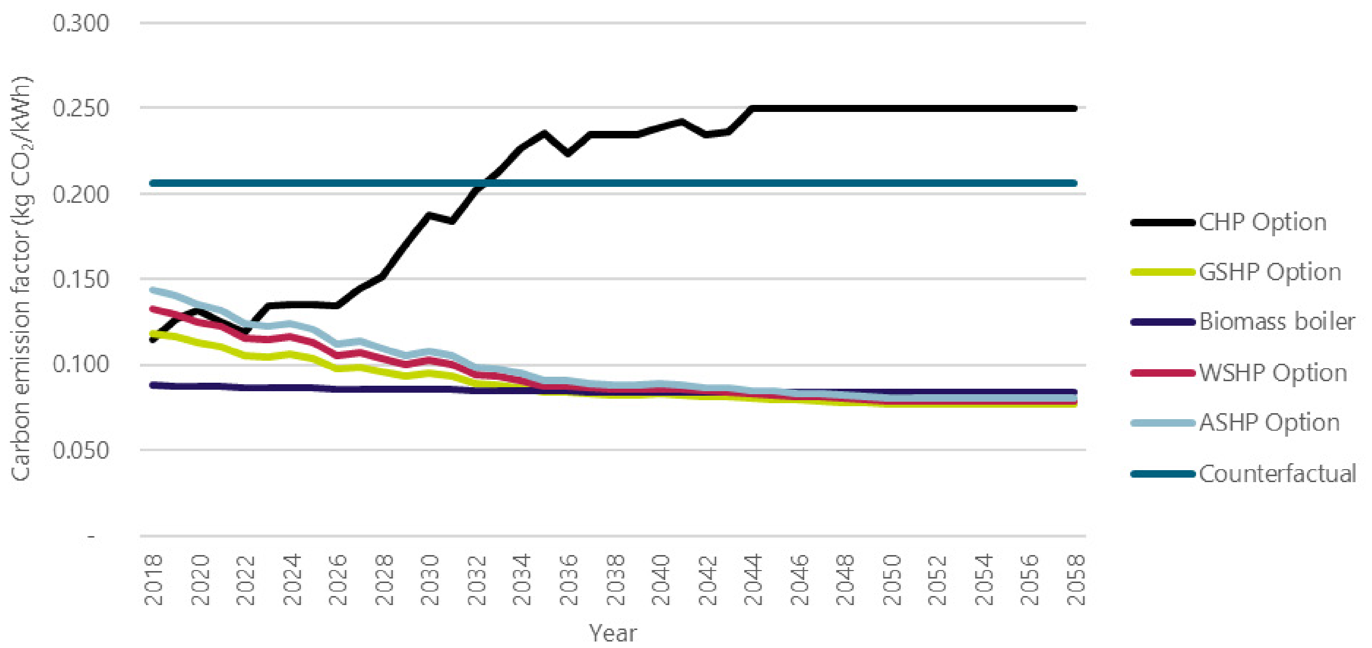


Figure 5.1: Carbon factor model to 2055 based on typical efficiencies and using BEIS projected carbon factors

Table 5.2: Heat pump technology review

Heat pumps		Comments
Capital costs		Heat pump plant is relatively low cost, but ground, water or heat recovery installation can be expensive.
Operational costs		Electricity costs are higher than gas, but this is offset by the high efficiencies for heat pump plant if connected to a constant heat source.
Future energy prices		Grid electricity forecast to increase in cost. No electricity generation, meaning that the only revenues would be from heat sales and any Renewable Heat Incentive (RHI) payments. RHI replacement from March 2021 is currently unknown.
Future decarbonisation		Grid electricity forecast to decarbonise significantly to 2050, meaning that the heat supplied by heat pumps will reduce in carbon intensity.
Technology risk		There is precedent for deployment at large scale in the UK and abroad, however the market in the UK for large DH heat pumps is still reaching maturity. Heat pumps are most efficient at lower temperatures than traditional heating systems and therefore interventions may be required at connections to existing buildings.
Local environmental impact		No emissions at the source of heat generation, as electricity is the fuel used rather than combustion. This avoids local air quality issues associated with heat generation, such as are experienced with combustion units like gas CHP.
Sustainability		Grid electricity projected to significantly decarbonise over the lifetime of the plant. Heat pumps also present the opportunity to connect to alternative electricity sources.
Space and access		Spatial issues associated with GSHPs due to the need for boreholes or ground loops.
Transport		No transport requirements for fuel to site.
Security of supply		Connection to National Grid considered to be a secure supply. Could build resilience by running heat pump on locally-generated electricity, potentially also using battery storage. Implementation of heat pumps, especially in a centralised configuration is likely to require electricity grid reinforcement due to the high power demand.

Hydrogen

An alternative to installing new low carbon technologies is to inject lower carbon gases into the existing gas network. It is possible to inject the gas to varying degrees in order to reduce the carbon factor of the system. Hydrogen as an alternative fuel is being piloted in many projects across the country.

At Keele University, a project called 'HyDeploy' is testing the effect of injecting hydrogen into the gas grid up to a mix of 20% . Should the scheme be successful, there is a vision to test on a larger scale in the North East and the rest of the UK. This could lead to emission savings without major infrastructure changes.

In addition, it is possible to completely replace natural gas with hydrogen. Tests have been being carried out at a facility in Buxton for transforming the existing gas grid to 100% hydrogen. As a result of it's success, a further £6.8m has been awarded for phase 2 of the project .

Should these tests prove safe and viable, the transition to a hydrogen network could be an alternative decarbonisation solution in Lewisham, particularly for the housing estates with individual boilers as appliances can likely be replaced with similar products, however conversion of gas pipework within the buildings could still create large disruption and cost.

The deployment of hydrogen networks are however in their infancy and the timescales of introduction of hydrogen at scale are unknown, with large scale trials in the UK not set to be complete till the early 2030s. Widespread use also requires the development of significant new infrastructure, including a new transmission system, hydrogen production (through renewable energy sources) and storage facilities.

Given this uncertainty this study focusses on commercially ready technologies in order to implement low carbon heat networks within the next 10 years and help Lewisham achieve their climate emergency targets. That said hydrogen has the potential to play a strategic role in long term heat decarbonisation.

5.2 Secondary heat supply

This section provides some detail on secondary heat resource opportunities within the Borough of Lewisham. A previous study undertaken by Buro Happold for the GLA identified that across London, about 38% of heat demand could be met by secondary heat sources integrated with heat networks.

As described in the previous section, heat pumps are likely to be a key technology for the development of low carbon district heating going forwards. Heat pumps operate most efficiently when the temperature of the heat source is closer to the temperature of the heat delivered. This means that heat pumps operating with ambient air source are least efficient in the winter, when the air temperature is much colder. It is desirable to identify heat sources with consistent year-round temperatures, such as in the ground or large waterbodies.

In addition to natural features, man-made waste heat can also be good sources for heat pump technology, such as heat rejection from cooling and refrigeration (e.g. data centres and supermarkets), and waste heat from electricity transformers.

Figure 5.2 shows the locations of key secondary heat sources across the Borough. Table 5.3 gives further details on the most significant secondary heat sources identified within Lewisham.

Table 5.3: Details of potential heat supply opportunities within Lewisham

Secondary Source	Location	Capacity if known	Notes
TFL Bakerloo Line Extension – vent shafts	New Cross	Unknown	Proposed plans to have a vent shaft location East of New Cross at the current Big Yellow Storage site. Potential for heat recovery using an air source heat pump, similar to the operational scheme at Bunhill Phase 2. Bunhill Phase 2 recovers an annual average 780kW of heat from the TfL Northern Line vent shaft.
London Power Tunnels 2	New Cross	75-100kW	The National Grid London Power Tunnels projects extends across Lewisham from a New Cross substation to Eltham. Early proposed routing indicated that this cable will run through Deptford. A ventilation shaft at New Cross could be utilised for heat recovery in a heat pump system.

Secondary Source	Location	Capacity if known	Notes
Citibank Datacentre	Riverside, Lewisham Town Shopping Centre	Unknown	A 2.8MW Combined cooling and power system was installed within this datacentre. Heat from a couple of CHP engines is being used to run an absorption chiller. The heat rejection units are located on the roof. Buro Happold have reached out to the installers for information on the potential for any heat recovery from the system.
Ravensbourne River	Catford and Lewisham Town	1.1MW (upstream of Quaggy) 1.6MW (downstream of Quaggy)	Possibility to utilise a WSHP on this river, both before and after the confluence with the River Quaggy. Requires liaison with the Environment Agency to determine constraints on abstraction and discharge. Using river data obtained through the NRFA, it is estimated that a capacity of 1.1-1.6MW could be achieved depending on the location on the River.
River Quaggy	Lewisham Town	450kW	Tributary of the Ravensbourne River, confluencing by the Lewisham Gateway site. Requires liaison with the Environment Agency to determine constraints on abstraction and discharge. Using river data obtained through the NRFA, it is estimated that an average capacity of 450kW could be achieved.
SELCHP	South Bermondsey	~300GWh/yr	The SELCHP waste incineration plant is currently supplying waste heat to a heat network in Bermondsey. SELCHP's operators, Veolia, have secured £5.5m funding to extend this network into north Lewisham.
Parks and Public Open Spaces	Borough-wide	43MW	The Powering Parks report outlines an area of 193ha of parks and public green areas as potentially suitable for the utilisation of GSHPs. This contributes to a total capacity of 43MW.
Sewage heat recovery	North Lewisham and other	Unknown	The new Thames Tideway 'Super Sewer', due for completion in 2024 could be a large source of waste heat the borough. Early analysis suggests the Earl Pumping Station is the most suitable location to extract the heat. More work is required to estimate the available heat.

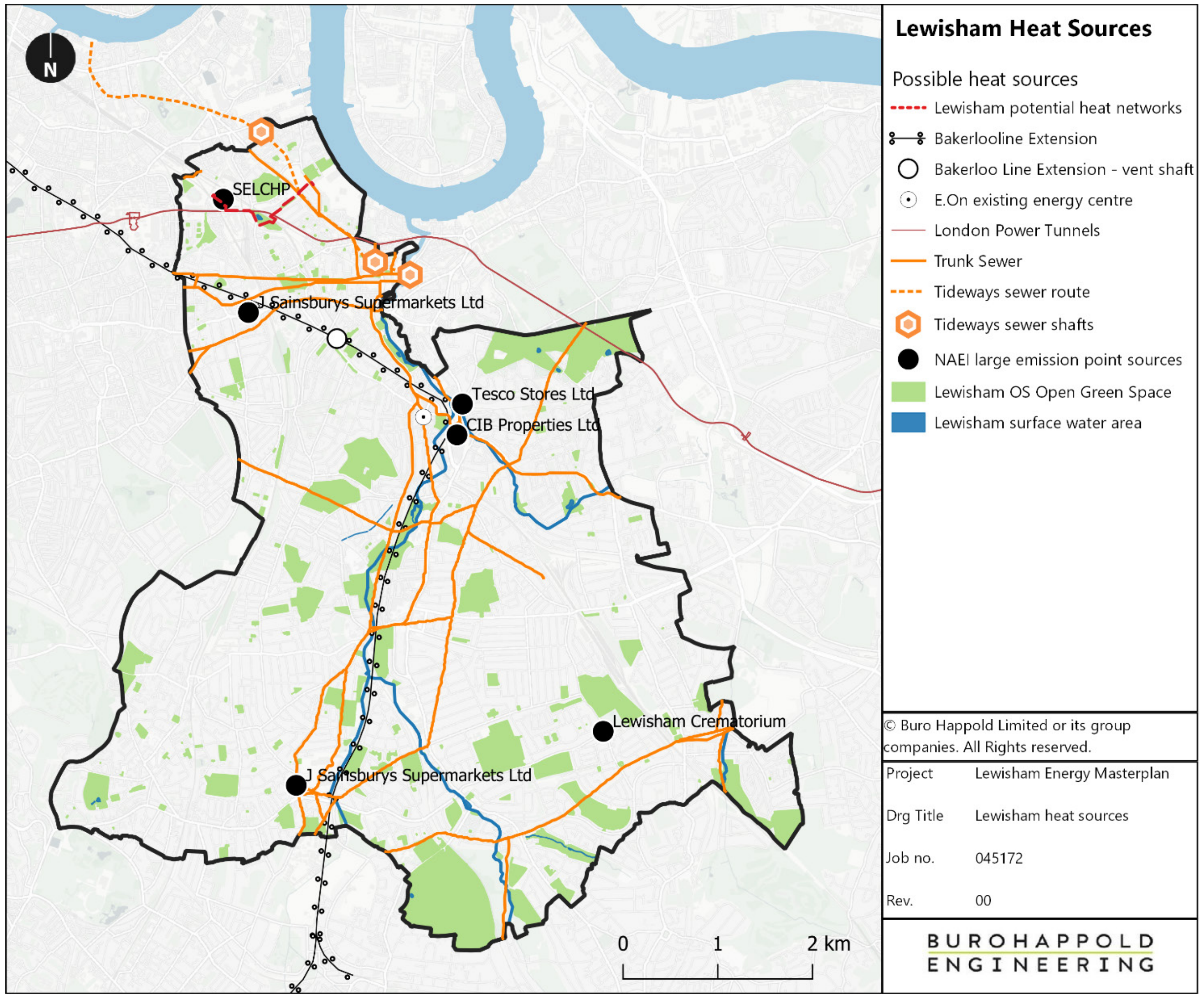


Figure 5.2: GIS map of potential heat opportunities within the Borough

5.2.1 Energy from Waste – SELCHP

South East London Combined Heat and Power (SELCHP) is the largest low carbon heat source in the borough. Veolia are actively looking at extending the network to serve the north Lewisham area.

Veolia (the owners and operators of the SELCHP waste incineration plant) have won £5.5m funding in 2020 through the Heat Network Investment Programme (HNIP) to initiate a connection to 3,500 new homes in the North of Lewisham borough at Convoy's Wharf. Convoy's Wharf is the key connection, however the DN400 trunk pipe has been sized to allow capacity for future connections. The routes currently under consideration are shown in Figure 5.3.

Buro Happold have been in discussions with Veolia who estimate there is approximately 300GWh/yr of available waste heat.

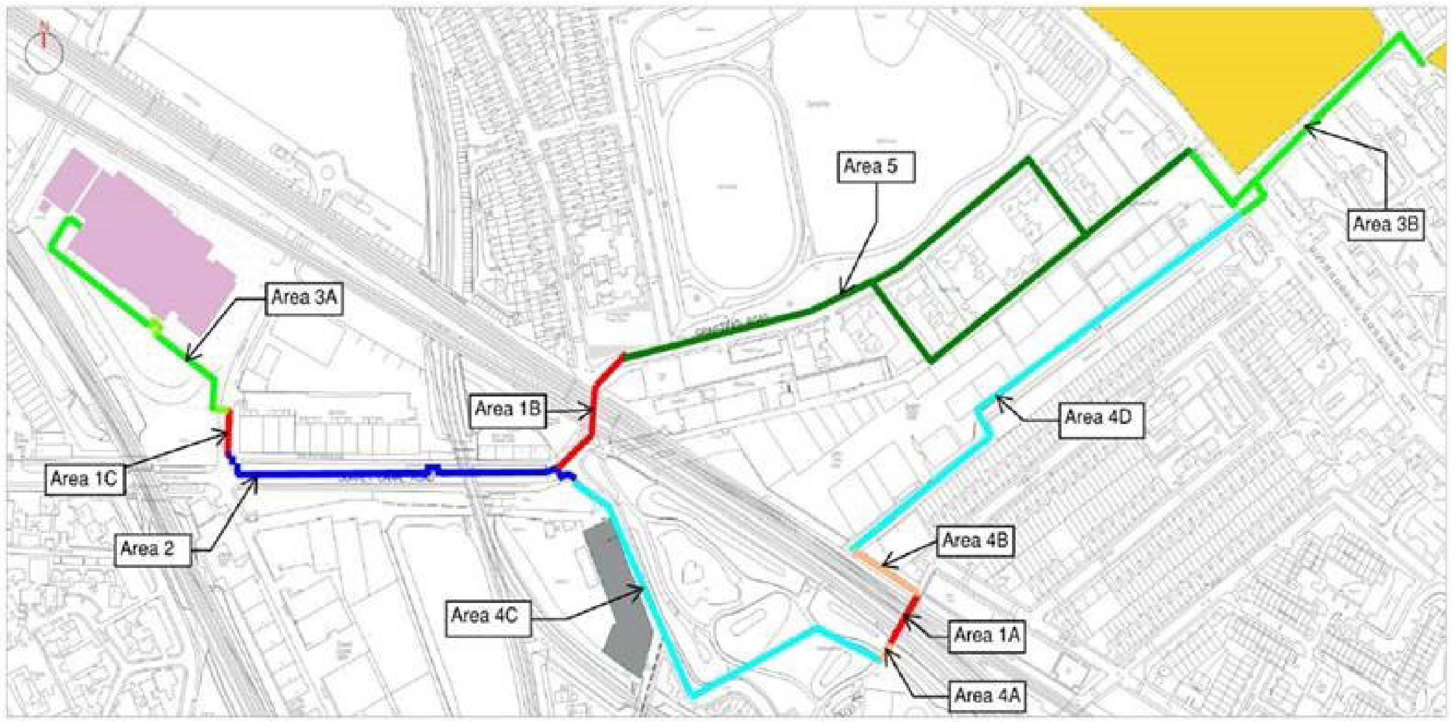


Figure 5.3: SELCHP routing options to Convoys Wharf

5.2.2 TFL Bakerloo Line Extension

The draft Local Plan identifies the Bakerloo Line Extension (BLE) as a key strategic transport infrastructure. The preferred route of the BLE proposes phase 1 extending from Elephant & Castle via Old Kent Road with stations at New Cross Gate and Lewisham. A potential phase 2 extension of the Bakerloo Line is being discussed that would run further south into the Borough (Figure 5.4). Construction on Phase 1 is expected to start in 2023, with earliest services running from mid-2030s .

A vent shaft for this route was been proposed to be located within Lewisham which brings the opportunity of using this source for heat recovery. This vent shaft has proposed to be located on the current Big Yellow Storage site on 155 Lewisham Way. Early engagement with TfL is recommended to ensure heat recovery is implemented where viable.

Previous case studies of utilising TfL underground ventilation shafts for heat recovery exist, with one example being a Northern Line ventilation shaft in Bunhill. This case study will be used as an example of the capacity of heat that can be extracted. Ventilation temperatures ranged from 19-26°C depending on season, discharging at 70m3/s and extracted 780kW via a heat exchanger, then upgraded via a heat pump to total 1033 kW. This ventilation shaft contributes to the Bunhill 2 District Heating Network project .

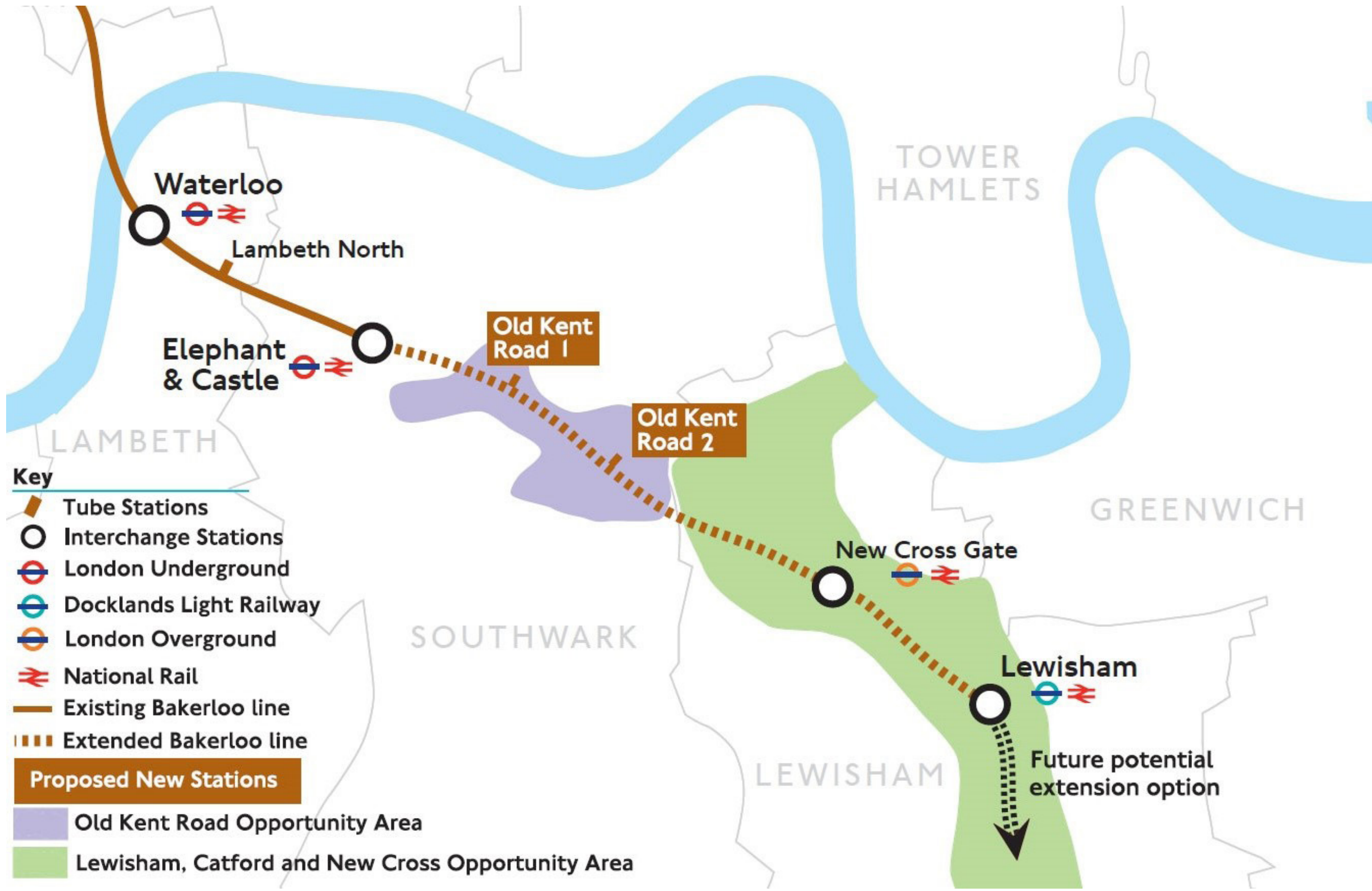


Figure 5.4: Bakerloo Line Extension route

5.2.3 London Power Tunnels 2

This is a National Grid project to rewire London as the current power network is reaching the end of its usable life. following the successful £1bn phase 1 programme in North London, the second phase focuses on South London and is three sections :

- Section 1: Wimbledon to New Cross – Operational by 2025
- Section 2: New Cross to Hurst – Operational by 2026
- Section 3: Hurst to Crayford – Operational by 2024

Construction was due to start in March 2020 and will take approximately six years to complete.

The new tunnel will be up to four meters in diameter and will replace existing electrical cables, the majority of which are buried beneath the road network. Shafts and head houses will be built at key locations to facilitate access and provide ventilation. The only ventilation shaft in Lewisham is at New Cross (Figure 5.5).

A significant amount of heat is produced as electricity is transported in these high voltage cables. Buro Happold have been in contact with National Grid to assess the potential for heat recovery in a heat pump system at the New Cross vent shaft.

The National Grid ventilation designers stipulate that the air stream at New Cross will carry 24 kW/degC. Given constraints on the acceptable pressure limits in the shaft, their initial estimates suggest 75-100kW could be recovered. This output is variable as the cables do not operate at their full capacity all year. While this is not enough heat to power a whole network, it could be incorporated into a larger heat network's supply.

Figure 5.5: London Power Tunnels route and shaft locations

5.2.4 Citibank Datacentre

The Citibank datacentre is located on Molesworth Street, backing onto the Ravensbourne River. A £5.2 million was invested in 2014 for energy, carbon and cost savings via the implementation of high efficiency technologies to the building. A 2.8MW combined cooling and power (CCP) system was installed together with energy efficient cooling units and efficiency improvements to the building's air conditioning system.

Buro Happold have reached out to Clarke Energy, the installers of this CCP system for indications on the potential for any heat recovery from the system.

5.2.5 Ravensbourne River

This river is a potential heat source, with calculations undertaken to estimate the maximum abstractable heat from the Ravensbourne River via the utilisation of a WSHP. This calculation followed the technical constraints assumed from consultation of the National Heat Map, produced by DECC (now BEIS):

- Temperature Change - A recommended maximum temperature change of 3°C when designing WSHP by the Water Framework Directive (WFD).
- Abstracted Flow – The maximum water flow available for abstraction from the river is limited by environmental constraints. Despite water source heat pump abstractions being non-consumptive as the volume is fully returned to the river, the Environmental Agency's Environmental Flow Indicator (EFI) is used as the maximum limit, expressed as a percentage allowable abstraction from natural flows. Beyond this threshold, abstractions can have an adverse impact on the river ecology. Each waterbody in the UK has an Abstraction Sensitivity Band (ASB) limiting the volume that can be abstracted depending on flow rate.

A tributary of the Ravensbourne River, the River Quaggy flows into the Ravensbourne at the Lewisham Gateway site, therefore two estimations of the abstractable heat capacity have been undertaken, one before this confluence and one after with the combined flows of the two rivers. These values are before a heat pump COP was applied to the abstracted heat rate the following average monthly flow rates, this takes into account the rivers EA abstraction sensitivity bands:

This indicates that the Ravensbourne River has been calculated to provide an annual average 1.16MW of abstractable heat before the confluence with the River Quaggy, and 1.61MW after using the combined flows of the two rivers.

5.2.6 River Quaggy

The River Quaggy is a tributary of the Ravensbourne River and has a much lower average flow to that of the Ravensbourne, the confluence of these rivers occurs at the Lewisham Gateway site within the Lewisham Town cluster. Using the same methodology as above for the Ravensbourne River and flow statistics provided by the National River Flow Archive, Figure 5.6 indicated that the River Quaggy has an average annual abstractable heat capacity of 450kW.

5.2.7 Parks and Public Open Spaces

Parks and public open spaces provide a big opportunity for the abstraction of heat via the utilisation of ground-source heat pumps. The Powering Parks16 report assessed the potential for GSHPs across Great Britain within these green spaces and estimated 30GW of heat could be supplied via this technology, of which a capacity of 43MW has been calculated for the Borough of Lewisham, covering an area of 193ha.

This estimation of heat capacity although does not take into account open-loop GSHP systems and states multiple assumptions within their estimates such as an average COP of 3.5, an average depth of 150m and an average thermal conductivity of 1.5W/mK to name a few.

Although this is a very indicative estimation this report provides a high-level estimate for the quantum of recoverable heat capacity via GSHPs across the applicable land in Lewisham. A full site investigation is recommended, however it is thought that both open and closed loop GSHP systems may be feasible in Lewisham from mapping from the British Geological Society.

		January	February	March	April	May	June	July	August	September	October	November	December	**Average**
Ravensbourne	**Monthly average heat rate (MW)**	1.78	1.55	1.38	1.29	1.04	0.97	0.86	0.73	0.63	1.07	1.19	1.42	**1.16**
Quaggy		0.70	0.58	0.49	0.50	0.41	0.36	0.29	0.28	0.25	0.44	0.50	0.58	**0.45**
Combined Flow		2.47	2.14	1.85	1.77	1.42	1.34	1.15	1.00	0.89	1.53	1.71	2.00	**1.61**

Figure 5.6: Ravensbourne and Quaggy abstractable heat capacity

5.2.8 Sewage heat recovery

Sewage heat recovery is already being practised in Europe and other parts of the UK. Figure 5.7 shows an example of system extracting heat out of an existing buried sewer and processing through a heat pump to provide high temperature heat to a heat network.

Figure 5.2 indicates the location of the existing trunk sewers in the borough which could be utilised for heat recovery. Further work needs to be done to understand the flowrates and temperatures at each sewer.

Thames Tideway Tunnel

Construction for London's new 25km "super sewer" is underway. This will prevent the tens of millions of tonnes of sewage that currently pollute the River Thames each year and also provides an opportunity for waste heat recovery. Tunnelling on the sewer is due for competition in 2022, with part of it extending into Lewisham. All works are to complete by 2024.

Buro Happold have identified the opportunity for a similar system to be implemented at the ventilation shafts or pumping stations of the Thames Tideway Sewer. The location of these is indicated in Figure 5.2 and in Lewisham include:

- The Earl Pumping Station – near Surrey Quays
- Deptford Church Street – in St Paul's Churchyard Gardens

Buro Happold's conversations with Thames Water suggest that the tunnel will only be filled to capacity around 30 times a year. The Deptford Church Street ventilation shaft will only operate when the tunnel is full (i.e. ~60 days per year), making it unsuitable as a reliable heat source.

The Earl Pumping Station may be more suitable for heat recovery as it is in constant use, however Buro Happold were unable to obtain any data for this site. Its proximity to SELCHP also means it is less likely to be the most cost effective heat source in the area.

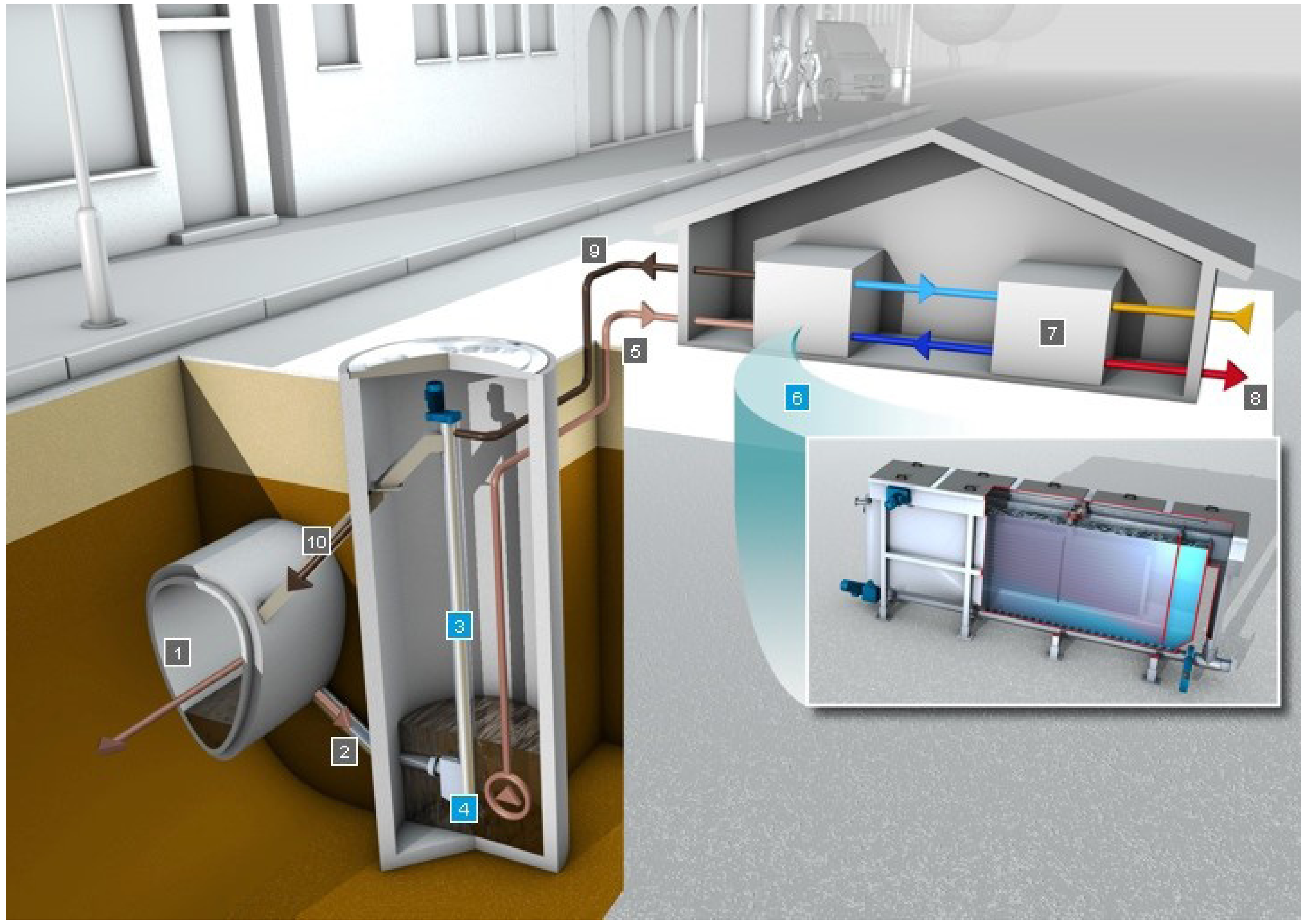


Figure 5.7: Sewage heat offtake (Huber)

5.3 Existing heat networks

There are two large known existing heat networks in the borough: SELCHP (see earlier), operated by Veolia and Loampit Vale, operated by E.On. E.On also operate a site-wide network at Catford Green that is served from a single EC with CHP and top-up boilers.

The two larger heat networks have also been summarised below:

E.On Loampit Vale Network

This existing heat network is located West of Lewisham train station and the Lewisham Gateway Site, connecting loads either side of the A20/Loampit Vale road and is owned and operated by the utility company E.On. This network supplies heat to a range of buildings, currently connected to Glass Mill Leisure Centre, Prendergast Vale School and the Thurston Point Renaissance housing developments, with the energy centre located within Western Renaissance development block.

E.On have outlined that the proposed developments on the Lewisham Retail Park and Lewisham Exchange sites may also be connected to this heating network scheme.

The current technology is CHP with gas boiler top-up. E.on have indicated that they are unlikely to expand the energy centre via boilers / CHP due to London Plan constraints and are likely to look at extension via decentralised Heat Pumps and waste heat capture with the existing energy centre providing either a heat or coolth injection as required.

5.4 Energy centre sizing

Energy centre sizing was carried out to obtain the low carbon technology capacity for each cluster, sized according to achieve a low carbon heat fraction of ~80%. Gas boilers are proposed for peak/back up purposes and are sized to be able to achieve 100% back up in the event of failure from the low-carbon technology. Analysis was based on the peak load per cluster and hourly load profiles per building typology.

5.5 Pipe sizing

The distribution pipe work capex costs are based on the required pipe capacity per connection and length of pipe from the GIS network routes. The required pipe capacity is based on the total peak heat load of all downstream connections, taken from the load schedule. Pipe sizing is based on a delta-T of 30K, maximum velocity 3m/s and maximum allowable pressure gradient 100Pa/m. Standard pipe dimensions ranging from 20mm-1,200mm have been used. All pipes are assumed to be hard dig to produce a conservative estimate of cost. The unit costs of pipework are based on costs from previous Buro Happold projects.

6 Heat Mapping and Cluster Selection

6.1 Borough wide heat map

The borough wide heat map is shown in Figure 6.1, this includes Tier 1 loads only used to determine clusters with potential heat density for heat networks. Appendix B shows the Tier 1 and 2 heat loads across the borough.

The heat mapping method undertaken for this study identified 8 potential cluster areas for DHN development, these were then grouped regionally within the Borough as North, Central and South Lewisham:

- North Lewisham

1. Deptford
2. New Cross
3. South Bermondsey

- Central Lewisham

4. Lewisham Town
5. Lewisham Hospital
6. Catford

- South Lewisham

7. Forest Hill
8. South Sydenham & Bell Green

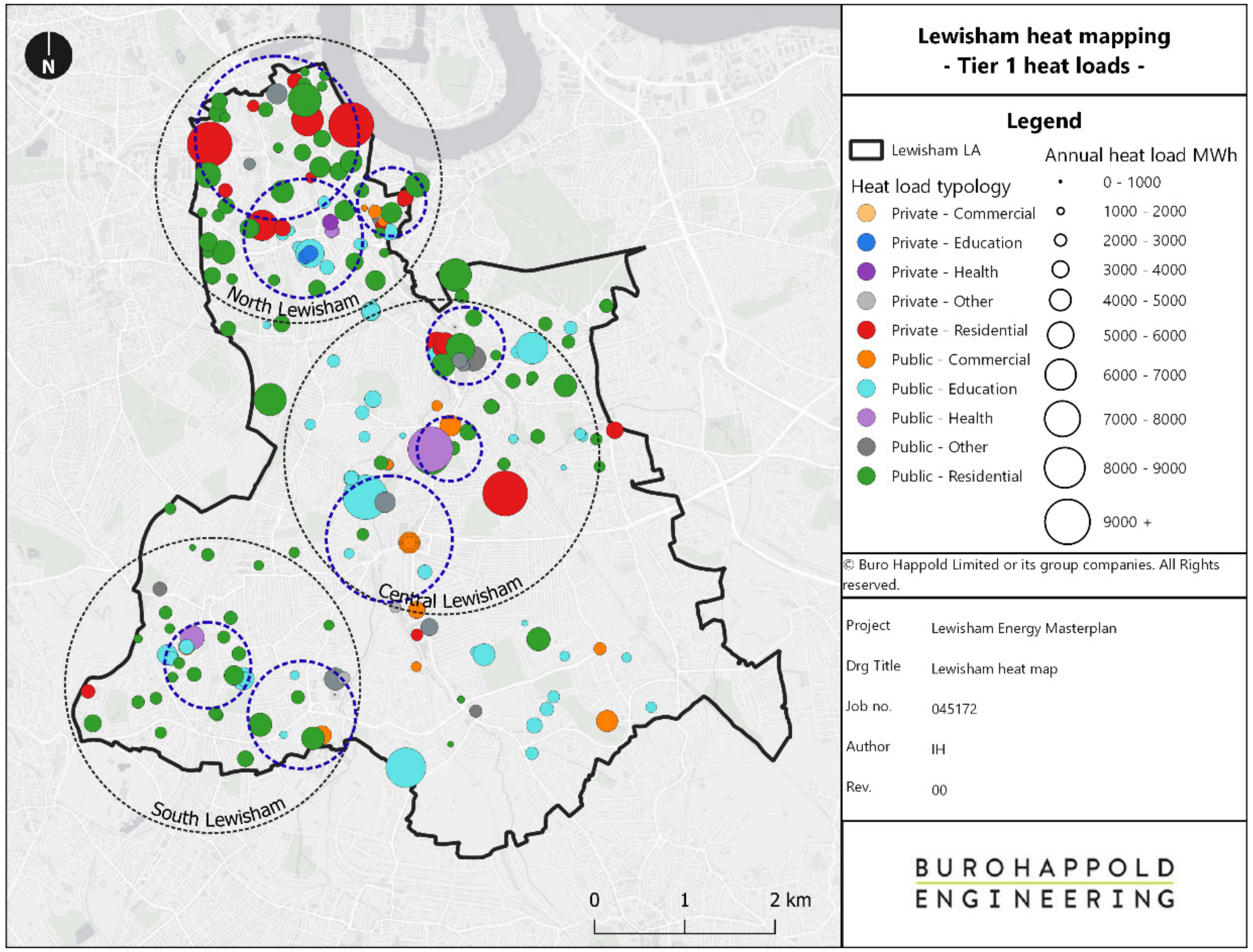


Figure 6.1: Map of identified clusters – tier 1 loads

6.2 Prioritisation of clusters

The following section gives an overview of initial high-level analysis of each of the identified cluster areas however these clusters were shortlisted to three to develop further for high level technical and commercial testing. The following criteria was considered when selecting these three clusters.

Technical: heat load, typology, heat density, phasing

Financial: ownership, network length, potential for expansion, existing LZC technology, fuel poverty

Deliverability: proposed refurbishments, new buildings, timescales for phasing, physical constraints (road and rail).

Table 6.1 summarises the matrix used to prioritise the eight clusters. Despite Lewisham Hospital ranking 1st in Table 6.1 it was discounted for further analysis as it consists of almost 100% one heat load: the hospital. Through conversations with the Director of Estates, Buro Happold understand that the hospital current runs on a steam network powered gas boilers (a new 1.3MWe/2.5MWth CHP is planned to be installed this year). This makes it unsuitable to connect into a wider network at this time.

The New Cross and Bermondsey clusters also presented a good opportunity for heat network development. However, after discussions with LBL, it was decided to not explore these opportunities further as they are already being pursued by SELCHP and other parallel heating studies.

Therefore, the following three clusters were taken forward for more detailed analysis:

- Deptford
- Lewisham Town
- Catford.

Table 6.1: Cluster prioritisation matrix

	Tier 1 & 2 Annual heat demand (GWh/year)	Tier 1 Annual heat demand (GWh/year)	New & future heat demand (%)	LBL & Public sector heat demand (%)	Area heat density (kWh/m²)	No. of connections	Heat sources (qualitative assessment)	Rank (equal category weighting, 1 is best opportunity)	Cluster chosen for analysis (Y/N)
Deptford	16.5	15.0	48%	78%	36	18	4	3	Y
New Cross	43.3	34.0	28%	76%	32	63	3	5.5	N
South Bermondsey	77.6	69.9	61%	39%	30	51	1	4	N
Lewisham Town	25.5	24.1	63%	52%	44	18	2	2	Y
Lewisham Hospital	39.3	38.6	0%	100%	99	7	8	1	N
Catford	32.6	26.9	74%	55%	21	27	5	5.5	Y
Forest Hill	16.3	14.8	36%	100%	23	19	7	7	N
South Sydenham	13.6	9.9	21%	78%	12	18	6	8	N

7 Cluster Overviews

This section provides an overview of each of the clusters chosen in this study, providing an insight into the current and future development in the area, including sites identified for connection to decentralised energy systems.

7.1 Deptford

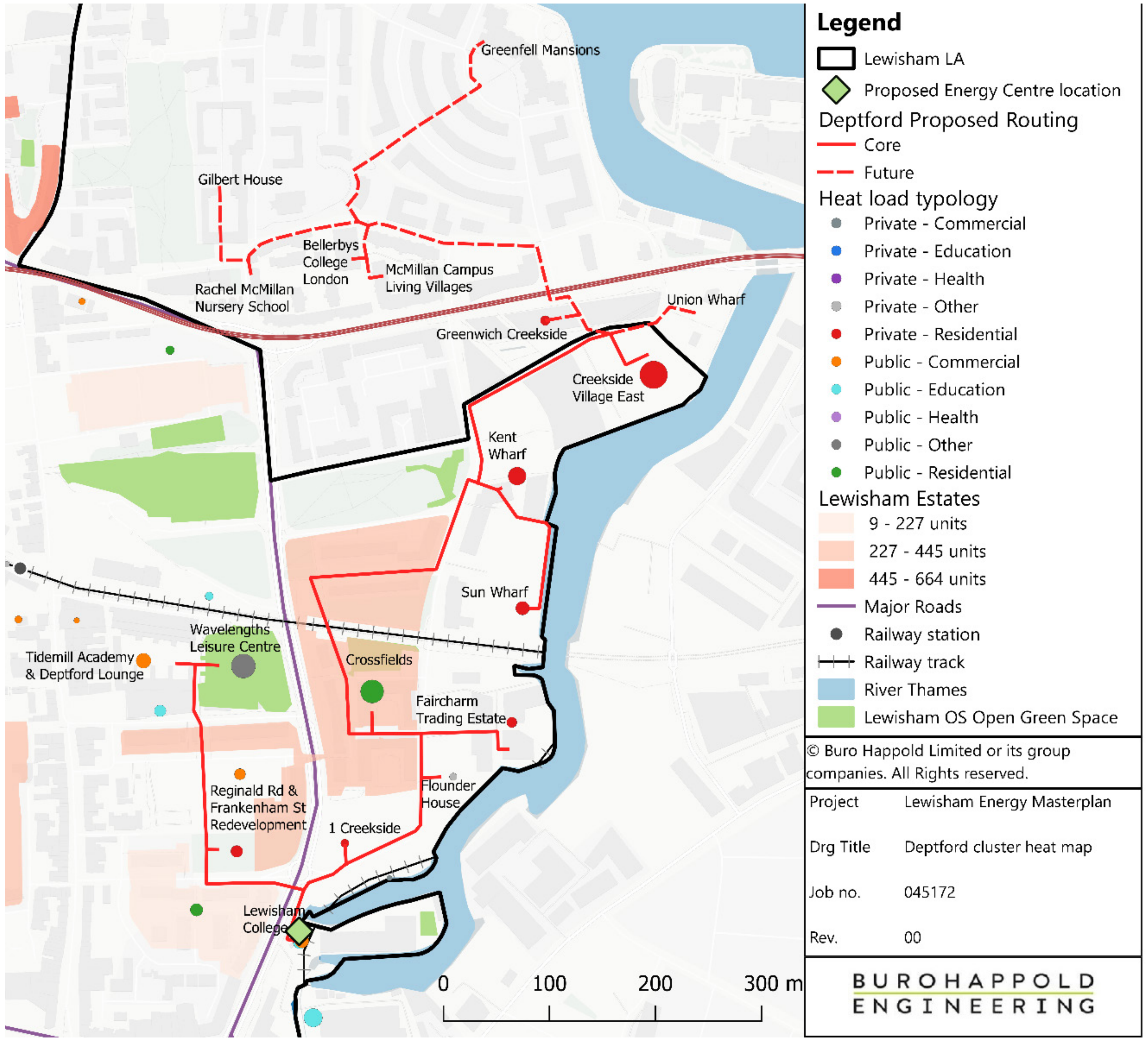


Figure 7.1: Deptford cluster

Summary

The Deptford area has undergone significant development in recent years in both the residential and commercial sectors. Many of the developments have been installed with CHP and have limited carbon futureproofing in their existing design. The CHPs will be approaching end of life by 2030. A heat network could provide infrastructure to help them decarbonise as well decarbonising a number of LBL's estates.

The proximity to the SELCHP waste incineration plant means it could benefit from the largest low carbon waste heat source in the borough. Greenwich Council have also expressed interest in the network, meaning future phases could extend to the large new developments to the north of the Lewisham borough boundary.

The proposed network will provide low carbon heat to LBL's 436 home Crossfield Estate, Lewisham College and several new residential developments along the creek.

Table 7.1: Deptford cluster core network metrics

Metric	Unit	Core Network
Heat Demand	MWh/yr	12,100
Network Length	m	1680m
Heat Line Density	MWh/m	7.20
Peak Load	MW	6.6
Percentage Heat load Tier 1	%	80%
Energy Centre Technology	-	Proposed ASHP technology with additional peak/back-up gas boilers.
Potential for SELCHP connection or heat offtake from sewage network.		

Proposed connections

The heat loads associated with the Deptford cluster and proposed core network are summarised in Table 7.2.

Table 7.2: Deptford cluster connections

Site	Description	Heat Supply	Heat Load (MWh/yr)	Tier	Source of Demand	Ownership	Status	No. units/ GIA(m²)
Tidemill Academy & Deptford Lounge	Existing school, community centre and library.	Natural gas	629	1	LBL gas data	Public	Existing	10,800m² commercial area.
Wavelengths Leisure Centre	Existing leisure centre	Natural gas	2100	1	DECs	Public	Existing	-
Reginald Road and Frankham St (land bounded by)	Residential redevelopment of the Old Tidemill School site and additional land	Proposed CHP scheme	687	1	Buro Happold benchmarks	Private	Approved	209 residential units
Lewisham College (Asquith, Ken Langley and McWilliam buildings)	Existing College site, consisting of 3 separate buildings.	Natural gas	2028	1	DECs	Private	Existing	-
1 Creekside	Proposed residential redevelopment of the land and MOT garage site.	Proposed CHP and back-up natural gas boilers	240	2	Buro Happold benchmarks	Private	Approved	56 residential units and 1541m² of commercial area.
Unit B – Flounder House	Existing commercial area.	Natural gas	192	3	NDEPC	Private	Existing	2020m² of commercial area.
Faircharm Trading Estate	Newly built mixed-use redevelopment of the previous trading estate.	Two CHPs and 4 boilers	672	1	Buro Happold benchmarks	Private	Existing	148 residential units and 5089m² of commercial area
Crossfield Estate	Existing LBL housing estate.	Individual gas boilers	2302	1	LBL estates database	Public	Existing	436 residential units
Sun Wharf	Proposed mixed-use development.	Proposed CHP scheme and back-up natural gas boilers	772	1	Buro Happold benchmarks	Private	Awaiting Approval	235 residential units and 1617m² of commercial area
Kent Wharf	Existing missed-use development.	Gas CHP and back-up gas boilers	520	1	Buro Happold benchmarks	Private	Existing	143 residential units and 1375m² of commercial area
Creekside Village East	Proposed mix-use redevelopment.	Proposed gas CHP and 3 gas boilers	1955	1	Buro Happold benchmarks	Private	Approved	393 residential units and 8076m² of commercial area

Low Carbon Potential

Buro Happold have assessed the secondary heat opportunities within the cluster. While both the London Power Tunnels and Thames Tideways Sewer both dissect this cluster, further stakeholder engagement suggests they are unlikely to be feasible waste sources for the proposed network.

Given the limitations around waste heat sources and limited open space available for a GSHP array means the most feasible LZC technology in the immediate area at this time is ASHPs. Sewage heat recovery may also be viable as trunk sewers run in the area, however further engagement with Thames Water is required.

Alternatively, the SELCHP network extension to Convoy's Wharf, and potentially Dolphin Tower, is planned to pass ~1km from the proposed Deptford network (see Figure 5.3). If this is realised it could act as a catalyst for further economically viable expansion into the Deptford area. This could also potentially pick up a number of additional connections on the way including the Greenwich and Lewisham estates either side of the A200. This additional load may require an upsizing of the planned pipework to Convoy's Wharf. A decision on this would need to be swift as Veolia plan to start works this year.

Many existing and already approved connections within the cluster are operated via communal gas boilers or gas CHP. As the electricity grid continues to decarbonisation, the carbon savings from these CHPs are reducing and they will require a future transition to a low carbon technology heat source to meet the GLA planning standards. The proposed heat network can provide this replacement heat source, negating the need for each development to install and operate its own plant.

Energy Centre Location and Technology

The potential locations for the energy centre and low-carbon heat technologies are limited within this cluster. It is proposed that the Lewisham College site is the most adequate location for the energy centre, due to the fact that there is available space within the existing site for ASHP installation. It is estimated that the installation of a 1.5MW ASHP with 6.6MW capacity peak/back up gas boilers to supply heat to the core network proposed. This plant configuration would achieve a low carbon heat fraction of 78%.

This cluster also provides the potential opportunity to connect into SELCHP for the provision of heat to the network which will be analysis as a sensitivity in later sections of the report.

Table 7.3: Summary of energy centre plant for Deptford cluster

Deptford	Unit	Value
Low carbon heat technology	-	Proposed: ASHP
Low carbon heat supply capacity	MW	1.5
Thermal store capacity	m3	75
Gas boiler capacity	MW	6.6
% yearly supply from low carbon heat	%	78

Retrofit

Currently Crossfield housing estate, within the proposed core network is supplied by individual gas boilers for the 436 units and therefore would require retrofit for the transition to a district heat network. A high-level retrofit of £1.85m for the conversion of these 436 residential units has been estimated. This cost is included as a sensitivity in the capital costs of the network as it may be possible to fund the retrofit via a separate funding stream.

Operating temperatures are a constraint when connecting to existing buildings – heat pumps run most efficiently at lower temperatures and therefore connected buildings may need further retrofit changes such as larger heat emitters or improved fabric performance to run at optimal temperatures.

Network Expansion

Expansion of the network to future loads are assessed and outlined in Appendix A. The energy centre proposed is sized for the core network only and therefore for the integration of these potential future loads on the network may require the connection of an additional energy centre or futureproofing for the provision of additional capacity within the proposed energy centre and network. A potential SELCHP connection may be able to provide the load for both the core and future network although further assessments will be required.

All of the proposed potential future connections within this cluster are within the Borough of Greenwich and detailed in Appendix A.

Opportunities and Constraints

Opportunities

Future Expansion Potential - Possibility to extend the network and connect to loads in the north of the cluster, within the Borough of Greenwich.

Existing Communal Heating - a large majority of the proposed connections in the Deptford cluster are currently communally heated either by an onsite boiler/CHP heat network and 'connection ready'. This makes connecting to a larger network much more simple and reduces the need for building retrofit. Connection charges may also be able to be recovered at the time of their plant replacement.

SELCHP – The expansion of the SELCHP network proposes an opportunity for the central heat source for this scheme instead of an energy centre.

Constraints

Low Carbon Potential - there are very few secondary heat sources in the surrounding area making ASHP the only obvious decarbonisation option for this scheme, other than extension of SELCHP network.

Retrofitting of Crossfield estate - The 436-unit LBL owned housing central to this cluster will require retrofitting in order to connect to the proposed DHN which can be costly. It is advised that plant replacement strategies are considered so as to support future connection to a DHN.

Commercial Performance - This cluster does not have a known existing energy centre or a heat network with capacity to extend and would therefore require a large CAPEX to build the scheme. To obtain a positive IRR, funding is required. Some 3rd party stakeholders who may be difficult to secure connection.

7.2 Lewisham Town

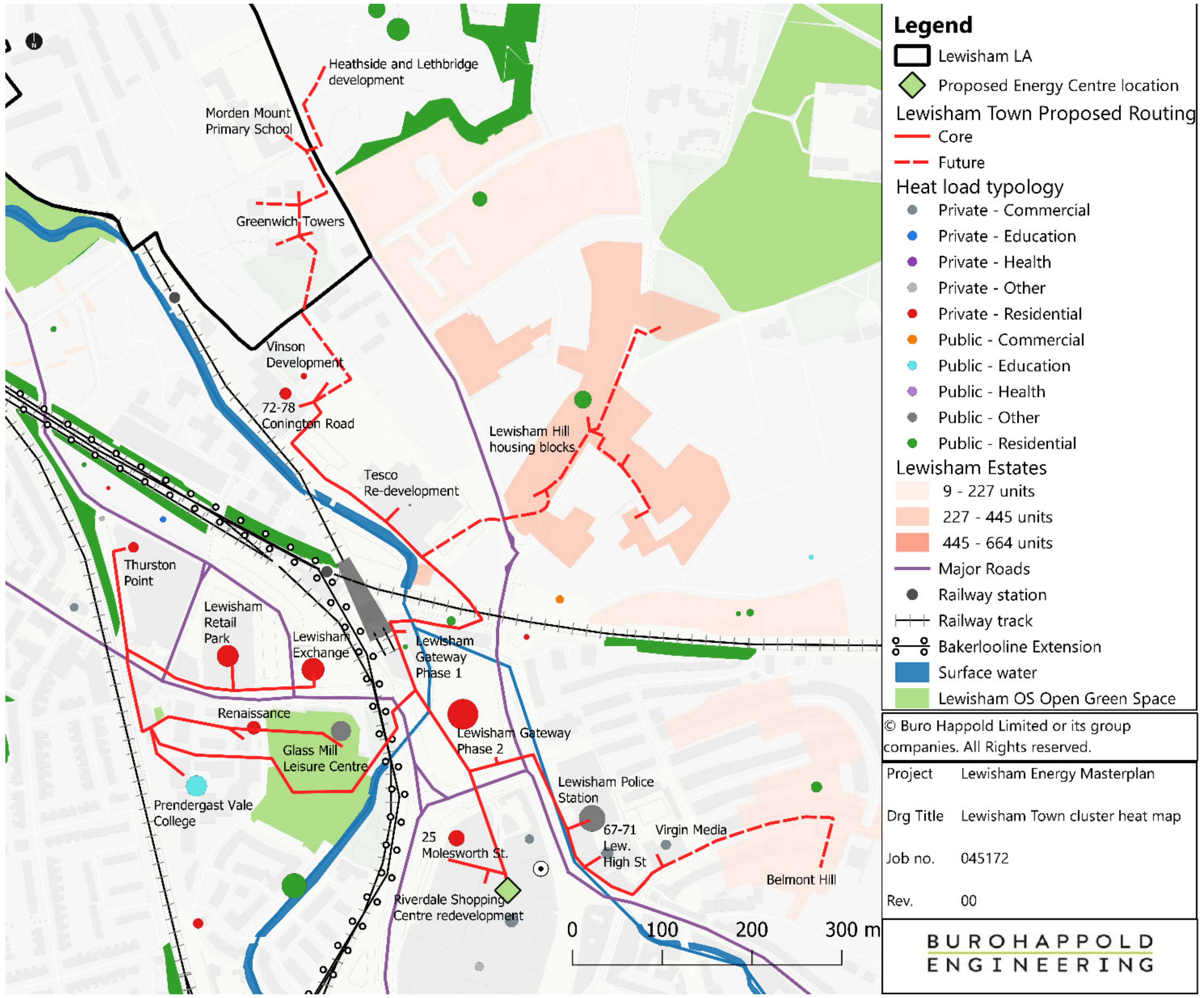


Figure 7.2: Lewisham Town

Summary

Lewisham Town has seen rapid growth in recent years which is set to continue as new residents are attracted to the area's improving transport links to the City. The large-scale redevelopment of the Riverdale Shopping Centre could see an additional 2,000 homes to the already high heat dense area. This presents an excellent opportunity to develop a future heat network in the area that will decarbonise a number of existing businesses, as well as the existing CHP networks at Lewisham Gateway and Loampit Vale. Future phases could extend to the recently developed Heathside and Lethbridge estate and to additional loads in Greenwich.

Table 7.4 outlines the key metrics for the Lewisham Town cluster.

Table 7.4: Lewisham Town cluster core network metrics

Metric	Unit	Core Network
Heat Demand	MWh/yr	23,600
Network Length	m	2,500m (including existing main Eon network)
Heat Line Density	MWh/m	9.43
Peak Load	MW	16.6
Percentage Heat load Tier 1	%	77
Energy Centre Technology	-	Proposed ASHP technology with additional peak/ back-up gas boilers. Opportunities for river source HP, data centre heat recovery and chiller heat recovery require further investigation.

Proposed Connections

The heat loads associated with the Lewisham Town cluster and proposed core network are summarised below in Table 7.5.

Note that in Table 7.5 the Riverdale Shopping Centre's heat load is sized on the information gleaned from the London Development Database (LDD) and based on 200 new flats. Since modelling was completed, Buro Happold have been in discussion with the shopping centre who indicate that this is going to be a significantly higher density development, at around 2,000 flats.

Table 7.5: Lewisham Town cluster connections

Site	Description	Heat Supply	Heat Load (MWh/yr)	Tier	Source of Demand	Ownership	Status	No. units/ GIA(m²)
Lewisham Riverdale Shopping Centre Re-development	Complete redevelopment of the current shopping centre site.	Unknown	983	1	Buro Happold benchmarks	Private	Pre-application	200 residential units and 10,000m² of commercial area.
25 Molesworth Street (Lewisham House)	Change of use from previous office space to provide 237 residential units.	Unknown	1251	1	Buro Happold benchmarks	Private	Awaiting Approval	Change of use to 237 residential units.
Lewisham Gateway (Phase 1)	Mixed-use redevelopment of the site.	Gas CHP and back-up natural gas boilers in EC.	1472	1	Buro Happold benchmarks	Private	Newly Constructed	362 residential units and 1086m² of commercial area.
Lewisham Gateway (Phase 2)	Mixed-use redevelopment of the site.	Separate EC with proposed gas CHP and back-up natural gas boilers. Will connect to Phase 1 EC too.	3040	1	Buro Happold benchmarks	Private	Approved	538 residential units and 19133m² of commercial area.
Lewisham Police Station	Existing metropolitan police station.	Natural gas	2830	1	DEC	Public	Existing	-
67-71 Lewisham High St (1st Floor and above – Tower House)	Existing retail space on the 1st floor and additional recently built residential units above.	Micro-CHP units and boilers.	131	3	Buro Happold benchmarks	Private	Newly Constructed	Existing retail space on the 1st floor and 26 residential units.
Virgin Media	Existing office space used by virgin media.	External generators outside of site	442	3	NDEPC	Private	Existing	-
Prendergast Vale College	Existing college connected to the E.On heating network.	E.On network	936	1	DEC	Public	Existing	-
Glass Mill Leisure Centre	Existing leisure centre connected to the E.On heating network.	E.On network	1621	1	DEC	Public	Existing	-
Renaissance development	Existing residential development connected to the E.On heating network.	E.On network	2744	1	Buro Happold benchmarks	Private	Existing	794 residential units and 2650m² of commercial area.

Site	Description	Heat Supply	Heat Load (MWh/yr)	Tier	Source of Demand	Ownership	Status	No. units/ GIA(m²)
Thurston Point	Existing residential development connected to the E.On heating network.	E.On network	1754	1	Buro Happold benchmarks	Private	Existing	415 residential units and 7610m² of commercial area.
Lewisham Retail Park	Proposed large mixed-use development to connect to the existing E.On heat network.	Proposed connection to E.On network	2303	1	Buro Happold benchmarks	Private	Approved	536 residential units and 4343m² of commercial area.
Lewisham Exchange	Proposed large mixed-use development to connect to the existing E.On heat network.	Proposed connection to E.On network	1796	1	Buro Happold benchmarks	Private	Approved	755 residential units and 838m² of commercial area.
Tesco Re-development	Redevelopment of the current Tesco site, to provide an additional 250 residential units. Supermarket below is assumed to maintain function.	Unknown	760	1	Buro Happold benchmarks	Private	Pre-application	250 residential units and assumed 4800m² of commercial area.
72-78 Conington Road	Large existing residential development heating by a district network.	District heating system	1110	1	Buro Happold benchmarks	Private	Existing	330 residential units and 550m² commercial area.
Vinson development	Large existing residential development.	Unknown	434	2	Buro Happold benchmarks	Private	Existing	132 residential units.

Low Carbon Potential

An ASHP array has been selected as the most feasibility LZC plant for the network. The secondary heat source potential considered at Lewisham Town are outlined below:

- A WSHP within the Ravensbourne River, either before or after the confluence with the River Quaggy: a desktop study estimates the heat capacity here could provide up to an annual average 1.61MW of heat (see the secondary heat supply section). However, seasonal fluctuations in temperature and flowrate mean it is unlikely to be suitable as the main heat source for the network
- The Citibank datacentre close to the shopping centre redevelopment site may provide the opportunity for a chiller heat recovery system. Buro Happold have reached out and are awaiting information.
- An ASHP system installed within the Riverdale shopping centre boundary: the proposed shopping centre redevelopment is likely to act as the anchor load to the network. It's large site area (8.3ha) could house the ASHP and associated EC: a requirement which can be enforced during the planning process.

The proposed network has the potential to rapidly reduce carbon emissions in the borough through connecting into the existing CHP lead E.On network at Loampit Vale. Discussions with E.On indicate they plan to extend this network to the new Lewisham Retail Park and Lewisham Exchange developments. To meet GLA planning requirements this CHP engine will need to be replaced at end of life with a LZC plant, which the proposed network could provide.

Riverdale Shopping Centre redevelopment

It was understood from information from the LDD that this would be a small redevelopment of 200 homes and retrofit/replacement of the existing shopping centre buildings. This is what has been modelled in this report.

However, since completion of the modelling Buro Happold have received further information from Landsec, the owner and operator of the shopping centre. They have completed some initial masterplanning looking at repurposing the site to 2,000 new homes with retail and office space on the ground floor.

Landsec have not yet explored heat and cooling options however they have a target to become carbon neutral by 2030 and have expressed interest in the proposed network as a way to achieve this.

Timeframes from the current masterplan indicate the development will be built in phases throughout the next 10/15 years, making it a good time to start a coordinated plan for the future decarbonisation of the wider area that takes advantage of this upcoming injection of investment.

Energy Centre Location and Technology

The proposed redevelopment of the Riverdale Shopping Centre site provides an ideal location for an energy centre to supply the wider area. Locating the energy centre here also provides the opportunity for the potential integration of a chiller heat recovery system from the Citibank datacentre across the road, and the potential abstraction of heat from the Ravensbourne River. Results from energy modelling recommend the installation of a 3.2MW ASHP with 16.65MW capacity peak/back up gas boilers to supply heat to the core network proposed. This plant configuration would achieve a low carbon heat fraction of 80%.

Table 7.6: Summary of energy centre plant for Lewisham Town cluster

Lewisham Town	Unit	Value
Low carbon heat technology	-	Proposed: ASHP
Low carbon heat supply capacity	MW	3.2
Thermal store capacity	m^3	150
Gas boiler capacity	MW	16.65
% yearly supply from low carbon heat	%	80

Network Expansion

In order to futureproof this proposal, expansion to future loads are assessed and outlined in Appendix A. The energy centre proposed is sized for the core network only and therefore for the integration of these potential future loads on the network may require the connection of an additional energy centre, or the provision of additional capacity within the proposed energy centre / network.

The proposed future routing and connections includes connecting loads within Lewisham as well as within the London Borough of Greenwich. The strategic long-term vision sees Lewisham Hospital, to the south of the cluster, connected as part of a larger network. These future connections detailed in Appendix A.

Opportunities and Constraints

Opportunities

**Futureproof development site - ** Lewisham Shopping Centre is undergoing planning for a large mixed use development which is likely to be the location of an energy centre in the next 5-15 years. Space should be allocated to futureproof to serve the surrounding area. If this site is unsuitable then the Tesco redevelopment site provides an alternative EC location.

**Future Expansion Potential - ** Possibility to extend the network and connect to loads in the north of the cluster, within the Borough of Greenwich as well as to the Heathside and Lethbridge redevelopment.

**Existing Communal Heating - ** a high proportion of the proposed cluster connections are currently communally heated either by an onsite boiler/CHP or connected to the E.ON energy centre/heat network. This makes connecting to a larger network much more simple and reduces the need for building retrofit.

**Bakerloo Line Extension – ** Proposed routing proceed to pass through Lewisham Town, there is likely to be population growth and increasing heat load density in this area

**Commercial Performance - ** as a larger percentage of the core pipework is existing at Loampit Vale, and the reduced need for retrofit, the scheme presents a positive IRR without funding.

**Additional Heat Opportunities – ** Additional heat supply opportunities include heat recovery from the datacentre, cooling demands and from the River Ravensbourne.

Constraints

**Private Ownership - ** a large proportion of the connections are privately owned which makes securing a co-ordinated scheme and plant replacement more difficult.

E.ON ESCo Agreement – Loampit Vale is already under an existing E.ON heat network and subsequent agreement

7.3 Catford

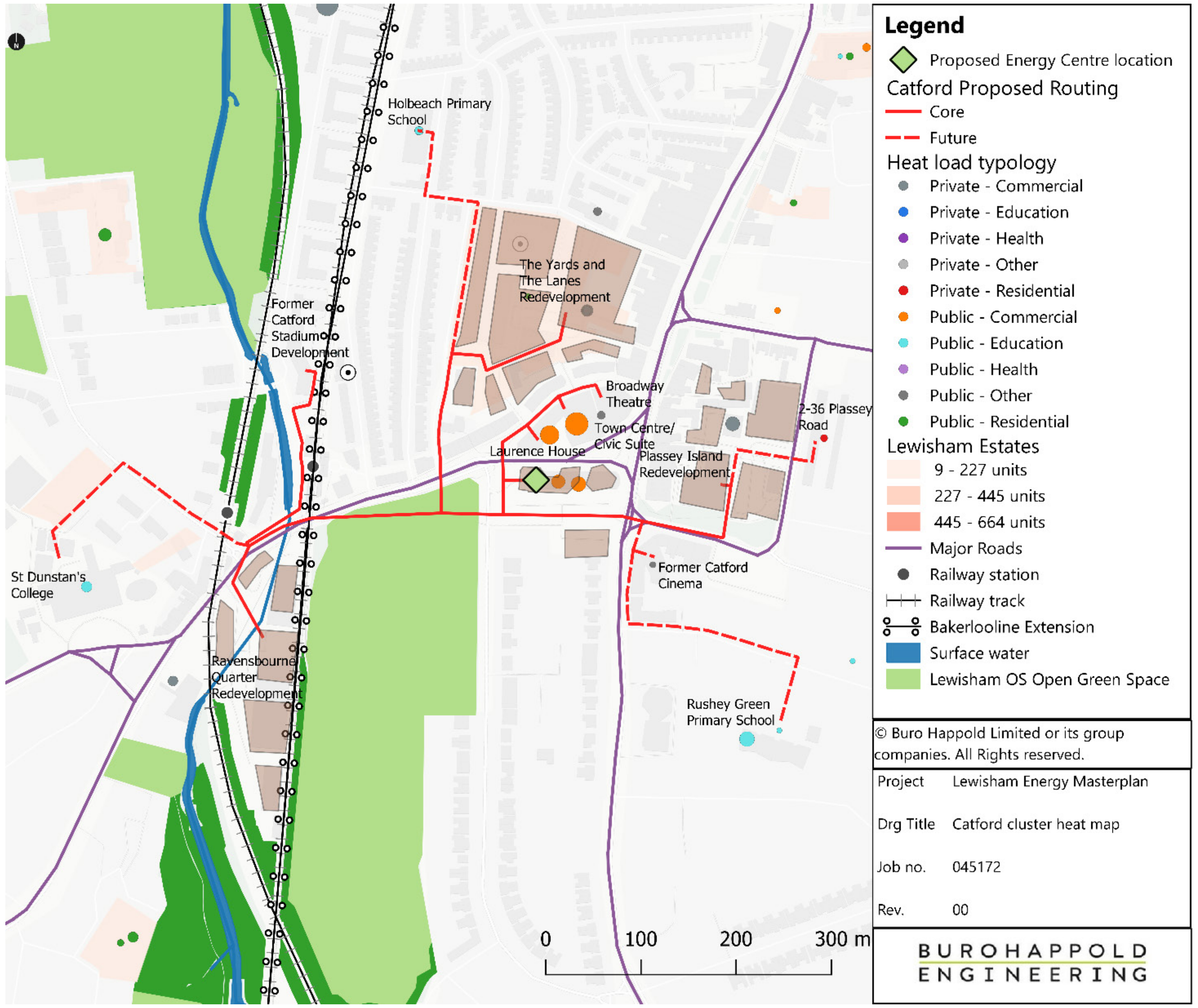


Figure 7.3: Catford cluster

Summary

With the expectation of the Bakerloo Line extending into Catford, the area is poised for major redevelopment. Buro Happold have consulted LBL's draft Catford Masterplan which reveals approximately 3,500 new homes are expected to be built within the next decade, along with the re-provision of the civic suite. One of the key objectives of the Catford Masterplan is to for it to be carbon neutral and for the Council's main corporate centre to achieve a DEC A rating. This cluster's proposed heat network should therefore be considered a priority to ensure futureproofed low carbon plant is designed into the developments from an early stage.

The re-routing of the South Circular road planned in the next couple of years also provides an excellent opportunity to coordinating trenching works and reduce capital costs of the network.

Table 7.7 outlines the key metrics for the Catford cluster.

Table 7.7: Catford cluster core network metrics

Metric	Unit	Core Network
Heat Demand	MWh/yr	14,890
Network Length	m	1,520
Heat Line Density	MWh/m	9.8
Peak Load	MW	11.6
Percentage Heat load Tier 1	%	60
Energy Centre Technology	-	Proposed GSHP array within St Dunstan's Jubilee Grounds. EC housed in Laurence House with additional peak/back-up gas boilers.

Proposed Connections

The heat loads associated with the Lewisham Town cluster and proposed core network are summarised below in Table 7.8.

Table 7.8: Catford cluster connections

Site	Description	Heat Supply	Heat Load (MWh/yr)	Tier	Source of Demand	Ownership	Status	No. units/ GIA(m²)
Plassy Island development	Part of the Catford masterplan for redevelopment of the area.	N/A	3897	2	Buro Happold benchmarks	Public	Pre-Planning	~1000 residential units and additional commercial area
The Yards and Lanes development	Part of the Catford masterplan for redevelopment of the area.	N/A	5806	1	Buro Happold benchmarks	Public	Pre-Planning	~1500 residential units and additional commercial area
Ravensbourne Quarter development	Part of the Catford masterplan for redevelopment of the area.	N/A	1895	1	Buro Happold benchmarks	Public	Pre-Planning	~500 residential units and additional commercial area
Former Catford Stadium development	Residential dominated development with district heating scheme.	One 337kWth CHP and 4 1MW gas boilers.	2131	2	Buro Happold benchmarks	Private	Newly Constructed	636 residential units and 806m² of commercial area.
Laurence House	Existing public office space.	Natural Gas	404	1	LBL gas data	Public	Existing	-
Lewisham Town Centre/Civic Suite	Existing public office space.	Natural Gas	777	1	LBL gas data	Public	Existing	-
Broadway Theatre	Existing theatre site.	Natural Gas	281	2	LBL gas data	Private	Existing	-

Low Carbon Potential

In the centre of the cluster lies St Dunstan's College Enterprises grounds, which are ideally positioned for integrating waste heat recovered via ground source heat pumps into the proposed energy centre location at the current Laurence House site. This area has been outlined as favourable for open-loop GSHP solutions according to the BGS GSHP Screening Tool .

The local plan highlights the opportunity at the A21 corridor from Catford, stretching up past the Hospital and into Lewisham Town: a strategic corridor which is earmarked for future densification. Buro Happold have identified the opportunity for a strategic heat network that extends the length of this road and combines the Catford, Hospital and Lewisham Town clusters into one strategic future network.

Energy Centre Location and Technology

The Catford redevelopment within this cluster provides the ideal opportunity for the integration of an energy centre within one of the proposed buildings and to locate this centrally within the cluster, with this study proposing the energy centre to be sited within Laurence House.

This location is within a close proximity to the St Dunstan's Jubilee Grounds east of the railway tracks identified for integration of a ground source array. Initial modelling suggests the installation of a 2MW GSHP with 11.6MW peak/back up gas boilers to supply heat to the core network.

Table 7.9: Summary of energy centre plant for Catford cluster

Catford	Unit	Value
Low carbon heat technology	-	Proposed: GSHP
Low carbon heat supply capacity	MW	2.0
Thermal store capacity	m^3	100
Gas boiler capacity	MW	11.6
% yearly supply from low carbon heat	%	81

Network Expansion

In order to futureproof this proposal, expansion to future loads within this cluster are assessed and outlined in Appendix A. The energy centre proposed is sized for the core network only and therefore for the integration of these potential future loads on the network may require the connection of an additional energy centre, or the provision of additional capacity within the proposed energy centre. The proposed future routing and connections includes connecting to existing smaller heat load close to the Catford masterplan development area, including Rushey Green Primary School and St Dunstan's College.

Opportunities and Constraints

Opportunities

Futureproof development site - The Catford masterplan redevelopment is likely to be the location of an energy centre in the next 5-15 years. Space should be allocated to futureproof to serve the surrounding area

Emerging Area Action Plan – Policy framework for the area currently being developed could be supportive of decentralised energy projects.

Public sector – The masterplan will be public sector owned, constitute the majority of the load and connections, reducing the complexity of connecting to a network

Commercial Performance – The large masterplan redevelopment means no retrofitting of loads is required and the scheme presents a positive IRR without funding.

Bakerloo Line Extension – Proposed routing proceed to pass through Catford, there is likely to be population growth and increasing heat load density in this area

Ground source heat resource – St Dunstan's College Enterprise grounds could be a major resource for a low-carbon ground energy system.

Constraints

Timings - Despite the masterplan not being finalised yet some developments are understood to to already be coming forward into the planning process, if a strategy is not developed for the wider masterplan then early phases may end up locked into alternative energy solutions, making a future DHN connection less attractive

South Circular realignment - opportunity to align works may be missed

7.4 Cooling demand appraisal

Ambient loop opportunities

5th generation DHN networks, otherwise known as ambient loops, use energy balancing of simultaneous heating and cooling demands to reduce the overall external heat required to be injected into the network, thus reducing operating costs. They also operate on a reduced temperature meaning lower heat losses and higher overall efficiency.

Buro Happold have used in-house benchmarks to estimate the cooling demand of each of the connections in the three clusters above, including the new office and retail space but excluding any residential areas. A typical rule of thumb for an ambient loop to be effective based on previous Buro Happold experience is for over 45% of the annual heating demand to also be required for cooling.

The large amount of new office and retail space being designed into the Catford masterplan means it could have a high enough cooling load for an ambient loop network. The results are presented in Table 7.10

Table 7.10: Cooling demand summary

		Deptford	Lewisham Town	Catford
Total cooling load	MWh/a	1,570	4,220	5,290
Total heating load	MWh/a	12,100	23,610	14,890
% cooling load to heat load	%	13%	18%	36%

These results indicate approximately 1,570 MWh of annual cooling demand is required in Catford, equating to 36% of the annual heating demand. This is initial estimate does not meet the 45% rule of thumb for ambient loop networks. However, depending on outcomes of the final Catford masterplan it may be a suitable option and therefore should not be ruled out.

Figure 7.4 illustrates one possible option of zoning the connections at Catford based on their cooling demand, which may result in a more efficient network. In this example, the cooling intensive loads of the civic centre, theatre and The Yards & The Lanes retail space is connected in a low temperature ambient loop. The less dense and more residential loads at Plassy Island and The Ravensbourne Quarter are supplied through a heat only higher temperature network. More detailed analysis of this option is recommended at the feasibility stage.

The disadvantage of designing an ambient loop network is it makes it harder for any nearby existing buildings to connect due to network temperatures. This therefore could have a detrimental effect on the long-term expansion of the network along the A21 corridor and into the nearby low-density residential areas.

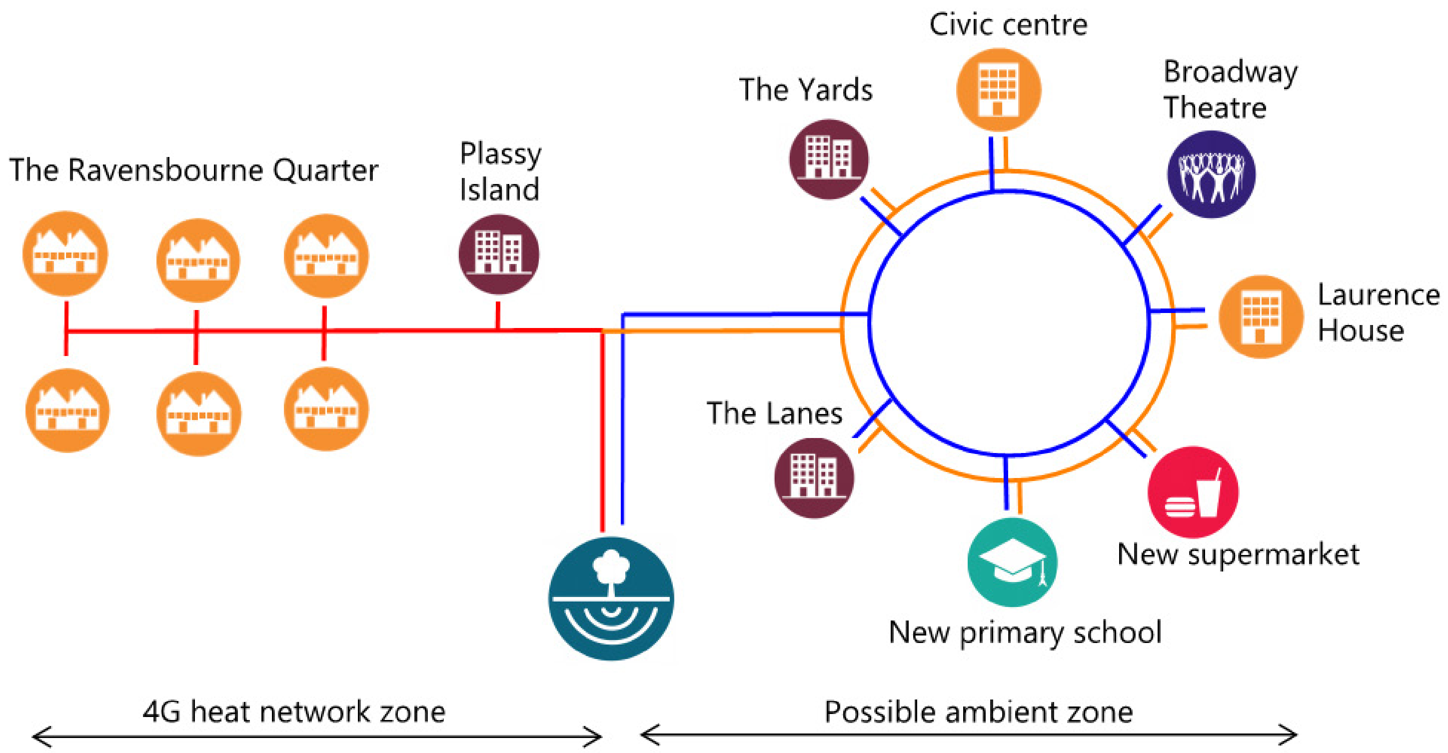


Figure 7.4: Ambient loop zoning option

7.5 Other clusters investigated at high level

This section provides an overview of clusters not taken forward for detailed modelling. An overview of why these clusters were identified as areas for decentralised energy projects is given.

Despite these clusters not being analysed in detail, there may still be opportunities in these areas – and low carbon energy projects in each will still need to be investigated if Lewisham is to meet its net zero carbon goal.

7.5.1 New Cross

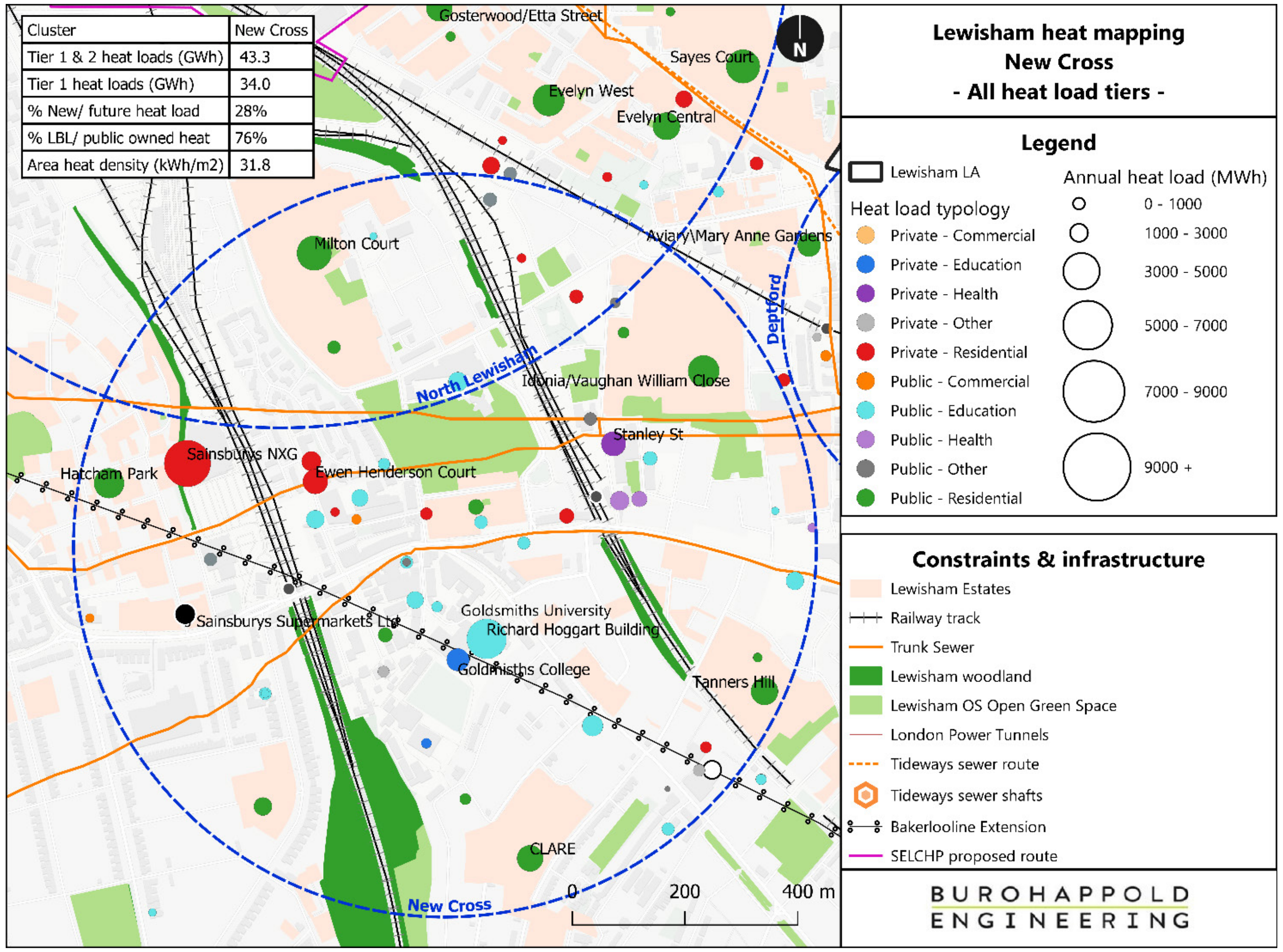


Figure 7.5: New Cross cluster heat map

The New Cross area was initially identified as a cluster of interest due to its high heat density and large proportion of LBL owned heat loads. Securing an extension from SELCHP to this area would see large scale decarbonisation at Goldsmiths University and the Sainsburys NXG development.

This cluster was identified to have a high Tier 1 and 2 annual heat load of ~43 GWh, consisting of some major loads and a range of demand typologies. A high proportion of existing high-density LBL estates are located within this cluster, including Tanners Hill (316 units), Milton Court (520 units) and Idonia/Vaughan William Close (425 units), with other major loads such as the pre-planning application for 1,500 homes on the Sainsbury's site and Goldsmiths University also within the cluster. The proposed routing for the Bakerloo Line Extension intersects this cluster, a potential catalyst for further development within this cluster which could be connected to a district heating network.

Table 7.11: New Cross cluster metrics

Metric	Unit	
Heat Demand (Tier 1 & 2)	MWh/yr	43,300
Percentage Heat load Tier 1	%	79
Percentage New/Future heat load	%	28
Percentage LBL/Public owned heat	%	76
Area heat density	kWh/m²	31.8

Opportunities and Constraints

The high heat demand and interest of key parties in decarbonisation mean that this area is well suited for an extension to the SELCHP heat network. Discussions with the university and Sainsburys NXG are already underway therefore it was decided that this masterplan should focus on other less developed clusters.

Opportunities

Large number of Tier 1 and Tier 2 heat loads - New Cross is amongst the most densily developed areas of the borough

Proximity to SELCHP - SELCHP is the largest waste heat source in the borough and has already secured funding to Convoys Wharf

Future expansion - opportunities to expand into North Lewisham

TfL vent shaft heat recovery - the Bakerloo Line Extension vent shaft is planned for this area and could be utilised as a waste heat source

Three LBL estates - that would greatly benefit from LZC heat and building fabric retrofit

Constraints

Existing and ongoing studies - there have been multiple feasibility studies in the area as well as active engagement from Veolia to extend SELCHP network

Sainsburys NXG and Goldsmiths are already exploring options for SELCHP connection

Two major railway lines disect the cluster

Retrofit - due to the large number of social housing estates in the cluster, wide spread retrofit is required which will be costly

7.5.2 North Lewisham

Similarly to New Cross above, the North Lewisham area has a large heat demand (78 GWh/a) with a number of new residential developments. The SELCHP waste incineration plant is located in this cluster with £5.5m HNIP funding secured to extend the network to Convoys Wharf. This futureproofed DN300 network will allow more developments to benefit from the LZC heat at SELCHP.

Various secondary heat opportunities exist within this cluster as well as the proposed SELCHP heat network route, including: the Thames Tideway Sewer, London Power Tunnels routing as well as green space potentially suitable for GSHPs.

This cluster is occupied with numerous constraints limiting the possibility of network connections. These constraints include the various railway lines which intersect the cluster, as well as a lot of existing or planned buried assets which would affect network routing.

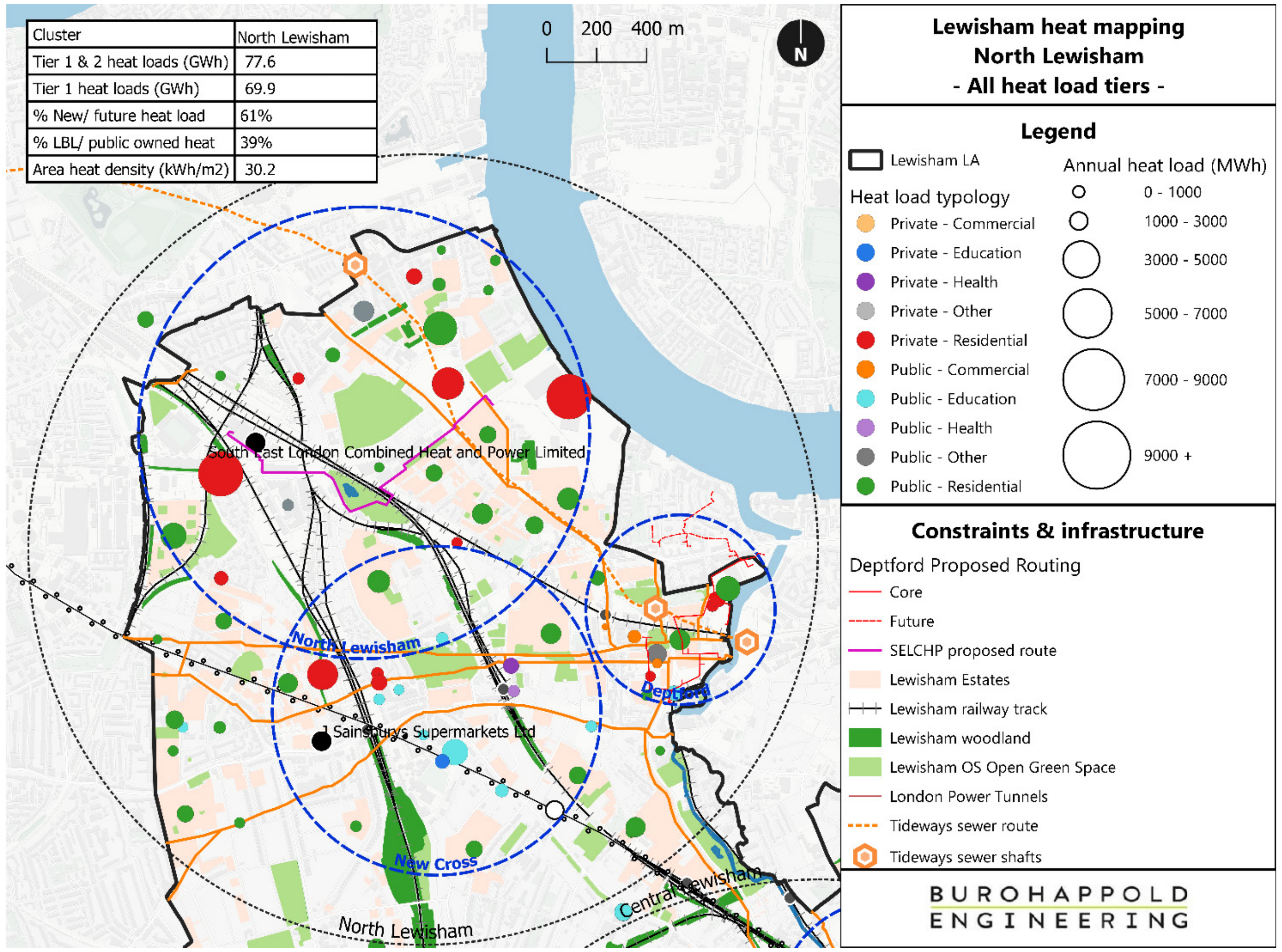


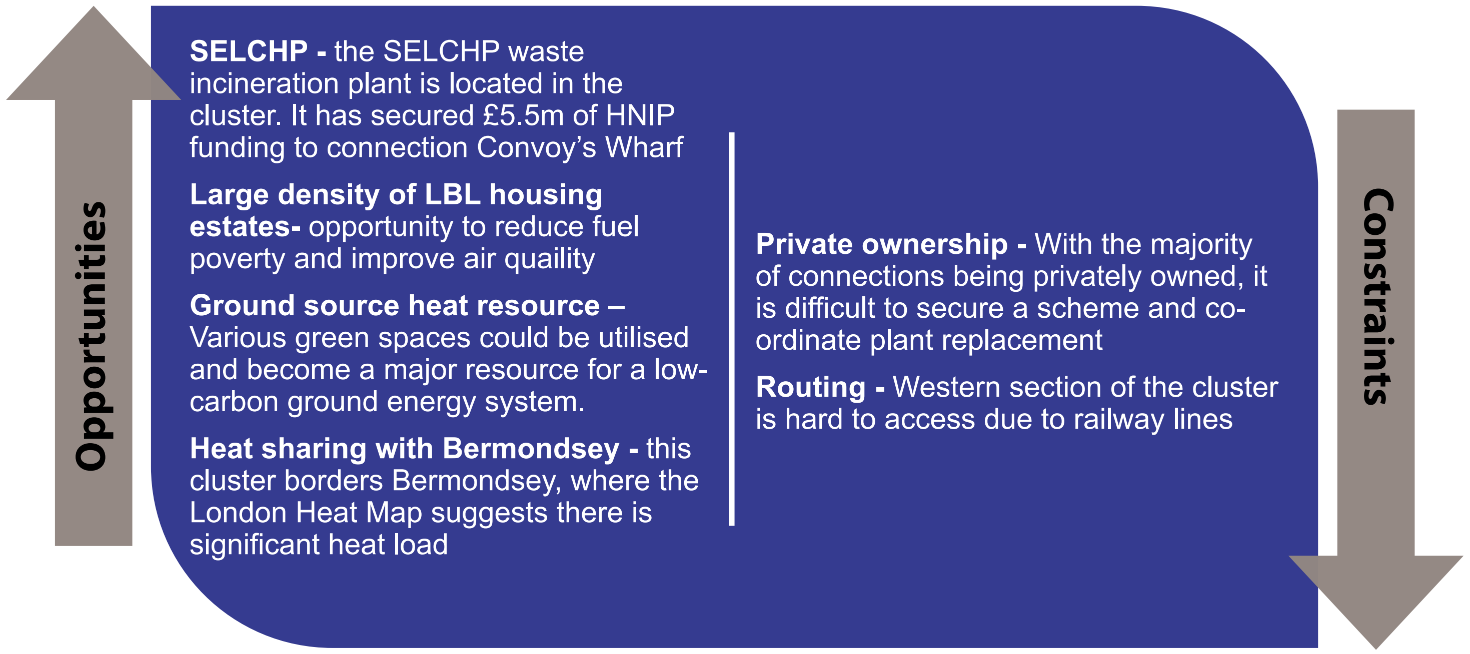
Figure 7.6: North Lewisham cluster heat map

Table 7.12: North Lewisham cluster metrics

Metric	Unit	
Heat Demand (Tier 1 & 2)	MWh/yr	77,600
Percentage Heat load Tier 1	%	69.9
Percentage New/Future heat load	%	61
Percentage LBL/Public owned heat	%	39
Area heat density	kWh/m²	30.2

Opportunities and Constraints

The North Lewisham Cluster has significant opportunity for heat network development. However, many new developments such as The Wharves and New Bermondsey are also in discussion with SELCHP. The high density of LBL housing estates to the east edge of the cluster are part of a LZC heating study running in parallel to this report. This is investigating the retrofit potential and feasibility of connecting to SELCHP. For these reasons, it was decided not to focus on this cluster as considerable work is already underway to decarbonise this area.



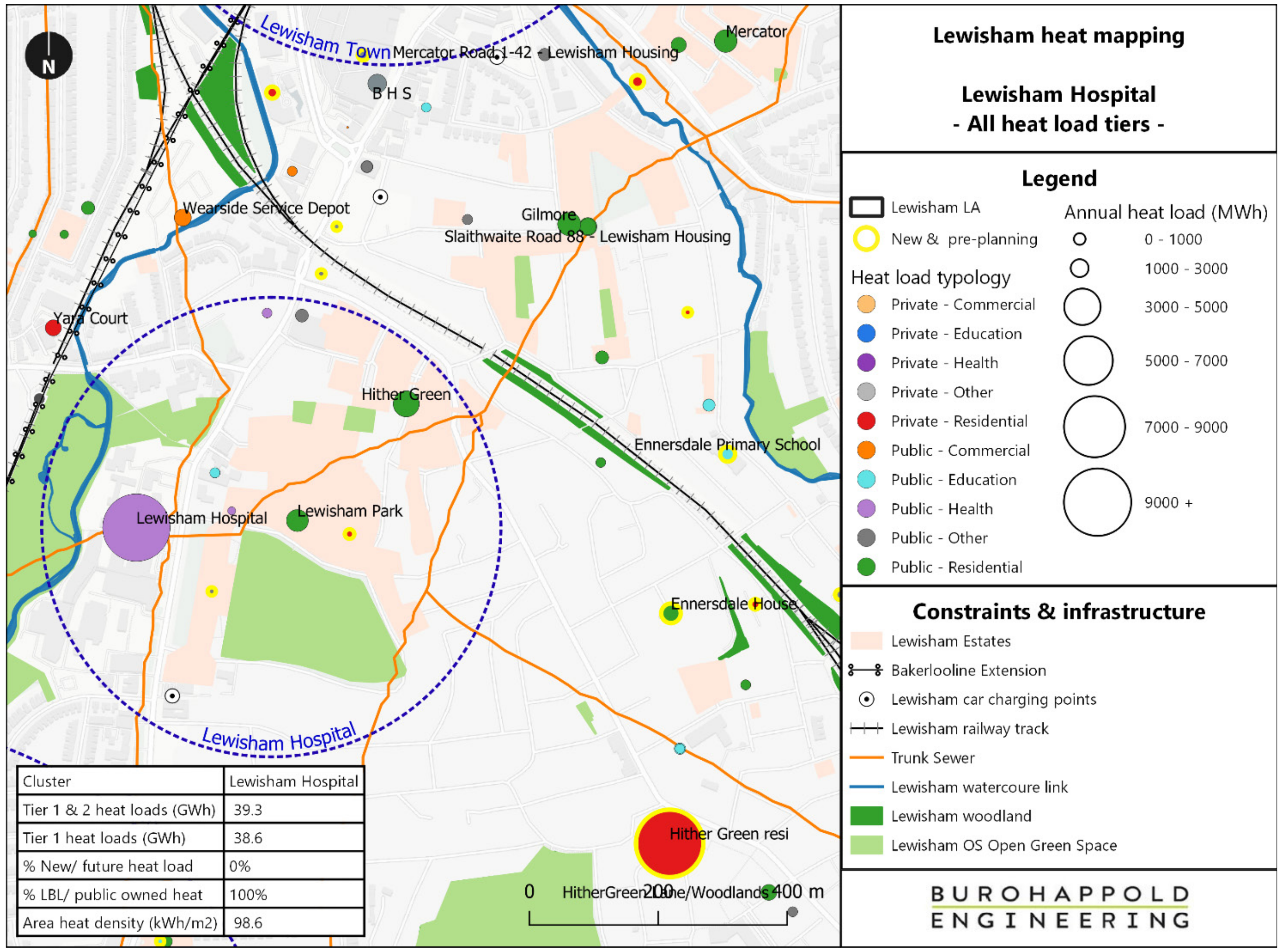


Figure 7.7: Lewisham Hospital cluster heat map

7.5.3 Lewisham Hospital

Lewisham Hospital is the largest heat load in the borough and acts as the anchor load within this cluster, contributing to 91% of the cluster's head load, other loads therefore contribute minimally. Two LBL housing estates (Lewisham Park Towers and Hither Green estate) are within in a close proximity to the hospital site. A wide variety of heat recovery opportunities exist within this cluster, with GSHP potential adjacent to Lewisham Park estate, the Ravensbourne River to the West of the Hospital as well as multiple trunk sewers intersecting the cluster.

Lewisham Hospital have already undertaken a study looking at the potential to export heat to the adjacent housing estate. However, the current onsite heat network is steam led, making costs to reduce network temperatures too high at this time.

Lewisham Hospital are taking steps to decarbonise by installing a CHP to replace some of their ageing boiler plant. However, due to reducing electricity grid carbon factors this is no longer the strategy recommended for new builds by the GLA. It is therefore recommended that Lewisham Hospital de-steam their existing network in the future and take steps to make their estate suitable for a low-temperature heat pump led network; there may be eligibility for HNIP funding towards this de-steaming.

The proximity of this cluster to both Lewisham Town and Catford means that in the long-term a strategic network could form along the A21 that could incorporate the hospital campus and nearby LBL estates (see strategic network route).

Table 7.13: Lewisham Hospital cluster metrics

Metric	Unit	
Heat Demand (Tier 1 & 2)	MWh/yr	39,300
Percentage Heat load Tier 1	%	98
Percentage New/Future heat load	%	0
Percentage LBL/Public owned heat	%	100
Area heat density	kWh/m²	98.6

Opportunities and Constraints

There are minimal loads in the cluster other than the hospital. A study has already been done to assess the feasibility of exporting heat to the nearby LBL estates. It believed the hospital is already upgrading their existing system for the site and not looking to expand to the surrounding area in the near future.

Opportunities

Heat Opportunities – Additional heat supply opportunities include sewer heat recovery from the network within the cluster as well as GSHP from green spaces close to the hospital site and the Ravensbourne River.

Public sector - all of the connections are public sector, which reduces the complexity of connecting to a network

Line Density – loads within the cluster are closely located, reducing the amount of pipework required, significantly reducing costs

LBL owned housing - there is a number of LBL housing estates in the area presenting heat demand under council ownership and influence

Constraints

Retrofit - due to the number of social housing estates in the cluster, wide spread retrofit is required which will be costly

Steam network - Lewisham Hospital currently runs on a steam network, making it incompatible for heat pump led network

Energy centre (EC) - The EC at Lewisham Hospital will likely need to be increased to incorporate the additional low carbon plant required.

7.5.4 Forest Hill

Forest Hill is a mainly residential area, including multiple LBL estates and a number of schools. Its high proportion of LBL owned heat means that it may be possible to reduce fuel poverty and decarbonise the area through a heat network.

Adequate green space within the cluster poses the opportunity for GSHP implementation as a low-carbon heat technology. The railway track intersects through the centre of the cluster, a major constraint to heat network development.

Buro Happold have been in contact with the Horniman Museum who expressed an interest in the network as part of their decarbonisation strategy.

Table 7.14: Forest Hill cluster metrics

Metric	Unit	
Heat Demand (Tier 1 & 2)	MWh/yr	16,300
Percentage Heat load Tier 1	%	91
Percentage New/Future heat load	%	36
Percentage LBL/Public owned heat	%	100
Area heat density	kWh/m²	22.9

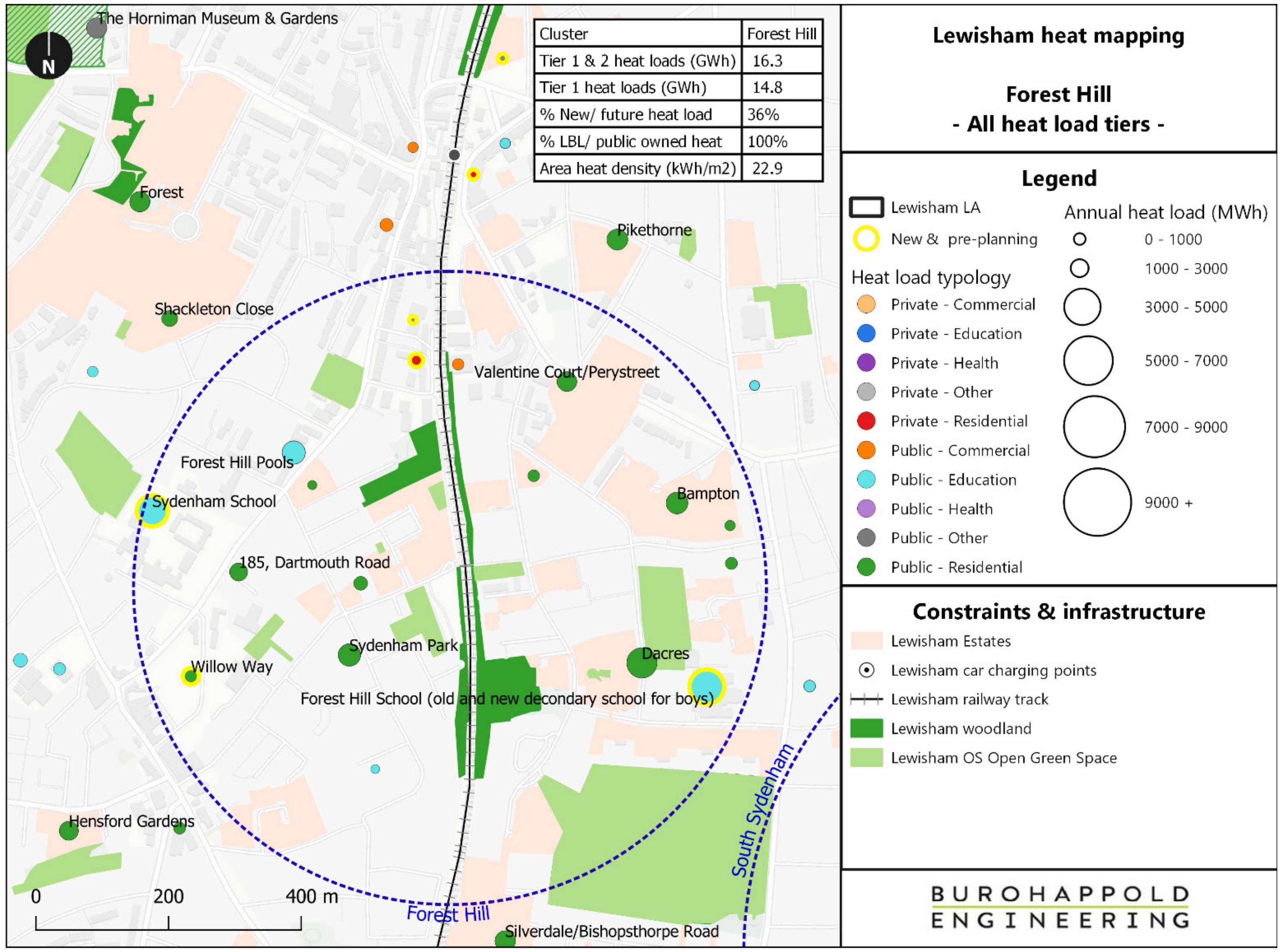
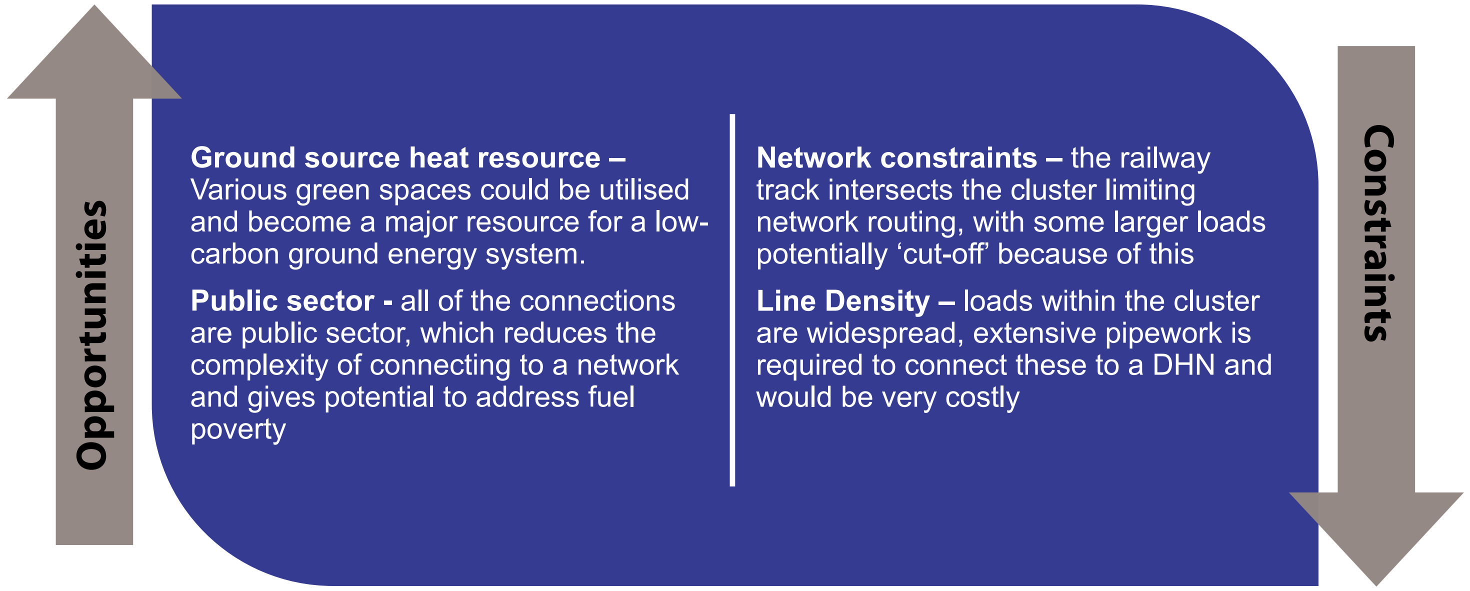


Figure 7.8: Forest Hill cluster heat map

Opportunities and Constraints

The low density of these heat loads means that the network costs are likely to be high, particularly as the railway line that dissects the cluster may result in less direct routing. Other clusters outperformed Forest Hill during prioritisation and there it was not considered for further analysis.



7.5.5 South Sydenham & Bell Green

The South Sydenham and Bell Green cluster consists of a large proportion of public owned heat loads, including the large Home Park and Hazel Grove estates (532 and 555 residential units accordingly), as well as incorporating the Bell Green Gas Works redevelopment. Although only a small percentage of loads are currently categorised as new or future this is expected to increase due to the Bakerloo Line Extension (BLE) intersecting this cluster and expected to be a catalyst to additional developments in the near future. LBL have started looking at the retail park with a view to the emerging local plan and the area is currently identified as an 'Opportunity Area' which could mean around 5000 new homes.

Various trunk sewers exist within the Eastern proportion of the cluster which pose the opportunity for secondary heat recovery, the vast green space may also be utilised for GSHP heat recovery.

A GSHP array and EC could be developed at The Bridge Leisure Centre, with the network connecting to the LBL estates, Haseltine Primary School and up to the Bell Green redevelopment area.

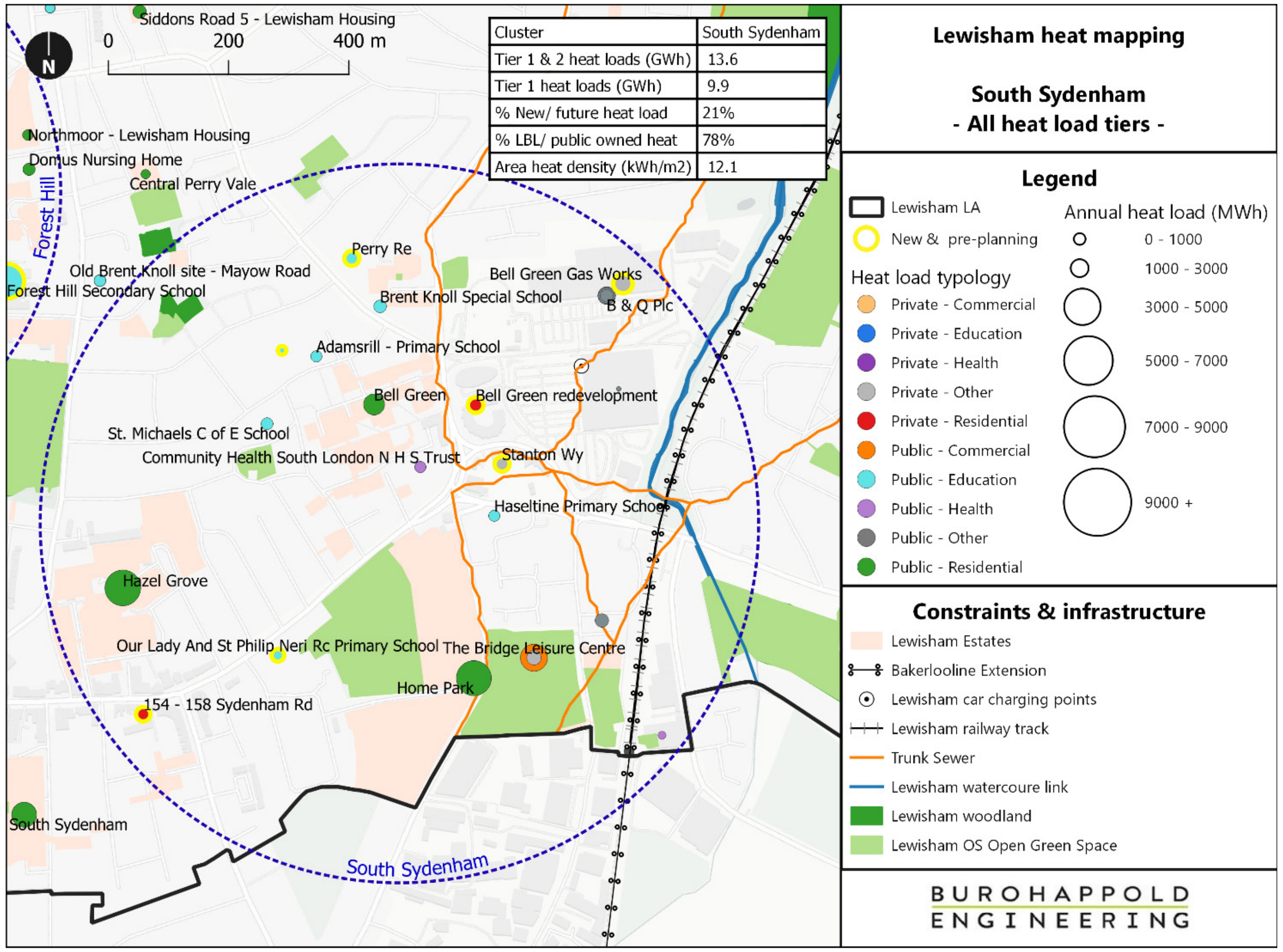


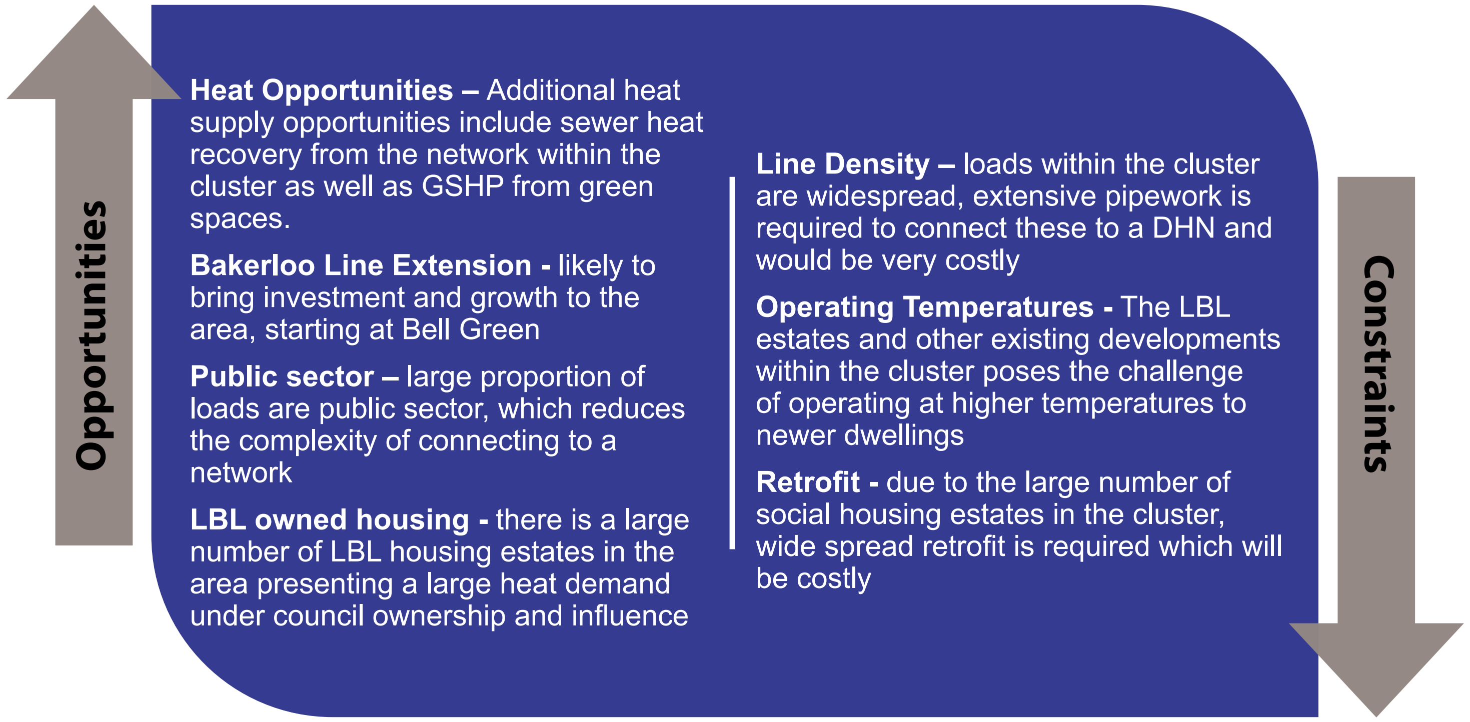
Figure 7.9: South Sydenham and Bell Green cluster heat map

Table 7.15: South Sydenham & Bell Green cluster metrics

Metric	Unit	
Heat Demand (Tier 1 & 2)	MWh/yr	13,600
Percentage Heat load Tier 1	%	73
Percentage New/Future heat load	%	21
Percentage LBL/Public owned heat	%	78
Area heat density	kWh/m²	12.1

Opportunities and Constraints

This cluster has the smallest heat density of all the clusters. The scale of development planned in the Bell Green area is currently unknown and therefore it was not taken forward for further analysis.



7.6 Strategic network

Two strategic networks have been identified (Figure 7.10):

- North Lewisham: this network would see the planned Convoys Wharf network extended into Deptford as well as the large heat loads surrounding SELCHP and the New Cross area.
- Central Lewisham: connecting the Lewisham Town, Hospital and Catford clusters in one large network. This option is highly dependent on the densification of the A21 corridor.

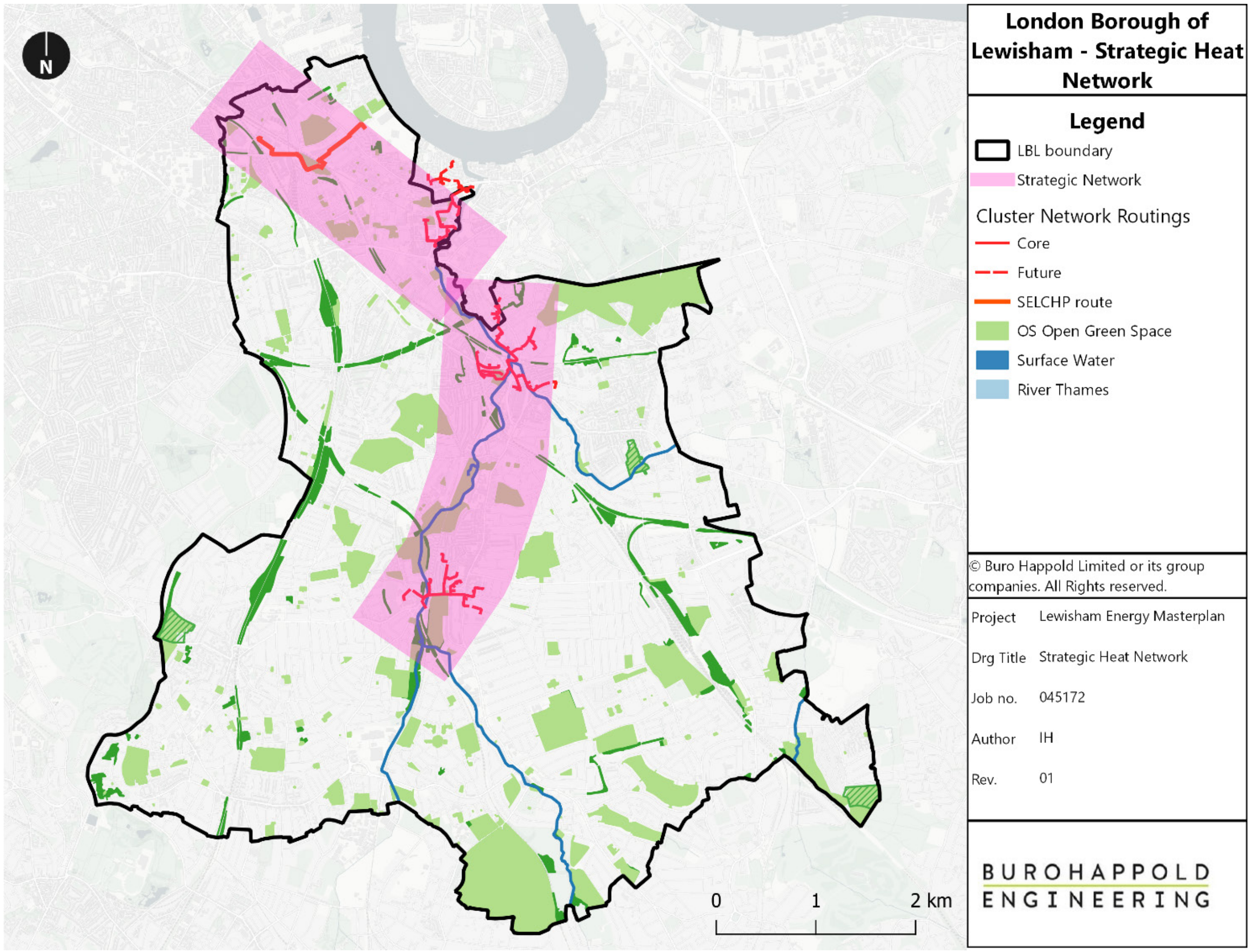


Figure 7.10: Strategic network

8 Commercial Appraisal

8.1 Modelling approach

The three prioritised clusters were commercially assessed with a techno-economic appraisal, which estimates the return on investment over the lifetime of the project using a number of inputs. The model calculates the energy consumption of the network, the capital expenditure, operational expenditure, replacement expenditure and income from heat sales over the lifetime of the project. A sensitivity analysis was then performed to test the schemes with various levels of capital grant funding, Renewable Heat Incentive funding and heat sales price variation. The process is summarised in Figure 8.1.

The three main financial outputs calculated are:

- **Internal rate of return** – the discount rate at which the project NPV is equal to zero at the end of the project lifetime
- **Net present value** – the cumulative present value of net project cash flow over a period of time
- **Discounted payback** – payback with positive net project cash flow taking into account the time value of money

For modelling purposes, it is assumed that one entity installs, owns and operates the heat network throughout its lifetime. Residential heat loads are billed up to the HIU, while commercial loads are billed to the building level thermal substation.

Cashflows are modelled over a 30-year period. It is assumed all connections come online in year 1, with Deptford and Lewisham Town beginning in 2022. Catford begins in 2025 to better reflect the expected timeframes gleaned from the draft Catford Masterplan.

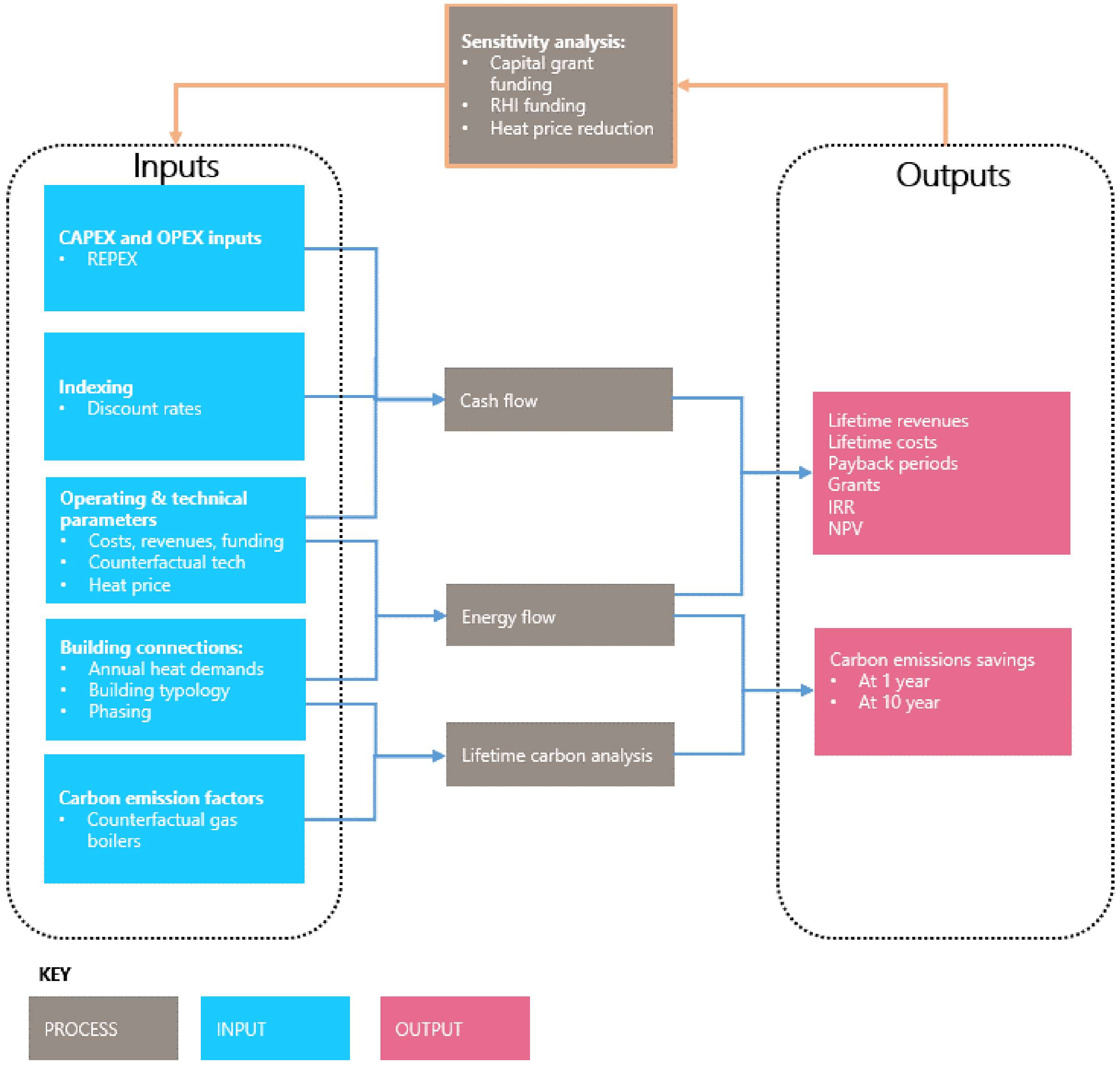


Figure 8.1: Techno-economic model process summary

8.2 Techno-economic modelling inputs

8.2.1 Capital costs

Capital costs for each of the core schemes for the clusters have been developed from consultation with manufacturers, industry reference data and previous Buro Happold experience of similar projects. A summary of the Capex cost for each cluster taken forward are shown below in Table 8.1 and illustrated in Figure 8.2.

The distribution pipework costs are based on the required pipe capacity per connection length of pipe from the GIS core network routes shown in Section 7. Within the Lewisham Town cluster, the existing and proposed E.On heat network was excluded from the Capex costs (totalling approximately 800m of pipework). However, the networks pipework is sized to include the peak heat load of each of these connections meaning the network can take over operation of the existing pipework and supply heat to these developments.

A cost for retrofitting existing buildings is included within the Capex, depending on the type of existing heating system. The cost of the residential heat interface unit (HIU) is included in this capex and is subsequently included in the Repex costs for lifetime replacement.

No connection charges have been modelled at this stage to provide a conservative estimate to projected cashflows.

Table 8.1: Summary of Capex cost estimates - core schemes

Cluster – core schemes	Energy centre + LZC heat source (£m)	DH Network (£m)	Heating system retrofit (£m)	Total Capex (£m)
Deptford	3.46	3.00	3.95	10.4
Lewisham Town	7.19	3.70	0.62	11.5
Catford	5.24	3.11	0.92	9.3

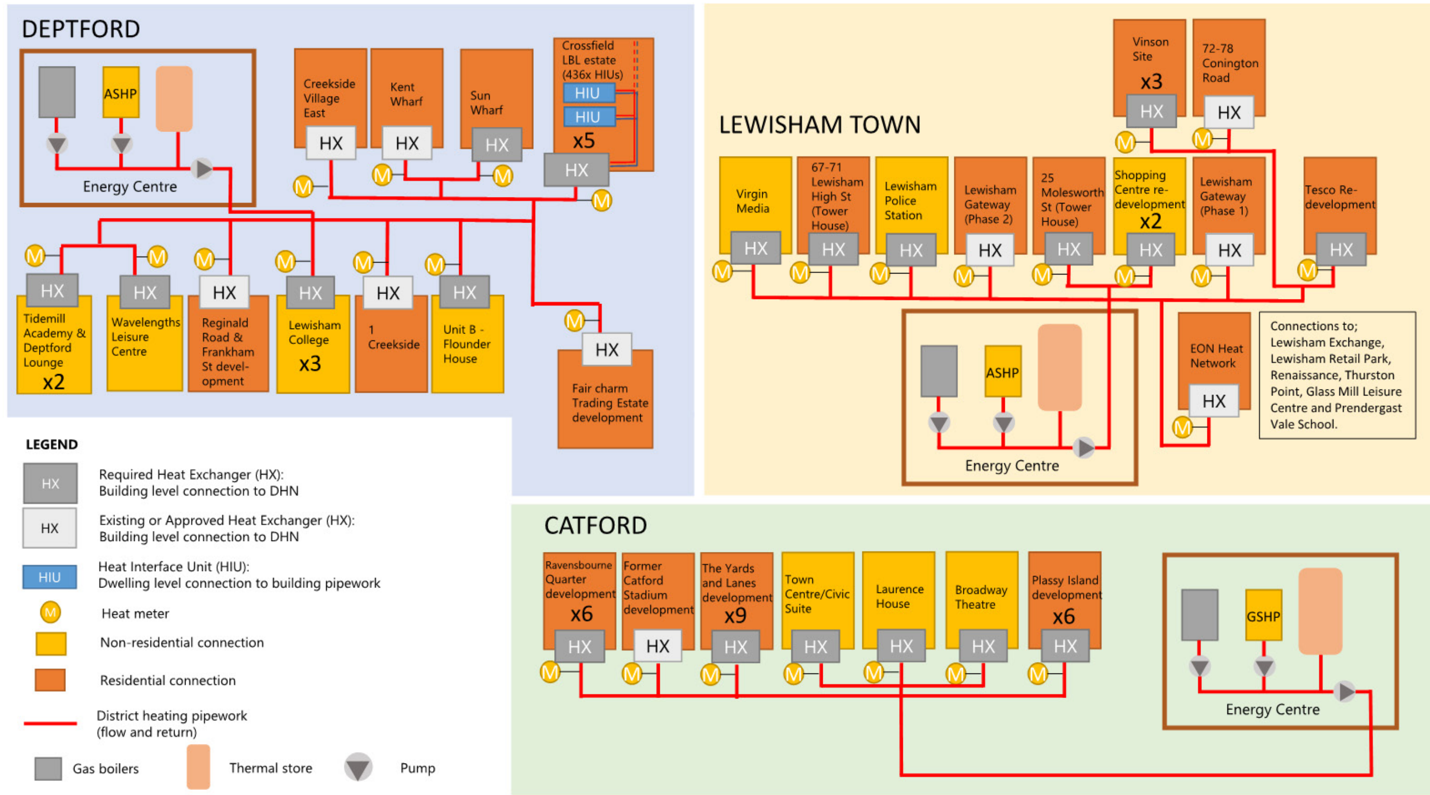


Figure 8.2: Capex illustration

8.2.2 Opex, Repex & business costs

Operational (Opex), replacement (Repex) and business costs were applied to each cluster, based on the rates shown in Table 8.2. The lifetime costs are summarised in Table 8.3.

In many cases, it is proposed communal heating systems with a secondary network including HIUs in residential blocks are to be connected to the network. Here it is assumed the Capex is covered by the developer/building owner and the Opex and Repex costs are taken on by the network operator once connection is secured.

Table 8.2: Opex, Repex and Business rates

Description	Rate	Unit	Reference
Opex: Heat supply equipment			
Heat pumps	0.65	p/kWh	Manufacture guidance
Gas boilers	0.25	p/kWh	Previous Buro Happold project/ DECC
Opex: Network and connection equipment			
Plate heat exchangers	3%	% of capex	Manufacture guidance
HIUs	£32	Per resi unit	Manufacture guidance
Heat meters – bulk	£25	Per bulk connection	Previous Buro Happold project
Heat meters – non-bulk	£5	Per resi unit	Previous Buro Happold project
District network	0.06	p/kWh	DECC
HIU repex	£1,190	Per resi unit	Manufacture guidance – for repex only
Metering and billing			
Bulk	£200	Per bulk connection	Previous Buro Happold project
Non-bulk	£60	Per resi unit	Previous Buro Happold project
Business rates			
Staff costs	0.3	p/kWh	Previous Buro Happold project
Business costs	0.6	p/kWh	DECC
Discount rate	3.5%	%	Green Book
Repex expenditure			
% Repex cost incurred	80%	% of heat supply Capex	Assumed

Table 8.3: Summary of lifetime Opex, Repex and Business costs

Cluster	Total lifetime (30yrs) Opex costs (£m)	Total lifetime (30yrs) Repex costs (£m)	Total lifetime (30yrs) business costs (£m)
Deptford	2.59	5.05	2.16
Lewisham Town	5.77	12.02	4.21
Catford	4.26	9.30	2.66

8.2.3 Fuel prices

An initial electricity price of 12.6p/kWh and natural gas price of 2.4p/kWh is assumed in the model . BEIS publish retail electricity and natural gas projections to 2035 which have been used as an index to predict change to fuel prices through the model's annual cashflow. The indexation used is illustrated in Figure 8.3 below.

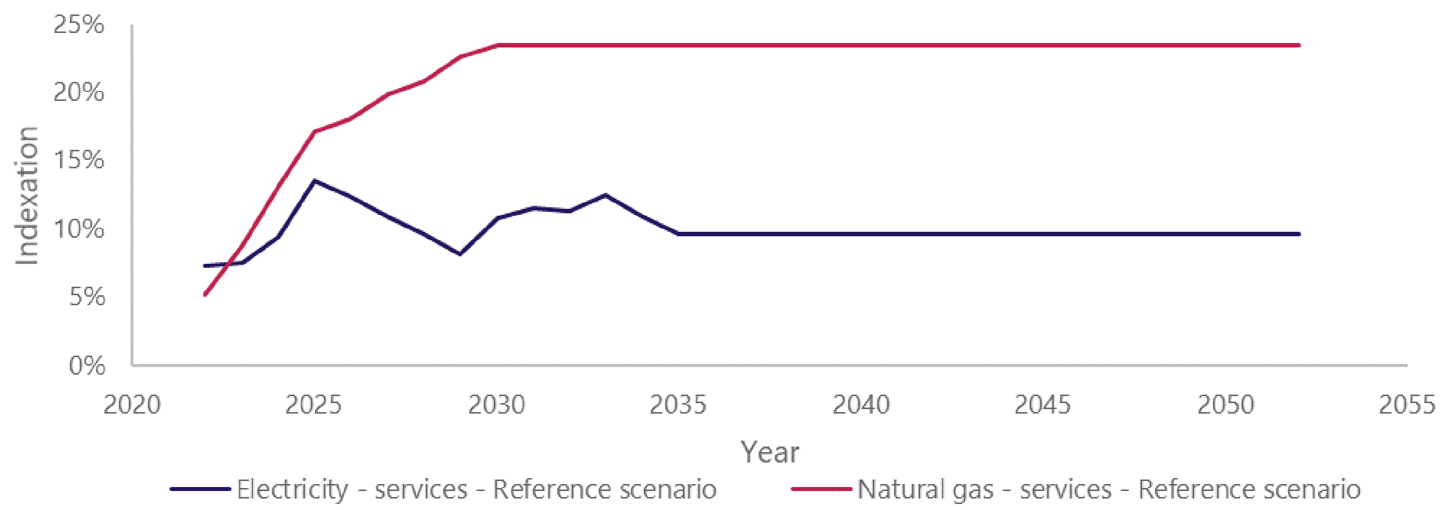


Figure 8.3: BEIS fuel price projections indexation from 2019 – reference scenario

8.2.4 Heat sales price

The heat tariffs for DHN projects are often difficult to determine as it comes down to a number of factors. The cost of heat for the DH case must be equal to or lower than the Business as Usual (BAU) case to make DH a viable option. The retail cost could then potentially be reduced depending on financial performance of the scheme, to pass on savings to residents and LBL.

The assumed heat prices for residential and commercial connections are shown in Table 8.4, split into standing charge and variable rate. Both rates are based on an average of several Heat Trust registered operational projects and quotes for schemes in London obtained by Buro Happold.

- The standing charge is a flat rate paid to the DHN operator for connection to the network. For heat network pricings, this is usually based on the avoided costs of connecting into the DHN compared to the counterfactual of gas boilers.
- The variable rate is the price paid per unit of heat consumed by each customer – again usually based on the fuel cost to deliver a kWh of heat compared to the counterfactual. E.g. cost of gas per kWh divided by the boiler efficiency.

The heat price at this stage is indicative and subject to change. There is currently no regulatory body for the supply of heat from DHNs however the heat pricing strategy will need to comply with the Heat Network (Metering and Billing) Regulations 2014 . All schemes Buro Happold have based the heat price are based on are Heat Trust compliant - in-lieu of official regulation for heat networks the Heat Trust is a not for profit company focussed on customer protection for the district heating sector.

The variable portion of the heat price is indexed to the BEIS natural gas price projections (Figure 8.3).

Table 8.4: Heat price - residential and commercial

	Variable rate (p/kWh)	Standing charge – residential (£/yr)	Standing charge – commercial (£/kW)
Residential	5.6	328	-
Commercial (Bulk)	4.2	-	24

8.3 Results Summary

The results from the techno-economic model (TEM) are summarised in Table 8—5. The results show that the Lewisham Town and Catford clusters will achieve a positive payback within a 30-year scheme (assuming a discount rate of 3.5%). This is based on the basecase modelling, a conservative approach of assuming no capital funding, connection chargers or RHI payments.

Table 8.5: TEM results summary – basecase (no funding)

Option	Low carbon technology	NPV @ 30 years £m	IRR @ 30 years %	Capital costs £m
Deptford	ASHP	-7.94	N/A	10.4
Lewisham Town	ASHP	-1.67	2.3%	11.5
Catford	GSHP	1.73	4.9%	9.3

8.3.1 Cluster results

Figure 8.4, Figure 8.5 and Figure 8.6 that follow show examples of the cash flows for the Deptford, Lewisham Town and Catford clusters respectively.

All three clusters have a positive cashflow each year. Catford performs the best, with an IRR of 4.7% over the 30 years, achieving the assume 4% hurdle rate for LBL interest in investment. This is due to the high density of new build developments which can be easily designed into a heat network.

A positive IRR is achieved after 30 years for the Lewisham Town, of 2.3% IRR. While this doesn't quite meet the LBL hurdle rate, this can be improved upon with additional incentives such as RHI funding. The Deptford cluster doesn't achieve a positive value after this timescale. This is largely due to the significant Capex of retrofitting the 436-unit LBL Crossfield estate, a combined £3.3m fee for the HIU and retrofitting of heating system cost.

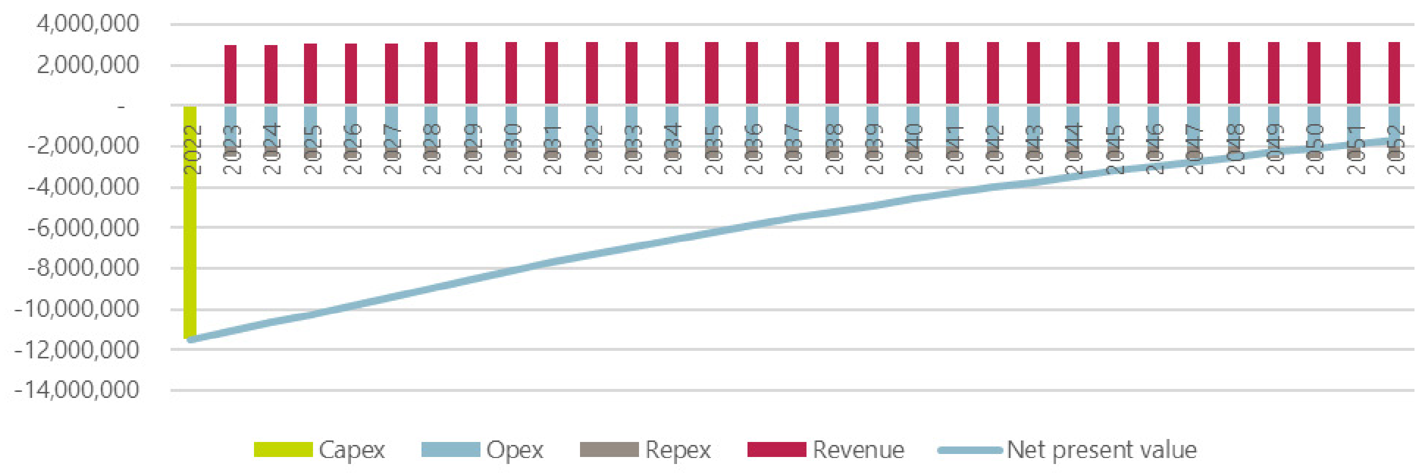


Figure 8.5: Basecase cash flow and NPV - Lewisham Town cluster

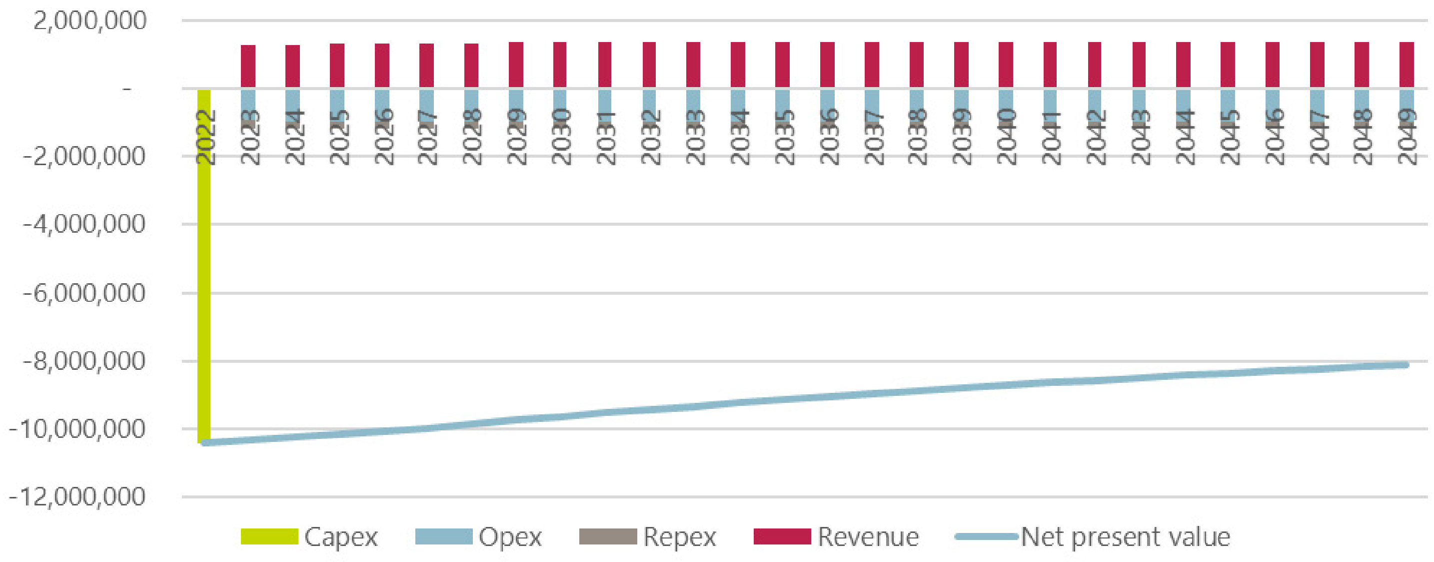


Figure 8.4: Basecase cash flow and NPV - Deptford cluster

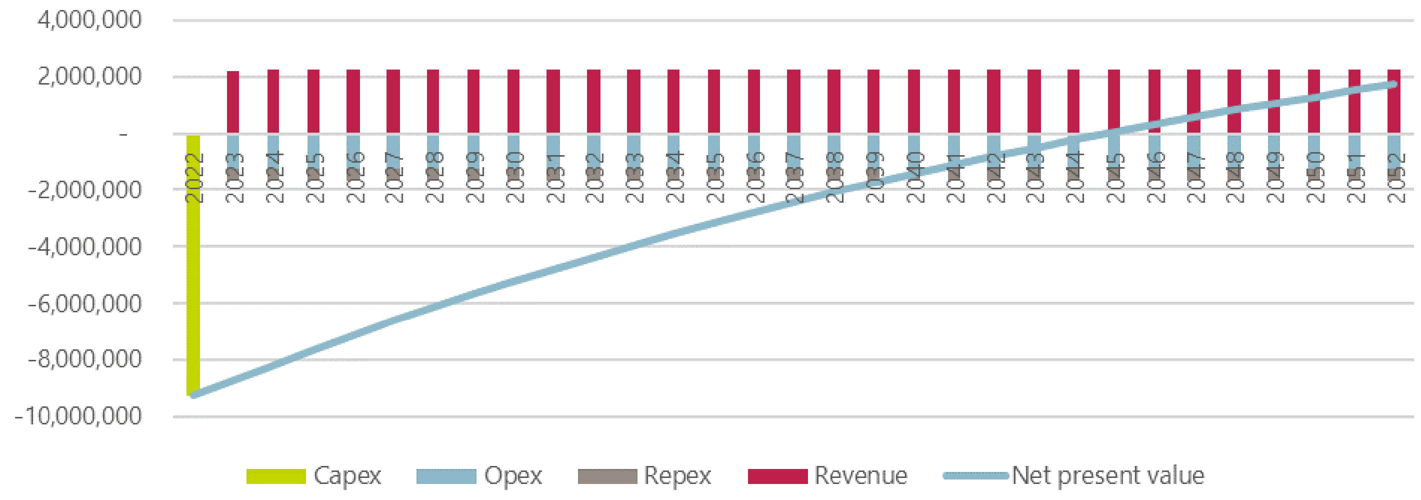


Figure 8.6: Basecase cash flow and NPV - Catford cluster

8.3.2 Sensitivity analysis

Sensitivity of the model to key inputs has been tested by changing each input in turn and assessing the impact on NPV. The inputs tested are:

- Fuel cost
- Capital cost
- Standing charge
- Variable heat price
- Annual heat load

Figure 8.7 Figure 8.8 and Figure 8.9 show the impact of ±10% change in the key variables noted on the vertical axis. The purpose of undertaking this analysis is to establish which variables are key to project performance and therefore which need particular management focus in order to reduce and mitigate risk.

A variation in the heat sales variable rate and standing change both have a large impact on the network's performance. As with all LA led DHN networks, there is a trade off in benefits sought through increasing revenue to the council and providing value for money to customers. This is particularly important in areas with high fuel poverty where heat prices should reflect the average household income where possible.

The heat sales price therefore represents a high risk assumption in model for all three clusters. The NPV of the Lewisham Town cluster drops by £2.7m compared to the basecase with a 10% decrease in the variable heat sales price, this represents a 2.1% reduction in IRR.

As with any capital-intensive infrastructure project, overall viability is heavily influenced by capital cost. If the Capex of the network and energy centre could be reduced by 10% this would have a very positive impact on the scheme. This is an area with some element of project management control; opportunities should be explored to reduce costs where possible.

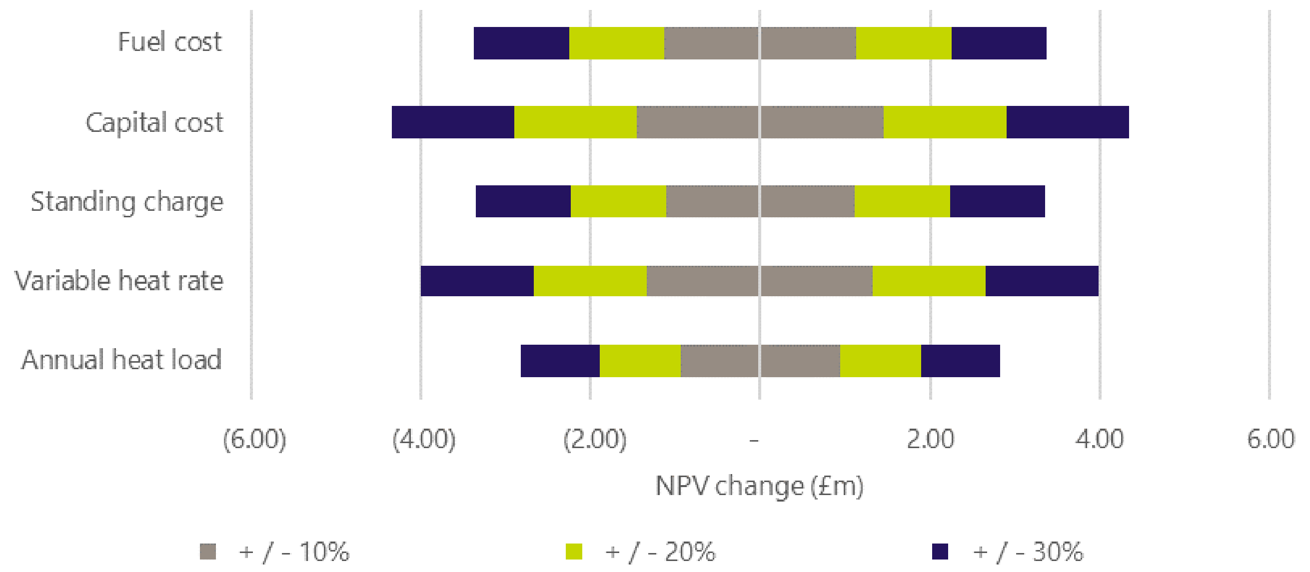


Figure 8.7: Tornado graph of NPV change from basecase – Deptford

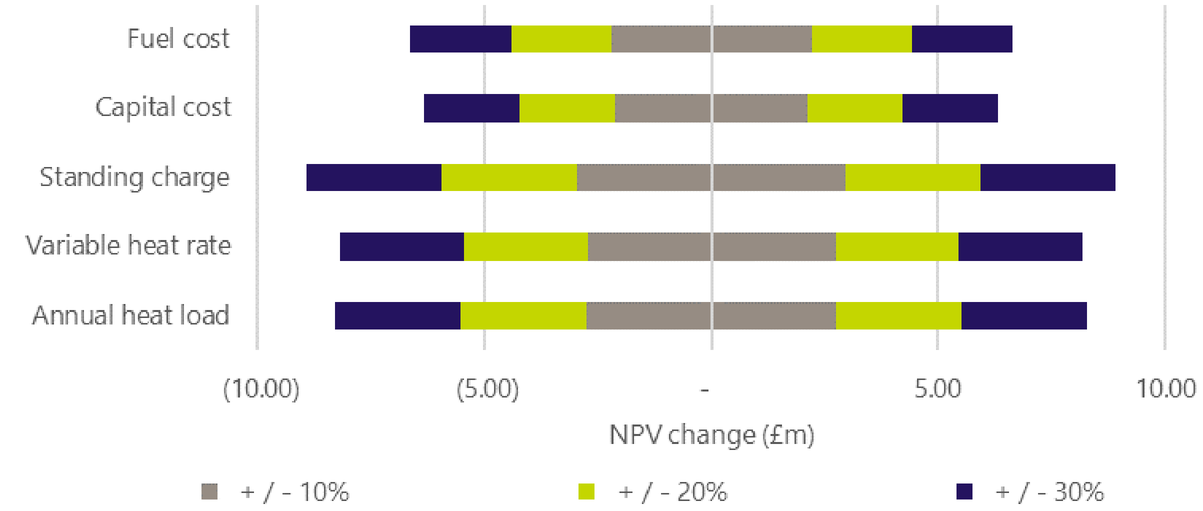


Figure 8.8: Tornado graph of NPV change from basecase – Lewisham Town

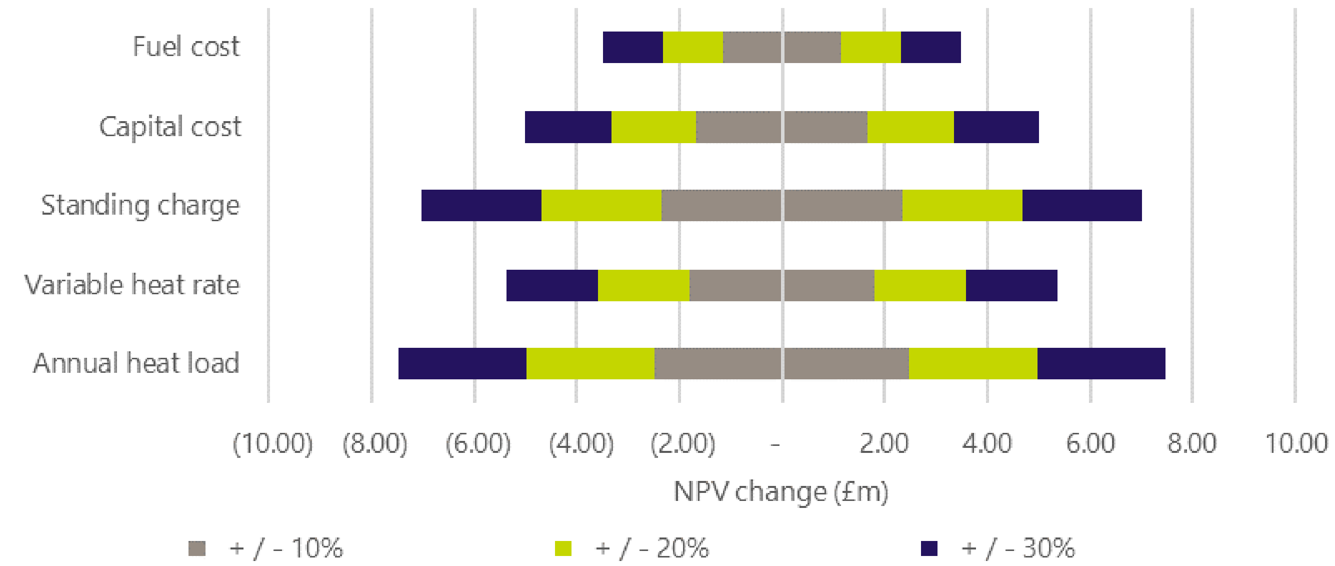


Figure 8.9: Tornado graph of NPV change from basecase – Catford

8.3.3 Scenario testing

Three scenarios have been tested to take into account the sensitivities to key outputs described above. These are described below:

- RHI funding: with each cluster receiving the associated additional income from RHI payments
- Deptford cluster alternative configurations:
  - Capex retrofit funding: assuming the £3.3m retrofit capital cost required to connect the Crossfield Estate is funded from an alternative source such as s106 payments
  - SELCHP connection: assuming an extended connection to the SELCHP waste incineration plant is made.

RHI funding

The Renewable Heat Incentive (RHI) is a government scheme aimed to increase the uptake of LZC heat technologies in the UK through providing additional revenue per kWh of heat produced. The current commercial RHI rate is payable for the first 20 years of the scheme, at a rate of 8.72p/kWh (tier 1 – available for up to 15% of run time) and 2.60p/kWh (tier 2) for GSHP and WSHP. ASHPs are eligible for a lower flat rate of 2.79p/kWh for all delivered heat.

RHI funding has the potential to increase the commercial appeal of a scheme by raising the IRR. As this funding ends in 2022, it is important to understand the commercial performance without the funding. Table 8.6 outlines the NPV and IRR for each scheme with RHI and without RHI. This comparison can be clearly seen in Table 8.6.

RHI funding enables all clusters excluding Deptford to achieve a positive IRR above the investment hurdle rate. Although RHI improves the Deptford cashflow it still does not achieve a positive IRR due to the large capital costs to retrofit the Crossfield Estate. This is further explore in the next section.

Table 8.6: NPV and IRR with and without RHI

Cluster	NPV @ 30 years without RHI	NPV @ 30 years with RHI	IRR @ 30 years without RHI	IRR @ 30 years with RHI
Unit	*£m*	*£m*	*%*	*%*
Deptford	-7.94	-4.20	N/A	N/A
Lewisham Town	-1.67	5.82	2.3%	7.6%
Catford	1.73	8.27	4.9%	10.3%

Retrofit Capex

Within the Deptford cluster, an estimated £3.3m retrofit of the LBL Crossfield estate is necessary to connect this load to a heat network. This cost includes the adapting the secondary system pipework and installing HIUs in each flat. This associated capex could significantly affect the commercial performance of the scheme if funding is not provided. A sensitivity is carried out to understand the impact of the isolated retrofit costs on investment return, with RHI also considered.

Figure 8.7 demonstrates that even if the retrofit costs were covered by an alternative funding stream, without RHI the IRR would still remain negative after 30 years. While on the other hand with RHI also considered, this would produce a positive IRR after 30 years of 2.3%.

Table 8.7: IRR sensitivity with retrofit costs at 30 years

Cluster	IRR @ 30 years without RHI	IRR @ 30 years with RHI
Unit	*%*	*%*
Deptford – With retrofit cost	N/A	N/A
Deptford – Without retrofit cost	N/A	2.3%

8.3.4 SELCHP connection to Deptford

The proximity of the Convoys Wharf SELCHP extension to the proposed Deptford network means it may be more economically viable to source heat from SELCHP and negate the need for a dedicated EC and associated LZC plant for the network.

Key changes from the basecase:

- All heat is supplied through a connection to the SELCHP waste incineration plant. The heat network operator pays a heat purchase price for this heat (that has been based on information from Veolia) and sell at the basecase heat sales rate (Table 8.4)
- Capital costs include an extra 1,000m of DN300 pipework, branching off from Convoys Wharf and into the proposed network
- Assumed SELCHP provides the peak supply I.e. there are no capital costs included for EC or LZC/ top-up plant.

These changes to the costs result in an initial total Capex of £9.60m for this scenario (a £0.82m reduction from the basecase). The heat purchase price is indexed to the electricity purchase price (Figure 8.3) to reflect future changes in electricity cost. All other Opex and Repex values remain as detailed in the basecase.

The results (Table 8.8 and FFigure 8.10) suggest the network could reach an IRR of 3.1% if connection to SELCHP is made. If the Crossfield Estate retrofit is also funded from elsewhere this increases to a 6.6% IRR, a value which is likely to attract ESCo investment. It is therefore recommended that this scenario is further explored with Veolia.

Table 8.8: Deptford SELCHP scenario results

Option	Low carbon technology	Crossfield Estate retrofit cost? (yes/no)	Capital costs	NPV @ 30 years	IRR @ 30 years
Unit			*£m*	*£m*	*%*
Deptford basecase	ASHP	Yes	10.4	-7.94	N/A
Deptford SELCHP	SELCHP	Yes	9.60	-0.50	3.1%
Deptford SELCHP – no Crossfield retrofit cost	SELCHP	No	6.36	2.73	6.6%

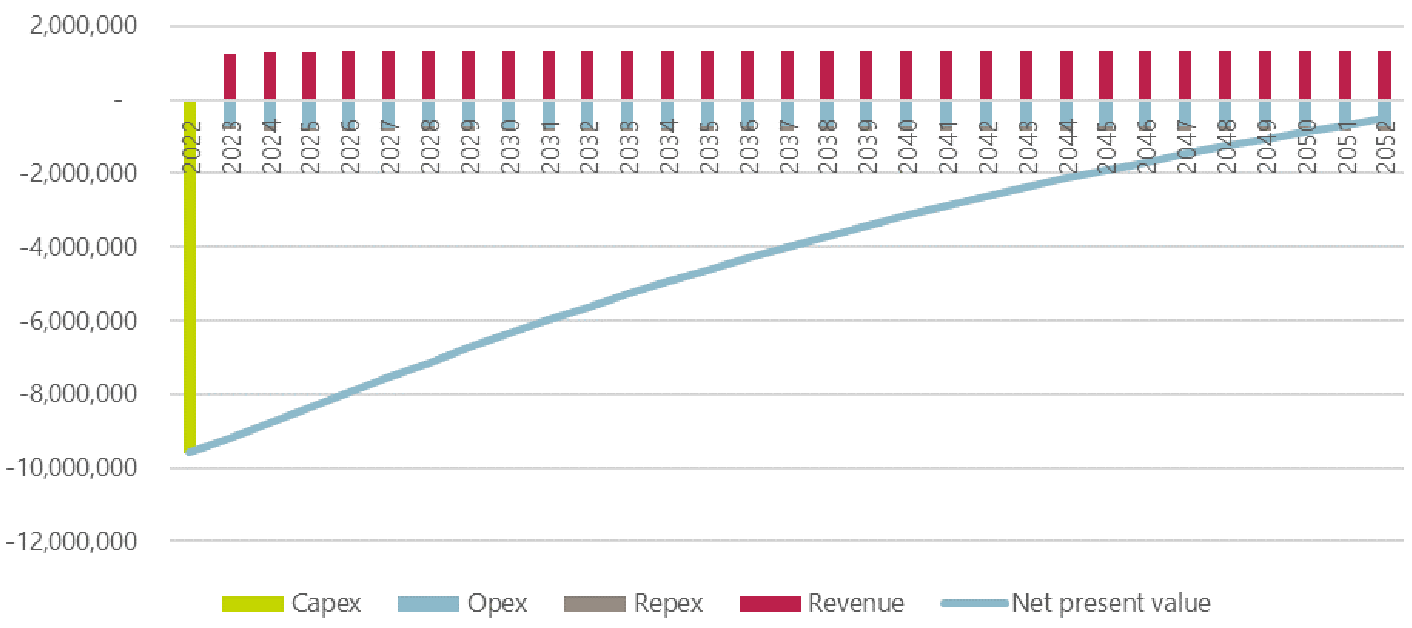


Figure 8.10: 30-year cashflow – Deptford with SELCHP connection

8.4 Funding streams

RHI funding

The Renewable Heat Incentive (RHI) is a government funding stream that provides financial incentive to increase the uptake of renewable heat within England, Scotland and Wales. Eligible installations receive quarterly payments over 20 years (non-domestic only). The RHI rate varies depending on the technology used and payments are made on a £/kWh of renewable heat generated basis .

In the Policy Paper Budget 2020 released on the 11th of March, UK Government confirmed funding for the Heat Networks Investment Project for a further year to 2022 and £270 million of new funding to enable new and existing heat networks to adopt low carbon heat sources. It also announced it will introduce a new allocation of flexible tariff guarantees to the Non-Domestic RHI in Great Britain in March 2021, helping to provide investment certainty for the larger and more cost-effective renewable heat projects

HNIP funding

The Heat Networks Delivery Unit (HNDU) was set up to address the barriers to market faced by local authorities (LAs) for DHN project development. The HNDU provides grant funding and guidance to LAs through the early stages of heat network development, as is currently used on the energy master plan to fund a percentage of the study fee.

For the later stages of DHN development, the Heat Networks Investment Project (HNIP) can provide capital investment to support with the associated costs of construction, operation and maintenance of a DHN. The scheme will provide £320 million of capital funding to gap fund heat network projects in England and Wales . The BEIS typical project development lifecycle and HNDU and HNIP funding timeline is shown in Figure 8.11.

To be eligible for HNIP funding the scheme must deliver a minimum of 2GWh/yr of heat. The network must also meet one of the following heat source requirements :

- 75% of the heat from CHP (which can include non-renewable fuel source)
- 50% of the heat from a renewable source
- 50% of the heat from any combination of renewable or recovered heat and non-renewable fuelled CHP.

ECO funding

The Energy Company Obligation (ECO) is a government energy efficiency scheme to reduction carbon emissions and reduce fuel poverty. This funding stream is aimed at retrofitting old, inefficient housing. The main eligibility criteria is dwellings with an EPC rating of E or below.

GLA DEEP funding

The Decentralised Energy Enabling Project (DEEP) supports London boroughs to develop decentralised energy (DE) projects, including heat networks. It can give technical, financial and commercial advisory help for large energy projects. The predecessor to DEEP, the DEPDU (Decentralised Energy Project Delivery Unit), has supported 13 decentralised energy projects to market; worth a total of £100 million in investment potential.

The project can fund all work (excluding capital) related to DE projects from an early stage of energy master planning, through to feasibility, business case, procurement and commercialisation .

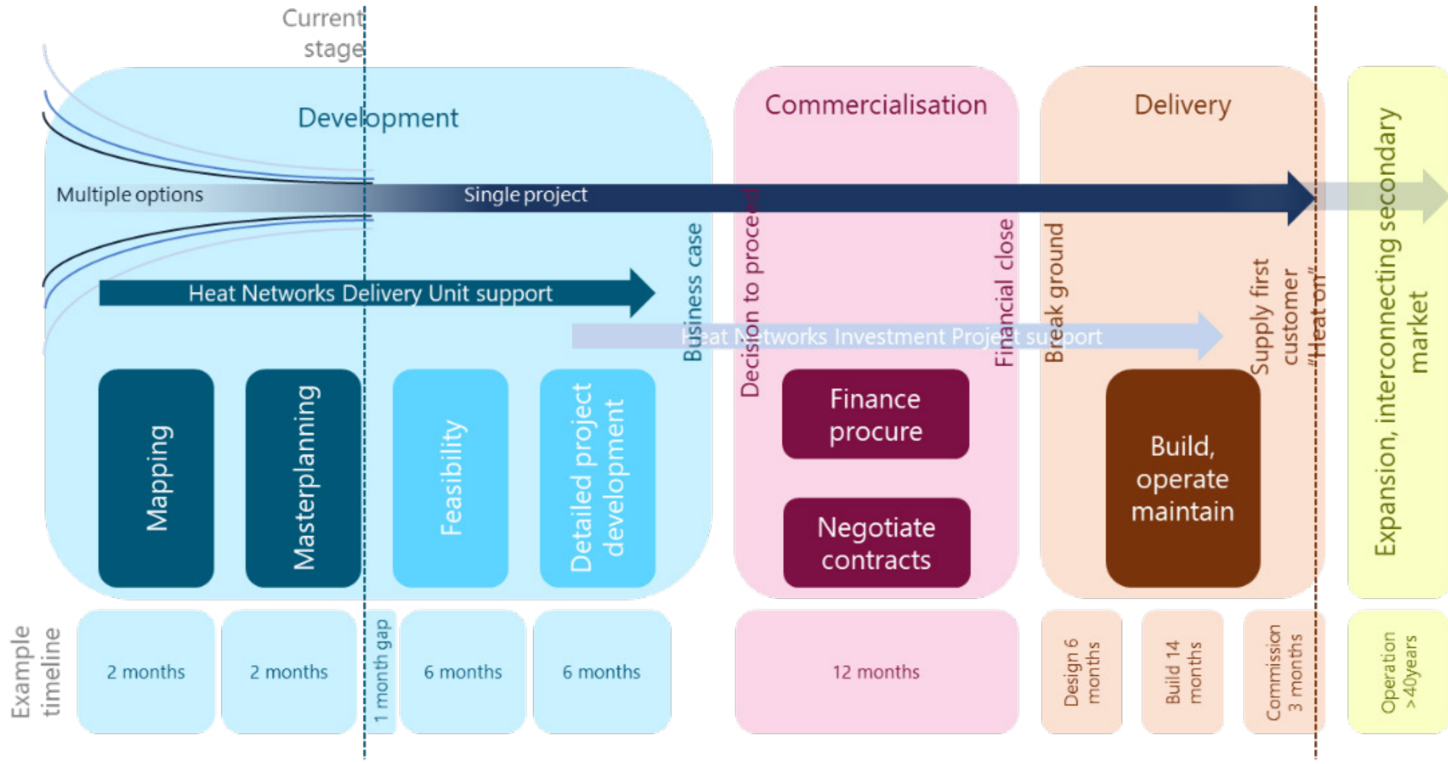


Figure 8.11: HNDU and HNIP funding timeline

MEEF funding

The Mayor's Energy Efficiency Fund (MEEF) provides flexible and competitive finance as well as other funding options to aid delivery of new low carbon technology, over an investment period of 20 years. This is part funded by the GLA through the European Regional Development Fund (ERDF).

MEEF can support energy efficiency, decentralised energy, and renewable energy generation projects, including innovative technologies . Key metrics include:

- £500m fund size
- Invest across the capital structure, with rates as low as 1.5% for up to 20 years
- £2m of technical support funding available to support a projects business case.

Carbon offset fund

Where the London Plan carbon reduction targets for new developments cannot be met (due to technical or commercial feasibility), developers must contribute to a carbon offset fund which will go towards funding the off-site CO2 reduction measures.

For all major developments (above 10 residential units or GIA of over 1,000m²), the financial contribution is based on the product of an established price (currently set at £60/tonne per year) and the shortfall in CO2 tonnes saved below the minimum threshold over 30 years. The revenue received by LBL from this is ring fenced for off-site carbon emission reduction and sequestering projects within the borough. There may therefore be opportunity to secure some of this funding stream for the development of a district heat network.

8.5 Commercial structures and procurement strategy

The commercial case for any district energy project in the Borough should demonstrate that the scheme will have a viable procurement and contractual strategy that provides a sustainable basis for the long-term operation of the system.

In further development of scheme options, Lewisham Council will decide what formal role they will take in the design, installation, commissioning and long-term operation of the system. If no private sector involvement is possible (e.g. due to lack of commercial performance for private sector involvement) or desired, then LBL can choose to self-deliver and operate the network. LBL has access to low cost finance through the Public Works Loan Board and other funding streams discussed within this report and could benefit from the revenue generation of the scheme.

The possible structures that are valid for the schemes discussed in this report are summarised in Table 8.9.

Table 8.9: Potential commercial structures

Commercial structure	Description
Private ESCo	Common approach whereby a private ESCo company installs, owns and operates the district heating network and acts as the energy service provider. Where the scheme is likely to be attractive to a private ESCo, this can remove any burden of operation and maintenance from the Council.
Council owned (direct involvement)	■ LBH undertakes delivery and operation of the project in its entirety. This will include sourcing all necessary funds, undertaking procurement, and owning and operating the scheme including acting as heat supplier to end customers. ■ Any capacity the Council does not have in house would be contracted to third parties, e.g. through operating and maintenance contracts with equipment suppliers, and billing and metering with a dedicated company. The Council gains more strategic control, but also takes on more risk.
Council owned (DBOM)	If there is not appetite for the Council to operate the network directly, this can be done via a Design, Build, Operate and Maintain (DBOM) contract in which a private entity is responsible for design and construction as well as long term operation and maintenance. The public sector secures the project's financing and retains the operating revenue risk and any surplus operating revenue.
LBH Joint Venture	LBH enters into a formal agreement with a third party for supply of funding and / or operational and technical expertise. A Joint Venture can bring significant benefit by bringing expertise in the sector by managing delivery and operation however there needs to be a clear benefit to all JV partners.

The procurement strategy for any of the proposed schemes needs to address all works and services required to deliver the project, considering risk allocation and mitigation.

Alternative procurement routes are illustrated in Figure 8.12 ranging from self-delivery where LBH retains most risk through to DBFOT (Design, Build, Finance, Operate, Transfer) where LBL passes as much risk as possible to a third party. The final route selected will depend on risks associated with the project.

Balancing LBH's limited experience of delivering district heating networks on the one hand with the desire to make sure the system is economic viable for the Council and future tenants, it is likely that the preferred procurement route would be DBOM or separate DB and OM procurement. Bringing together Design & Build with Operation & Maintenance mitigates the risk of value engineering of design adversely impacting operating costs. This is particularly important for infrastructure projects with a life in excess of 50 years where short-term savings in capital cost can be more than offset by higher operating costs over the project life.

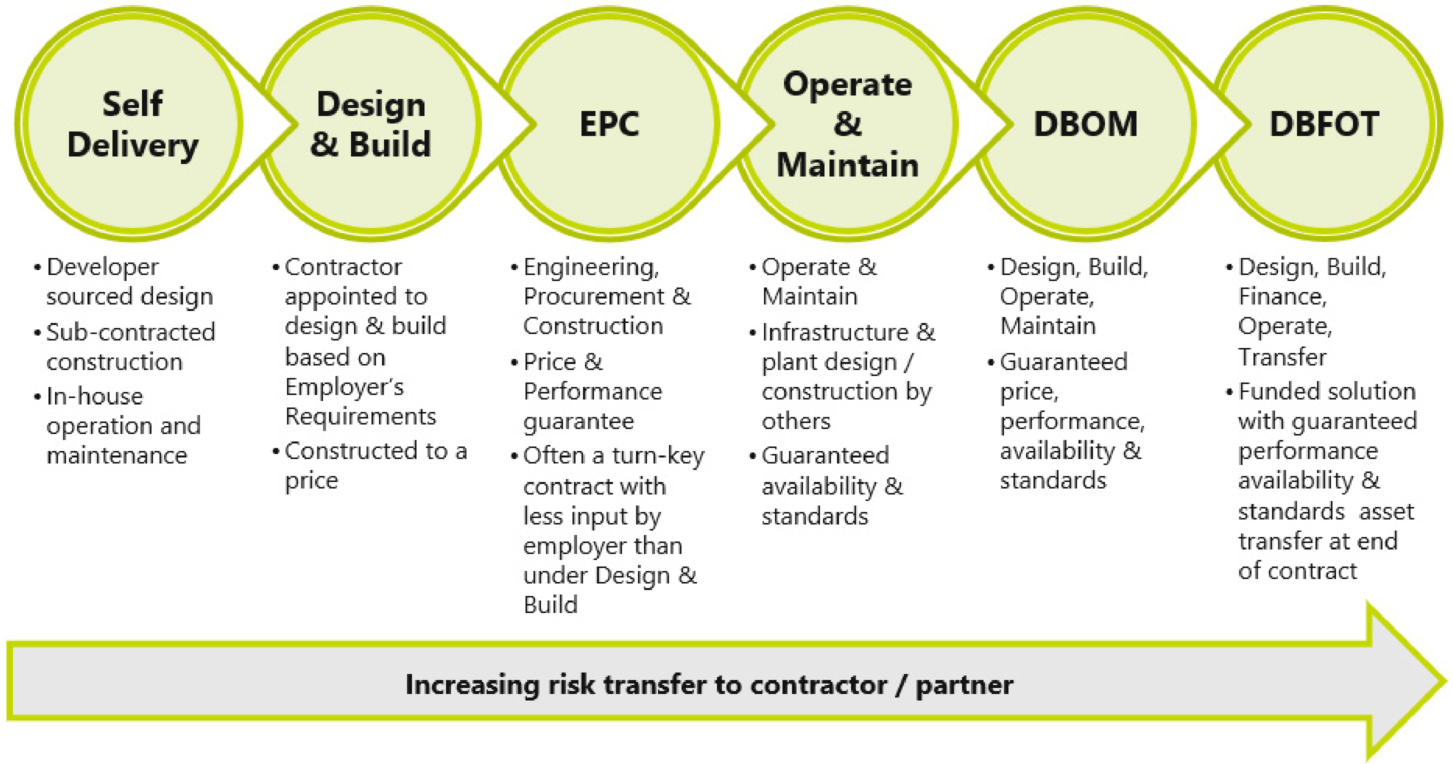


Figure 8.12: Procurement options

9 Environmental Performance

9.1 Modelling approach

The carbon emissions of the proposed schemes were analysed using average carbon equivalent factors for UK grid electricity and gas from BEIS. A carbon equivalent emissions factor is the mass of carbon dioxide (CO2), methane and nitrous oxide emitted for each unit of energy consumed (kgCO2e/kWh). BEIS produce annual projections of these factors for the UK. Figure 9.1 shows the electricity carbon factor is forecast to decrease significantly in the next 30 years due to increased uptake of renewable energy generation on the grid. These are modelled following the BEIS indexed grid average consumption-based (commercial/public sector) values. The grid gas emission factor remains constant over the 30-year lifetime at 0.184kgCO2e/kWh (the 2018 BEIS gross calorific value factor).

The DHN emissions are compared against the counterfactual case for each cluster (see Table 9.1) to determine relative carbon savings. The difference between each cluster's energy centre emissions and the counterfactual case equates to the scheme carbon saving.

Table 9.1: Counterfactual technologies

Cluster	Counterfactual technology 1	Counterfactual technology 2	Justification
Deptford	100% heat demand met by Individual gas boilers (89% efficient)	None	Most of Deptford's heat demand is existing and assumed gas boilers
Lewisham Town	55% heat demand met by Individual gas boilers (89% efficiency)	45% heat demand met by gas CHP network (45% htg/clg efficiency)	The existing CHP E.On network constitutes ~45% of the network's total heat load. the remaining assumed to be gas boilers
Catford	70% heat demand met by ASHP (300% efficiency)	30% heat demand met by top-up gas boilers (89% efficiency)	As the majority of Catford heat loads are new builds it is likely these will be heat pump led, with gas boilers providing peaking capacity

9.1.1 SELCHP carbon factor

The SELCHP annual carbon factor has been modelled based on the recently approved BRE Standard Assessment Procedure (SAP12) for Energy from Waste (EfW) heat sources . This method estimates the amount of displaced electricity generation using the z-factor and is applied to the BEIS factors to reflect ongoing grid decarbonisation.

The z-factor is the ratio of steam extracted in a turbine (MWth) by the amount of reduced electricity generation (MWe) this causes. By using this approach the carbon factor of EfW is directly linked to the electricity grid's carbon intensity. The resulting carbon factor of SELCHP EfW when using this approach are shown in Figure 9.1 with an assumed z-factor of 6, back-up boiler fraction of 3% (from Veolia) and the BEIS carbon factors.

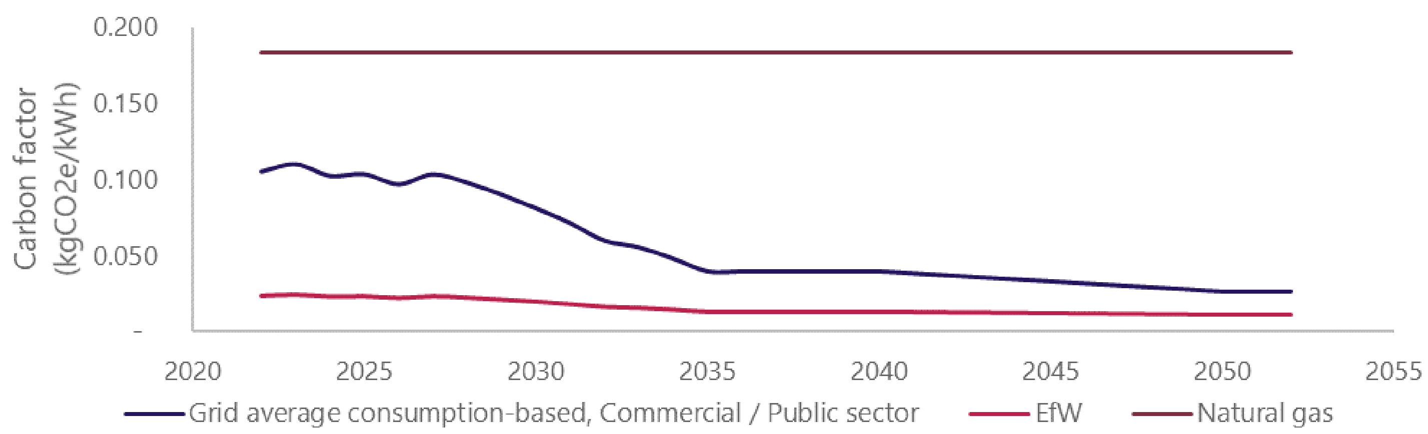


Figure 9.1: BEIS indexed grid electricity carbon factors (2019)

9.2 Results and analysis

The implementation of a DHN is projected to produce significant carbon savings in comparison to the counterfactuals, with the three clusters taken forward for analysis producing high carbon savings over the 30-year timescale. The projected carbon savings for the three core clusters are presented in Figure 9.2 and Table 9.2.

The carbon emissions savings are predicted to increase throughout the network's lifetime up until around the year 2045, at which point they level out. This trend is strongly linked to the carbon factor of the grid electricity used to power the heat pumps.

Lewisham Town saves the highest amount of carbon because of its larger heat load and high-carbon gas boiler/CHP counterfactual. If a connection to SELCHP can be secured, the Deptford cluster has the potential to save up to 94% of carbon emissions. Catford's carbon emissions savings (34% at year 30) are lower than the other two clusters due to the ASHP counterfactual. However, when lifetime emissions are taken into account, the emissions from Deptford and Catford are very similar (approximately 24 tCO2e over the 30-year period).

Table 9.2: Carbon projection results

Option	DH emissions saving @ year 1	DH emissions saving @ year 30	DH emissions saving (30-year total)
Unit	%	%	tCO2e
Deptford - ASHP	59%	72%	50,723
Deptford - SELCHP	86%	94%	68,436
Lewisham Town	61%	83%	157,494
Catford	29%	34%	11,639

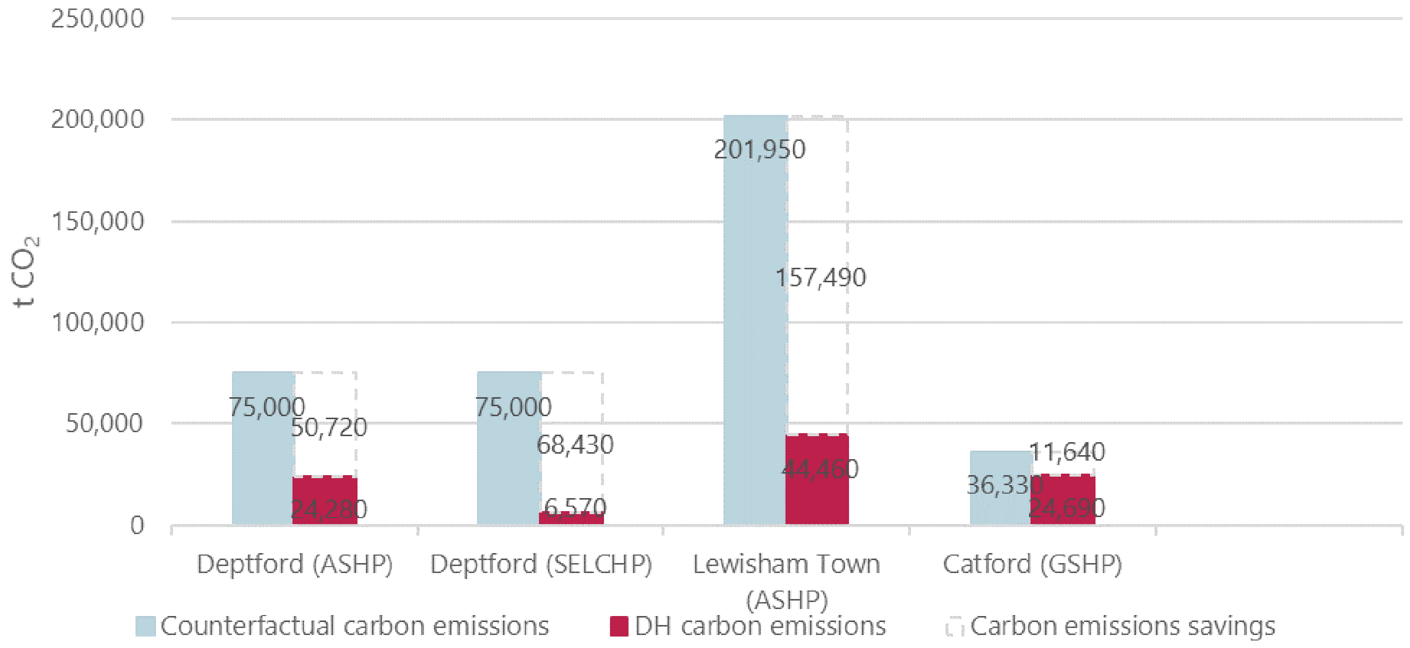


Figure 9.2: Carbon emission savings over 30 years vs counterfactual

10 Conclusions and Next Steps

10.1 Key conclusions

This energy masterplan updated the previous heat mapping studies within LBL and identified eight promising areas for DHN development within the borough. These areas were quantitively assessed based on their heat density, ownership, potential for expansion, timescales and physical constraints. From this initial assessment, the most promising three clusters were taken forward for more detailed technical design, environmental assessment and commercial analysis.

Table 10.1: Cluster summary

	Deptford		Lewisham Town	Catford
Annual heat demand (MWh/yr)	12,100		23,600	14,890
Heat line density (MWh/m)	7.2		9.4	9.8
No residential units on core network	1,620		4,570	3,640
Percentage tier 1 heat (%)	80%		75%	60%
Percentage public owned	40%		23%	50%
Capex (£m)	10.4		11.5	9.3
LZC technology	ASHP	SELCHP	ASHP	GSHP
IRR @ 30 yrs (%) – no funding or RHI	N/A	3.1%	2.3%	4.9%
IRR @ 30 yrs (%) – with RHI	N/A	N/A	7.6%	10.3%
DH emissions saving @ year 1 (%)	59%	86%	61%	29%
DH emissions saving – 30-year total (tCO2e)	50,720	68,440	157,490	11,640

The key outcomes of the clusters are described below.

Deptford

The Deptford area has undergone significant development in recent years in both the residential and commercial sectors. Many of the developments have been installed with CHP and have limited carbon futureproofing in their existing design. The CHPs will be approaching end of life by 2030. A heat network could provide infrastructure to help them decarbonise as well decarbonising a number of LBL's estates.

The proximity to the SELCHP waste incineration plant means it could benefit from the largest low carbon waste heat source in the borough. Greenwich Council have also expressed interest in the network, meaning future phases could extend to the large new developments to the north of the Lewisham borough boundary.

The financial performance of the network is challenging, largely due to the costs of retrofitting Crossfield Estate. If these retrofit costs can be sourced from another capital budget and the SELCHP connection can be secured, high-level modelling suggests that the network could achieve a 6.6% IRR over the 30 years modelled.

If the waste heat from SELCHP is utilised this could reduce carbon emissions in the Deptford cluster by up to 98% - a significant contribution to tackling the climate emergency and improving air-quality in the area.

Modelling assumes that the planned SELCHP connection to Convoys Wharf has capacity to extend to Deptford. Early engagement is recommended with Veolia to discuss the connection and ensure that the network is futureproofed for extension to the Deptford area before installation (if further feasibility work proves it to be viable).

Lewisham Town

Lewisham Town has seen rapid growth in recent years which is set to continue as new residents are attracted to the area's improving transport links to the City. The large-scale redevelopment of the Riverdale Shopping Centre could see an additional 2,000 homes to the already high heat dense area. This presents an excellent opportunity to develop a future heat network in the area that will decarbonise a number of existing businesses, as well as the existing CHP networks at Lewisham Gateway and Loampit Vale.

Due to the decarbonisation of the grid, the existing gas CHP networks can no longer deliver long term carbon savings and therefore a transition plan is required to futureproof the existing networks for decarbonisation. The redevelopment of the shopping centre, if realised, provides a large catalyst to develop this network. Early engagement with the shopping centre is recommended to ensure they are aware of the opportunity in the area.

Catford

The Catford Masterplan is due to be published later this year. In it is a plan for large scale redevelopment of a currently under-utilised area, including 3,000 new homes and a new civic suite. It is critical for low carbon infrastructure implementation plan to be designed into the masterplan from an early stage to ensure a futureproofed approach to heating and cooling emissions. The heat network proposed in this report is estimated to see a carbon saving of 38% at year 30 compared to if no such plan was enforced.

The timing is critical as works on the South Circular re-routing are due to begin after 2020. If the DHN trenching can be coordinated it will save LBL significant disruption. In addition, some development sites are already coming forward in advance of the formalisation of the masterplan and these should be futureproofed for any energy scheme.

The techno-economic modelling results suggest Catford performs positively without any additional funding (~5%). If RHI can be secured then IRR increases to ~10%, indicating a strong potential to attract third investors.

10.2 Next steps

The following actions are recommended for the three identified clusters:

- Detailed feasibility
- A consolidated roadmap
- Incorporate findings into updates to local policy, including the Local Plan and any local area action plans
- Explore opportunities for LBL to integrate findings into GIS system.

Table 10.2: Key actions and interdependencies for individual clusters:

Cluster	Key action
Deptford	▪ Consider a detailed feasibility study of extending the SELCHP network into Deptford – including investigation of connecting additional loads along the route ▪ Engagement with Veolia SELCHP in advance of Convoys Wharf network installation ▪ Identify alternative capital budget for retrofit costs of LBL estates ▪ Maintain contact with Greenwich Council to ensure opportunity for inter-borough heat sharing is not lost
Lewisham Town	▪ Early engagement with Landsec so this opportunity for wider decarbonisation is not missed at the Riverdale Shopping Centre redeveloped ▪ Reach out to E.On to understand their long term plan for decarbonisation and present findings of study as a potential future ESCo
Catford	▪ Incorporate findings into the Catford Masterplan and carry out further energy strategy work to determine best solution e.g. low temperature heat network or ambient loop option for cooling integration ▪ Further discussions with St Dunstan's College on GSHP installation at the Jubilee Ground ▪ Coordination of possible network installation with the South-Circular re-routing team

10.3 Cluster implementation plans

The section below sets out the possible routes to implementation for each cluster. The main steps to progress from detailed feasibility through to construction are mapped, along with the key milestones.

Deptford

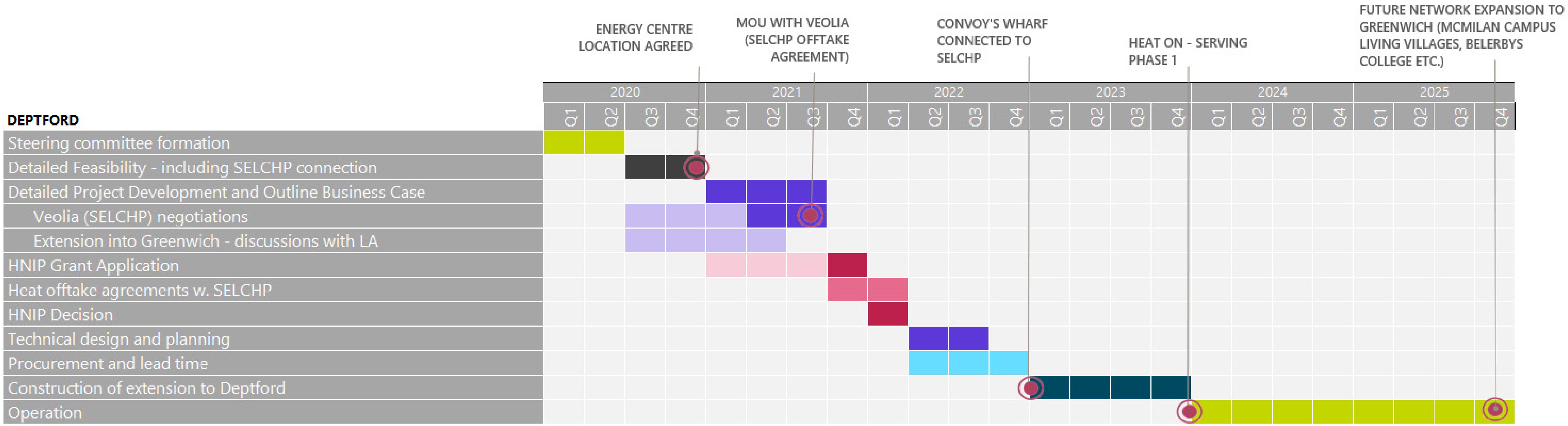


Figure 10.1: Deptford cluster implementation plan

Lewisham Town

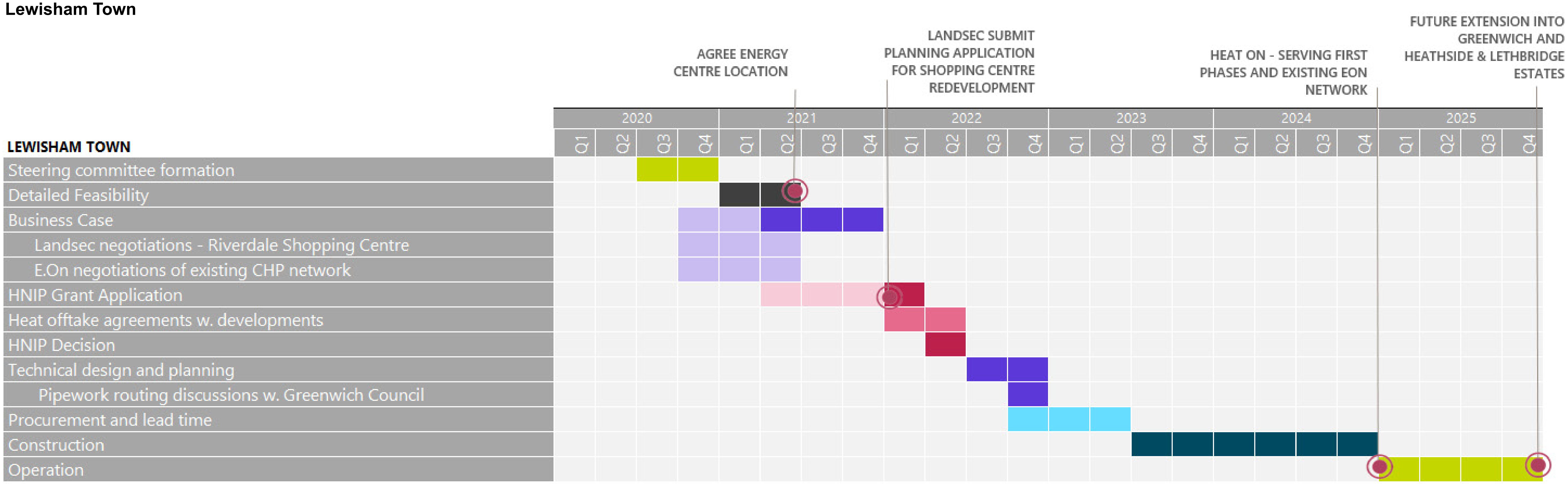


Figure 10.2: Lewisham Town implementation plan

Catford

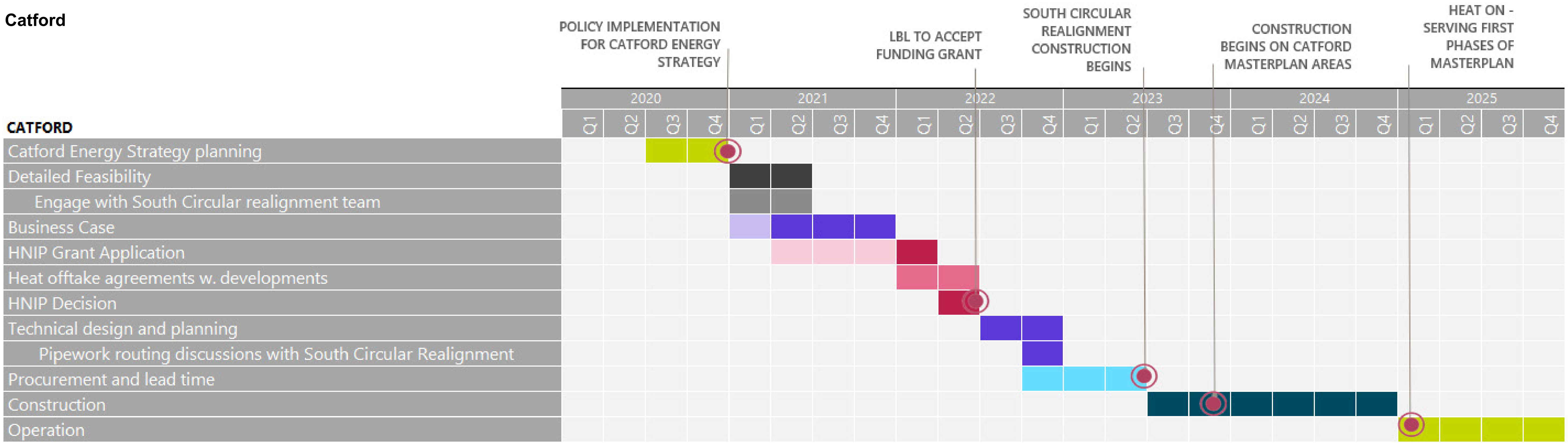


Figure 10.3: Catford cluster implementation plan

11 Risk Register

DHNs require collaboration with multiple stakeholders which introduces complexity during development, from feasibility stage through to operation. This introduces inherent risks that need to be overcome, particularly surrounding ownership structures and heat supply regulations. The risks relating to developing a DHN in Lewisham have been identified at ranked based on their likelihood and potential impact to the progression of the scheme. Some risks are applicable to all the identified clusters.

The risks have been split into the following categories:

- Technical
- Business case
- Planning Consents, Permitting and Environment
- Stakeholders
- Construction and procurement
- Operation and maintenance.

11.1 Quantifying the risk

Scores are developed on a scale from 1 to 5.

- 1 indicates an unlikely event, or a mild level of severity.
- 5 indicates a likely event, or a severe consequence of such an event.

The risks are quantified based on their impact and probability of occurring. The impact of the risk is the outcome that may occur if the risk is not properly managed. Mitigating measures are suggested to reduce the impact and probability of each risk. Table 11.1 shows the matrix used to assess the risk. The product of impact and probability dictates the overall risk level and is presented both pre and post mitigation in Table 11.2.

Table 11.1: Risk matrix ranking

Risk ranking		**Probability**				
		1	2	3	4	25
Impact	1	1	2	3	4	5
	2	2	4	6	8	10
	3	3	6	9	12	15
	4	4	8	12	16	20
	25	5	10	15	20	25

11.2 Key risks

Deptford:

- Sourcing funding for Crossfield Estate retrofit
- Securing LZC heat source at either:
  - Lewisham College – engage with college from outset
  - Through SELCHP extension – timing is critical as larger pipework than currently planned to Convoy's Wharf may be required
- Engagement with 3rd party stakeholders for connection

Lewisham Town:

- Early engagement with E.On over the future of the existing heat network and its proposed extension to Lewisham Exchange. A clear futureproofed decarbonisation strategy is required when CHP plant nears end of life
- Timeframes – the network is highly dependent on the redevelopment of the Riverdale Shopping Centre as not only a key anchor load but also to provide space for the EC

Catford:

- The LZC heat source is dependent on successful engagement with St Dunstan's College to allow a GSHP array to be installed at the northern end of the Jubilee Ground
- Ensuring a developed energy strategy is incorporated into the Catford Masterplan and any opportunity is not missed including coordination with the South Circular re-routing to reduce network costs and disruption.

11.3 Risk register

Table 11.2: Risk register

Item ref.	Risk description	Pre-mitigation			Mitigation measure	Lead by	Post-mitigation		
		Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)			Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)
1	**Technical**								
1.1	Heat consumption estimates vary vs actual consumption. If heat loads do not materialise (e.g. Riverdale Shopping Centre and Catford Masterplan new developments) the scheme may become difficult to operate economically	4	3	12	Heat demand confidence level included in feasibility study. Demands are derived from existing building data where possible. Recommend locking non-LBL customers into long term contracts where possible (e.g. in planning agreements for new builds)	BH / LBL	3	2	6
1.2	Securing LZC heat source at either Lewisham College or SELCHP	5	3	15	Engage with college from outset. Timing is critical for proposed SELCHP extension as larger pipework than currently being planned to Convoy's Wharf may be required. Keep communicating with Veolia, carryout desk study of connection potential	LBL	5	2	10
1.3	Existing developments install renewed boiler plants; reducing the incentive for connection to DHN	4	2	8	Maintain communication with stakeholders identified in feasibility study to discuss alternative strategies in case of plant failure and update existing plant replacement strategies. Ensure LBL are aware of any planned upgrades to building secondary systems to ensure DHN connection capability. Suggest deferring any replacements where possible and use funds for DHN connection. New development connections to be ensured through planning policy	LBL	4	1	4
1.4	Heat load insufficient to justify running of LZC plant during the summer	4	3	12	Obtain hourly heat profiles where possible. Current sizing based on typical hourly heat loads profiles for clusters to ensure sufficient base load. Measure heat loads over long period of time for best possible design information. Provide large thermal store or heat pump modulation for lower summer loads	LBL	3	2	6
1.5	LZC technology availability - if the plant does not achieve the required availability it may impact running costs and carbon emissions. Significant plant failure may leave customers without heat	5	3	15	Transfer risk to operation and maintenance contractor via guaranteed minimum availability contract provisions and penalties. Back-up boilers (or alternative) provided for resilience and fuel flexibility	LBL	2	2	4

Item ref.	Risk description	Pre-mitigation			Mitigation measure	Lead by	Post-mitigation		
		Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)			Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)
1.6	Large heat network distribution losses may lead to substantial loss in value if heat network is not adequately designed or insulated	3	2	6	Transfer risk to O&M contractor - specify high performance as per CP1 guidance and ensure detailed approval, inspection, testing and acceptance process including penalties for under performance. Minimise route lengths where possible in route proving process at detailed feasibility	LBL	3	1	3
1.7	Ground source heat potential not certain	5	2	10	Consult relevant literature as to ground conditions in London/Lewisham area (e.g. British Geological Survey maps and existing borehole data). There are many successful closed and open loop GSHP installations throughout the London area, but a detailed ground survey is recommended once a suitable scheme is developed	BH	3	2	6
1.8	Lack of capacity to supply electricity required for heat pumps or natural gas for peaking boilers	4	3	12	Check utility plans to indicate if there are power cables in the area near to EC locations. Get indicative connection quote from gas/power provider to suggest fee for connection. Connection cost allowance included in techno-economic model	BH	4	2	8
2	**Business case**								
2.1	Funding								
2.1.1	Failure to identify funding sources for Crossfield Estate retrofit in Deptford cluster	5	3	15	Continuous engagement with the GLA to ensure schemes meet requirements for HNIP funding. CP1 and HNDU checklists will be carried out to ensure scheme compliance. Do not proceed if adequate funding cannot be secured	LBL	2	2	4
2.1.2	Lack of interest from commercial developers	5	3	15	Establish what IRR/ NPV values would attract commercial investment through soft market testing	BH	4	2	8
2.2	Capital costs								
2.2.1	Budget overspend due to poor cost controls	4	2	8	Undertake design reviews with relevant stakeholders. Consider procurement via a contractor to cover energy centre and networks	LBL	2	2	4
2.2.2	Budget underestimated due to unforeseen issues	5	3	15	20% contingency added to cost estimates	LBL	4	2	8

Item ref.	Risk description	Pre-mitigation			Mitigation measure	Lead by	Post-mitigation		
		Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)			Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)
2.2.3	Cost increases due to connection works at each block	5	3	15	Engage with planned developments to ensure secondary systems are connection ready to DHN. Cost of secondary system retrofit already estimated in CAPEX, however surveys of each connection required is needed for detailed costing.	LBL	3	2	6
2.3	Revenues								
2.3.1	Resulting cost of heat too high for residents	5	2	10	LBL required to provide additional capital funding over and above loan value in order to reduce heat cost. However, this will affect the schemes revenue performance. Tight control on scheme costs is required through detailed development	LBL	4	1	4
2.3.2	Uncertainty around access to the Renewable Heat Incentive (RHI) after March 2021	4	3	12	Access to RHI funding is ending in March 2021. In the Policy Paper Budget 2020 released on the 11th of March, UK Government confirmed it will introduce a new allocation of flexible tariff guarantees to the Non-Domestic RHI in March 2021. Details of this are not currently known. Ensure schemes are viable without RHI funding – current base modelling at EMP stage excludes RHI.	LBL	1	3	3
2.3.3	Information not forthcoming from potential heat consumers to include in the study	2	2	4	Customers are largely LBL owned or planned developments. Metered data should be used where available	LBL	2	1	2
2.3.4	Changes to energy taxes could impose costs on the energy business	3	2	6	Any increase in tax will be transferred to customer - include change of law provision in heat contracts that adjusts charges to reflect new taxes	LBL	2	2	4
2.3.5	Occupancy risk - takes longer to build up heat demand than anticipated	3	2	6	Difficult to mitigate as dependent on housing market	LBL	3	2	6
3	**Stakeholders**								
3.1	TFL oppose street-works or propose onerous requirements	4	2	8	LBL to manage TFL interface through normal channels with assistance from LBL Highways. Early liaison with the South Circular re-routing team.	LBL	3	2	6

Item ref.	Risk description	Pre-mitigation			Mitigation measure	Lead by	Post-mitigation		
		Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)			Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)
3.2	Private developments not interesting in connecting to DHN	5	3	15	Early engagement with developers, improved planning policy to include connection obligation. Ensure scheme is viable that is not reliant on developments who are not obliged to connect. Engagement already carried out with Landsec (Riverdale Shopping Centre), St Dunstan's College and SELCHP	LBL	3	2	6
3.3	Failure to gain resident support for the scheme	4	2	8	Structure proposal to make it attractive to residents and ensure a communications plan is enacted for local residents. Ensure residents are no worse off and bring savings where possible through the cost of heat	LBL	4	1	4
3.4	LBL lack of expertise to carry project forward	4	3	12	External project manager recommended to lead the scheme. Operation and maintenance can be contracted out	LBL	3	1	3
3.5	Low support from within LBL council	5	3	15	Identify a "champion" from within council to take project forward and increase awareness. LBL to manage ongoing discussions with BH input.	LBL	4	2	8
3.6	Thames Water not interested in supplying waste heat from Hogsmill Sewage Treatment Works	4	3	12	Early engagement with TW has already been carried out, who have expressed interest in the scheme. Continued engagement at all stages of DHN development is required. CRE team already in contact with TW as adjacent landowners.	LBL	4	2	8
3.7	LBL's ability to invest in the 'leg work' in setting up a DHN	4	2	8	Involve relevant LBL internal departments from project outset to raise awareness of project. Apply for funding/support from GLA/BEIS	LBL	2	2	4
3.8	Third party negotiations (SELCHP, E.On, Greenwich Council, Landsec)	4	3	12	Early stakeholder involvement in proposed schemes once identified. Discussions with third parties as to acceptable IRRs	LBL	3	2	6
4.9	E.On not interested in incorporating their existing DHN into the wider proposal	5	3	15	Early engagement to assess likelihood. A clear futureproofed decarbonisation strategy is required when CHP plant nears end of life	LBL	5	2	10

Item ref.	Risk description	Pre-mitigation			Mitigation measure	Lead by	Post-mitigation		
		Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)			Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)
4	**Planning consents, permitting and environment**								
4.1	Failure to obtain planning permission for energy centre, particularly in Deptford	5	2	10	The energy centre in Deptford is proposed within Lewisham College site. LBL to manage planning concerns going forward through engagement with local stakeholders and the planning team – alternative locations to be considered.	LBL	5	1	5
4.2	High noise levels from energy centre	4	3	12	Acoustic impact managed through using proven compliant heat pumps and noise insulating casing	LBL	3	2	6
4.3	High level of visual impact from energy centre	3	2	6	Flues from the gas boilers may cause concern in built up areas, particularly Deptford where EC is near the Thames. Long term energy centre façade concept to be created for communication to planning team to ensure clarity of the intent. Where possible, flues integrated into building development to reduce visual impacts	LBL	2	1	2
4.4	Planning permission required for heat network	3	2	6	LBL to confirm whether permitted development rights cover installation of heating pipework in the public highways	LBL	2	2	4
4.5	Air quality issues increase cost or result in restriction on operation of energy centre	4	2	8	Air quality impact managed by ensuring flues extend to a higher level than the surrounding buildings. Early consultation with planning team advised. De-risk by installing high efficiency gas boilers	LBL	3	2	6
4.6	Failure to negotiate use of Landsec land for Lewisham Town Centre energy centre	4	3	12	Continue engagement with Landsec and pursue a memorandum of understanding for use of land for energy centre	LBL	2	2	4
4.8	Failure to obtain planning permission for GSHP at St Dunstan's College in Catford due to environmental issues	5	3	15	Early engagement with the Environment Agency (EA) and St Dustan's. Alternative energy centre location incorporated into Catford Masterplan on LBL land	LBL	5	1	5
5	**Construction and procurement**								
5.1	Access to properties for installation not possible in timely manner	2	2	4	LBL housing team to manage risk in conjunction with contractor. DHN scope to end at the meter at block plate heat exchanger	LBL	2	1	2

Item ref.	Risk description	Pre-mitigation			Mitigation measure	Lead by	Post-mitigation		
		Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)			Impact (I) 1-5	Probability (P) (1-5)	Risk level (I*P)
5.2	Asbestos present in existing plant rooms	3	3	9	Obtain asbestos information from stakeholders and LBL and factor into construction programme. Higher risk in Lewisham Town due to larger proportion of older building stock	LBL	2	2	4
5.4	Contract choice inappropriate and prevents project aims from being delivered	5	3	15	Review contract choice as part of development of business case. Ensure wide engagement in bid process to attract range of contractors	LBL	4	2	8
5.5	Redevelopment time windows missed	4	4	16	Early and continued engagement with all major stakeholders identified (e.g. Catford Masterplan team, Veolia, Landsec, E.On, Lewisham College etc.) to ensure they are aware of the EMP project and potential to connect into a DHN. Promotion of work from within LBL and across the borough so that future developers are aware of proposed scheme	LBL	4	3	12
6	**Operation and maintenance**								
6.1	Heat delivery failure	5	4	20	Design resilience into system including redundancy for pumping, boilers etc. Make plans and procedures for emergency boiler hire for connection at building level.	LBL	3	1	3
6.2	Lack of clarity over the department with LBL who is responsible for operation and maintenance	3	2	6	LBL to make a clear statement of responsibility as part of internal business case. Particularly important for schemes where energy is being supplied by third party (SELCHP)	LBL	2	2	4
6.3	High losses in primary or secondary network negate cost savings and create inefficient system	4	3	12	Commissioning and ongoing monitoring conducted to ensure performance is achieved	LBL	3	2	6

Appendix A Greenwich Proposed Connections

Deptford:

Future Site	Heat Load (MWh/yr)	Reason for exclusion from core scheme
Creekside/Union Wharf	890	Long distance from proposed network, line density would be very low and within a separate London Borough.
Greenwich Creekside	Unknown	Long distance from proposed network, line density would be very low and within a separate London Borough.
McMillan Campus Living Village	Unknown	Long distance from proposed network, line density would be very low and within a separate London Borough.
Bellerbys College London	278	Long distance from proposed network, line density would be very low and within a separate London Borough.
Rachel McMillan Nursery School	Unknown	Long distance from proposed network, line density would be very low and within a separate London Borough.
Gilbert House	968	Long distance from proposed network, line density would be very low and within a separate London Borough.
Greenfell Mansions	Unknown	Long distance from proposed network, line density would be very low and within a separate London Borough.
Total future heat load	2,136+	

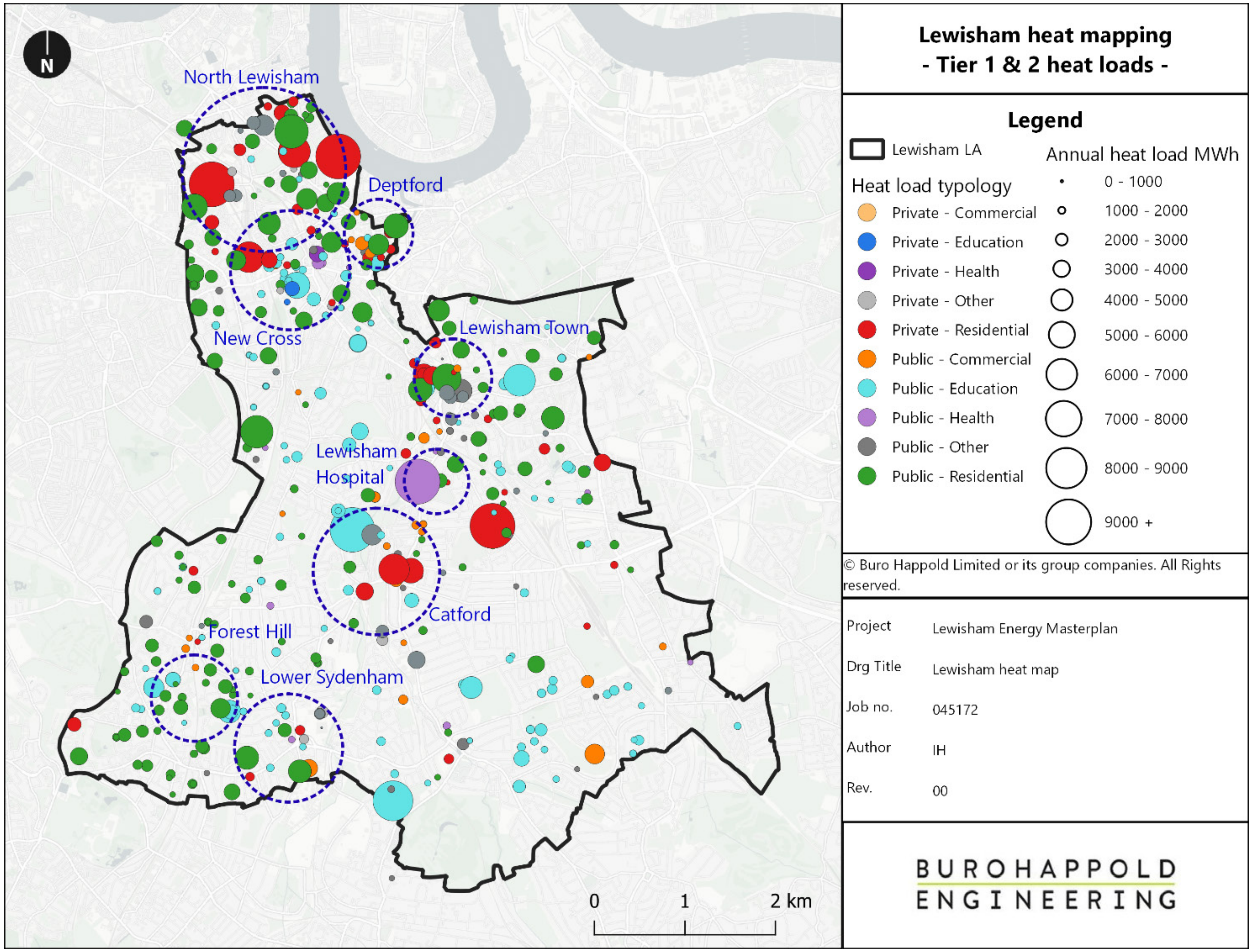
Lewisham Town:

Future Site	Heat Load (MWh/yr)	Reason for exclusion from core scheme
Belmont Hill housing	187	Most of the housing here is low-rise, with three mid-rise buildings. The line density to these dwellings would be very low.
Lewisham Hill housing	1056	Large proportion are low-rise housing, ~200 mid-rise units modelled here, although these loads are scattered and would create a low line density due to the distance to other major loads.
Greenwich Towers (Warner, Ellison, Pitmaston and Egremont Houses)	1234	Long distance from proposed network, line density would be very low and within the Borough of Greenwich.
Morden Mount Primary School	339	Long distance from proposed network, line density would be very low and within the Borough of Greenwich.
Heathside and Lethbridge development	3528	Long distance from the proposed core network, line density would be low. Existing communal heating network for this newly build development – may be capacity to serve the wider area, requires further engagement with Peabody.
Total future heat load	6344	

Catford:

Future Site	Heat Load (MWh/yr)	Reason for exclusion from core scheme
St Dunstan's College	518	Long distance to connection, the line density would be very low. Requires navigating retained section of South Circular
Holbeach Primary School	282	Long distance to connection, the line density would be very low.
2-36 Plassey Road	207	Long distance to connection, the line density would be very low.
Former Cannon Cinema	137	Minimal load, would be feasible if other close connections such as Rushey Green School were also connected to the network.
Rushey Green Primary School	866	Long distance to connection, the line density would be very low.
Total future heat load	2,010	

Appendix B Tier 1 & 2 Heat Loads Map



Tier 1 & 2 heat loads

BURO HAPPOLD

0045172 Lewisham Energy Masterplan

ENERGY MASTERPLAN

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