PARSONS BRINCKERHOFF

January 2016

LONDON BOROUGH OF HARINGEY

ENERGY MASTERPLAN

287404A

Rev7

London Borough of Haringey Energy Masterplan

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Prepared for
London Borough of Haringey

Prepared by
Parsons Brinckerhoff

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CONTENTS

LIST OF ABBREVIATIONS

CHP	Combined heat and power
CIBSE	Chartered Institute of Building Services Engineers
DHMfL	District Heating Manual for London
DHW	Domestic Hot Water
IRR	Internal Rate of Return
LVHN	Lea Valley Heat Network
NLSA	North London Strategic Alliance
NPV	Net Present Value
PB	Parsons Brinckerhoff
SAP	Standard Assessment Procedure

SECTION 1

NON-TECHNICAL SUMMARY

1 NON-TECHNICAL SUMMARY

1.1 Introduction

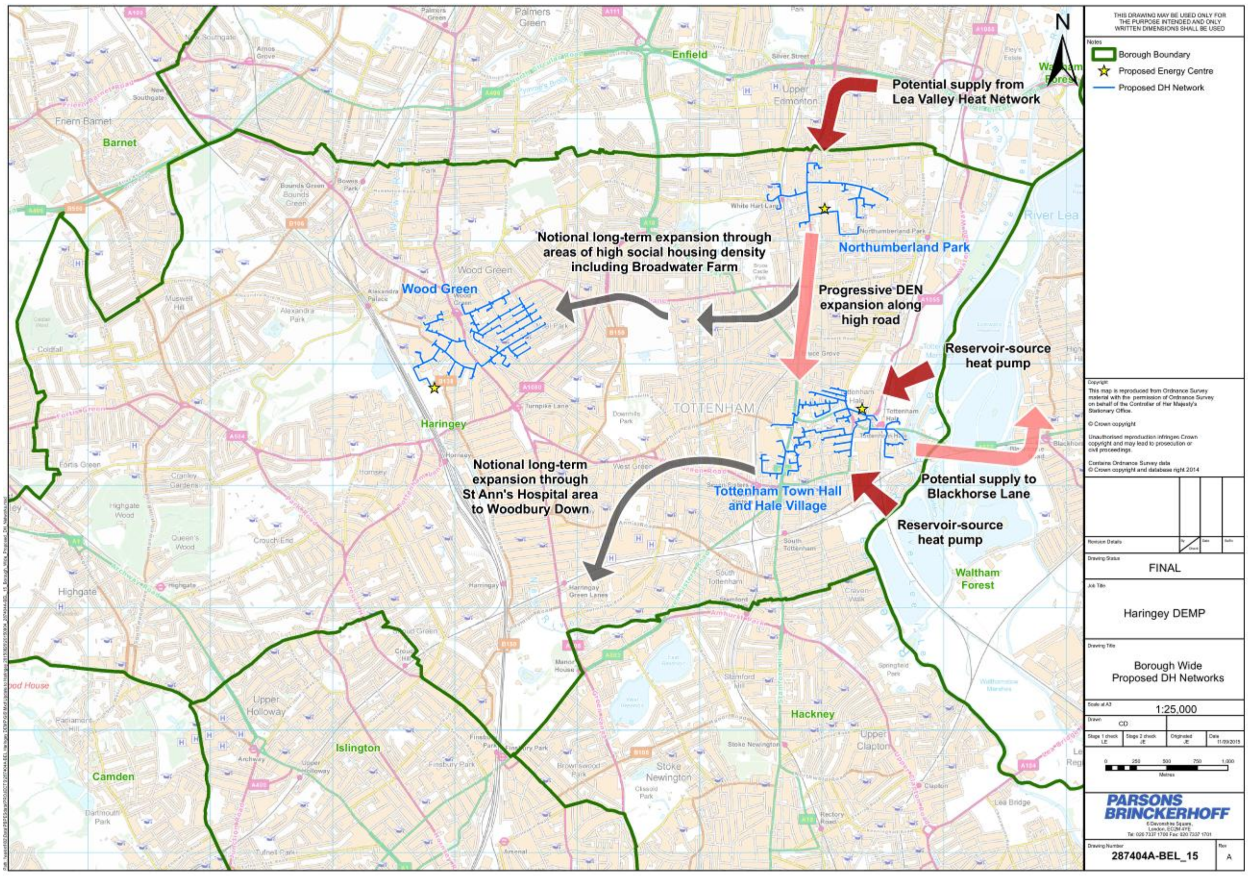
1.1.1 Parsons Brinckerhoff was appointed by the London Borough of Haringey to establish an Energy Master Plan (EMP) based on the provision of decentralised energy (DE) networks within the borough. The work is driven both by the Council's ambition to achieve a 40% reduction in carbon emissions over 2005 levels by 2020 and by the imperative to address fuel poverty, improve energy security and support inward investment in the area.

1.1.2 This report is being prepared at a time when key Planning Policy documents are being drafted i.e. the Area Action Plan for the Tottenham area, Development Management DPD, and Site Allocation DPD. This report feeds into this policy development process.

1.2 Strategic vision

1.2.1 This study identifies a number of key areas of high heat densities and development focus, and envisages that in the long term, networks such as those illustrated on the 'vision map' below could emerge. This shows both a number of cross-borough linkages to Enfield, Waltham Forest and Hackney and also a series of large-scale decentralised energy networks, particularly in the east of the borough.

Figure 1-1 Strategic vision for Haringey



1.2.2 The development of this type of 'visionary' scale of network is beyond the timescales of current policy targets. However, kick-start networks are also identified in these key locations, discussed below.

1.2.3 Three key policies related to decentralised energy are:

- The UK's legally binding target of an 80% carbon emission reduction by 2050 on a 1990 baseline
- The London Mayor's targets of achieving a 60% reduction on a 1990 baseline by 2025, and for 25% of energy to be supplied by decentralised energy
- The Haringey 40:20 pledge to reduce emissions by 40% by 2020 over a 2005 baseline.

1.2.4 The introduction of decentralised energy networks (in their kick-start form) will help to achieve the shorter term targets (i.e. Haringey 2020, and London Mayor's 2025 targets), and also provide key infrastructure to enable further decarbonisation towards the UK 2050 target with appropriate expansion.

1.3 Overall approach

1.3.1 This is a high-level study that generates estimates of the feasibility of the installation of heat networks linking existing buildings and new development loads.

However, it must be noted that the analysis has not attempted to determine the actual feasibility (i.e. technical / commercial compatibility) of connecting existing buildings, nor has the sensitivity of potential conversions from existing individual heating systems to communal supplies been considered. From this point of view the aim is primarily to identify key priority areas where decentralised energy should be developed – the process of identifying these areas is necessarily based upon notional networks that must be further developed in design and delivery terms as schemes progress.

1.4 Heat demands

1.4.1 As part of this commission the heat demand information available for the borough has been re-assessed. A mix of data sources has been used in modelling including: Haringey internal records of fuel and power consumption in their properties, the London Heat Map database, Energy Statements accompanying planning applications, the application of benchmarks to Site Allocation data, and individual property information based on data from Registered Social Landlords and Homes for Haringey. A total of more than 3,500 data points have been analysed and mapped using a Geographic Information System (GIS). Whilst social housing properties have been modelled within this report, their inclusion does not represent the intention to convert these to communal heating on a widespread basis. This study is not comprehensive it its coverage of potential heat demand points, but hopes to address key accessible loads, particularly for kick-start networks, based on development information provided by LB of Haringey.

1.5 Heat supply technologies

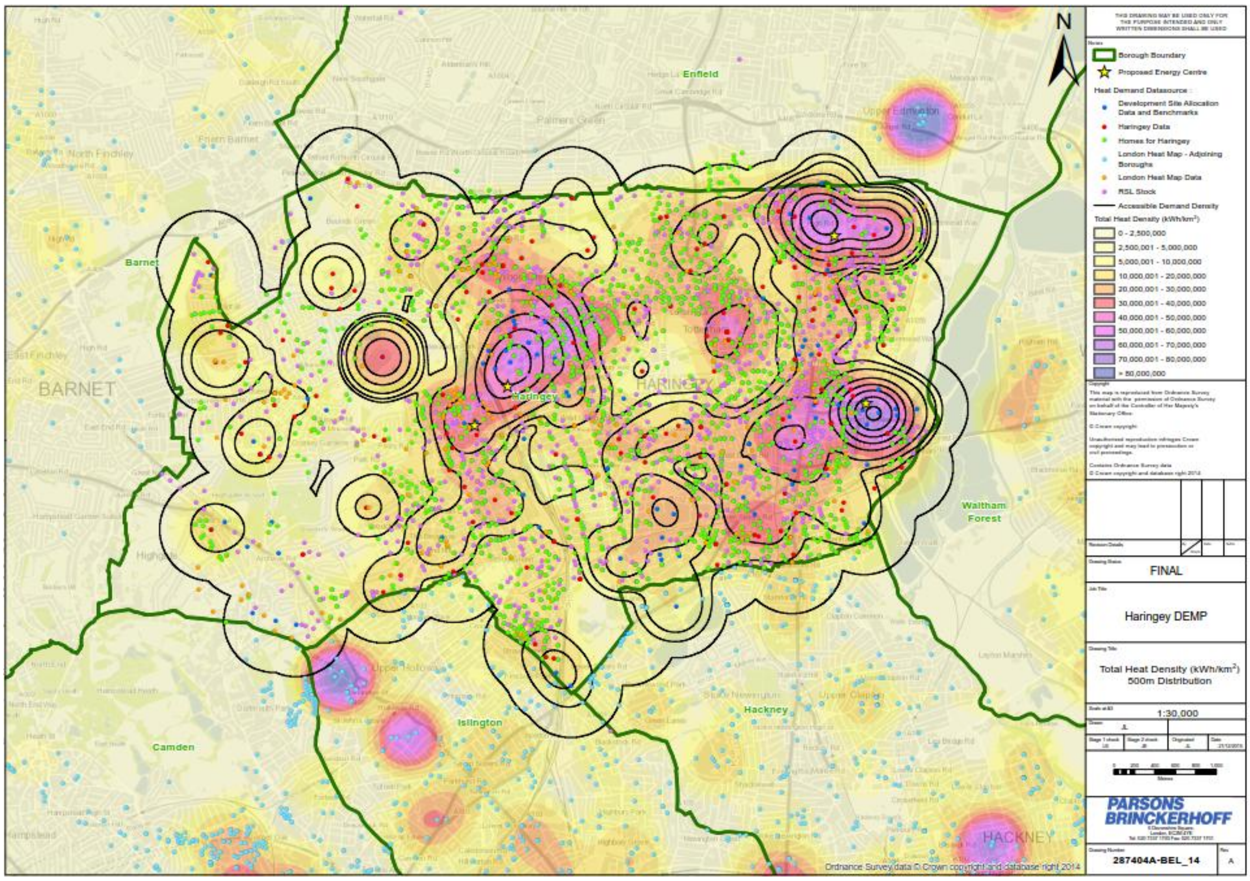
1.5.1 A qualitative assessment of energy supply technologies for the scale and timing of scheme emergence leads to the recommendation that in the current environment, gas-fired CHP is the most suitable and proven technology for early DEN scheme implementation. However, Haringey's Strategic Policy SP4 requires housing coming forward from 2016, and non-domestic sites from 2019 to be 'zero carbon'. Given the current Government's abolition of 'zero carbon homes' and of the 'Code for Sustainable Homes', the form in which further environmental improvements will be implemented is as yet unformulated. Whilst these particular routes to decarbonisation have been discontinued, the overall regional and borough targets for emissions reductions and the global need for action has not diminished, and a step change continues to be needed in energy supply solutions (as well as other areas) to meet these targets. The only technologies with sufficient carbon-saving potential to make significant contribution towards this aspiration are renewable-fuelled CHP units – i.e. biofuel CHP engines. However, both supply chains for these fuels and the conversion technologies are still in the development stage.

1.5.2 With decarbonisation of the grid, there will be a tipping point in a medium-term timeframe at which efficient heat-pumps operating in conjunction with low-temperature heat distribution networks deliver greater carbon savings than gas-fired CHP. However, heat pumps will never deliver entirely carbon-free heat, which is the case with renewable CHP. The recommended strategy for Haringey, therefore, is to develop the key *enabling* technology that is district energy infrastructure, and to plan for a mix of gas-fired CHP and heat pumps in the short and medium terms, with a view to moving toward renewable-fuelled CHP generation in the longer-term. The speed of this implementation must be based upon a view of the maturity of renewable-fuel CHP technologies (and their supply chains) and the rate of decarbonisation of the grid.

1.6 Scheme selection

1.6.1 The selection of schemes for the implementation of decentralised energy has been conducted on the basis of a combined analysis of heat load densities from all identified buildings, and analysis of new-build and Haringey-controlled heat demand densities. The confluence of high-density areas of these two parameters indicates where both there is a significant technical potential (total density) and accessible potential (new build and Haringey-controlled). The following chart illustrates the output of this heat density analysis:

Figure 1-2 Heat density analysis (total and accessible demand)



1.6.2 A second level of analysis has then involved the identification and analysis of kick-start networks within these areas that could catalyse the development of heat infrastructure in the borough.

1.6.3 The four networks identified for economic analysis were:

Table 1-1 Kickstart network summary

Network	Plant size (CHP kWe)	Number of connections[1]	Length of kick-start network[2] (m)
Northumberland Park	2 no. 1,560kWe	5	1,800
Wood Green	1,560kWe	7	1,269
Tottenham Hale	1,560kWe	5	574
Hornsey	600kWe	6	384

1.7 Economic analysis

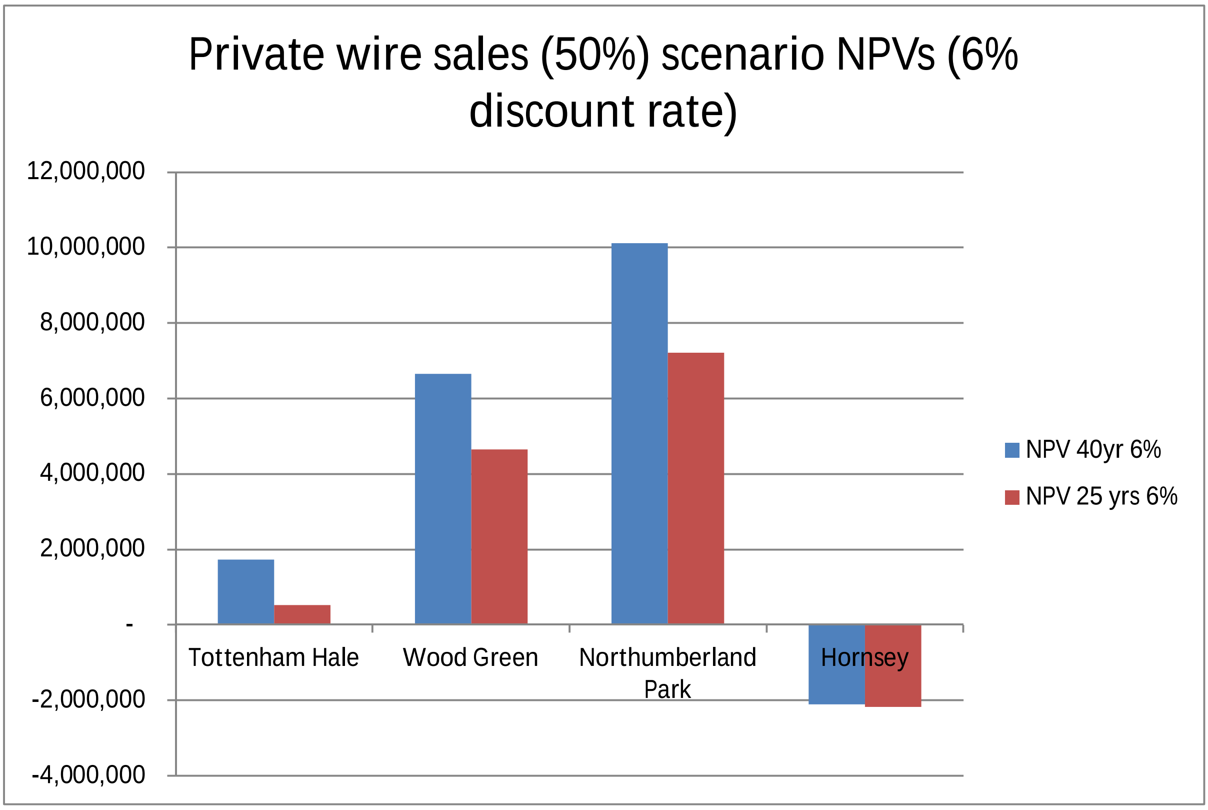
1.7.1 This study only illustrates economic outputs at a high level, and can only be broadly indicative of overall likely performance. More detailed business and feasibility work will be required to establish robust financial models for these schemes. The outputs of this study are used primarily on a *comparative* basis in this study.

1.7.2 Kick-start networks have been identified and economic analysis has been undertaken for these schemes. The kick-start schemes have been analysed under an 'export-only' scenario, and also a 'private-wire' power sales scenario. The private wire sales results are illustrated here:

:

[1] NB this figure only includes connections of a single energy centre on development sites
[2] NB this figure does not include the length of distribution pipework required within development plots – this only represents the district heating pipework required to link the energy centres / plant rooms of the different development sites.

Figure 1-3 Private wire sales, kick-start networks, NPV, 6% discount rate

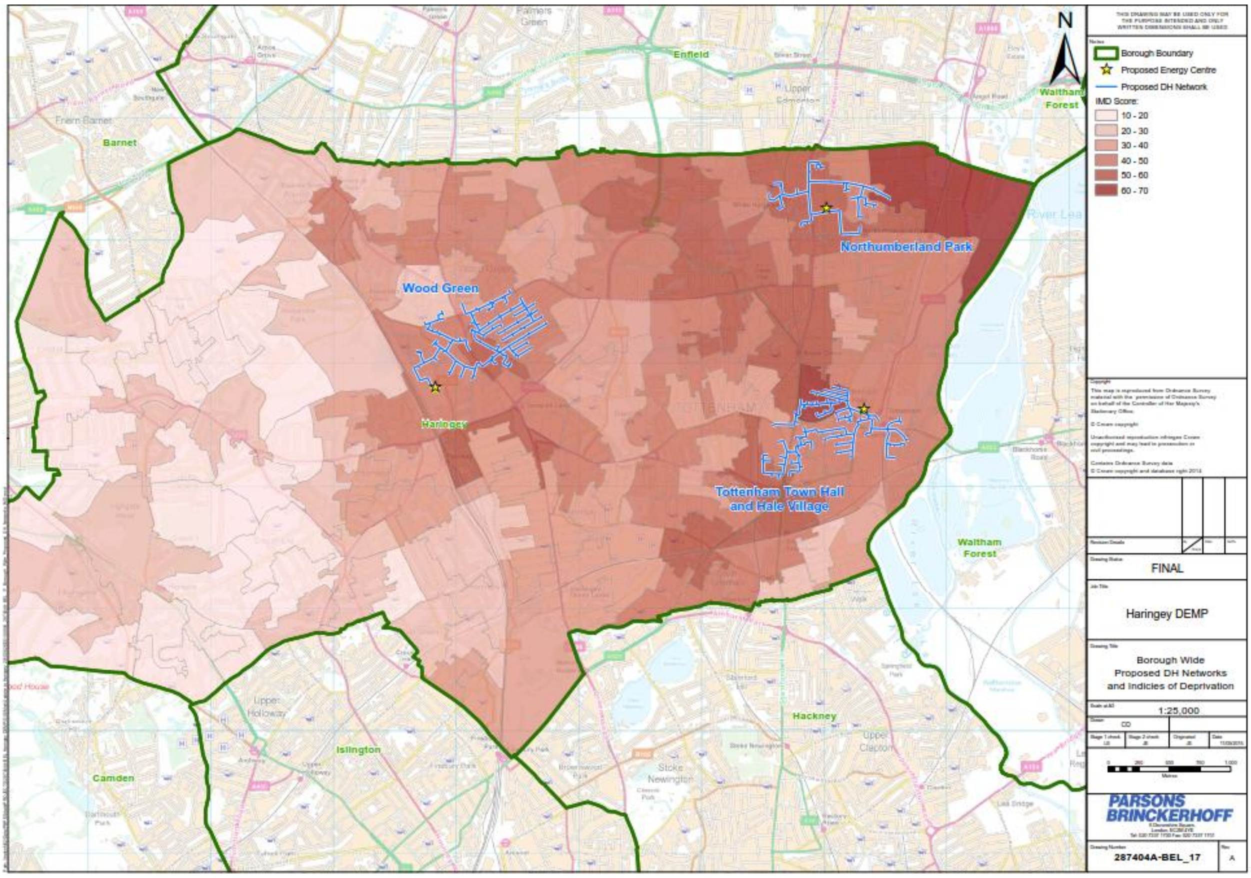


1.7.3 This illustrates the positive performance of the Wood Green, Northumberland Park, and Tottenham Hale schemes under this analysis.

1.8 Social objectives

1.8.1 The location of the proposed DENs has been mapped against fuel poverty and multiple deprivation indices (IMD) in order to indicate which schemes are likely to have the potential to deliver most positive social impact. The following figure illustrates DEN locations and a combined index of multiple deprivation (darker colours represent more deprived areas).

Figure 1-4 Proposed extended (long-term) networks and IMD bands



1.8.2 This IMD figure illustrates that the schemes in the eastern part of the borough (and Northumberland Park and Tottenham Hale in particular) should be pursued more vigorously on social grounds.

1.9 Carbon results

1.9.1 Haringey has carbon reduction targets for 2020[3] and 2025 (by extension from London-wide targets), and a general duty to enable emissions reductions and minimise the likely climate change impacts of anthropogenic emissions. By these dates, gas-fired CHP units installed at assumed scheme inception dates would not have yet reached the end of their useful lives. Therefore the carbon savings calculated to be delivered by each scheme in 2025, as illustrated in the table[4] below, are based around gas-fired CHP technology:

[3] Haringey 40:20

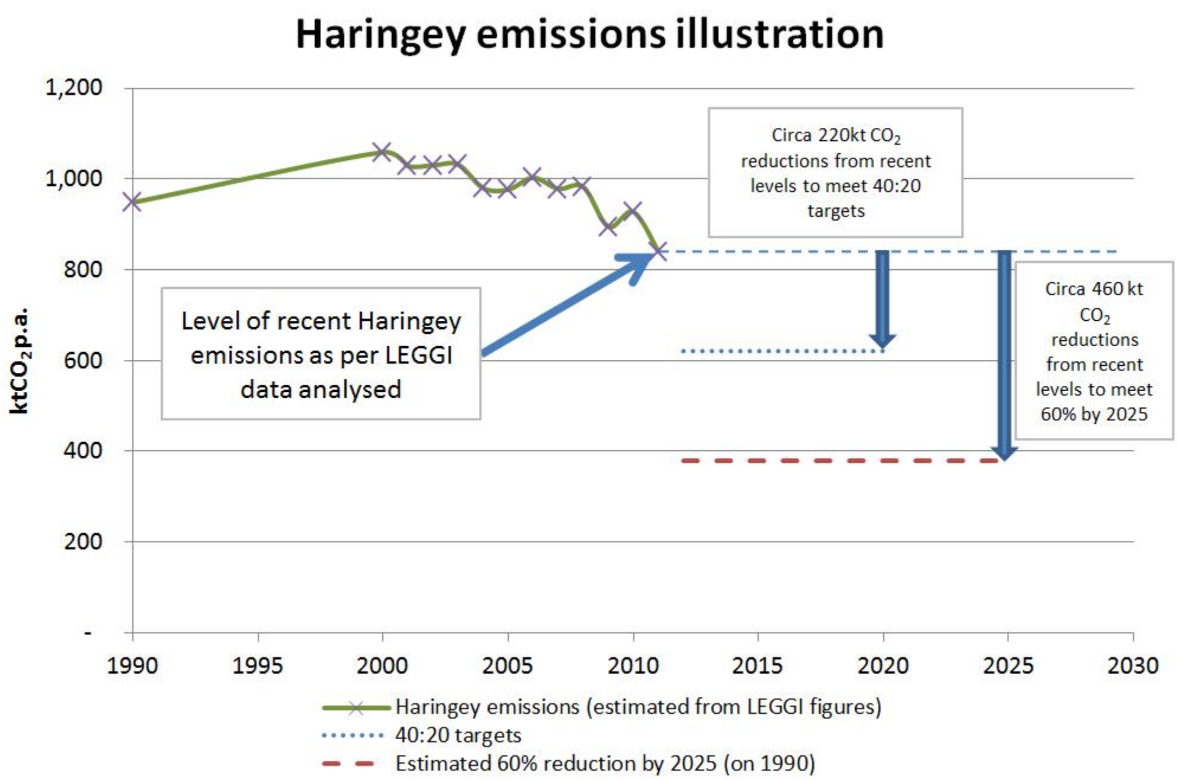
[4] Please note that these carbon savings figures do not take grid decarbonisation into account, and are based against a gas boiler, grid import counterfactual..

Table 1-2 Carbon savings projected in 2025

	Carbon savings tonnes (CO_2) p.a. (2025)
Tottenham Hale	1,908
Wood Green	2,059
Northumberland Park	4,207
Total	8,174

1.9.2 This table can be compared with the following emissions reductions required by Haringey under its commitments under the 40:20 pledge and an extrapolation of its contribution towards the delivery of carbon savings for London.

Figure 1-5 Haringey emissions and projected carbon emissions reductions required



1.9.3 This graph shows that annual carbon dioxide emissions reductions of somewhere in the region of 400ktCO_2 p.a. will be required by 2025 from now. An exact figure cannot be cited as there is 'lag' in the data and it is not clear exactly where emissions levels are currently.

1.9.4 However, a comparison of this target figure and the annual projected potential emissions reductions across all of the DENs illustrates that the DENs are only likely to be able to make a minor contribution to emissions savings (approx. 3.5% of the target reduction). This is not to dismiss the impact of these reductions, because as noted above, this initial phase is principally an *enabling* phase, to unlock the potential for future carbon savings to be delivered highly efficiently through development of primary heat sources.

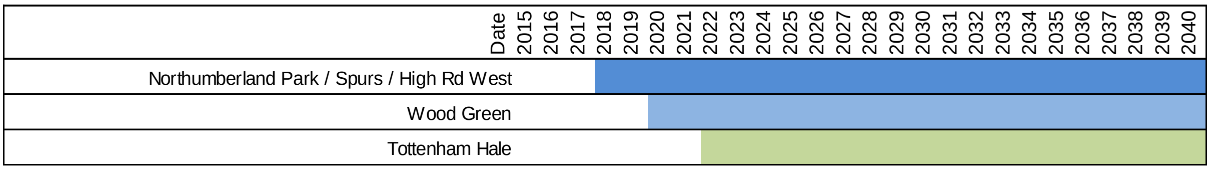
1.10 Recommendations

1.10.1 Scheme delivery

1.10.2 This analysis, including attention to the anticipated emergence of new developments (which form the majority of the key loads for the kick-start schemes), gives rise to the following recommended programme of delivery of the kick-start networks.

1.10.3 The programme is based on a number of factors – not least of which is the need to deliver a successful project as a first phase in the wider programme. On this basis both scale, demand density and composition will all play a role.

Figure 1-6 Proposed delivery programme



1.10.4 The first priority for Haringey should be the development of the centralised heat supply infrastructure on the Spurs stadium / High Road West / Brook House / Northumberland Park Estate area. Given the imminent emergence of the Spurs site in particular, this should take the form of initial supply from CHP, with a view to facilitating the connection of the Lee Valley Heat Network (LVHN) to the area, and enable this sub-regional network to unlock carbon savings in existing properties both in Haringey and Enfield. This scheme is one of the earlier anticipated to emerge, with works on the Spurs site already on-going. At the same time, the structures of the LVHN are solidifying, and it should be possible to form a view on potential delivery structures and the preferred long-term approach for the area in the near future.

1.10.5 The second priority area for DEN implementation should be Wood Green. There is understood to be currently momentum in the property market. An energy centre site should be identified for this scheme through discussions with developers. This report has identified a site (as a basis for modelling a network), but other development sites could equally perform this function, and this report does not seek to identify any particular development as a preferred location. A further key approach for this area must be to ensure that in any pre-app discussions developers are made aware of this potential network and are required to take it into account as the design progresses.

1.10.6 The third priority area for DEN development is recommended to be the Tottenham Hale area. Some development in this area is anticipated to emerge relatively early, and the proximity of Hale Village, Hale Wharf, the Retail Park site, and Ashley Road, inter alia, make this a key area for DEN expansion. The existing Hale Village development has its own low carbon heat supply plant without sufficient physical space or capacity to serve the peak demands of a wider area. However, Haringey are encouraged to explore innovative arrangements for catalysing DH in this area, whereby the utilisation levels of the Tottenham Hale plant could be increased in the summer / shoulder seasons, in order to provide cost-effective heat to the area. One such innovative arrangement would be the installation and operation of heat distribution pipework infrastructure in this area (linking to Tottenham Green, for example) and recouping costs on the basis of heat distribution charges, and with the use of substantial thermal storage. Initial network focus should be to deliver future-proofed infrastructure around the Tottenham Hale station area.

1.10.7 It is recommended that the other networks identified in the borough are prioritised at later dates. It appears unlikely that a network in Highgate or Hornsey will be viable on the basis of the existing loads / development plans, and hence these areas should be reviewed only when significant additional development emerges in this area. Broadwater Farm should be investigated as a location for a DH scheme in its own right, and as a potential 'stepping stone' for wider area networks, but this must be reassessed when regeneration plans for this estate come forward, and when other networks have developed. Further opportunities may also arise within the St Ann's Hospital site area and surrounds, and hence this zone, and potential connectivity to both the Tottenham Green area and Woodberry Down (Hackney) should also be reviewed when significant sites come forward.

1.10.8 Other actions

1.10.9 For all significant scale applications and refurbishments in DEN areas, policy should be developed and implemented to require low temperature heat emitters (i.e. those delivering low return temperatures to an energy centre) to be used. This will facilitate future shifts to efficient heat recovery systems (either CHP-based DH, or secondary-source heat recovery with heat pumps) and should generally be implementable at little or no extra cost to developers if they are made aware of this stipulation from the outset. It is recommended that Haringey adopts the technical standards for district heating as outlined within the District Heating Manual for London[5] (DHMfL). This should be implemented as a general requirement that will ensure compatibility between projects within Haringey and other cross-borough-boundary schemes as they emerge, and will also assist the development of standardised skills and products in the market to match these standards. However, at the same time, local networks will also need to reflect the operating conditions of wider systems such as the Lee Valley Heat Network, and ensure that design compatibility is maintained in instances where integration with an extant wider system is foreseen.

1.10.10 The following planning policy recommendations are made for emerging policy documents:

- Inclusion of technical standards as per the DHMfL.
- Providing geographic zones where there is a clear expectation on developers to connect to DENs
- Providing a threshold distance to networks or DEN zones for different development scales where there is a clear expectation of connection
- Clarifying the expectation on developers for interim periods where networks are expected to emerge
- Considering inclusion of a carbon offset fund to ensure that developments not coming forward in DEN priority areas also contribute to carbon emissions reductions in the borough

[5] http://www.londonheatmap.org.uk/Content/uploaded/documents/DH_Manual_for_London_February_2013_v1.0.pdf, accessed 7th Oct 2015

- Providing clarity on the demarcation between CIL funding of main spines of networks and S106 agreements which may seek contributions towards final connection elements of network costs.

- Requiring DH scheme operators in the borough to participate in the 'Heat Trust' scheme[6] to protect consumers.

1.10.11 It is also recommended that with the implementation of these policies, Haringey maintain a geo-spatial database of 'DEN-compatible' properties, which can be passed to developers to assist in the assessment of DEN viability as each new site comes forward.

1.11 Next steps

1.11.1 The key next steps for the borough are:

- The implementation of spatially specific planning policy with clear guidance on DE for developers, including technical standards for DH networks

- The continued progression of the Northumberland Park scheme in terms of a preferred technical solution and delivery vehicle

- Setting up a geo-spatial database of DEN-compatible properties

[6] http://www.heattrust.org/index.php/about, accessed 6th October 2015.

SECTION 2

INTRODUCTION

2 INTRODUCTION

2.1 Aims and scope

2.1.1 Parsons Brinckerhoff was appointed by the London Borough of Haringey to establish an Energy Master Plan (EMP) based on the provision of decentralised energy (DE) networks within the borough. The work is driven both by the Council's aim of achieving a 40% reduction in carbon emissions over 2005 levels by 2020 and by the imperative to address fuel poverty, improve energy security and support inward investment and regeneration in the area.

2.1.2 The project brief for this commission contains the following key outcomes:

- *High-level feasibility assessment for the energy supply infrastructure within each DE opportunity area and expansion of DE scheme. To culminate in plans to take forward each preferred solution, including a roadmap of delivery timescales and milestones.*
- *A suite of communications media aimed at stakeholders, setting out details of each preferred solution*
- *A summary of key themes occurring across feasibility assessments*
- *Review of existing/ proposed planning policy frameworks to identify gaps in requirements for delivering a low carbon grid*
- *Identification of enablers and barriers to developing new planning policy framework supporting a low carbon grid, and recommendations on how to fast-track enablers/ lift barriers*
- *Provide recommendations on how the council can embed policies within its planning operations.*

2.2 Project Rationale

2.2.1 The policy summary above contains the following headline targets:

- The Climate Change Act 2008: UK's legally binding target of an 80% carbon emission reduction by 2050 on a 1990 baseline
- The London Mayor's target of achieving a 60% reduction on a 1990 baseline by 2025, and for 25% of energy to be supplied by decentralised energy
- The Haringey 40:20 pledge to reduce emissions by 40% by 2020 over a 2005 baseline.

2.2.2 Emissions for 2011 for the 33 London boroughs are set out within the *London Energy and Greenhouse Gas Inventory 2011* (LEGGI 2011)[7]. The document also sets out overall London emissions going back to baseline 1990 levels.

2.2.3 As well as the headline emissions reduction target for London of a 60% reduction in emissions based on 1990 levels by 2025[8] there are also interim targets; these are summarised in the table below:

[7] http://data.london.gov.uk/datastore/package/leggi-2011
[8] https://www.london.gov.uk/sites/default/files/Energy-future-oct11-exec-summ.pdf

Table 2-1 GLA emissions reduction targets

Target year	Target CO_2 emissions reduction on 1990 levels
2015 (interim target)	20 per cent
2020 (interim target)	40 per cent
2025	60 per cent
2050	At least 80 per cent

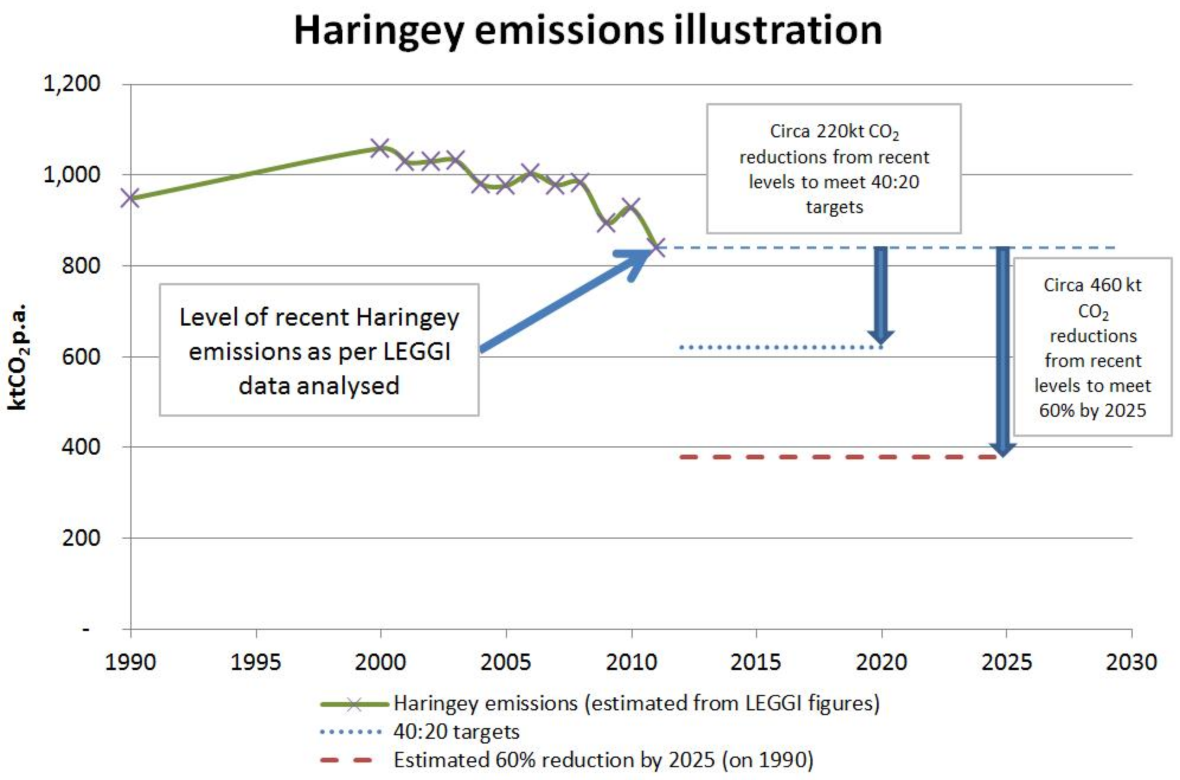
2.2.4 An estimation of the reductions which need to be achieved within the borough of Haringey is set out in the following table:

Table 2-2 Estimated required Haringey emission reductions

2011 Haringey levels	840	ktonnes CO_2
2011 total London emissions	39,905	ktonnes CO_2
% emissions from Haringey	2.1%	
London		
Overall London 1990 levels	45,054	ktonnes CO_2
60% reduction by 2025	18,022	ktonnes CO_2
Haringey		
Haringey estimated 1990 levels	948	ktonnes CO_2
40% reduction by 2020	569	ktonnes CO_2
60% reduction by 2025	379	ktonnes CO_2

2.2.5 The Haringey target in comparison to its approximate baseline emissions is shown on the chart below:

Figure 2-1 Haringey emissions reduction targets



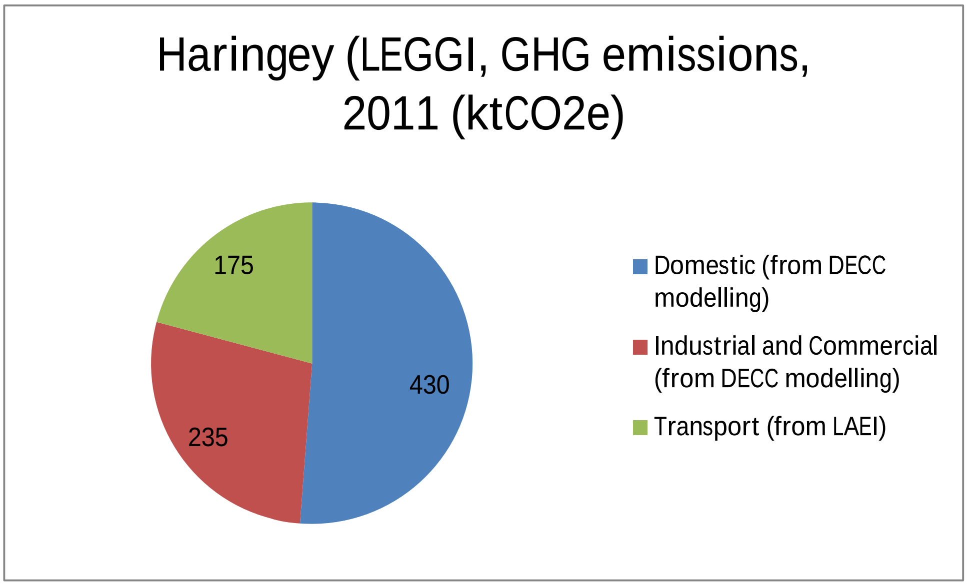
2.2.6 The table above and this graph illustrate that a significant reduction in emissions is required over the next 10 years, under both the 40:20 target and the London Plan targets.

2.2.7 There are a number of implicit assumptions in this projection i.e. that emissions reductions will be shared out ‘equally’ between the boroughs (i.e. in line with current emissions levels).

2.2.8 This report considers a 40-year timescale in terms of the roll-out of decentralised energy, albeit the development horizon is such that little is known about schemes that will come forward beyond the next 15 years or so.

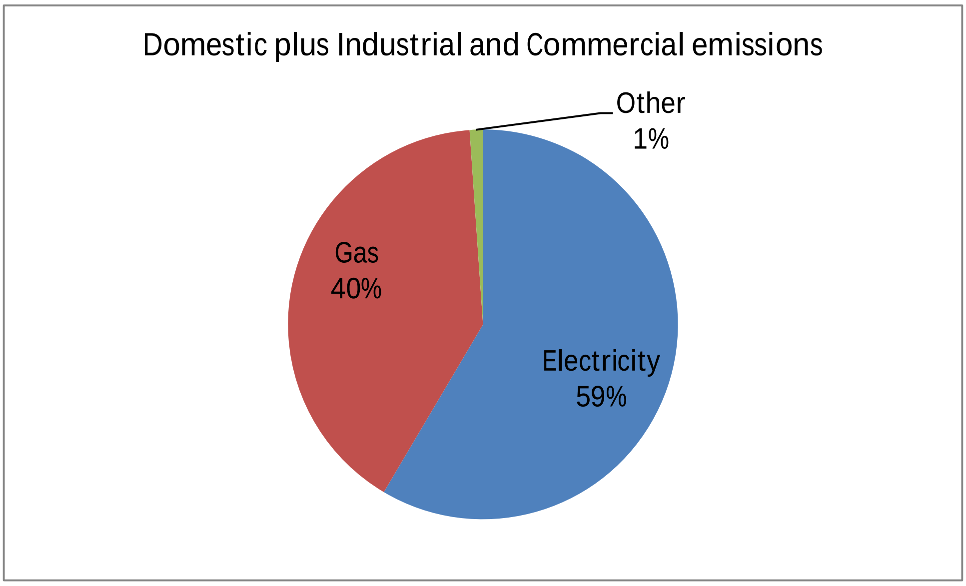
2.2.9 Emissions within the borough can be broken down as follows:

Figure 2-2 Emissions by sectors



2.2.10 It is also interesting to note that within the two sectors that this report addresses (i.e. Domestic' and 'Industrial and Commercial'), the following breakdown in emissions applies:

Figure 2-3 Emissions by source for Haringey (Leggi, 2011)



2.2.11 The two figures above of emissions by sector and fuel type frame this commission in terms of what could be possible on a borough-wide scale. It can be inferred from these two charts that even if the entire emissions from gas from the domestic and industrial and commercial sectors were reduced to zero, then this would achieve an overall reduction in emissions of 32%. However, a DEN is unlikely either to reduce emissions to zero, nor can it achieve 100% coverage of the borough in the terms of this study. This means that additional measures will be required in order to meet emissions targets. This could include efforts to improve the energy efficiency of the existing building stock, decarbonisation of the electricity grid, and reductions in emissions from vehicles within the borough. This illustrates the magnitude of the challenge.

2.2.12 Infrastructure needs

2.2.13 The London Infrastructure Plan9 (2015 – 2050) has highlighted that the capital is a large consumer of electricity and the geographic imbalance between the main sources of generation in the UK (mostly towards the north of England and in Scotland) is putting strain upon the distribution infrastructure at both a national and local level. Distributed energy has the potential to help alleviate these problems and should therefore be seen as a part of the required approach towards delivery of London's energy needs.

[9] https://www.london.gov.uk/priorities/business-economy/vision-and-strategy/infrastructure-plan-2050, accessed 7th Oct 2015

SECTION 3

ENERGY DEMANDS

3 ENERGY DEMANDS

3.1 Energy demand mapping principles

3.1.1 In order to build a profile of the demands within the Borough (and beyond), the heat demands of both existing buildings and proposed developments were mapped.

3.1.2 The following data sources were used to determine the demands of existing buildings which could be candidates for connection to a future district heating network:

- Gas consumption data for council-owned non-residential buildings and communally-heated social housing over the last three years.
- Data on council-owned social housing and residential social landlord housing
- London heat map data

3.1.3 This data was prioritised in the order listed above, in order to allow the best data to take precedence.

3.1.4 Information about future developments was obtained from the data provided by Haringey Council and Haringey Site Allocations DPD document[10], and from latest development data as provided to Parsons Brinckerhoff. Where available, further details were obtained from information provided on the Haringey planning portal.

3.1.5 The Haringey Site Allocations document is written at a fairly high level, with key information provided being development date within a five-year range (two ranges are provided between 2015 and 2025) and proposed development area by use type.

3.2 Domestic Benchmarks

3.2.1 It should be noted that the Code for Sustainable Homes was withdrawn on 27th March 2015[11].

3.2.2 In light of the Code for Sustainable Homes regulation withdrawn, a new set of domestic benchmarks have been developed after discussions with LBH. They are as below:

[10] http://www.haringey.gov.uk/site-allocations-dpd.htm
[11] https://www.gov.uk/government/publications/2010-to-2015-government-policy-energy-efficiency-in-buildings/2010-to-2015-government-policy-energy-efficiency-in-buildings#appendix-7-code-for-sustainable-homes

Table 3-1 Benchmarks for new domestic dwellings

			Note
Assumed dwelling area	70	m^2	
Energy benchmarks:			
For construction period 2015-2020	41.2	kWh/m^2/yr	Space heating only
For construction period 2020-2025	28.8	kWh/m^2/yr	Space heating only
For construction period 2025-2030	27.4	kWh/m^2/yr	Space heating only
DHW demand	1620	kWh/yr	SAP calculation methodology
Electrical demand (pumps, fans and fixed lighting)	543	kWh/yr	Based on previous project data

3.3 Non Domestic Benchmarks

3.3.1 Demands for commercial properties were based on CIBSE Guide TM:46 2006 benchmarks, with reductions applied to these ‘raw’ national figures to account for the greater proportion of multi-storey buildings in London, compared with the national figures represented by TM:46.

Table 3-2 Non-domestic benchmarks (existing, as basis for predicting future development demand)

Use type	Total Heat demand (kWh/m^2/year) – TM46 2006 benchmarks	Total Heat Demand after accounting for London reduction of 15% (kWh/m^2/year)	Percentage demand attributable to space heating	Electricity Benchmarks (kWh/m^2/year)
General office	96	88	55%	95
General retail	84	77	55%	165
Restaurant	296	283	30%	90
Cultural activities	160	147	55%	70
Community facilities	120	110	55%	40
General Industrial	144	132	55%	35

3.3.2 The non-domestic buildings in the Haringey area have been classified as either ‘Employment’, ‘Town Centre’ or ‘Others’. This is to be in accordance with the data given by Haringey Council. The classifications of each of these types of buildings are as shown in the table below:

Table 3-3 Non-domestic benchmarks (for mixed use typologies)

Type	Demand Figure Combinations	Heat demand ($kWh/m^2/year$)	% demand attributable to space heating	London Benchmark ($kWh/m^2/yr$)	Electricity benchmarks ($kWh/m^2/yr$)
Employment	General Office	96	55%	88	95
Town Centre	25% of General Office + 50% of General Retail + 50% of Restaurant demand figures	164	44%	153	153
Other	25% of Cultural activities + 50% of Community facilities + 50% of General Industrial	176	55%	161	64

3.4 Tightening of fabric standards

3.4.1 The following fabric standards are assumed to apply for developments coming forward (NB this takes account of potential delays between planning permissions dates and construction dates – i.e. sites will come forward to construction under 'earlier' planning policies):

Table 3-4: Tightening of fabric energy efficiency standards

Date	Non-domestic buildings[12]
2015-2020	15% London reduction in space heating 43% reduction in space heating energy demand over 2006 (TM46) benchmarks.
2020-2025	15% London reduction in space heating 60% reduction in space heating energy demand over 2006 (TM46) benchmarks.
2025-2030	15% London reduction in space heating 62% reduction in space heating energy demand over 2006 (TM46) benchmarks.

[12] These are indicative reductions in space heating requirements – overall compliance with Building Regulations would in practice be achieved through different balances of reductions in regulated electricity and heating requirements. These figures are indicative of anticipated demand reductions related to tightening of fabric and air-tightness standards in particular.

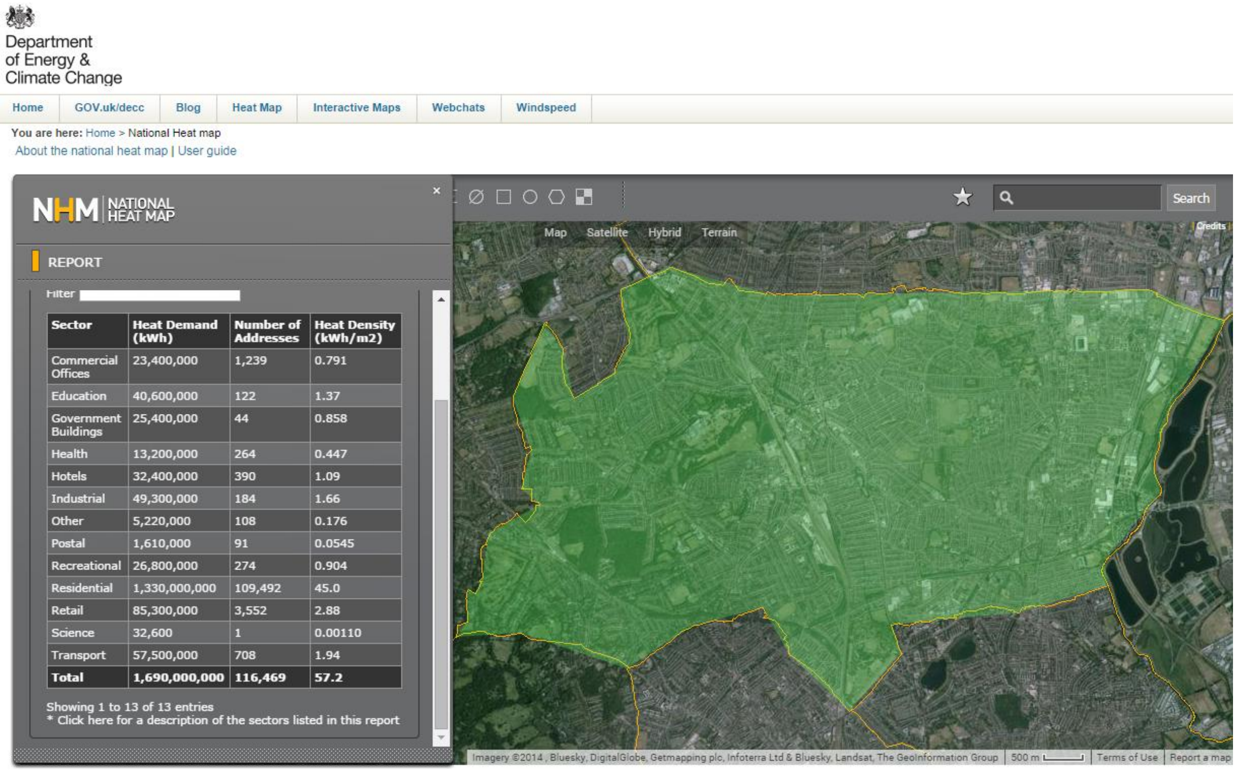
3.4.2 The heat demand used for residential and non-residential buildings are therefore as follows:

Table 3-5 Residential and non-residential summary benchmarks

	Residential (kWh/year)	Employment (kWh/m²/year)	Town Centre (kWh/m²/year)	Others (kWh/m²/year)
Heat Demand				
2015-2020	4,502	55	88	93
2020-2025	3,637	38	62	65
2025-2030	3,541	36	59	62
Electric Demand				
2015-2020	543	66	114	48
2020-2025	543	37	64	27
2025-2030	543	34	58	24

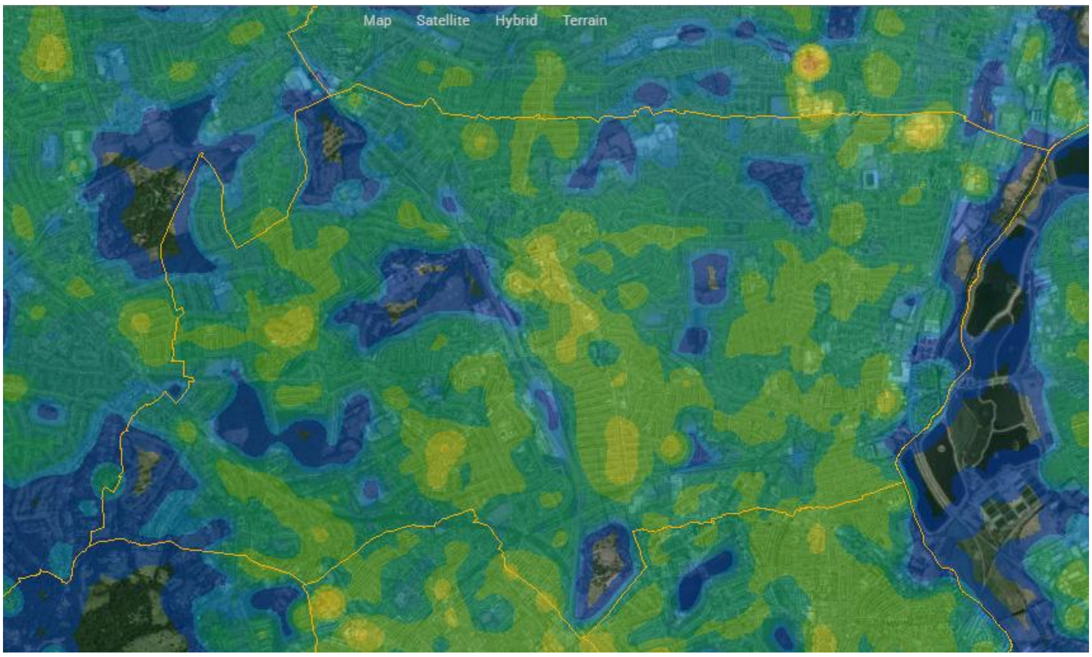
3.4.3 The following graphics illustrate the data available from the National Heat Map for the borough. These illustrations were used to reference the demands identified through other means.

Figure 3-1: National heat map output report



Sector	Heat Demand (kWh)	Number of Addresses	Heat Density (kWh/m2)
Commercial Offices	23,400,000	1,239	0.791
Education	40,600,000	122	1.37
Government Buildings	25,400,000	44	0.858
Health	13,200,000	264	0.447
Hotels	32,400,000	390	1.09
Industrial	49,300,000	184	1.66
Other	5,220,000	108	0.176
Postal	1,610,000	91	0.0545
Recreational	26,800,000	274	0.904
Residential	1,330,000,000	109,492	45.0
Retail	85,300,000	3,552	2.88
Science	32,600	1	0.00110
Transport	57,500,000	708	1.94
Total	1,690,000,000	116,469	57.2

Figure 3-2: National heat map density contours

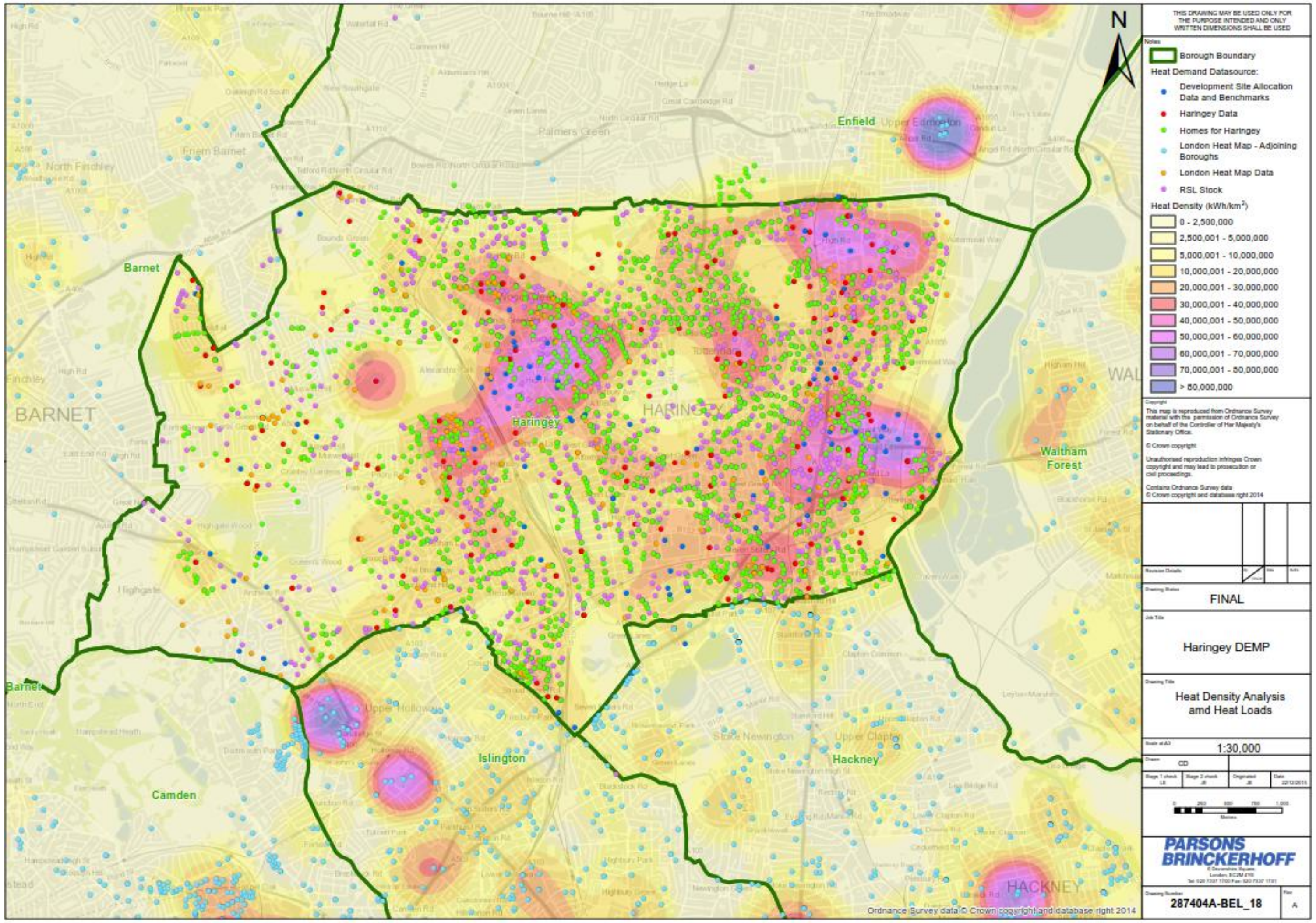


3.5 Heat mapping

3.5.1 Calculated heat demands were mapped geographically to identify clusters of high heat demand which could form the basis of viable heat networks.

3.5.2 A technique for analysing heat density, developed by Parsons Brinckerhoff, was used. For each load, an associated "area of influence" was used to identify neighbouring loads with the potential to link to form networks. An "area of influence" radius of 500m was used in analysis. The resultant contours, showing heat densities including all projected developments, are illustrated in the subsequent figure.

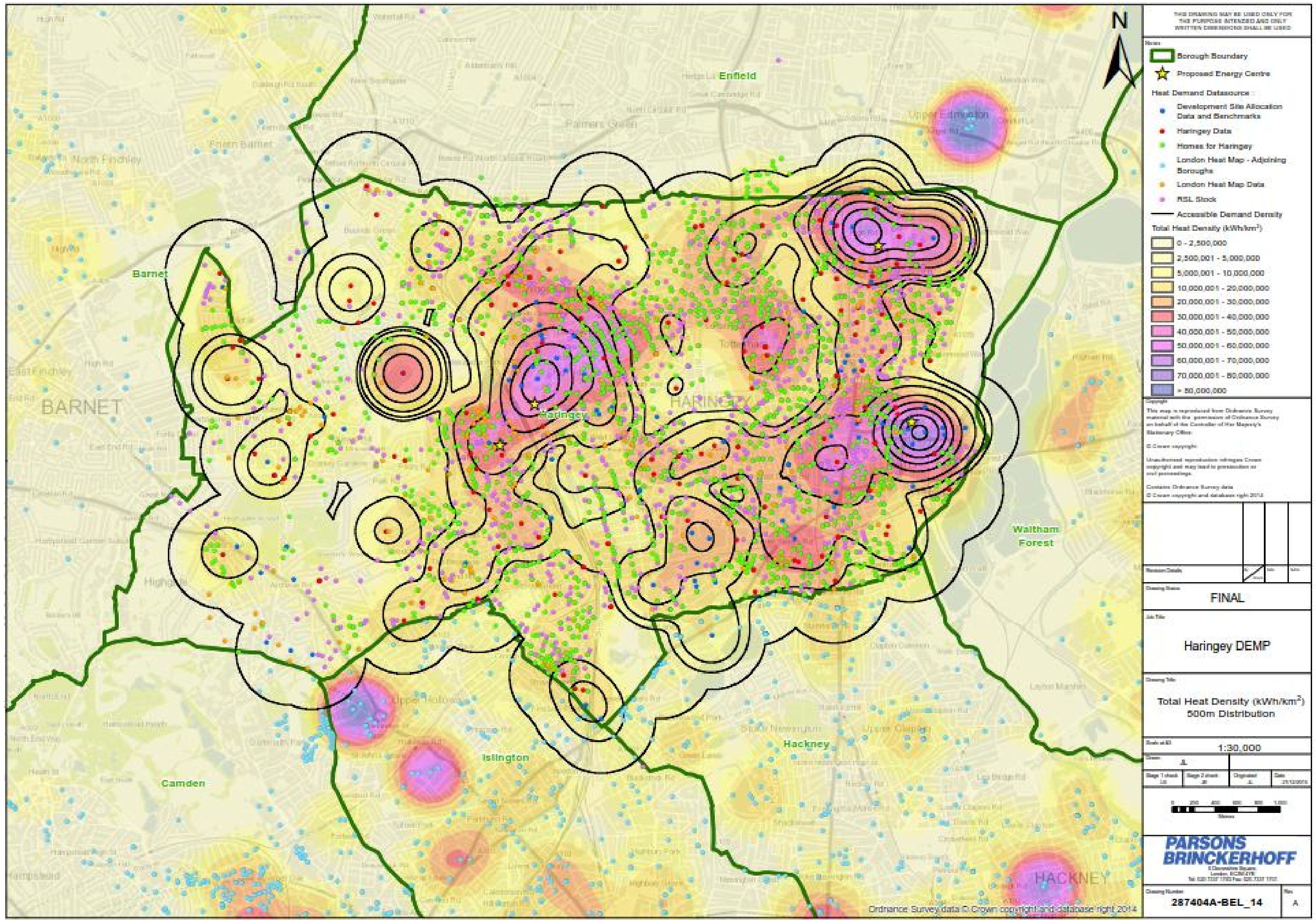
Figure 3-3: Existing and potential future heat demands: 500m area of influence



3.5.3 Heat networks within the borough of Haringey are most likely to be “kick-started” through new developments, and buildings within Haringey’s direct control. Regional and local policies require these to connect to, or have the ability to connect to, a district heating network in precedence over other individual solutions. In addition, new development is better able to install secondary systems– such as underfloor heating - that are more compatible with heat supply via district heating than traditional radiator systems (although it should be noted that the installation of insulation within existing buildings to reduce overall heat demands can allow existing systems to operate at lower temperatures).

3.5.4 In order to analyse the influence of new development on scheme selection potential, contours showing new development and Haringey controlled buildings were superimposed onto the maps. These are shown as contour lines on the map below:

Figure 3-4 Heat density and 'accessible' heat density



3.5.5 Following the production of maps, the following areas were identified as having the potential for the implementation of decentralised energy networks:

- Northumberland Park
- Tottenham Hale
- Hornsey
- Wood Green

3.5.6 These areas have both a high heat density and significant proportion of accessible demand (i.e new development or Haringey controlled buildings).

3.6 Heat load profiling

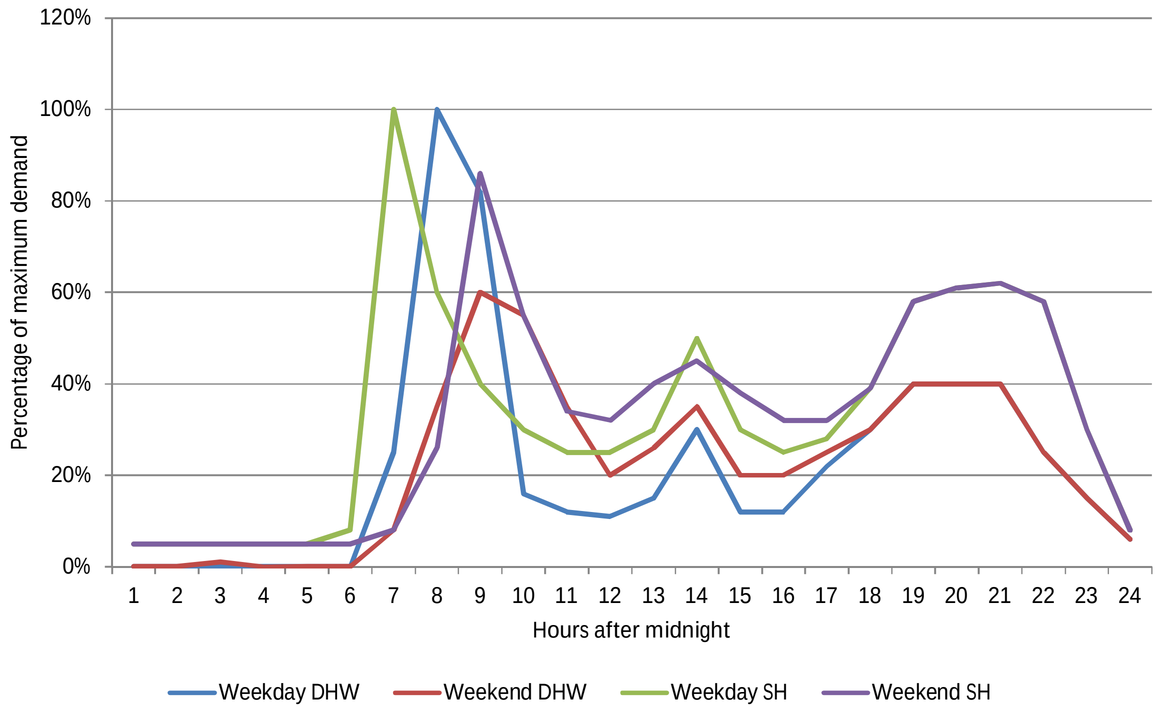
3.6.1 The heat demands used within the modelling described in section 3 above are in the form of a single annual figure (kWh/year). However, for the purposes of choosing a heat supply source and peripheral infrastructure to serve these loads an annual profile of hourly is useful.

3.6.2 Annual profiles were produced for each load using Parsons Brinckerhoff's bespoke load profiling tool. For each building use type, this splits annual demand between space heating and hot water requirements, allocating a diurnal demand profile to each. The diurnal hot water profile is assumed to be constant throughout the year. However, space heating demands are dependent upon external temperature, and heating is considered to be required once the external temperature drops below 15.5°C. This is modelled using a degree day series for London[13].

3.6.3 The figure below shows example heat demand profiles for an existing residential property.

[13] CIBSE Temperature Reference Year for London.

Figure 3-5: Heat demand profile – residential property



3.6.4 For developments with multiple use types (i.e. a split between residential and different commercial uses), an overall combined profile was generated. This was generated through weighting demand profiles for each constituent use type by heat demand.

3.6.5 The end output is an overall demand profile for each heat network reflecting the heat demand throughout the year.

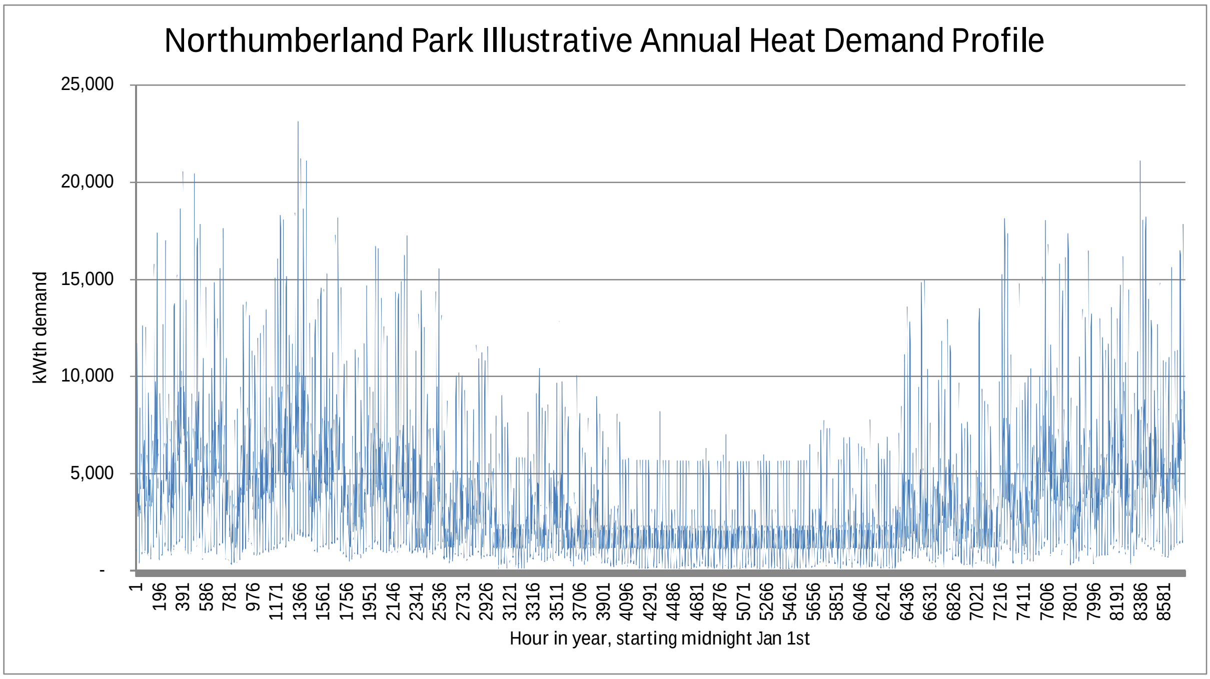
3.6.6 The overall heat demand and resultant annual profiles for the kick-start schemes taken forward are shown below. These are shown at full build-out.

Figure 3-6: Annual heat demand of proposed kick-start DH networks

Network name	Total annual heat demand (GWh)
Northumberland Park	31.3
Tottenham Hale	15.7
Hornsey	3.1
Wood Green	19.2

3.6.7 A single example of the development of these annual figures into a demand profile is included below on an annual basis. The other scheme profiles are included in the appendices to this document.

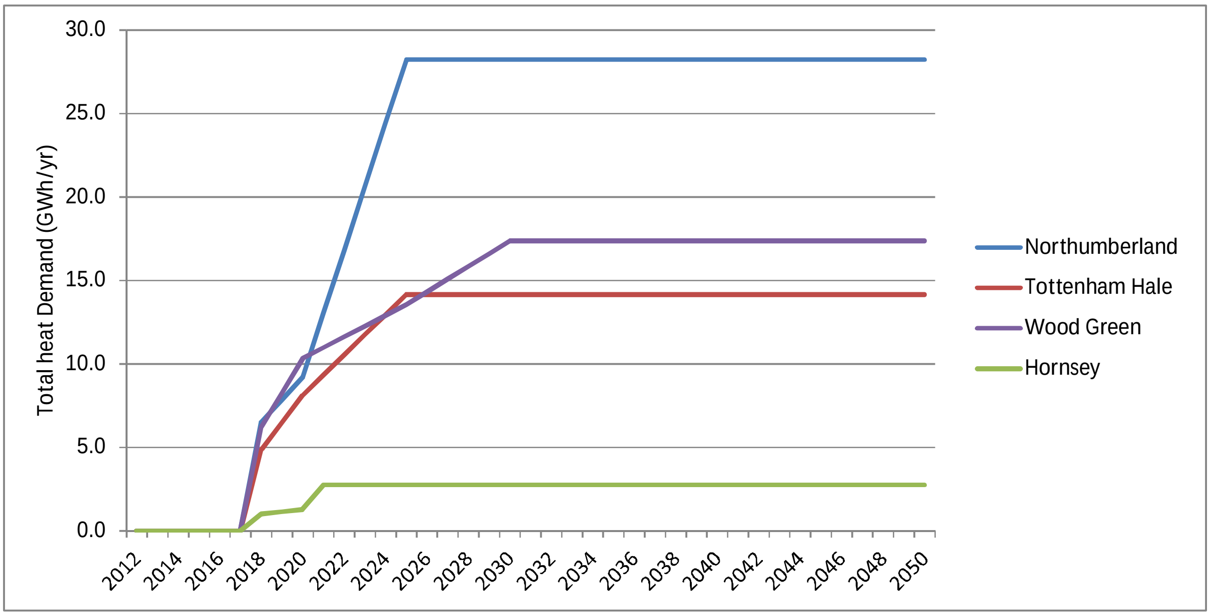
Figure 3-7: Northumberland Park annual profile



3.6.8 In terms of the implementation of heat networks, a key consideration will be the dates at which new developments are constructed and thus are able to be connected. Heat networks may not be viable until a certain critical mass of new development is able to be connected and take heat.

3.6.9 The graph below shows the development of heat demand over time for the networks (excluding network losses). This graph illustrates the assumed rate of connection of loads to the networks – which is also linked to the capital spend rate on the district heating network element of the project.

Figure 3-8: Phased development of kick-start network heat loads



3.6.10 It has been assumed that where applicable the connection rate of existing properties is linked to the new-development load connected to each system. The graph above also assumes that 2018 is the earliest date by which it is realistic to assume that heat demands could be connected to new networks.

SECTION 4

ENERGY SUPPLY

4 ENERGY SUPPLY

4.1.1 The use of a district heating system provides a high degree of flexibility in heat supply. Multiple heat sources can be used, supplying heat onto the network from different locations. In addition, because the heat network itself has a relatively long lifespan – in the region of 50 years - heat sources can be replaced as new technologies become available, effectively providing a strategic future proofing of supply.

4.1.2 This section comprises a summary of the possible heat sources (fuels and conversion technologies) which could be used to supply decentralised energy schemes within Haringey. As well as traditional heat sources, opportunities to use waste heat are also considered within this section.

4.2 Fuel options

4.2.1 Certain fuel streams are long-established and benefit from a mature infrastructure for delivery, whilst others are nascent. The following table highlights some outline considerations and prognoses:

Table 4-1 Primary heating fuels and anticipated development

Fuel [current conversion technologies and status]	Current status	Anticipated status in 2025	Anticipated status in 2050
Natural gas [boilers, CHP units, mature]	Mature, established supply chains and delivery routes	Continuation of status quo – prices predicted to remain relatively stable (see DECC projections, albeit this must be viewed with caution given recent volatility in prices)	Further continuation of status quo, albeit security of supply may decrease with an increase in imported gas required as indigenous reserves dwindle
Electricity (grid) [heat pumps (established), storage heating, electrode boiler DHW heating, mature]	Mature delivery mechanism. Short-term supply capacity concerns.	Stabilisation of grid supply capacity. Increasing proportions of renewable and low-carbon technologies to grid mix reducing carbon intensity of supply, anticipated significant price rises (see DECC projections)	Further reduction in carbon content of grid-supplied power with increasing renewable components and biomass fuel portions in large-scale power generation
Hydrogen [fuel cells, innovative, pilot projects]	Pilot / non-commercial innovation	Localised pilot distribution schemes	Hydrogen supply chains become more established in specific urban / industrial areas.
Liquid biofuels [Small numbers of pure plant oil units operational at larger scale in Europe, glycerol fuelled units (converted gas engine CHP units) at small scale, pilot projects in UK]	Biodiesel grades supply chains are established through a limited number of companies, typically supplying the transport sector, but the market is immature. Other fuels such as fuel-grade glycerol are nascent and limited.	Biodiesel supply will continue to require subsidy to be competitive with traditional fuels, and alternative biofuel (i.e. glycerol / PPO) supply chain will start to establish itself, but also continue to require subsidy to compete with natural gas.	Legislative pressures and fiscal measures are anticipated to push biofuel supply chains to become established, and increasingly competitive with the current ‘mature’ fuel streams.
Heat (supply from outside of Haringey) [direct supply, emerging]	Emerging via LVHN	LVHN established	Potential for growth of supply from both LVHN and from other boroughs – e.g. Hackney (Woodberry Down)

Fuel [current conversion technologies and status]	Current status	Anticipated status in 2025	Anticipated status in 2050
Secondary heat sources (see next section for further detail) [heat pumps, emerging]	Pilot, innovative schemes emerging for district heating applications	Small numbers of demonstration projects	Use of this heat source becomes commonplace and mature in terms of conversion technologies.
Municipal Solid Waste (MSW) / Refuse Derived Fuel (RDF) [large-scale boilers / steam cycles, mature]	Mature, established fuel source of power generation and in a number of cases heat recovery for district heating. Established chains for gathering and sorting waste streams	Continued growth in district heating applications as new facilities come under increasing pressure to make use of waste heat from power generation process based on waste	Utilising heat from waste incineration becomes the 'norm' and longer transmission systems to
Biogas [emerging as a fuel source for heat] [CHP units, mature (i.e. water industry, landfill)]	Considerable numbers of fuel sources, typically agricultural or landfill-based. Typically located away from urban centres	Continued growth in the agricultural sector with increasing volumes of biogas feeding into the natural gas distribution network	Biogas generation from both agricultural and food wastes used widely to feed into natural gas grid
Solid biomass [boilers, established; CHP, emerging]	Established, but not mature fuel chains	Increasingly competitive market in solid biomass supply stimulated by RHI, particularly in non-urban areas	Mature market anticipated for solid biomass,

4.3 Secondary heat sources

4.3.1 Secondary sources of heat, or sources of waste heat, are those which are either the by-product of a process, or are available from the environment. Typical sources of secondary heat are listed within the table below, together with comments on the availability of the heat sources within Haringey. Information on the resources available within the borough of Haringey has been obtained from the GLA's report *London's Zero Carbon Energy Resource: Secondary Heat, Report Phase 1*, January 2013[14].

14 https://www.london.gov.uk/sites/default/files/130220%20031250%20GLA%20Low%20Carbon%20Heat%20Study%20Report%20Phase%201%20-%20Rev01.pdf

Table 4-2 Secondary heat sources

Secondary heat source	Description	Relevance to Haringey	Magnitude of supply potential
Ground source (heat pumps)	Ground temperature remains at relatively stable temperatures throughout the year. Heat may be extracted using heat pumps.	This source of heat could be used within Haringey, although is more likely to be suited to smaller scale systems (i.e. heating individual buildings) rather than wider decentralised energy schemes, due to the number of boreholes required for larger schemes.	Huge – only limit is imposed by commercial viability and area of available land for heat extraction
Air source (heat pumps)	Heat may be extracted from outside air and its temperature raised using a heat pump	This technology may be used in Haringey, but again is more suited to individual buildings rather than wider district heating schemes. The amount of heat which can be extracted is proportional to air temperature, meaning that less heat can be extracted in winter, when demand is highest.	Huge – as for ground-source heat pumps, limits are predominantly commercial / behavioural / performance-related rather than technical capacity-related.
Reservoirs and watercourses (heat pumps)	Heat can be extracted from reservoirs and watercourses using heat pumps. A licence is required from the Environment Agency for the extraction / reinjection (discharge) of water	Haringey has significant reservoir capacity available in the reservoirs on its eastern borders. Water has a relatively high thermal capacity, meaning that significant quantities of heat can be extracted.	Significant – the reservoirs hold large reserves of energy, and the viable scale of implementation is likely to be limited by viable distribution systems rather than energy-source limits.
Power station rejection	Significant amounts of waste heat are rejected from conventional power stations.	There are no power stations within the borough. However, the Barking Power Station and the Edmonton EcoPark Energy from Waste facility could provide heat in the longer term. These are covered in more detail below.	No known resource within Haringey
Industrial waste heat rejection	Some industrial heat sources (e.g. chemical and food processing plants) produce relatively large amounts of waste heat. Availability varies significantly, however.	There are no known relevant process loads within Haringey, but recovery of heat from large facilities beyond Haringey's borders (particularly Enfield), may be possible.	No known resource within Haringey
Data centres / building cooling systems	Data centres and buildings with large cooling demands produce a	No data centres are mapped within the borough. Generally, the	No known resource within Haringey – but opportunities for

Secondary heat source	Description	Relevance to Haringey	Magnitude of supply potential
	significant amount of waste heat, which may be extracted using heat pumps.	location of commercial data centres is kept confidential, and we have not identified any locations as part of this study. However, large new office developments typically have some heat rejection requirement (albeit not well-matched to heating demands).	connection of neighbouring buildings with heat rejection and year-round heat demands should be targetted.
Water treatment works	Low temperature heat is released from bacterial activity on sewerage. Heat may be obtained from the treated sewage by passing it through a heat exchanger before discharge. As in the case of watercourses, heat pump is required.	There are no significant sewage treatment works within Haringey.	No known resource within Haringey
London Underground	Heat may be recovered either from stations themselves, or from mid-tunnel ventilation shafts using heat exchangers. Although the temperature within tunnels will vary throughout the year, it is generally higher than the surrounding air temperature.	There are seven tube stations located within the borough of Haringey together with ventilation shafts.	The heat source maps replicated within this report show five areas with a heat supply potential of up to 500MWh (assumed p.a.), corresponding to a notional total supply capacity of 2,500MWh p.a. within Haringey (see maps below)
UKPN / National Grid transformers	Large transformers are oil cooled, and heat extracted from this process can be used within district heating systems. Generally only transformers operating at voltages of 33/111kV and above would produce enough heat to make extraction worthwhile (estimated 300kW of heat)	The National Grid substation in Watermead Way could potentially be a source of heat for this area – relevant both for the Northumberland Park area and the neighbouring development of Meridian Water in Enfield.	The scale of this resource has not been identified as part of this study.
Sewer heat mining	Sewerage is generally at a higher temperature than surrounding groundwater, and heat can be extracted in a similar manner to a ground source heat pump.	There is some incursion of major trunk sewers into the borough, but in general the potential for this heat source is limited.	The heat source maps replicated within this report show eight areas with a heat supply potential corresponding to a notional total supply capacity of 28,750MWh p.a. within Haringey (Figure 9-4 Sewer heat ming mapFigure 9-4)[15]

[15] Supply potential figure derived through addition of potential supply in each MLSOA illustrated.

4.3.2 Benefits of using waste heat can be significant. These include:

- Reduced cost of heat compared to traditional sources
- Less reliance on a fossil-fuel market perceived to be volatile
- Potentially a source of very low carbon heat, as secondary heat is generally regarded as carbon neutral or very low carbon.

4.3.3 Under the 'ambitious' scenario outlined for 2050 in the Secondary Heat Sources report, the total available level of secondary heat in the borough is the second lowest in percentage terms of all the London boroughs[16]. However, in terms of absolute figures, the volume of heat demand that could be met by secondary sources identified in this study is still very large – 529GWh in Haringey. This is listed as representing approximately a quarter of the borough's heat demand.

4.3.4 However, there are some key considerations to waste heat recovery. Firstly, by its very definition waste (or secondary) heat is, in the vast majority of cases, of a low grade (compared to the temperatures required by typical heating systems), and this will need to be raised, using heat pumps, prior to use within a conventional district heating network. As such, it is best suited to low temperature networks – to reach higher temperatures more electrical input (to heat pumps) would be required which, under typical market conditions, would make operation uncompetitive with gas. As electricity is required to drive heat pumps, this technology will become more competitive with lower electricity prices and higher gas prices (i.e. allowing heat pumps to displace heat that would be generated by gas that is increasingly expensive). This is the opposite of the trend of utility prices that is currently widely predicted.

4.3.5 Secondly, efficient operation of a low temperature network requires the secondary systems installed within buildings to maximise heat transfer and thus minimise return temperature. This generally means the installation of large radiators or underfloor heating systems. This is considered best practice within district heating systems in general - maximising the temperature differential increases the amount of heat which can be transferred within a certain pipe size and reduces heat losses from the network, leading to greater efficiency and reduced costs. However, in view of this, such supply would be best suited to new buildings within the borough, where this technology could be installed from the outset, rather than in existing buildings where a potentially costly retrofit would be necessary. One potential strategy, therefore, would be for initially only new buildings to connect to the network, with existing buildings joining as, over time, installed technology is replaced and upgraded. However, this process is likely to be slow.

4.3.6 Thirdly, the use of waste heat lends itself best to a decarbonised grid, where the carbon content of the electricity used within heat pumps is low. At current carbon intensities, and typical heat pump efficiencies achievable for DH networks which need to serve existing heating system temperatures, only minimal carbon savings are typically achievable over a gas boiler alternative. Thus this technology is

16 https://www.london.gov.uk/sites/default/files/130220%20031250%20GLA%20Low%20Carbon%20Heat%20Study%20Report%20Phase%201%20-%20Rev01_0.pdf, Table 4-9: amount (MWh) and percentage of current heat demand met by secondary (low grade) sources of heat for each London borough sorted in order of percentage, Ambitious scenario, 2050, accessed 14th Nov 2014

recommended primarily as a solution to use in the longer term. However, high-temperature secondary sources, and the opportunity to use low-temperature networks would increase efficiency and improve savings.

4.3.7 Discussion of secondary heat sources is contained within the appendices of this report. A summary of key prognoses for the technologies is outlined below.

4.4 Key technologies

4.4.1 There are a few key energy supply technologies that are considered in the context of supply:

- Boilers –
  - Compatible with a variety of fuels (natural gas, liquid fuels, solid biomass) and a mature technology
- CHP engines / turbines
  - Compatible with multiple fuels at larger scale (i.e. > 2MWe), and mature at all scales with natural gas as a fuel
- Heat pumps
  - Electricity and a secondary heat source as energy inputs. An established technology at the domestic and small commercial scale, but little used currently at the district heating scale.
- Fuel Cells
  - Hydrogen as fuel (or natural gas with a reformer module as part of the fuel cell). Demonstration / innovative stage.

4.5 Summary of potential supply capacities by fuel and technology

4.5.1 The potential supply capacities assumed for Haringey of the various heat sources identified within the report London's Zero Carbon Energy Resource: Secondary Heat Report Phase 1[17] are not identified here. However, it is clear that only a relatively small proportion of this heat can be attributed to London Underground heat recovery, power station heat rejection, electrical substation recovery, industrial sources, water treatment works, or sewer heat mining. The remaining sources must therefore be the key sources identified for Haringey. These are:

- Ground source heat pumps
- Air source heat pumps
- River / reservoir source heat pumps

[17] London's Zero Carbon Energy Resource: Secondary Heat Report Phase 1 http://www.london.gov.uk/sites/default/files/130220%20031250%20GLA%20Low%20Carbon%20Heat%20Study%20Report%20Phase%201%20-%20Rev01_0.pdf

- Building cooling

4.5.2 Of these sources, the key local resource within Haringey that in PB's view should be pursued with most vigour is the use of reservoirs / waterways as a source of heat for heat pump technology. This could specifically be targeted at waterfront housing areas (i.e. Marsh Lane, Hale Wharf), but this should not preclude investigations of synergies with heat rejection from cooling systems in all areas of the borough.

4.5.3 Recovery of heat from water courses for use in heat pumps is not widespread, but has been employed on UK projects (e.g. Kingston Heights, Richmond), and has many other precedents in Europe (notably Drammen, Norway).

4.6 Kick start phases and future-proofing heat supply technologies

4.6.1 During the early phases of decentralised energy scheme provision within the borough (i.e. a time frame of around 10 to 15 years into the future), it is recommended that established, readily available technologies such as gas-fired CHP be installed. This would allow schemes to become operational quickly, especially within the regeneration areas in the borough. This recommendation is based upon the technology's market maturity, proven reliability and ability to deliver carbon savings over a gas-fired boiler option. This technology is also recommended in the context of the current price projections put forward by DECC, where the widening spark spread should lead to increasing economic competitiveness for gas-fired CHP – particularly for schemes with a private wire element.

4.6.2 It is strongly recommended, however, that the installed technology allows compatibility with future energy sources. To this end, the installed systems should:

- Operate at low return temperatures, in order to minimise heat losses on the network and allow future use of waste heat which would be provided at a lower grade
- Maximise the difference between network flow and return temperatures to minimise the diameter of pipework required to transfer heat, thus reducing cost (see the District Heating Manual for London guidance on temperatures).
- Potentially allow for the installation of renewable-fuelled CHP units. These are currently envisaged to be powered by glycerol or biodiesel.

SECTION 5

DISTRICT HEATING NETWORKS

5 DISTRICT HEATING NETWORKS

5.1 Existing and proposed heat networks in the borough

5.1.1 There are two known existing heat networks located within the borough. In addition, there have been a number of studies carried out looking at district energy schemes within the borough. These are discussed in the following paragraphs.

Existing district heating systems

5.1.2 Two district heating systems currently exist within the borough of Haringey:

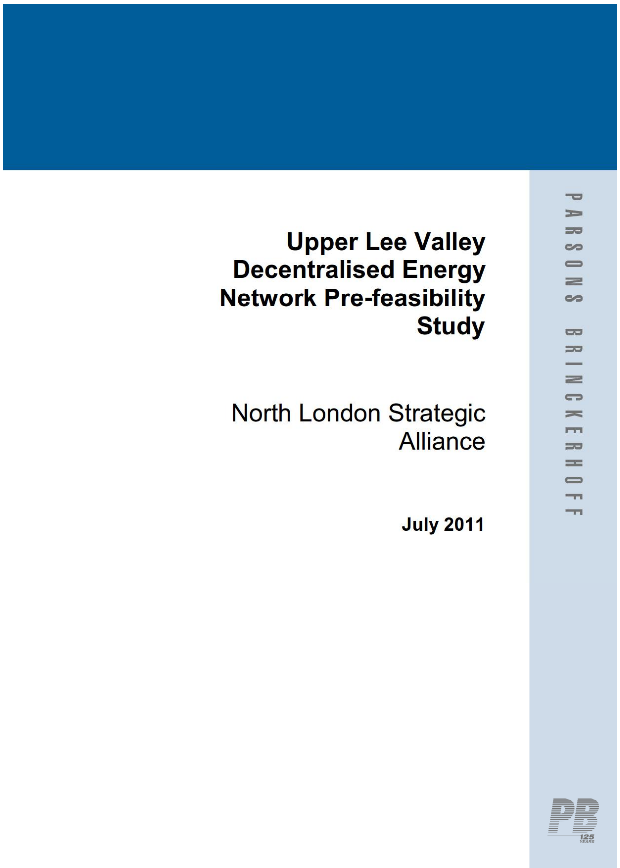
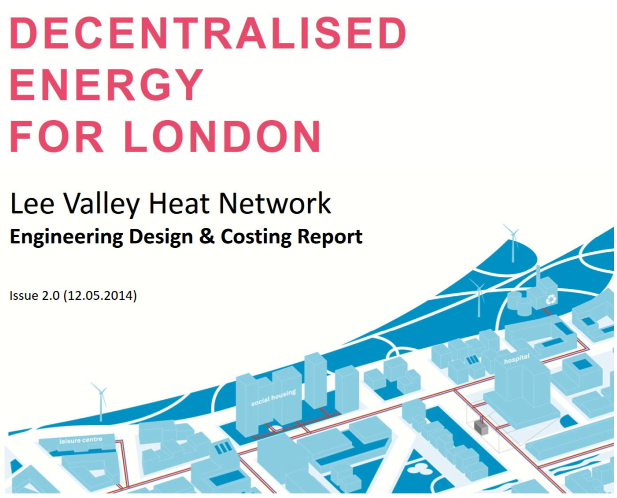
- Broadwater Farm: Originally supplied from a district heating system, all of the residential buildings, with the exception of the two tower blocks, were fitted with individual gas boilers in the 1990s. However, some communal areas continue to be heated from the DH system. A study was carried out by Parsons Brinckerhoff in 2011 to examine the options for extending the coverage of the DH system
- Hale Village: Hale Village is a recently constructed development located near Tottenham Hale station. The 2220 homes are provided with heat from two wood pellet biomass boilers and a small gas-fired CHP unit; the scheme is currently operated by Veolia (formerly Dalkia).

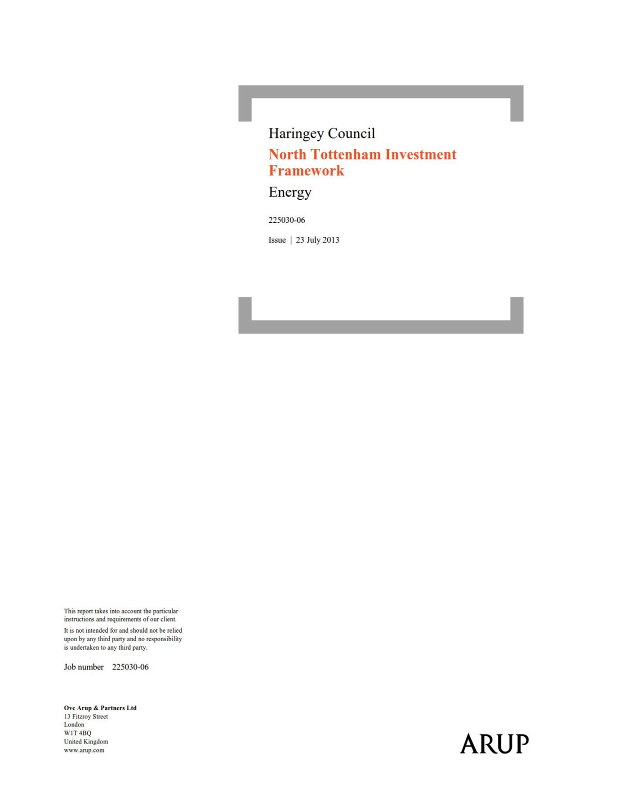
5.1.3 District heating schemes currently in planning include that at the Woodberry Down development, where CHP is also proposed, as well as developments at Brook House, Lawrence Road and St Luke's hospital.

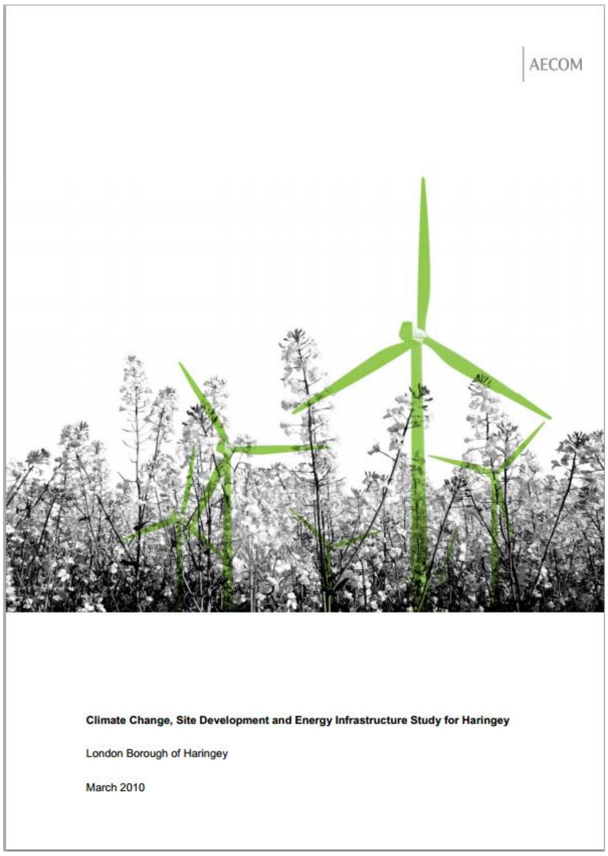
5.1.4 One further scheme is located just over the border in Barnet – the Strawberry Vale Estate. This provides heat to 265 dwellings from a central gas-fired boiler plant. There are also a number of other further networks / communal supply systems in Islington (Crouch Hill and Elthorne Estate, for example), and these should be kept under review should networks in St Ann's hospital area be developed.

5.1.5 The Woodberry Down scheme is also considered as part of this report, as a key potential load / source of heat to provide a link to the St Ann's area and thence further towards Tottenham Green / Hale Village.

5.1.6 In addition, there have been a number of studies examining the potential for district heating clusters to emerge within the borough of Haringey. These comprise the following:

Upper Lee Valley Decentralised Energy Network – PB (feasibility (including satellite scheme analysis) and pre-feasibility)	
Lee Valley Heat Network	

North Tottenham	 Haringey Council North Tottenham Investment Framework Energy 225030-06 Issue | 23 July 2013 This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party. Job number 225030-06 Ove Arup & Partners Ltd 13 Fitzroy Street London W1T 4BQ United Kingdom www.arup.com ARUP
Hornsey Town Hall	 DECENTRALISED ENERGY FOR LONDON MAYOR OF LONDON GLA Decentralised Energy for London Hornsey Town Hall Decentralised Energy Outline Feasibility Assessment REP-HTH/Draft1 Draft 1 | 14 May 2012 Draft This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party. Job number 218060-43 Ove Arup & Partners Ltd 13 Fitzroy Street London W1T 4BQ United Kingdom www.arup.com ARUP

Local Plan Evidence Base	

5.1.7 This section briefly summarises the findings of these previous studies.

5.1.8 Upper Lee Valley Heat Network (aka Lee Valley Heat Network)

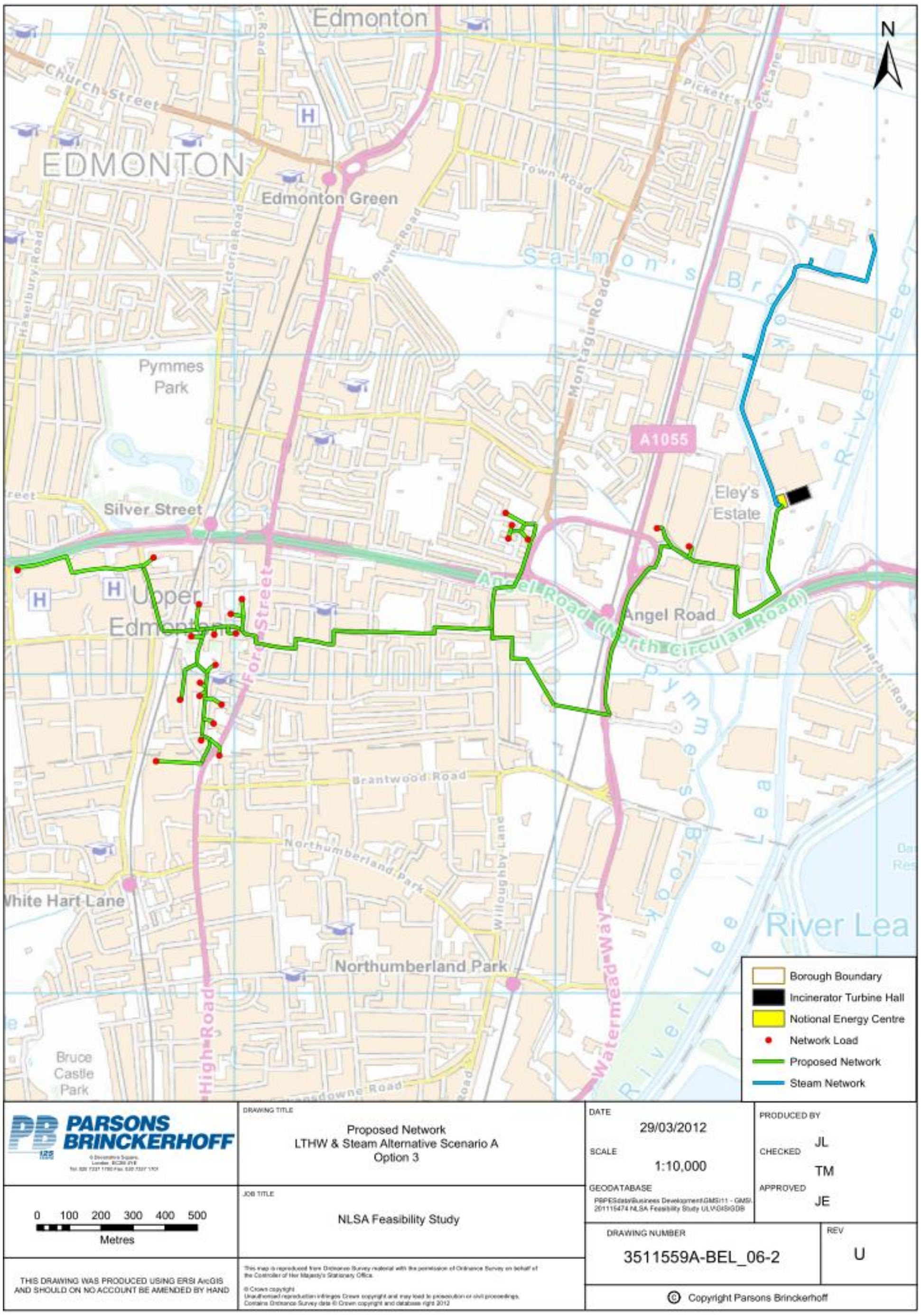
5.1.9 The analysis carried out on the Lee Valley Heat Network[18] highlighted the opportunities presented by the changes occurring at Edmonton EcoPark, Meridian Water, Deephams Sewage Treatment Works and Northumberland Park. This work highlighted the potential to create a strategic network based around planning interventions associated with all these developments and to link energy supply to the Edmonton Incinerator site.

5.1.10 The Lee Valley Heat Network feasibility work indicated that there was a comparatively small funding gap for an identified scheme, before taking into account the potential contribution that CIL contributions, Allowable Solutions, market re-financing, additional loads and other sources might be able to contribute.

5.1.11 The scheme proposed for further development by the feasibility work is illustrated below:

[18] Upper Lee Valley Decentralisted Energy Network Pre-feasibility Study, NLSA, July 2011, http://www.enfield.gov.uk/download/downloads/id/5770/pre-feasibility_report_on_ulv_den, accessed 16th May 2014, and Upper Lee Valley Decentralised Energy Network Feasibility Study, NLSA, August 2012 (PB).

Figure 5-1 Lee Valley Heat Network (feasibility stage core scheme)



5.1.12 This network shows that this initial phase network is primarily in Enfield. However, the development of the Tottenham Hotspur Football Club in Haringey and surroundings is a key heat demand nexus for this system, and represents an important element of the overall network.

5.1.13 Within the 'satellite' schemes reports for Haringey[19] the area around White Hart Lane (and Tottenham Hotspur Football Club) was analysed both under the scenario of taking a heat supply from the Lee Valley Heat Network (LVHN), and also as a scheme operating its own gas-fired CHP units. The analysis illustrated that under the LVHN scenario, the scheme returns positive whole life costs at all discount rates analysed.

5.1.14 The Lee Valley Heat Network 'satellite schemes' analysis for Haringey also identified the Tottenham Green area kick-start scheme as a strategically important node in the potential expansion of the Lee Valley Heat Network south toward Tottenham Hale (Hale Village).

5.1.15 The Hale Village complex is currently supplied with heat from a Veolia-operated energy centre. This is a 25-year concession agreement, and the commercial incentive to take heat from the LVHN will arise only if it appears that Veolia can purchase cheaper heat from the network than they can produce themselves at their own energy centre. There may also be requirements related to the carbon intensity of heat. Their own energy centre contains biomass boilers, thermal storage, and it is understood that a small CHP engine is also now installed. The satellite schemes report therefore concluded that it was considered unlikely that the LVHN could offer a sufficient cost-saving margin over this existing installation in order to attract commercial interest from Veolia in the short-term. It was suggested that when the biomass boilers become life-expired in around 2029, there may be an opportunity to attract commercial interest in connection.

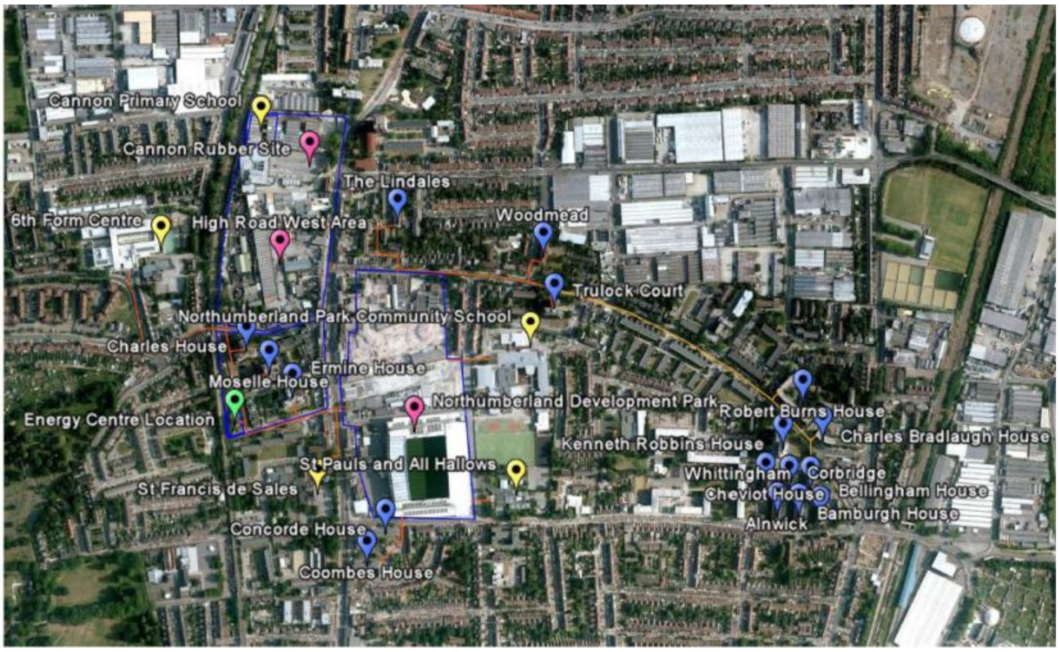
5.1.16 North Tottenham heat network (July 2013)

5.1.17 This study, undertaken by Arup, examined the viability for the implementation of a district heating network across North Tottenham, based on analysis of possible development standards within the borough. The analysis of the potential district heating network builds upon a previous feasibility study undertaken by the North London Strategic Alliance[20].

5.1.18 The proposed scheme would see a total of 1660 residential units connecting, together with a total of 6634kW of commercial demand, with implementation phased over a five year period. All of the demands identified in the NLSA assessment are included in the network (loads illustrated in the figure below), together with the additional High Road West, Spurs and Brook House developments.

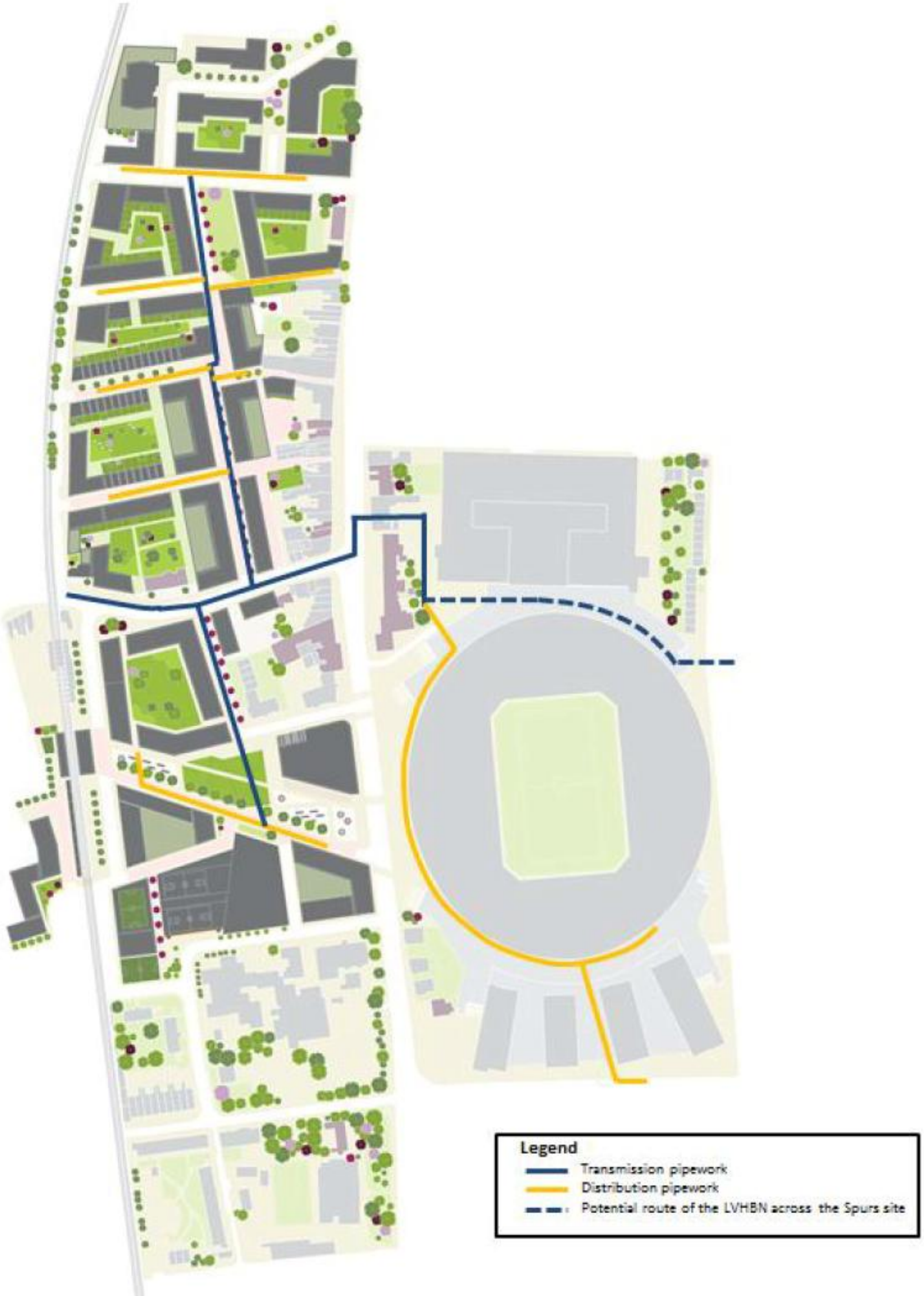
[19] Haringey Satellite Schemes, NLSA, September 2012
[20] *Haringey Satellite Schemes, London: Strategic Alliance*, September 2012

Figure 5-2: Areas and demands considered in NLSA assessment



5.1.19 The proposed network is illustrated in the figure below; this includes a potential route for connection to a wider Lea Valley Heat Network (LVHN).

Figure 5-3: Indicative network layout. Transmission pipework is indicated in blue, distribution in yellow. The dotted transmission line indicates the potential district heating main connecting to the LVHN.



5.1.20 Taking into account benchmarked developer contributions, the North Tottenham Investment Framework: Energy report concluded that the scheme should achieve an 8% internal rate of return (IRR) over 25 years for a CHP-led scheme.

5.1.21 Hornsey Town Hall

5.1.22 This draft (not finalised) study, undertaken by Arup and updating a previous study by Capita Symonds, examined the feasibility of a district heating system supplying the proposed Hornsey Town Hall redevelopment. The planned redevelopment includes refurbishment of the grade 2* listed town hall, partly financed through the sale of adjoining land for residential development.

5.1.23 An indicative plan for the implementation of district heating networks serving the area is presented in the figure below.

Figure 5-4: Indicative network routing options for Hornsey Town Hall

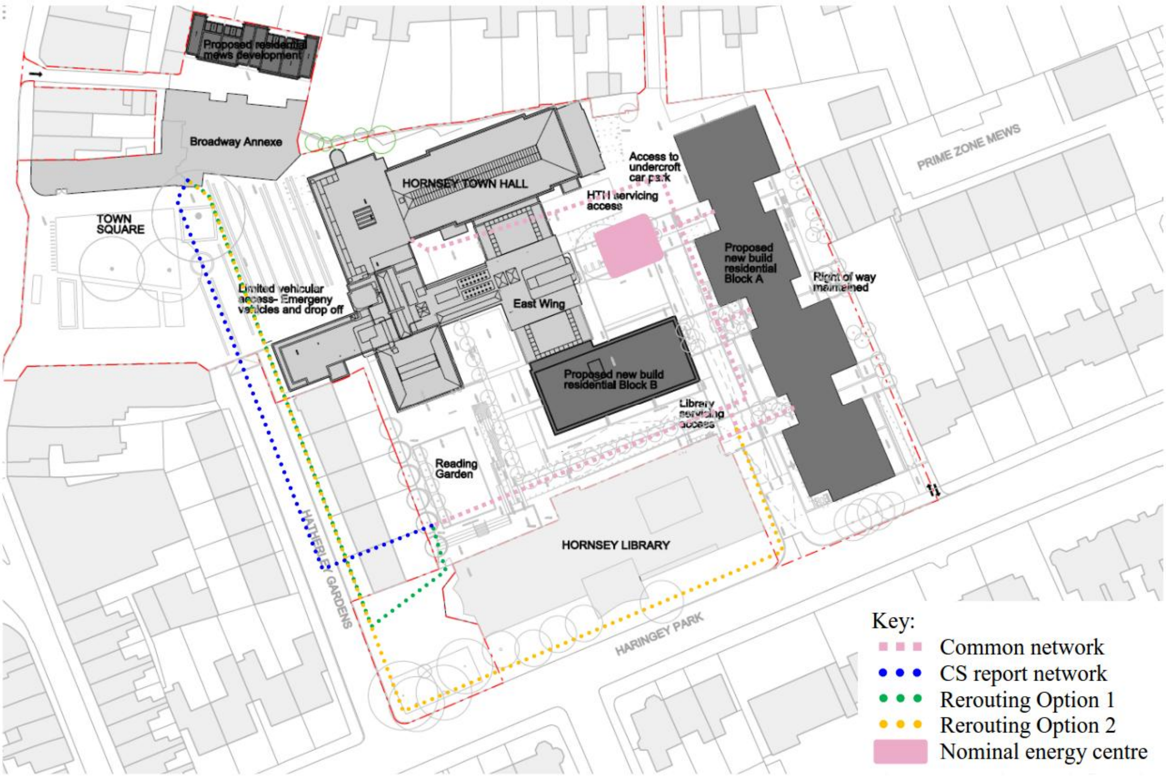


Figure 6: Indicative network rerouting options for HTH scheme. Base map source: Stage D Report.

5.1.24 Local Plan Evidence Base[21] (2010)

5.1.25 This study provided an evidence base for planning policy development for the emerging Core Strategy of the Local Development Framework. Four policy options were considered and tested on representative sites across the borough. A key output from this work that is of relevance to this Energy Masterplan was that '*one of the key recommendations arising from the study [2010 report] is that the implementation of district heating system and the use of combined heat and power systems should be enforced for all suitable sites. This will be crucial in the long term strategy for the development of wider district heating networks across the Borough and those extending beyond the Borough. Where this is not technically feasible, communal*

[21] Climate Change, Site Development and Energy Infrastructure Study for Haringey, AECOM, http://www.haringey4020.org.uk/aecom_site_dev___en_infra_study-2.pdf, accessed 16th May 2014

systems should be implemented, to enable future connection as energy networks develop[22]'.

5.2 Pipeline sizing

5.2.1 Network route selections were input into Parsons Brinckerhoff's proprietary pipeline model to establish the required pipeline dimensions. PB's 'Decentralised Energy Pipeline Model' is a MS Excel-based model developed specifically for the analysis of decentralised energy schemes and their heat supply systems at a strategic level.

5.2.2 The inputs into this model are the spatial distribution of loads (i.e. the lengths of pipeline joining loads), their magnitudes, anticipated return temperatures, diversity factors applicable to DHW usage, typical pipe roughness factors, typical heat losses per m for different pipework diameters, and maximum allowable pressure drops and velocities. The model calculates the required diameter of each element of a network based on appropriate temperature differentials and hence flow rates. This then allows cost estimation of the network based on per metre of trench cost indices for pre-insulated pipework of varying diameter.

Network design - temperatures

5.2.3 The temperatures used to calculate pipeline diameters are in the range of those recommended by the District Heating Manual for London[23], which sets out the preferred operating temperatures for decentralised energy networks.

- Flow temperature: 95 deg. C (peak load periods / network design temp[24])
- Return temperatures
  - Existing residential space heating: 75°C
  - Existing residential DHW: 25°C
  - Existing non-domestic: 75°C
  - New residential space heating: 55°C
  - New residential DHW: 25°C
  - New non-residential: 55°C

5.2.4 In general, it is advised that the temperature difference between flow and return is made as high as possible in order to maximise the heat transfer per unit volume of water which passes through the system. The subsequent reduction in water which is required to flow through the system reduces the required pipe diameters and pump sizes, thus reducing costs.

5.2.5 In addition, minimising the temperatures at which the network operates is also beneficial, reducing heat loss and allowing the use of secondary heat sources.

[22] Ibid, executive summary, pdf page 6.
[23] District Heating Manual for London recommends a primary flow temperature between 110 to 80 deg C.
http://www.londonheatmap.org.uk/Content/uploaded/documents/DH_Manual_for_London_February_2013_v1.0.pdf
[24] A variable flow and variable temperature system would be advocated for operational optimisation

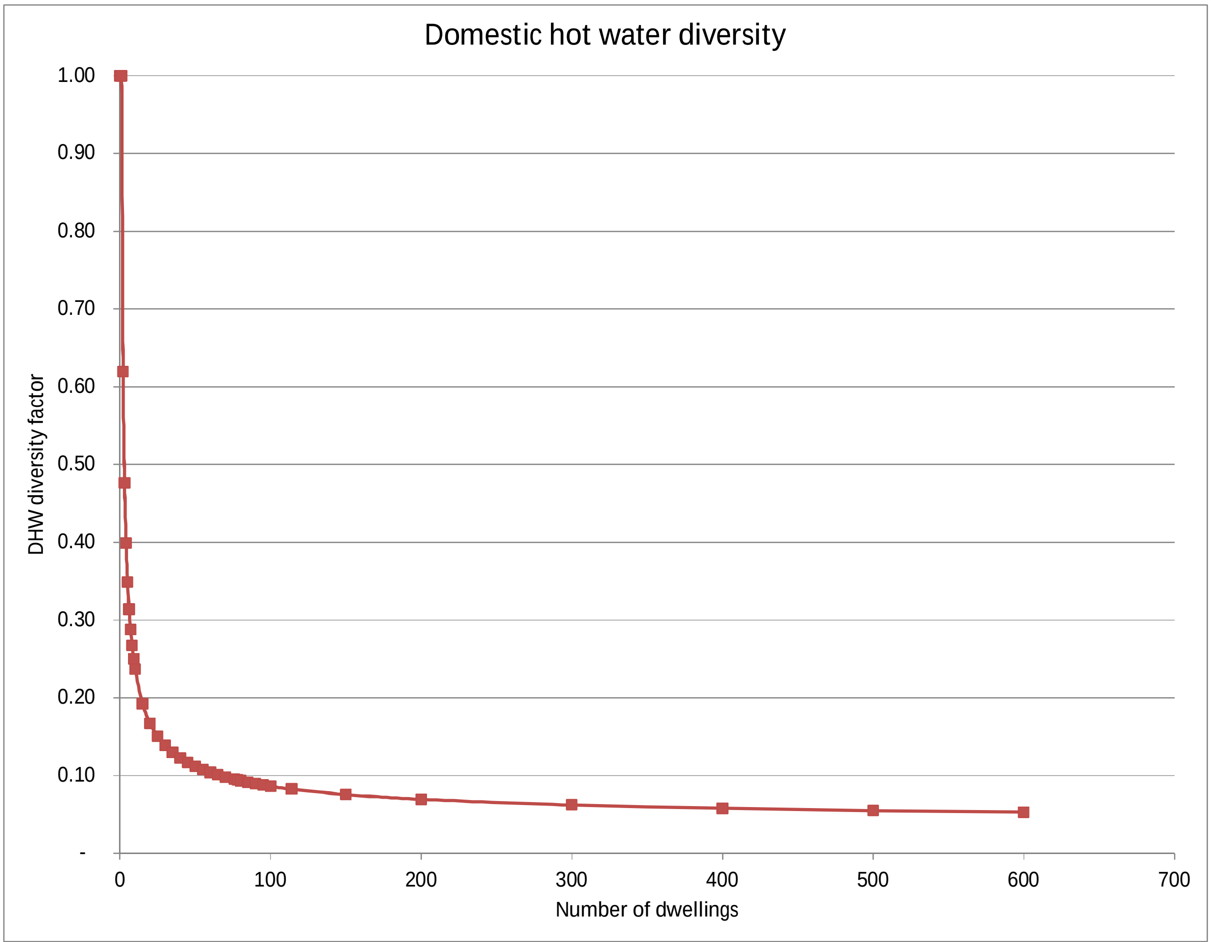
Network design - loads

5.2.6 The heat network is sized on the basis of the peak demands which will be required by each load. The heat demands plotted in Section 3 above are all annual values - i.e. kWh/annum. To estimate the peak demand for each load, the following strategies were used:

- Domestic loads - A maximum hot water demand of 33kW was assumed for DHW purposes (before diversity), and peak demands of 4.5kW (existing dwellings) or 2.5kW (new dwellings) for space heating. A discussion of diversity factors is provided below.
- Commercial loads - A 15% load factor was used to calculate peak load from annual load.
- Mixed developments - Commercial and domestic loads were split and each calculated using the methodologies outlined in the bullet points above.

5.2.7 Households will have differing occupancy patterns and require hot water at differing times. This means that peak heat demands will also differ temporally and as such be lower in aggregate than suggested by the simple multiplication of the number of dwellings by each dwelling's maximum requirement for hot water. In order to account for this a diversity factor is applied, as illustrated in the figure below.

Figure 5-5: Diversity factors used within domestic hot water demand modelling



5.2.8 Thus, for example, when 600 properties are connected to the scheme, their maximum heat demand is calculated by the following equation:

$$\text{Peak demand} = \text{number of properties} \times \text{maximum dwelling heat demand (for DHW)} \times 0.05$$

<u>Network design – pipe sizing</u>

5.2.9 The selection of pipe diameters is carried out within Parsons Brinckerhoff's pipeline modelling software, with sizes set by applying industry best practice with respect to the maximum pressure drops and flow velocities. The limits used within modelling are set out in the table below.

Table 5-1 Network design characteristics

		DH network elements	
Nominal diameter (mm)	Actual ID (Seamless Steel) (mm)	Max allowable pressure drop (pa/m)	Max velocity (m/s)
32	36.1	200	0.75
40	42	200	1
50	53.1	200	1.15
65	68.8	200	1.5
80	80.8	200	1.75
100	105.1	200	2
125	129.7	200	2.5
150	155.2	200	3
200	211.9	200	3
250	265.8	200	3.5
300	315.9	300	3.5
350	347.6	300	3.5
400	398.4	300	3.5
450	448	300	3.5
500	499	300	3.5
600	601	300	3.5

5.2.10 An allowance of 15% above frictional pressure losses has been included to account for bends and fittings.

5.2.11 The size of connections and hence costs of network development is driven by the temperature differential that can be achieved across consumer connections. For example, from the base assumption of a 65°C return temperature, a further 10°C reduction in return temperature would increase the capacity of connection by 20% for no increase in network capital or operating cost. This level of return temperature reduction is often relatively easily achievable but it requires an enlightened, different approach by building system designers. This approach will have a minimal impact on building costs at construction but will cost considerably more as a retrofit. Ensuring that this change is implemented as widely as possible from the first stages of building design will require a combination of incentives, lower connection charges, guidance and requirements through planning conditions or similar. The provision of lower return temperatures can be incentivised within the heat supply agreement to which scheme stakeholders sign up.

5.3 Heat loss

5.3.1 Distribution heat loss is a consideration when sizing heat supply technology, as losses along the route must be met, in addition to the heat loads. In addition, power will also be required to operate the network pumps. Network heat losses of 10.8% were assumed for each network based on typical values for networks[25].

5.4 Network design / materials

5.4.1 For the network installation within the borough for heat (and chilled water) distribution, PB recommends the use of pre-insulated steel pipework. The key alternative technology on the market currently is plastic pre-insulated pipework. This alternative system can have significant benefits in terms of reducing the labour-intensity of installation (by reducing the need for welded joints) and can help reduce overall installation costs. However, particularly at higher temperatures (i.e. 90°C and above), the longevity of the plastic systems is considerably reduced. Equally, larger diameters of plastic pipework are not available, and hence it is primarily recommended for application in lower temperature, local heat networks.

5.4.2 Within the category of pre-insulated steel pipework, there are also different levels of insulation available. Whilst specific circumstances can impact selections, at typical temperatures and scales of network under consideration here, it would normally be recommended that the higher levels of insulation are procured to maximise whole life benefit. This procurement decision should be confirmed as projects move through feasibility stage.

5.5 Wide area and kick-start networks

5.5.1 Installation of a new network across a significant area is clearly a major infrastructure undertaking, and one that carries with it significant investment and risk. The analysis behind this report has considered two scales of scheme:

- Area-wide networks based on the identified heat density contours; and
- Kick-start networks for each scheme, designed to maximise early phase viability.

5.6 Proposed energy networks - network design

5.6.1 Once overall areas (and the loads comprised therein) were identified, network routes were selected. This process was carried out within GIS, using an automated process to identify the shortest path to join all of the loads within each network, and a suitable site for the energy centre. PB's judgement was also used in the latter case – for example, new development sites with high heat demand are likely to offer some of

[25] P.S. Woods and G. Zdaniuk, CHP and District Heating – how efficient are these technologies?, 2011, CIBSE Technical Symposium, DeMontford University, Leicester

the viable energy entre sites (space for energy centre can be included within development design, whilst the high heat load does not need to be transported the length of the network). It is stressed that these energy centre selections do not represent Haringey's preferences for these schemes, but are notional locations that illustrate the basis on which the network modelling has been carried out.

5.6.2 In the drawings below (Figure 5-7 and onwards) for each key scheme area, the contour of heat demands, and network selections are illustrated.

Northumberland Park / White Hart Lane / High Road West

5.6.3 The Northumberland Park area comprises mostly residential loads, although several existing schools are also included. In terms of new development, the most significant is the Tottenham Hotspur Stadium development. Its level of heat demand, together with its status as a new development, would suggest that it is well suited to being the location of an energy centre sized to serve areas beyond its own boundary. The other key adjoining development area is known as High Road West[26], whose scale and location also mean that it could serve this function, although the phasing and anticipated date of emergence of this site would mean that a temporary energy centre would be required to serve the needs of the Spurs Stadium in the early years.

5.6.4 The northern location of the site within the Borough means that it is well placed to receive heat from the Edmonton EcoPark, and could provide a potential future link from here to the other proposed networks in the rest of the borough. In particular, the A1010, which runs in a north-south direction through the borough, has the potential to be a key pathway for linking district heating networks through the borough. Northumberland Park / North Tottenham is therefore a key 'gateway' area to link into and form part of the Lee Valley Heat Network.

5.6.5 Figure 5-6 below shows the planned initial Lee Valley Heat Network[27] in the Upper Lee Valley OAPF, together with potential expansions. It can be seen that the North Tottenham / Northumberland Park area forms part of the initial network (shown by solid orange line), with a proposed future expansion down to the Tottenham Hale area.

[26] http://www.haringey.gov.uk/hrw_masterplan_summary_web-3.pdf, accessed 16th Sept 2014
[27] https://www.london.gov.uk/sites/default/files/05%40A4.pdf, accessed 16th Sept 2014

Figure 5-6: Proposed Lee Valley Heat Network

Figure 5-7: North Tottenham / Northumberland Park kickstart DH network and heat contours, showing building ownership)

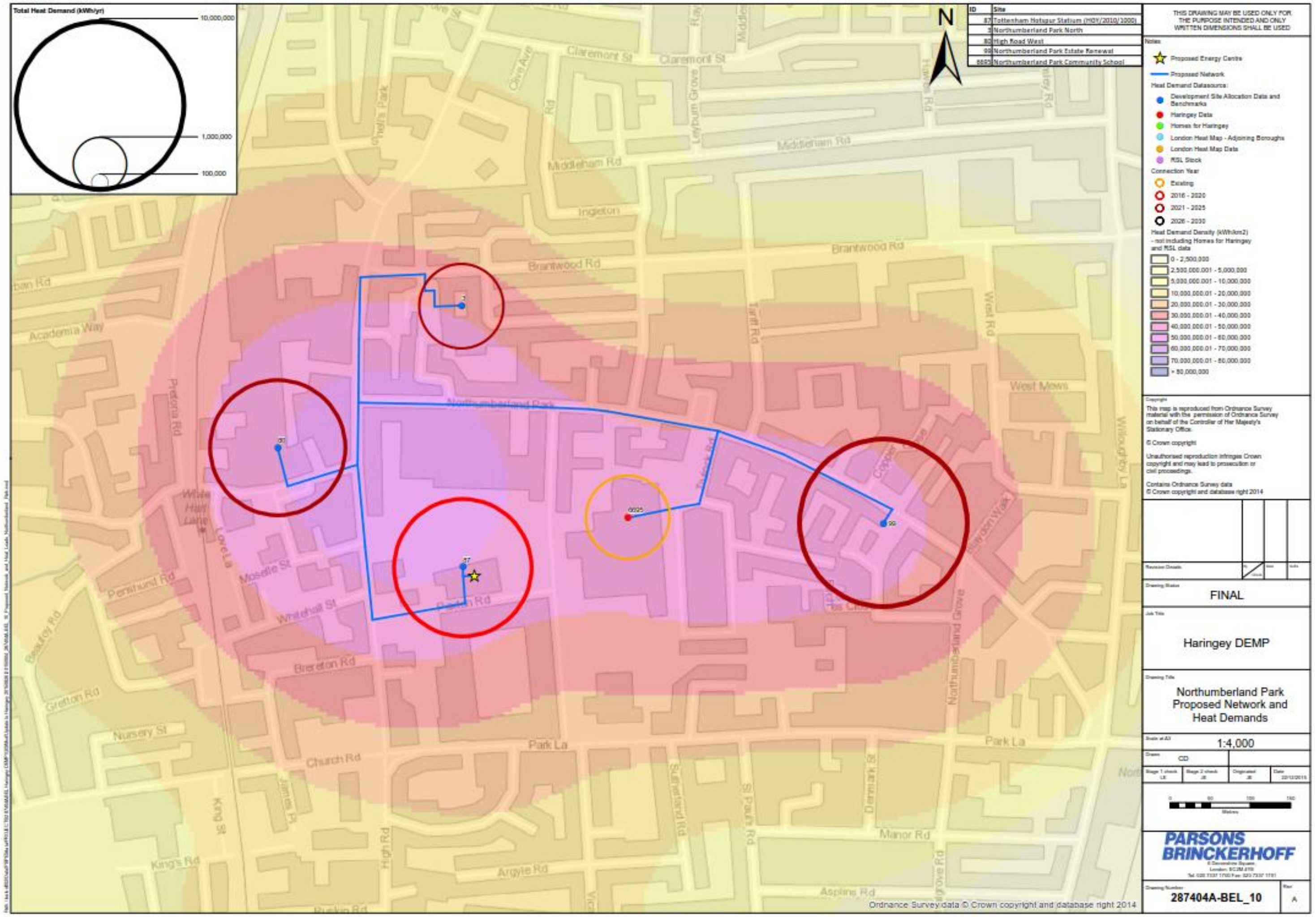
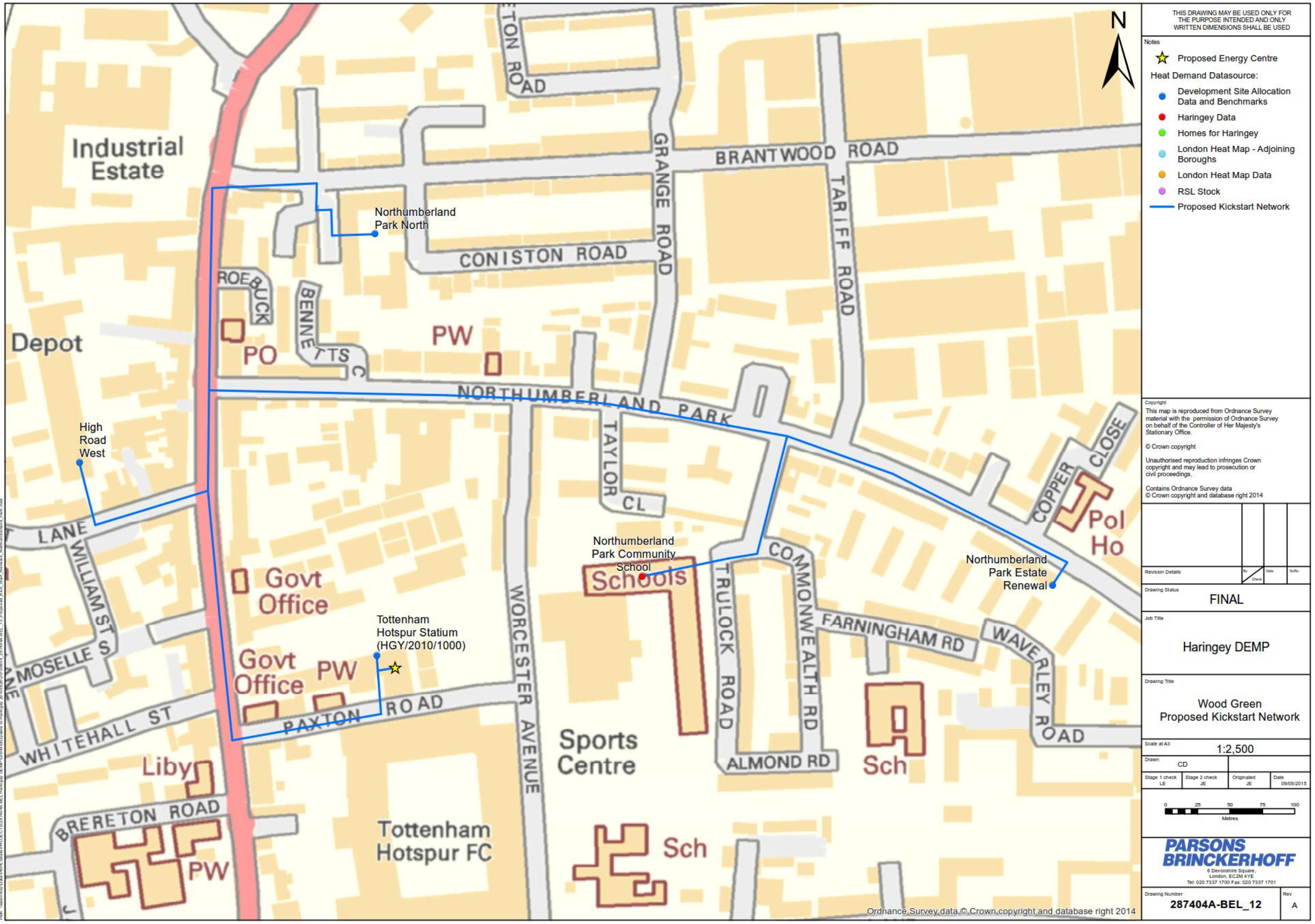


Figure 5-8 Northumberland Park kick-start network



Tottenham Hale

5.6.6 This network is located in the east of the borough near the border with Waltham Forest. The notional assumed energy centre location is at the Ashley Road North development.

5.6.7 There are a number of new developments with large heat demands located near to the notional proposed energy centre location. These include Ashley Road developments, Station Square West, and Tottenham Retail Park. These could equally well serve as energy centre host sites.

5.6.8 The proposed network area is intersected by a number of major roads: the A10, A503 and A1055. Designing networks to minimise crossing/ running networks along these roads and minimising disruption during implementation will be a key consideration. Other barriers to DH implementation include the Lea Valley Navigation (waterway), Network Rail railway lines and the London Underground Victoria line system at Tottenham Hale.

5.6.9 The Hale Village DH system has been included within this wider scheme visionary network, but excluded from the kick-start network. The Hale Village DH system is currently operated by Veolia under a 25-year concession agreement. It is unlikely that the scheme will connect to a new DH network unless there is an attractive commercial case. However, there may be an additional earlier opportunity to attract commercial interest once the biomass boilers reach the end of their life in around 2029. Equally, connection between Hale Village and the Hale Wharf site has also been considered[28], and the suggested approach reported is that the existing low carbon plant at Hale Village could supply the demands of Hale Wharf, with the use of an additional peaking boiler. The viability of this link is discounted when considering using the existing infrastructure routes (i.e. roadways) to link the Wharf and Village sites, although the installation of a new footbridge over the intervening waterway would improve viability. Hence if this new footbridge is installed, this DH connection between Hale Village and Hale Wharf should be pursued further.

[28] Infrastructure Feasibility Report, Lee Valley Estates, Hale Wharf, London, rev 2, K2 Consultancy, 2013

Figure 5-9: Tottenham Hale district heating network and heat contours, showing building ownership

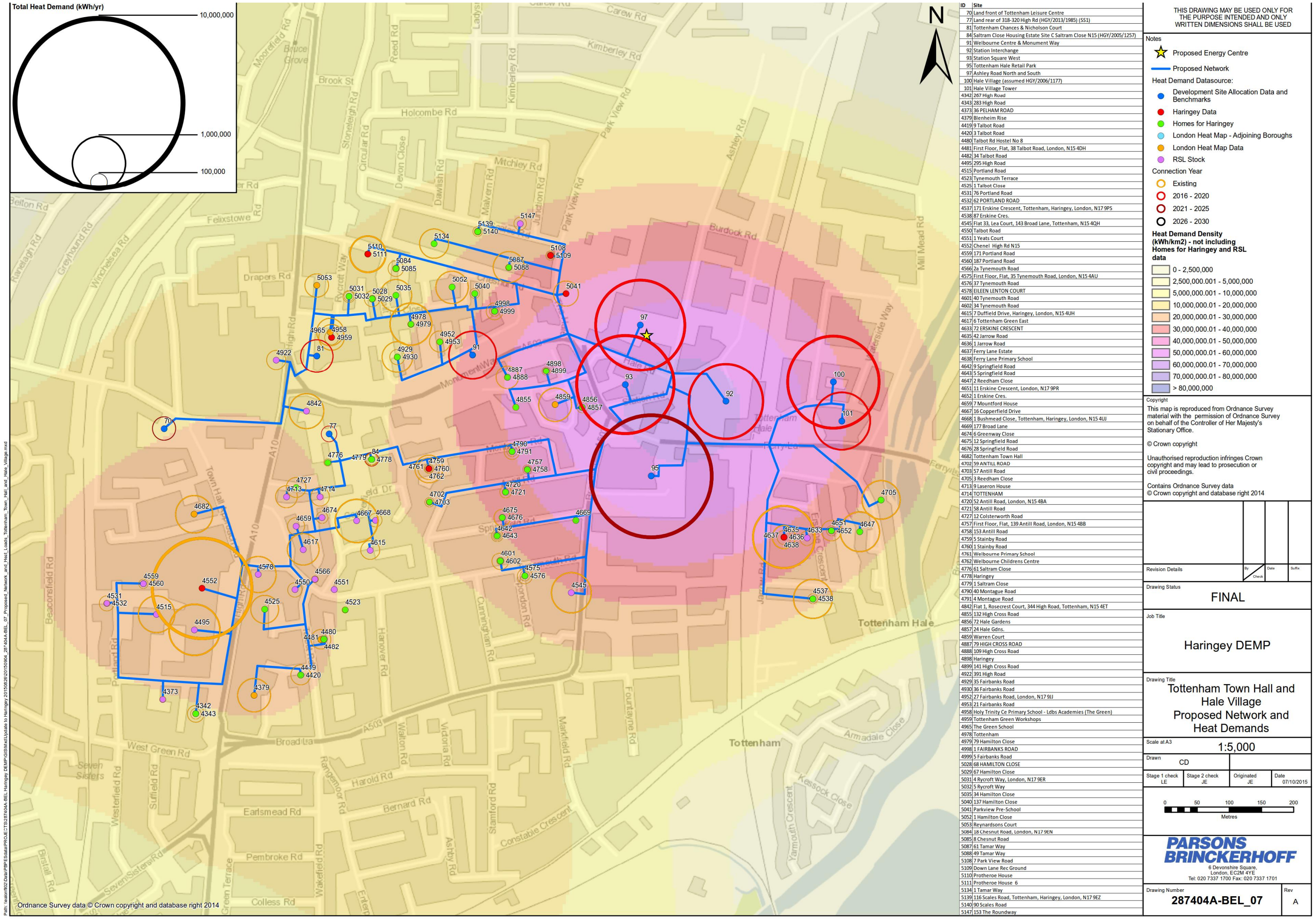
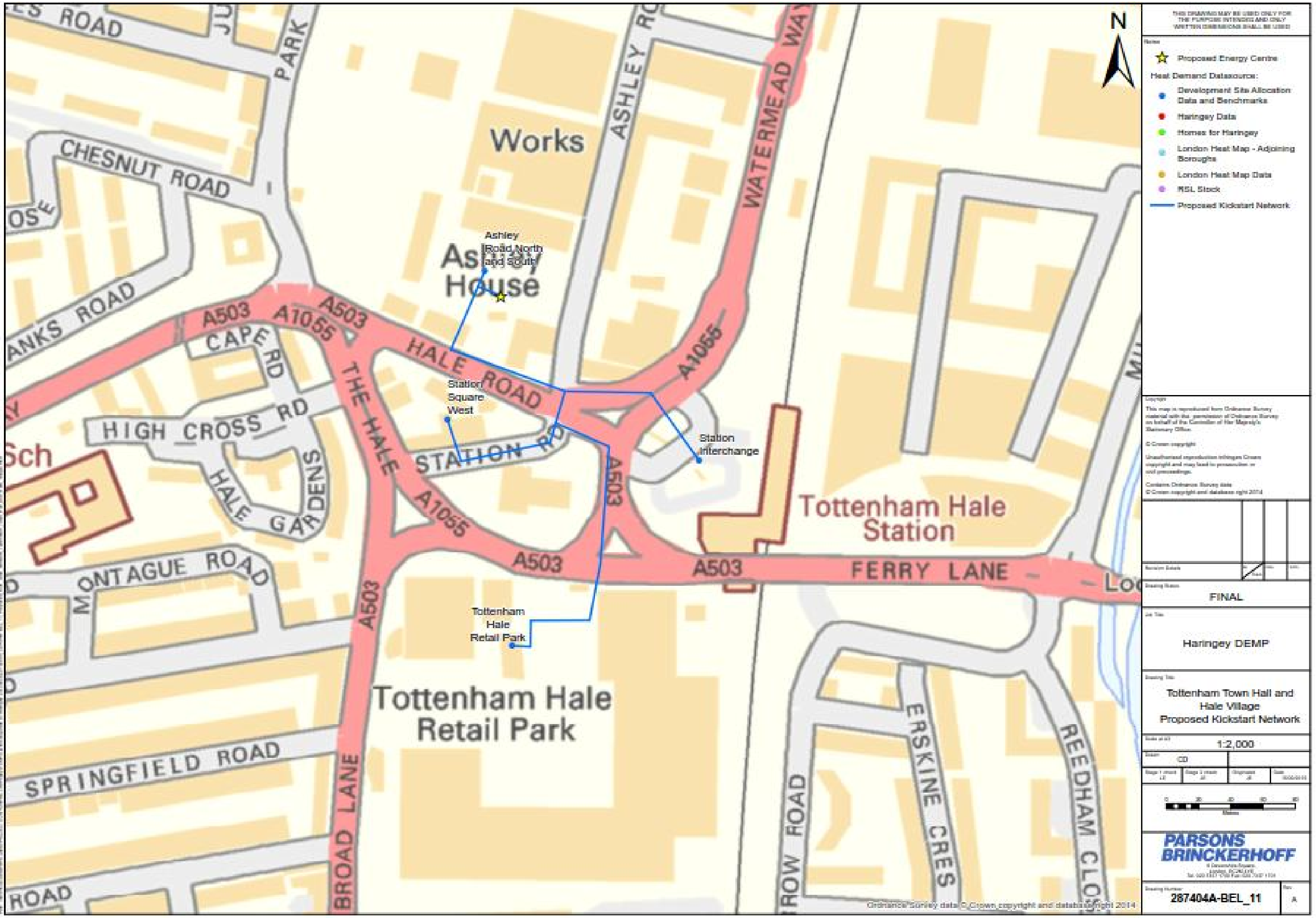


Figure 5-10 Tottenham Hale kick-start network



Hornsey

5.6.10 The Hornsey network is located very close to the Wood Green scheme, the two separated by a major railway line. Demand densities in this area are lower than for the other proposed networks addressed in this report, but analysis has been taken forward on a selected small scheme.

Figure 5-11: Hornsey district heating network and heat demand contours, showing building ownership

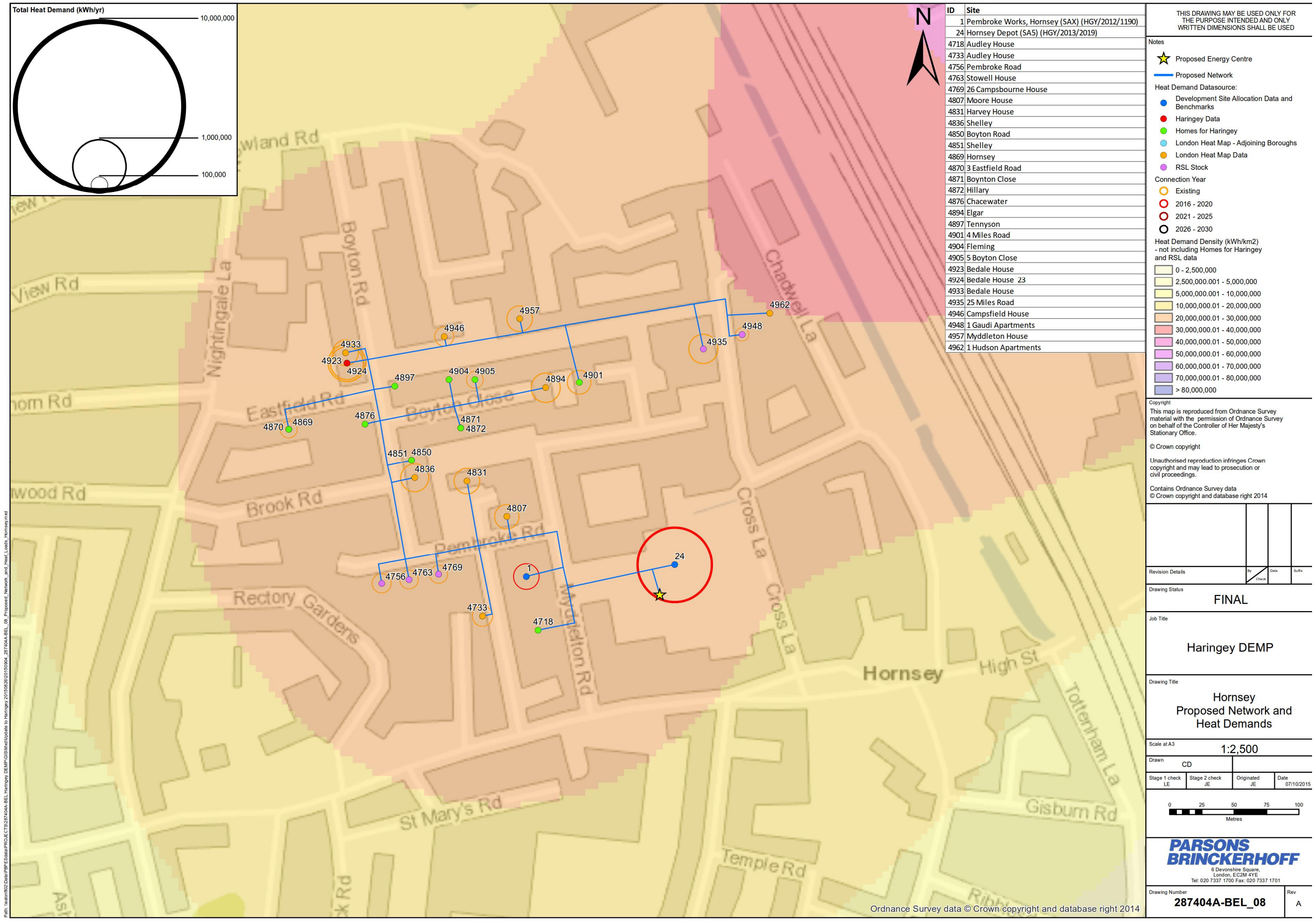
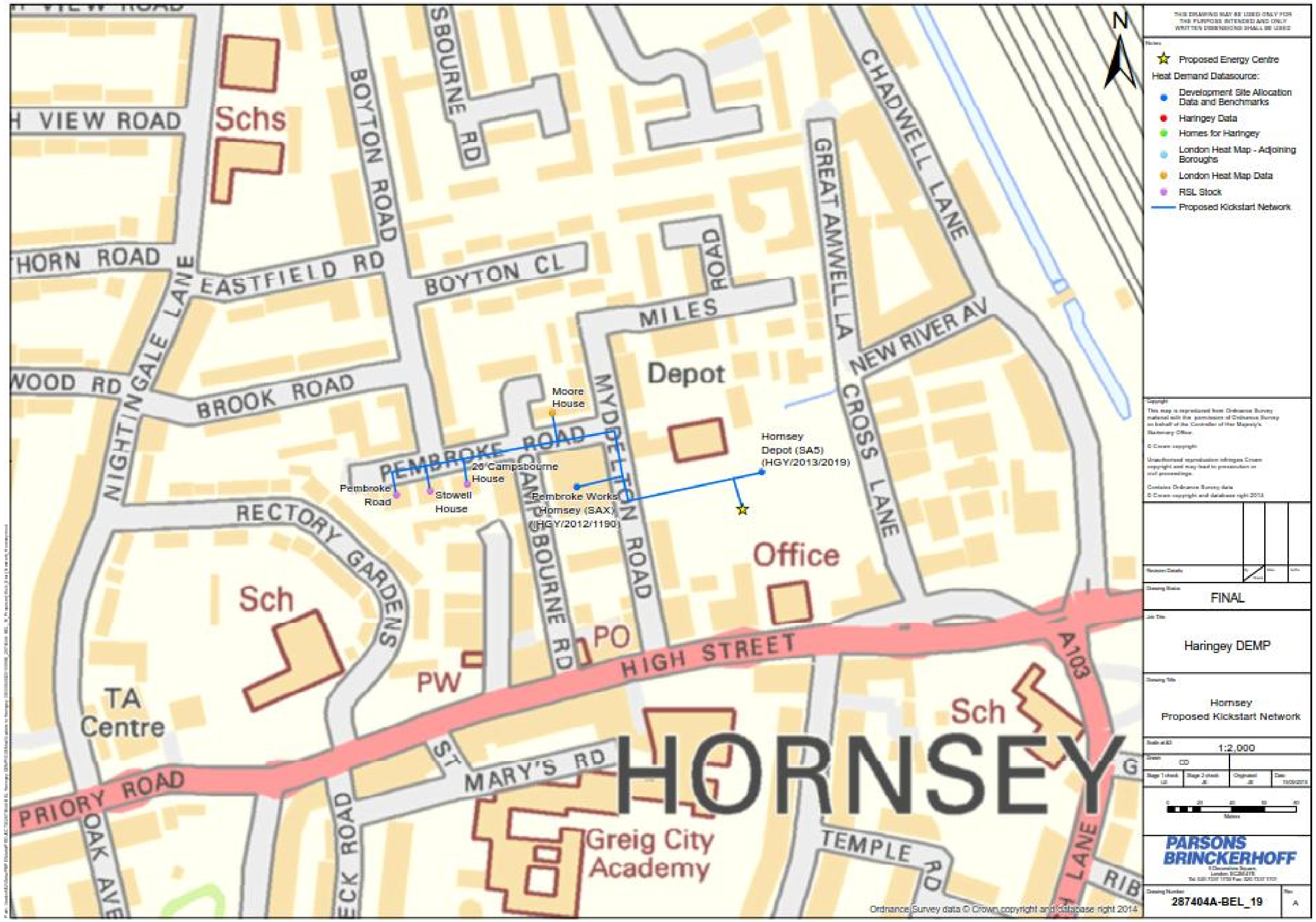


Figure 5-12 Hornsey kick-start network

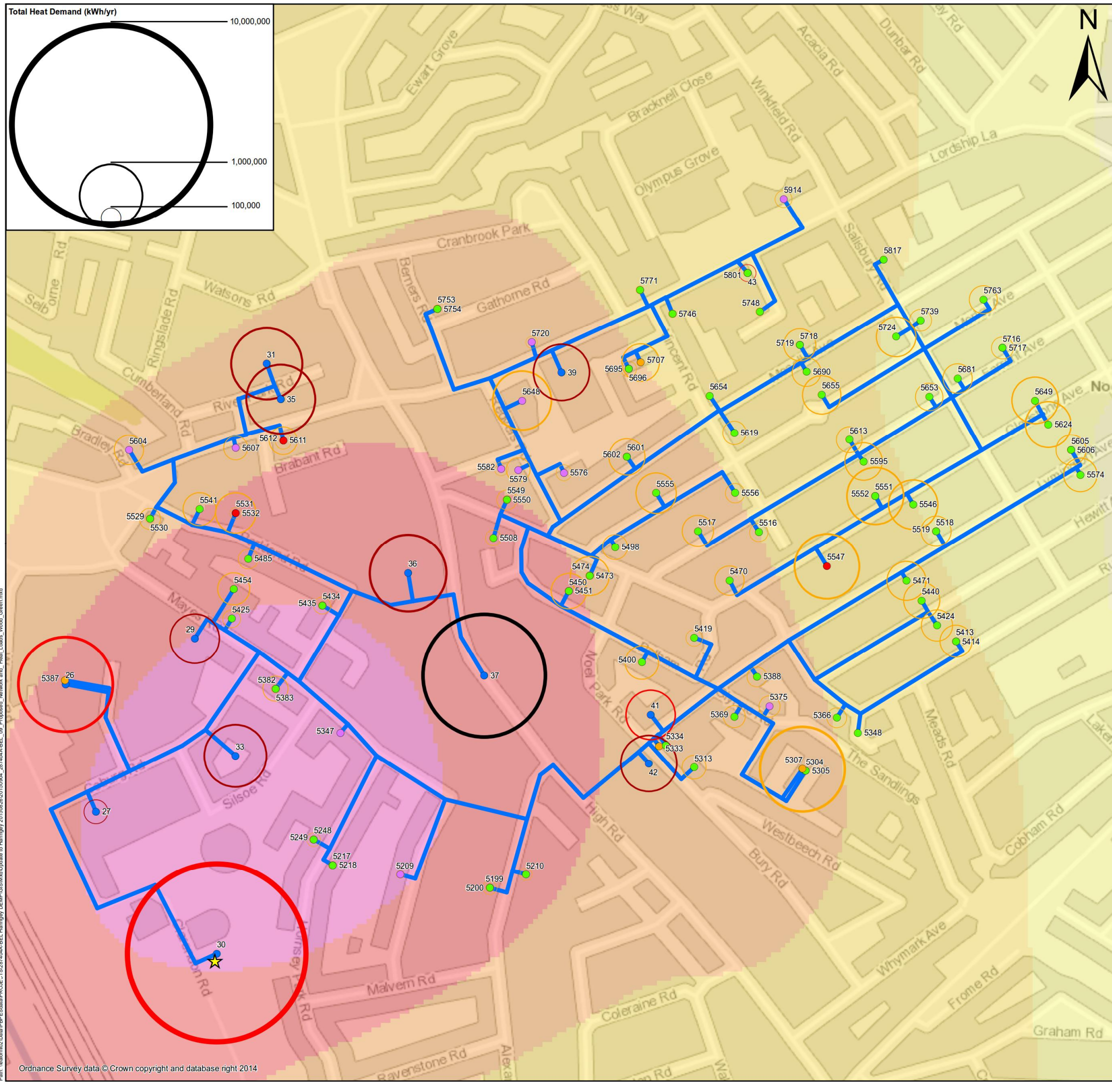


Wood Green

5.6.11 The proposed Wood Green network is located between Wood Green station, Turnpike Lane and Hornsey. The area is more commercial in character than the other proposed networks discussed in this report. The proposed energy centre location is at the Clarendon Square redevelopment, although other sites could also provide a location for energy centre plant.

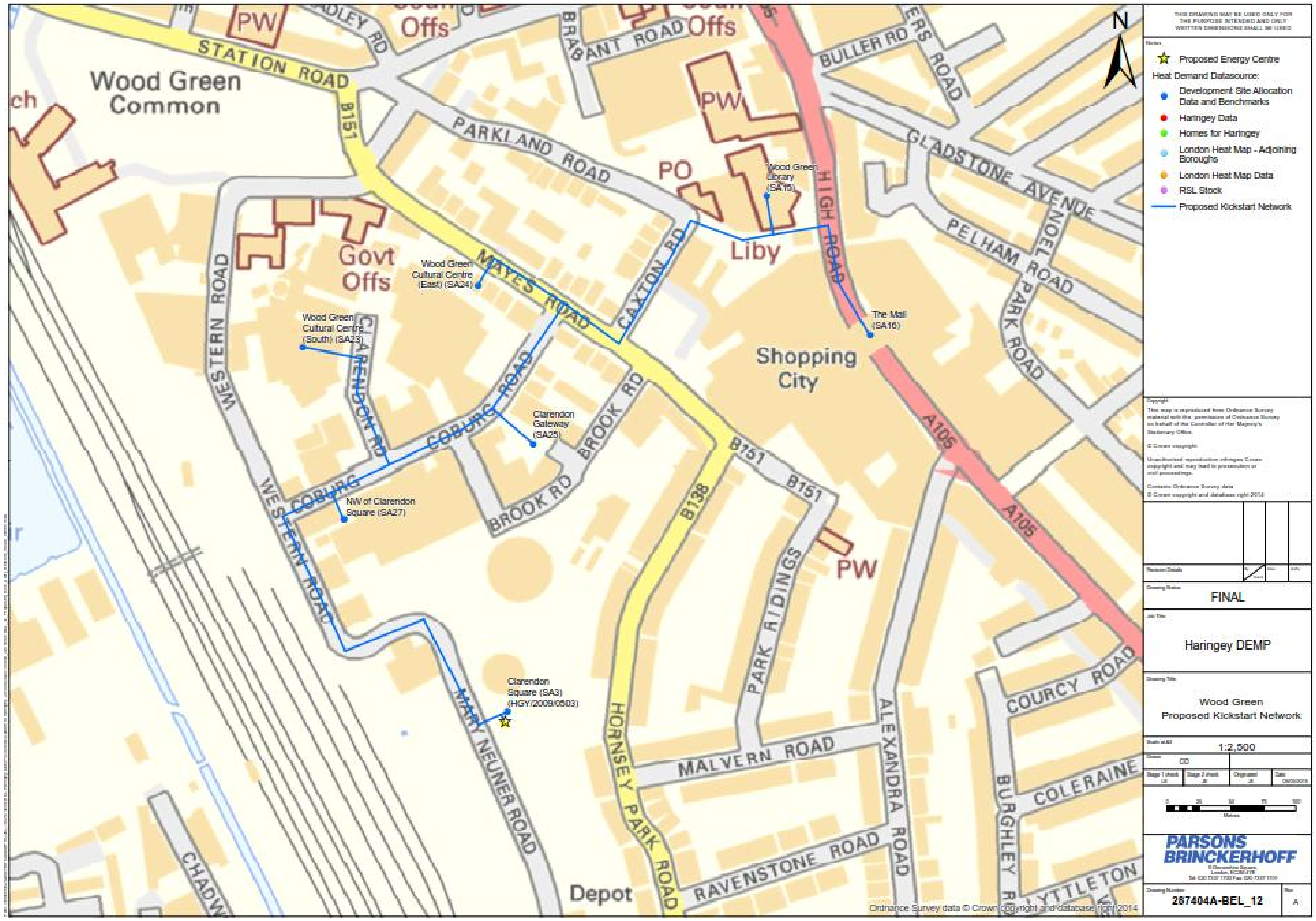
5.6.12 The Wood Green area has the potential to be affected by Crossrail 2, with a proposed section of line running between Turnpike Lane and Alexandra Palace. This is anticipated to significantly stimulate regeneration and therefore increase the potential number of new sites connecting to a DH scheme.

Figure 5-13: Wood Green district heating network and heat demand contours, showing building ownership



ID	Site
26	Wood Green Cultural Centre (South) (SA23)
27	NW of Clarendon Square (SA27)
29	Wood Green Cultural Centre (East) (SA24)
30	Clarendon Square (SA3) (HGY/2009/0503)
31	Wood Green Bus Garage (SA11)
33	Clarendon Gateway (SA25)
35	Station Road Offices (SA12)
36	Wood Green Library (SA15)
37	The Mall (SA16)
39	Mecca Bingo (SA13)
41	Lymington Avenue N22 6JB (HGY/2012/0770)
42	Bury Road Car Park (SA17)
43	673 Lordship Lane (HGY/2011/1597)
5199	99 ALEXANDRA ROAD
5200	85 Alexandra Road
5209	9 PARK RIDINGS
5210	100 Alexandra Road
5217	122 HORNSEY PARK ROAD
5218	56 Hornsey Park Road
5248	WOODGREEN
5249	125 Hornsey Park Road
5304	Wood Green
5305	The Sandlings
5307	The Sandlings
5313	3 Bury Road
5333	North London School Shop
5334	Maisonette
5347	51 MAYES ROAD
5348	Barbara Hucklesbury Close
5366	8 Russell Ave.
5369	10 Glynne Road
5375	1 Kwesi Johnson Court
5382	51 MAYES ROAD
5383	Gff
5387	Collage Arts Ltd
5388	42 Lymington Ave.
5400	39 Pelham Road
5413	39 Russell Avenue, London, N22 6QB
5414	3 Russell Ave.
5419	1 Ashley Cres.
5424	8 Hewitt Ave.
5425	100 Mayes Road
5434	17 Caxton Road, Haringey, London, N22 6TB
5435	Caxton Road
5440	1 Hewitt Ave.
5450	8 Pelham Road
5451	1 Pelham Road
5454	1 Jack Barnett Way
5470	55 Gladstone Ave.
5471	58 Lymington Ave.
5473	76 Gladstone Avenue
5474	18 Gladstone Ave.
5485	23 Parkland Road
5498	Gladstone Ave.
5508	4 Gladstone Ave.
5516	36 Vincent Road
5517	2 Farrant Ave.
5518	57 Lymington Avenue, London, N22 6JE
5519	35 Lymington Ave.
5529	12 TOWER TERRACE
5530	Flat A
5531	22 Parkland Road
5532	Parkland Rd Housing L /Lds Ltg
5541	120 Parkland Road
5546	94 Gladstone Ave.
5547	Noel Park Academy
5549	HARINGEY
5550	7 Gladstone Ave.
5551	122a Gladstone Avenue
5552	103 Gladstone Ave.
5555	2 Morley Ave.
5556	18 Vincent Road
5574	180 Lymington Ave.
5576	1 Wellesley Road
5579	2 Redvers Road
5582	6 Buller Road
5595	26 Farrant Ave.
5601	21 Moselle Avenue
5602	1 Moselle Ave.
5604	1 Bradley Road
5605	137 Lymington Avenue
5606	103 Lymington Ave.
5607	1 Solar House 37 Station Road
5611	35 Station Road
5612	38-46 Station Road
5613	45 Farrant Ave.
5619	6 Vincent Road
5624	148 Gladstone Ave.
5648	Redvers Road
5649	175 Gladstone Ave.
5653	24 Salisbury Road
5654	Vincent Road
5655	56 Morley Ave.
5681	47 Salisbury Road
5690	64 Moselle Ave.
5695	Sultan Terrace, Vincent Road, Wood Green, Haringey, London, N22 6NB
5696	Vincent Square
5707	Vincent Square
5716	130 Farrant Avenue
5717	100 Farrant Ave.
5718	145 Moselle Avenue
5719	81 Moselle Ave.
5720	680 Lordship Lane, Wood Green, Haringey, London, N22 5JN
5724	Salisbury Road
5739	27 Salisbury Road
5746	681 Lordship Lane
5748	1 Coombe Road
5753	Wood Green
5754	15 Berners Road
5763	112 Morley Ave.
5771	660 Lordship Lane
5801	629 Lordship Lane
5817	19 Salisbury Road
5914	Flat 59, Crown Close, Winkfield Road, Wood Green, London, N22 5HG

Figure 5-14 Wood Green kick-start network



5.7 Network design criteria

5.7.1 It is strongly recommended that Haringey stipulate that any district heating networks emerging within the borough adhere to the technical standards contained within the District Heating Manual for London. This should ensure compatibility between networks within the borough and also, assuming that other boroughs also adhere to the same guidance, in cross-borough boundary networks.

5.8 Energy centres for kick-start and extended networks

5.8.1 PB has identified a number of potential locations for energy centres within each scheme. One of these has been selected out of necessity to identify a single site for network modelling and costing purposes. However, it must be stressed that this does not represent Haringey's preference or priority for these selected sites.

5.8.2 Energy centres have been identified on the basis of being:

- Within new development
- Within sites developed at a phase in time that matches (at least approximately) the date when it would be expected that a network could start to operate
- Within sites of large demand (heat and electrical) and likely to be able accommodate the required plant to supply the scheme
- Close to the centre of schemes where possible
- With good transport / fuel delivery potential

5.8.3 The following tables list those sites identified on this basis (in no particular order):

Table 5-2 Scheme energy centre locations identified

Scheme name	Site name
Tottenham Hale	Tottenham Hale Retail Park (with temporary EC interim solution)
	Ashley Road North / South
	Station Square West
Northumberland Park area	Tottenham Stadium development
	High Road West development area
	Northumberland Park Estate / School
Wood Green	Clarendon Square
	NW of Clarendon Square
	Clarendon Square Gateway

5.8.4 No sites within Hornsey are listed here as a DEN in this area is not currently recommended for implementation on the basis of the low heat demand density and the resultant economic results – however, this should be reviewed as new sites come forward.

SECTION 6

FINANCIAL APPRAISAL

6 FINANCIAL APPRAISAL

6.1.1 This section presents the inputs and outputs of the financial modelling for the kick-start schemes identified through modelling of network cost vs demand analysis.

6.1.2 Results for the kick-start schemes are presented in terms of annual discounted cashflows, and 25 and 40 year net present values (NPVs). A range of discount rates is presented.

6.2 Economic considerations

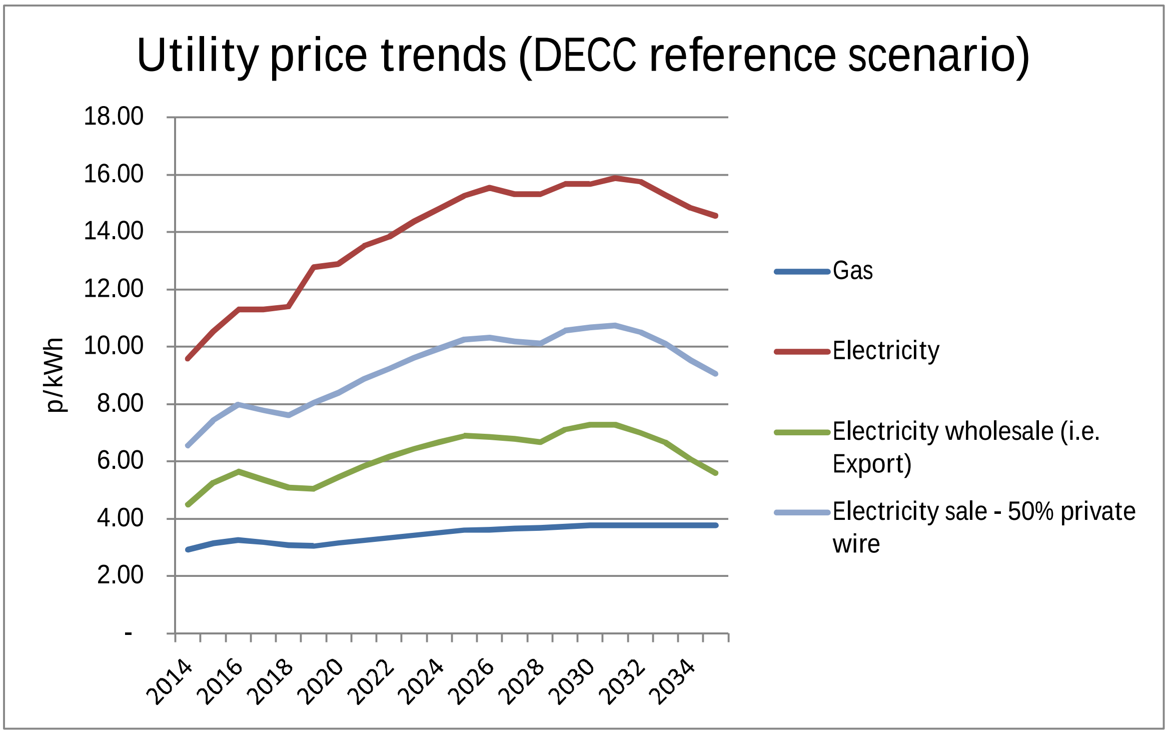
<u>Utility price changes through time</u>

6.2.2 As with the rest of the analysis in this study, the percentage variations in DECC's reference utility price projection have been applied to current (i.e. 2014, which is assumed to be year zero) gas and electricity prices. This approach accounts for future changes in gas and electricity costs in the modelling of commercial performance.

6.2.3 Recent utility price shifts in the markets have illustrated that unquestioning confidence in price projections is not justified. It is therefore important to undertake sensible sensitivity analysis around price assumptions as projects move forward.

6.2.4 The changes in gas price through time also feed through to the heat sales price as it is based on the cost of gas.

Figure 6-1 Utility price assumption illustration



6.2.5 The private wire cost has been adopted to reflect a 10% reduction on typical import prices – reflecting the need to offer private wire customers an incentive to connect to a system that will be perceived to have higher risk and transaction costs.

Avoided costs

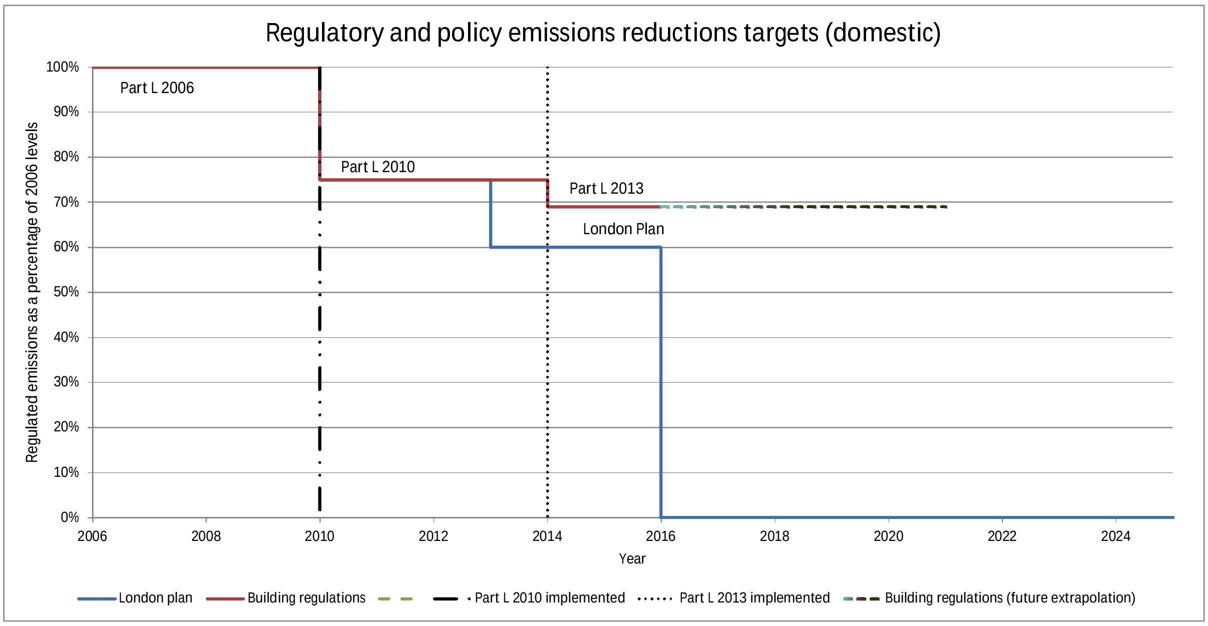
6.2.6 New development within the borough of Haringey will need to demonstrate compliance with Building Regulations and a good level of quality in construction as required through Planning Policy. Whilst the Code for Sustainable Homes (CfSH) regime is no longer in place at a national level, it is assumed here that similar levels of quality in housing delivery will be required.

6.2.7 Achieving the levels of carbon emissions compliance as required by planning policy has certain cost implications, with meeting the higher levels being more costly than the lower ones. Connecting to a district heating network can help developers reduce their compliance costs. For example, if a development is able to connect to a Haringey heat network, it will not have to provide low-carbon plant within an on-site energy centre providing a cost saving. This cost saving can be used as the basis for calculating developer contributions to network development costs.

6.2.8 Connection charges can normally only be levied in the case of *new* developments. This is because *existing* sites will have existing heat supply equipment and therefore levying an upfront charge will discourage them from connecting (unless the connection coincides with existing sites' boiler replacement cycles). Although connection charges are likely to be set following discussion with developers and further analysis, the avoided costs provide an indication of the levels of charge which are likely to be appropriate.

6.2.9 An indication of the carbon emissions reductions required by new developments from Building Regulation and Regional Planning Policy is illustrated here (based on a Part L 2006 compliant case):

Figure 6-2 Illustration of carbon targets



6.2.10 Government has announced that the 'Allowable Solutions' approach will not be pursued at a national level. This was originally conceived as a scheme whereby 'Allowable Solutions' could be used by developments to help meet their carbon reduction commitments.

6.2.11 There is potentially justification for developers to make a contribution to the cost of a DH scheme, but this depends on many factors specific to each site, including when planning permission was received (and therefore the Building Regulation and planning regime that applies), the degree to which required fabric measures might be impacted by a DH connection, the alternative supply options, etc. This level of detail should be incorporated at detailed feasibility level in dialogue with the developers of each site. This will allow the potential benefit to DH scheme roll-out of developer contributions to be assessed.

6.2.12 For the purposes of masterplanning, developer connection charges were calculated on the basis of the avoided cost of installation of primary plant. This assumes that on the basis of the existing planning requirements in London, that developers would in any case be obliged to install site-wide distribution systems, and all necessary plant to enable the delivery of heat from a centralised energy centre. The counterfactual case that is avoided is the installation of primary energy plant (assumed to be gas-fired CHP unit and peaking boilers). All other costs borne by the developer are assumed to be equal between the counterfactual and DH case.

6.2.13 Allocating this amount to both commercial and residential elements leads to the following average connection charges which have been applied to all new developments across the different schemes:

- Connection charge for commercial loads: £50/kW
- Connection charge for residential loads: £1,250 per dwelling

6.3 Economic analysis – heat sales price

6.3.1 As regards heat sales price the assumptions take into consideration the cost of gas, together with avoided costs of boiler maintenance and boiler replacement costs. Gas price is linked to DECC's statistical publication 'Quarterly Energy Prices – March 2014', and are indexed using the DECC energy price projection 'reference scenario'.

6.3.2 The following assumptions have also been made, based on the supply to an HIU and meter within a dwelling:

- Typical new domestic gas boilers would operate at 90 percent boiler efficiency[29]
- Avoided domestic boiler maintenance / servicing cost of £120 p.a.[30]
- Avoided boiler replacement cost of £2,500 on a 15 year cycle (annuitized).
- A 10 percent reduction in the overall cost of heat from this gas boiler base heat price has been applied to offer heat sales customers a saving on their 'alternative' supply scenario.

[29] This value has been applied throughout the project lifecycle, assuming that the boiler is well-maintained.

[30] Based on typical values as per http://www.moneysupermarket.com/boiler-cover/boiler-only-cover/?goal=Boiler+only+breakdown+cover.

6.3.3 Tables in the appendices illustrate this calculation process for new domestic customers and other customer types:

6.3.4 The following table summarizes the figures adopted in modelling.

Table 6-1 Summary of assumed heat sales values

Customer type	Heat sales value	Unit
New domestic	9.75	p/kWh (heat delivered)
New non-domestic	4.71	p/kWh (heat delivered)
Existing domestic	9.17	p/kWh (heat delivered)
Existing non-domestic	4.00	p/kWh (heat delivered)

6.4 CAPEX

6.4.1 An estimated energy centre cost was derived for each network option (contained within the appendices). A summary in the table below is provided for the capital cost of the kick-start networks.

Table 6-2: Summary of CAPEX

Network	Overall scheme CAPEX (£m)	...of which energy centre building inc utilities	...of which main DH network	...final DH connections (part of DH network)	...of which primary plant	....of which substations	...of which professional fees, contractor prelims, contingency, commissioning)
Northumberland Park	£13.7	£1.8	£2.1	£1.0	£4.8	£1.3	£3.7
Tottenham Hale	£7.7	£1.2	£0.6	£0.4	£2.6	£0.8	£2.5
Wood Green	£8.2	£1.1	£1.4	£0.4	£2.7	£1.1	£2.0
TOTAL	**£29.6**	**£ 4.1**	**£ 4.1**	**£1.80**	**£10.1**	**£ 3.2**	**£ 8.2**

Flat conversions

6.4.2 Although some of the blocks of flats/maisonettes connected to the DH network already have communal heating systems, the majority have individual gas boilers, and will need to have riser and lateral pipework installed in order to be supplied from a DH network. Conversion costs were based on a value of £7,500/dwelling[31] including all builders' works but excluding the HIU cost.

6.4.3 Residential data comes from three sources:

- Gas consumption data for Haringey communally heated stock. These buildings evidently already have communal heating installed.
- Homes for Haringey stock database. This database of Haringey-owned council social housing lists the heating system installed in each dwelling, allowing communally heating dwellings to be identified.

[31] Derived from previous PB project experience

- Haringey Residential Social Landlord housing stock database. This does not provide information on heating systems installed.

6.4.4 In order to estimate the number of dwellings requiring conversion, the percentage of dwellings in the Homes for Haringey database already with communal heating was established, and this was applied to the RSL properties. Across the board, it was established that 9% of residential dwellings already have communal heating systems installed, thus 91% requiring conversion.

6.5 Maintenance and replacement

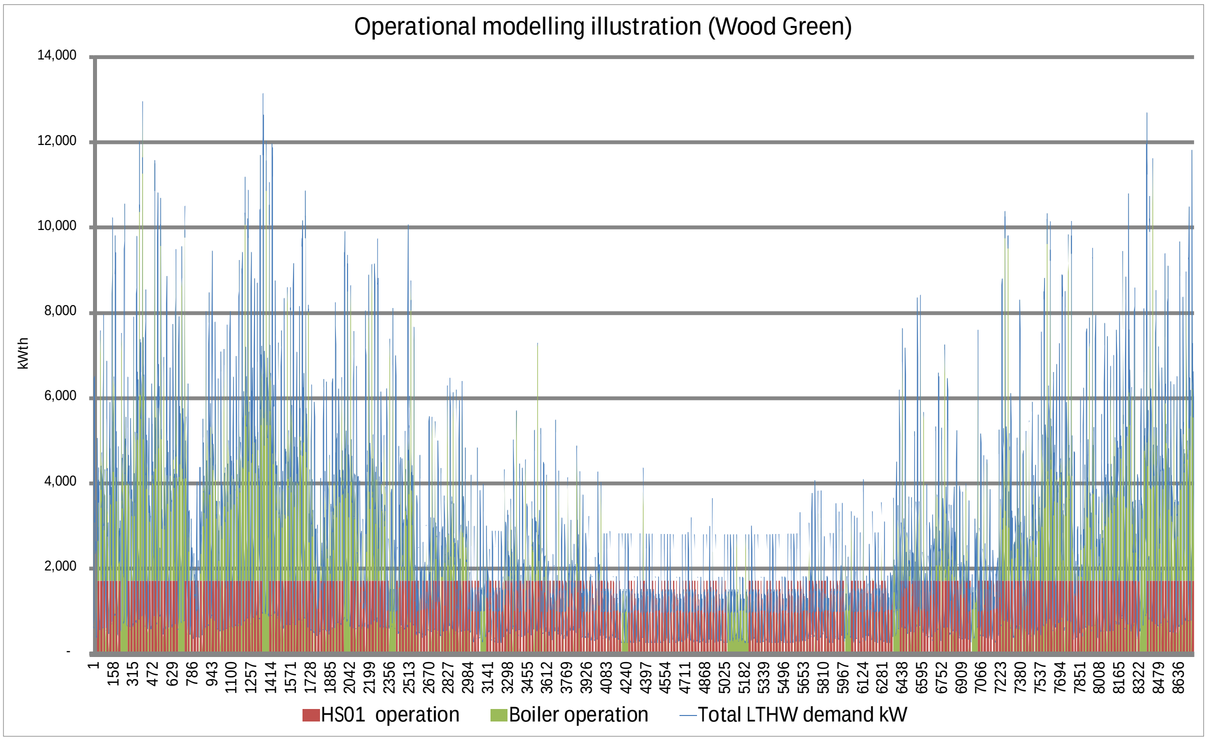
6.5.1 An allowance for maintenance and replacement of key plant items was included within modelling, as per the itemised lists in the appendices.

6.6 Operational modelling

6.6.1 For each of schemes modelled the performance of a number of different scale CHP units has been tested, so that the most economically beneficial performing unit could be selected. Typical operation of units was modelled for each year of scheme growth as follows:

For each hour of predicted annual demand, it was evaluated if the CHP unit(s) could operate (i.e. whether there was sufficient demand from the DH system or thermal store). The aggregated outputs of each hour of operation across each year of the project was then collated and combined with top-up boiler requirements to generate the overall energy balance results for each scheme through time. These annual figures were then adopted as the basis for compiling the financial modelling results shown below. An example of annual operation of a CHP unit against the available demands is shown below (for the Wood Green scheme in this example).

Figure 6-3 Operational model example illustration



This chart shows the CHP unit (HS01 in the legend on the chart) operating at close to its rated output for the hours of the year when it has been modelled as available. The boiler operates to meet demands that cannot be met by the CHP.

6.7 Financial appraisal results (export power scenario)

6.7.1 The following graphs show the financial performance of the different kick-start schemes analysed, adopting the assumptions listed above. The figures in this section reflect the assumption that electricity generated is exported to grid.

6.7.2 The graphs present overall performance over 25 and 40 years at a range of discount rates, and a discounted cashflow graph accompanies each set of results (up to 2050).

6.7.3 Wood Green

Figure 6-4 Wood Green NPVs

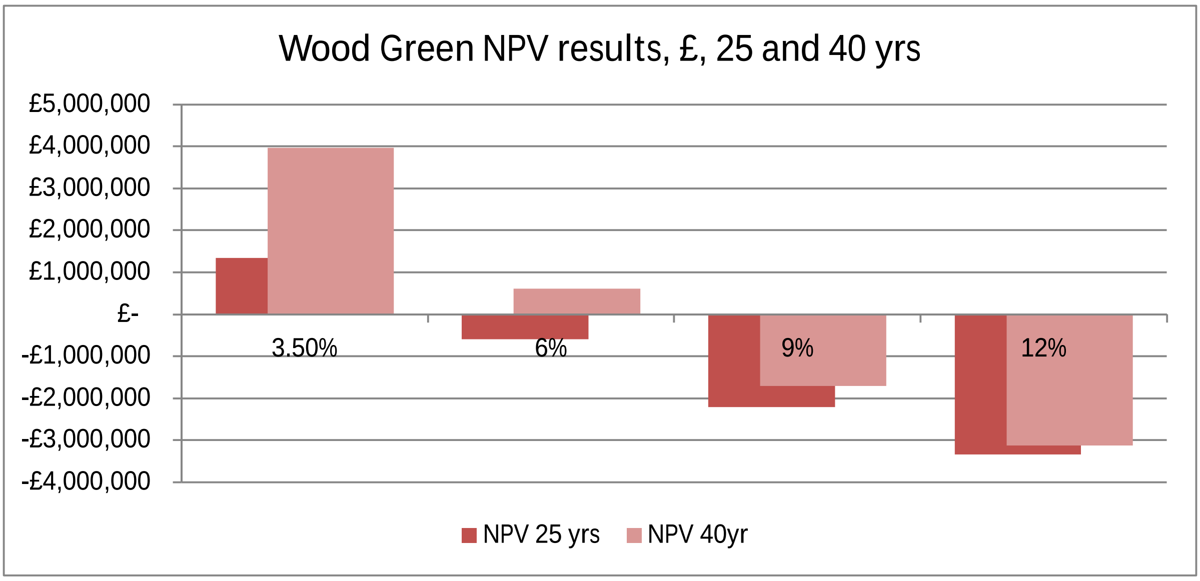
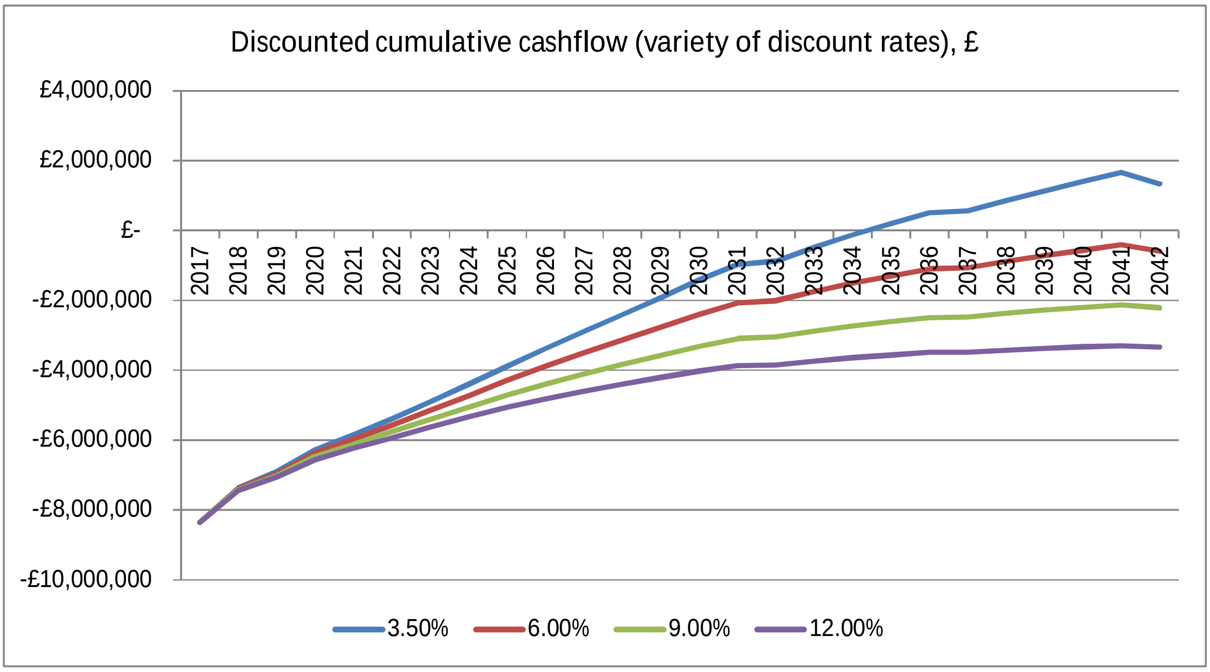


Figure 6-5 Wood Green discounted cumulative cashflow



6.7.4 These results illustrate that there is an operating profit once the scheme is established and that, taking a long-term view and at a low discount rate, the scheme is viable.

6.7.5 Hornsey

Figure 6-6 Hornsey NPVs

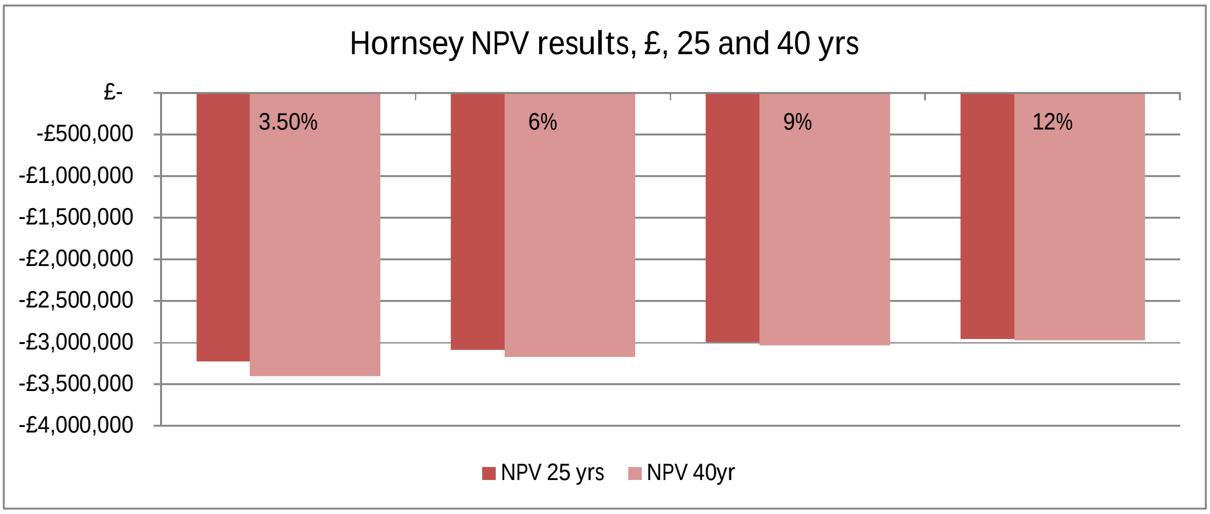
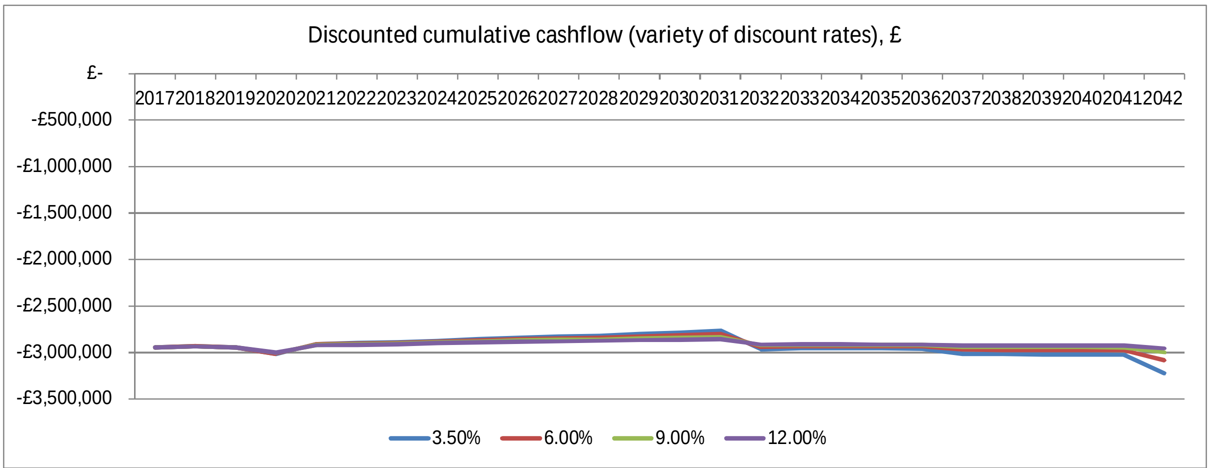


Figure 6-7 Hornsey discounted cumulative cashflows



6.7.6 These results show negative NPVs at all discount rates, and also that there is no (or very little) operating margin for the scheme once established. This is primarily due to the lower average heat sales price for the loads identified (i.e. existing non-domestic rather than domestic new-build).

6.7.7 Northumberland / Spurs / High Road West area

Figure 6-8 Northumberland / Spurs / High Rd West NPV results

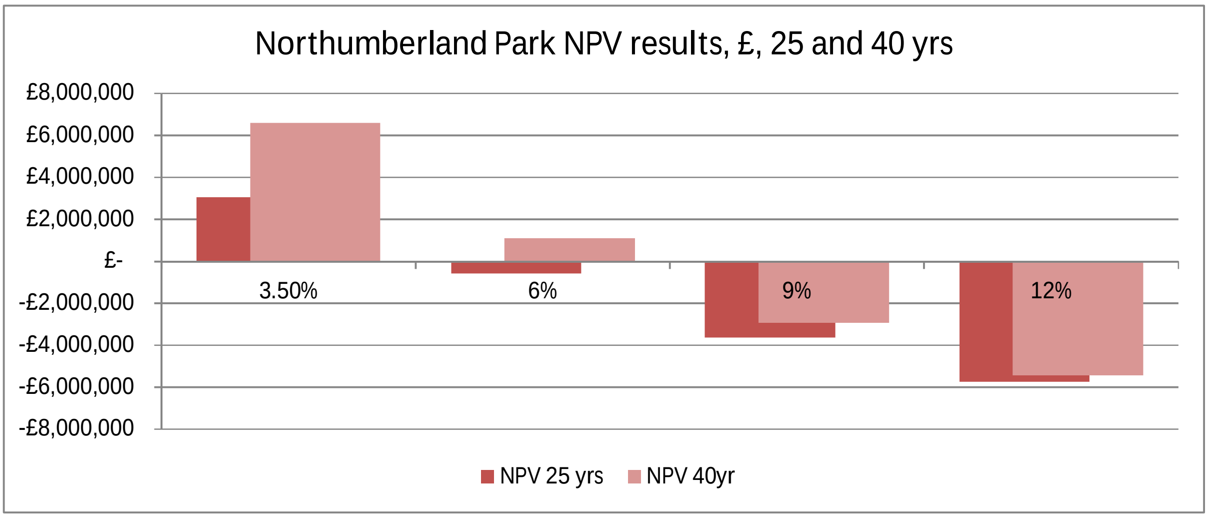
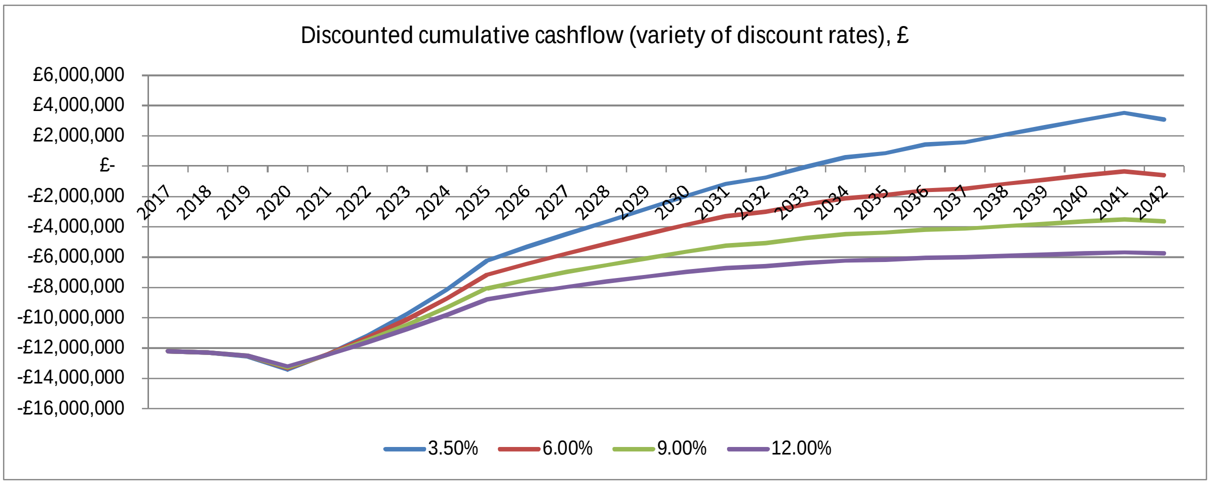


Figure 6-9 Northumberland Park area discounted cumulative cashflows



6.7.8 These results indicate that under a pure export scenario, that a CHP scheme delivers a positive NPV at low discount rates over the evaluation periods adopted here.

6.7.9 Tottenham Hale area

Figure 6-10 Tottenham Hale kick-start network NPV results

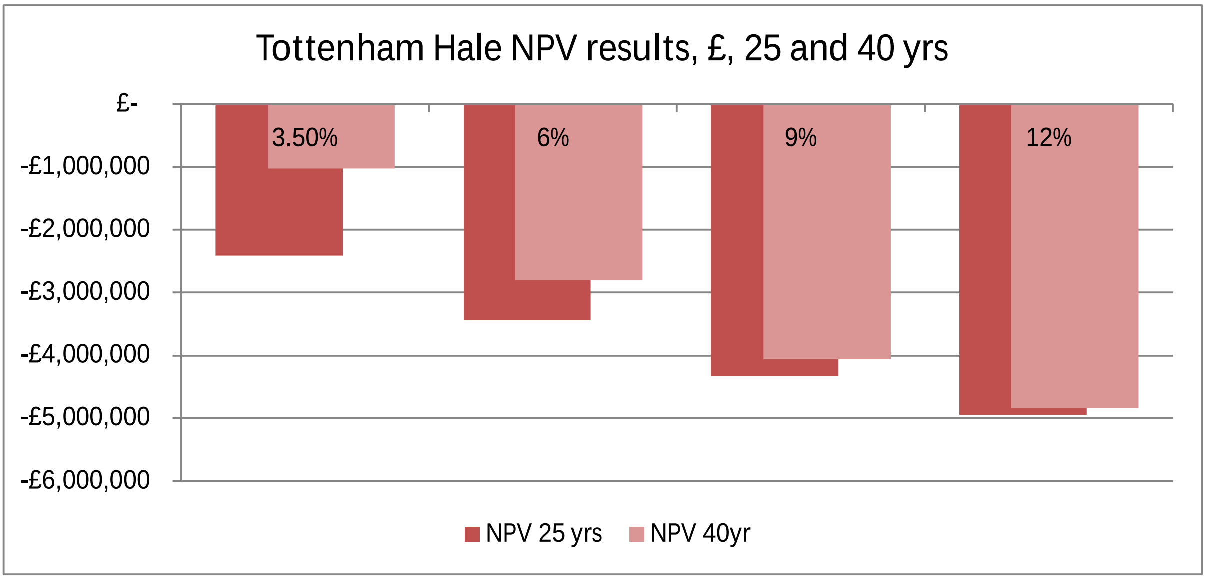
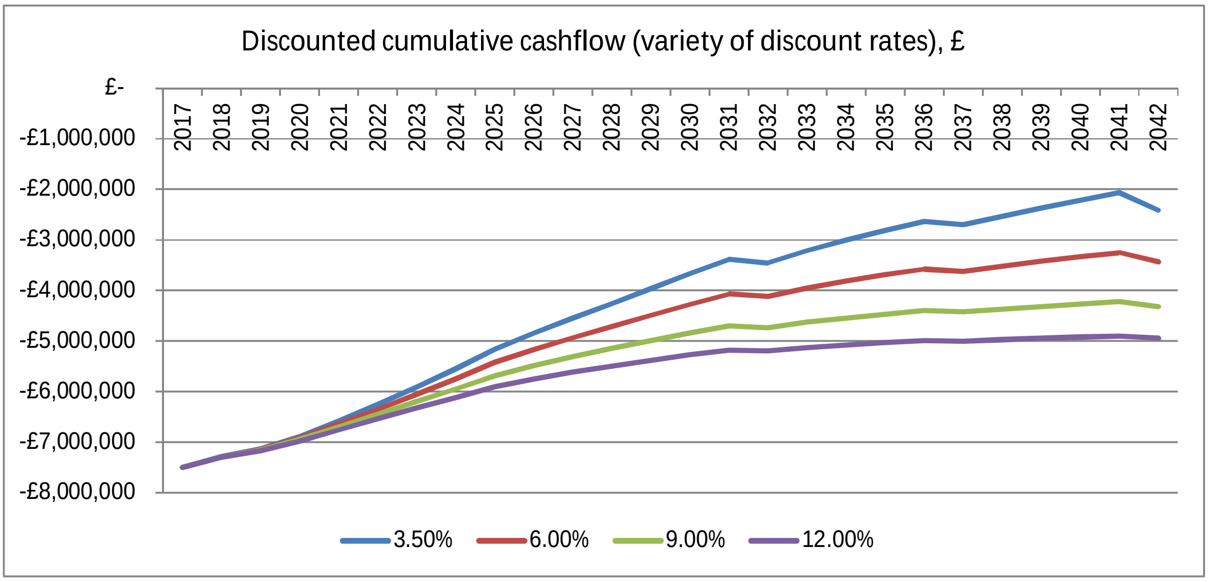


Figure 6-11 Tottenham Hale kick-start discounted cumulative cashflows



6.7.10 This set of results illustrates that the heat density is not sufficient to deliver a viable scheme on the basis of the predominantly new-build development in proximity to Tottenham Hale station. This is partially due to the significant commercial element of the loads anticipated in this scheme, and the lower heat sales value in comparison with residential-based schemes. However, with private wire electrical sales, as illustrated below, the scheme does deliver positive whole life cost results.

6.8 Electricity Sales

6.8.1 The value of electricity generated through a decentralised energy scheme equipped with CHP can be maximised through the use of private wire networks. Whilst the wholesale price of electricity to the grid is around 4-5p/kWh, a private wire network – whereby an electricity network is installed between an energy centre and nearby electricity users – is able to maximise the value of electricity generated by enabling retail values (or slightly below to allow recipients to see some value) to be obtained (e.g. around 8-12p/kWh). This study has adopted 2014 figures of 8.63p/kWh for private wire electrical sales and 4.49/kWh for export to the grid (see table below).

6.8.2 A further future option for electricity sale is the arrangement known as "licence lite". The licence should allow generated electricity to be procured by the public sector, providing generators with a higher price than would be obtained if they sold power directly to a supplier under a traditional 'power purchase agreement'. This electricity would then be sold at cost price to other public sector organisations. PB has liaised with GLA to establish the stage of development of this mechanism.

6.8.3 The GLA has become the first authority in the country to apply for Licence Lite, a form of junior electricity supply licence. This enables it to buy from smaller-scale electricity generators and supply their outputs to selected electricity customers. This system offers the generators better prospects of obtaining higher prices for their power, more in line with the large-scale wholesale market for electricity. To initiate the operation of our Licence Lite, the GLA is currently inviting companies that generate electricity to bid to provide the electricity[32].

6.8.4 PB would strongly recommend that electricity private wire sales are pursued for the Haringey schemes identified wherever possible.

6.8.5 The electricity sales prices assumed in the techno-economic analysis are as follows:

Table 6-3 Assumptions for electricity sales routes

Sales route	Price assumption	Value in 2014	Source
Export to grid	90% of wholesale electricity prices	4.49p/kWh	Based on DECC energy price projections (September 2014)
Private wire sales	90% of electricity import prices	8.63p/kWh	Based on DECC energy price projections (September 2014)

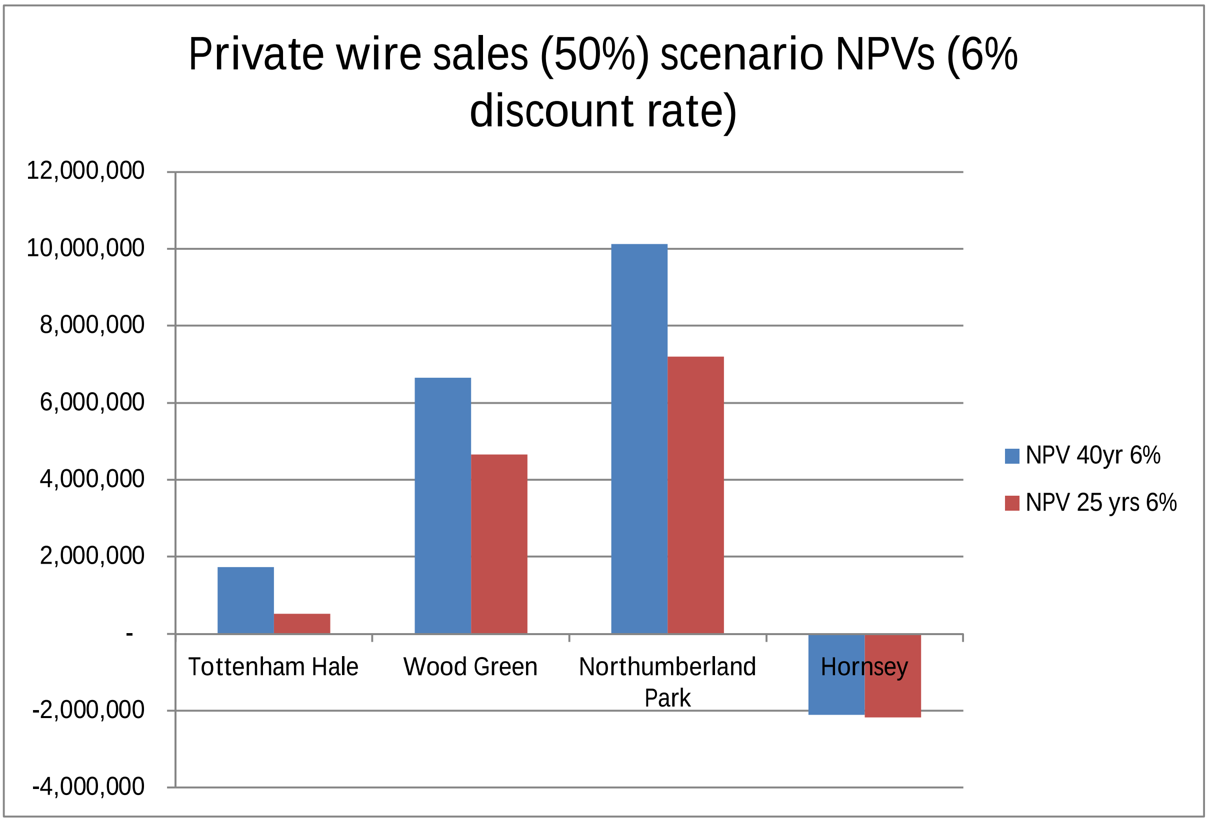
6.8.6 The overall price that could be obtained would also depend upon the size of customers to which sale could be organised.

32 https://www.london.gov.uk/sites/default/files/LIP%202050%20update%20report%20March%202015_0.pdf, accessed 7th October 2015

6.8.7 The graph below illustrates the NPVs of each scheme on the assumption that 50% of electricity is supplied via a private wire network, allowing higher electricity sales prices to be obtained.

6.8.8 This does not allow for the increase in capital cost associated with the private wire installation. Hence this table indicates the potential capital cost of a private wire system up to which it would be worthwhile pursuing the private wire sales route.

Figure 6-12: Kick-start scheme performance with 50% of electricity being sold via a private wire network



6.8.9 The table below summarises the 25 year NPVs (@ 6% discount rate) under each electricity sales option and the difference in NPVs between the two scenarios. This illustrates the maximum potential cost of a private wire network that could be implemented whilst improving the overall NPV of the scheme (under the 50% power sales via private wire scenario).

Table 6-4 Potential cost uplift for private wire system to be worthwhile

Scheme	Export to grid	Private wire (50%)	Possible private wire CAPEX
	25-year NPV (£m, 6%)	25-year NPV (£m, 6%)	25-year NPV (£m, 6%)
Wood Green	-£0.60	£4.65	£5.25
Hornsey	-£3.08	-£2.18	£0.91
Northumberland Park	-£0.59	£7.21	£7.80
Tottenham Hale	-£0.60	£4.65	£5.25

6.8.10 Whilst this study has not investigated the magnitude or cost of potential private wire supplies, this analysis strongly suggests that a private wire connection for all of the three recommended networks here would be beneficial to the whole life cost performance of the schemes, and in some cases essential to delivering a viable solution.

SECTION 7

DELIVERY PLAN

7 DELIVERY PLAN (INCLUDING PLANNING POLICY)

7.1.1 This report identifies an accessible technical potential for the expansion of DH within the borough of Haringey to 2050, and considers what actions are required to deliver this potential. This section considers some of the historical means of delivery of decentralised energy, and also considers the planning / funding options that Haringey could utilise moving forward.

7.1.2 It is split into the following main sections:

- Strategic Road Map
- Delivery
- Planning Policy

Strategic Road Map

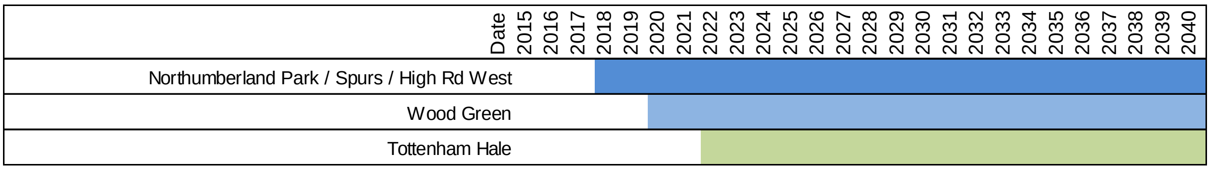
7.2 Short-term implementation - where should DE be implemented first?

7.2.1 One of the challenges in developing an Energy Masterplan across a wide geographic area and long time-period, is to ensure that the recommendations are sound even whilst it must be acknowledged that actual development timescales and details will deviate from the data used as a source of the projections and analysis.

7.2.2 In the case of Haringey it can be seen from the analysis of the schemes above that there is a variation in terms of performance and scale.

7.2.3 The delivery sequence of the schemes in different areas must be flexible enough to respond to changes in completion dates, i.e. delays or acceleration in the delivery of schemes. However, as initial recommendations for the focus of effort in the shorter-term, the following delivery sequence is envisaged:

Figure 7-1 Delivery sequence recommendation



7.2.4 Further links between these areas are also recommended in the longer term, although the timescale when this might be appropriate is heavily dependent upon the rate of emergence of localised networks / compatible systems.

7.3 Longer-term strategic vision

7.3.1 In the longer term, once kick-start networks have been established, and initial barriers to take-up have been overcome, particular attention should be given to the potential to link up key nodes of centralised heat supply. This aggregation of heat demand should in turn then allow more innovate or scale-dependent heat sources to be used to supply a wider area network.

7.3.2 In particular in the case of Haringey, key linkages that appear to offer the greatest potential are:

- Lea Valley Heat Network connection to High Road West / Northumberland Estate area
- St Ann's Hospital and Tottenham Green
- High Road West / Northumberland Park area to Tottenham Green
- Tottenham Hale and Blackhorse Lane (Waltham Forest)
- St Ann's Hospital and Woodberry Down (Hackney)

7.3.3 The interconnection of these areas should be responsive to local opportunities that arise, and the speed and scale at which local networks in each area emerge.

Figure 7-2 Long-term strategic vision

7.3.4 Beyond the inter-connectivity of DH zones as illustrated on the map above, it is also important to consider how the heat supply base might transition to an increasingly lower carbon supply. The 'heat supply' section of this report considers the technologies and fuels that are anticipated to be market-ready within the timeframes addressed in this study, and in line with this view and activity in neighbouring boroughs the following delivery recommendations are made:

- Actively support the delivery of the LVHN (either with or without the initial installation of CHP in the Northumberland Park / Spurs / High Road West area) and its potential to utilise secondary heat from the treatment of waste, as well as potential recovery of heat from biomass CHP (Kedco)

- Explore the potential for the eastern edge of the borough to utilise reservoir-source heat pumps by ensuring low temperature secondary system designs are installed in properties close to water-sources
- For those schemes anticipated to be delivered in the 2020 – 2030 timeframe in particular, the potential to install biofuel CHP plant should be explored at those sites where sufficient fuel storage space (and delivery access) can be identified.

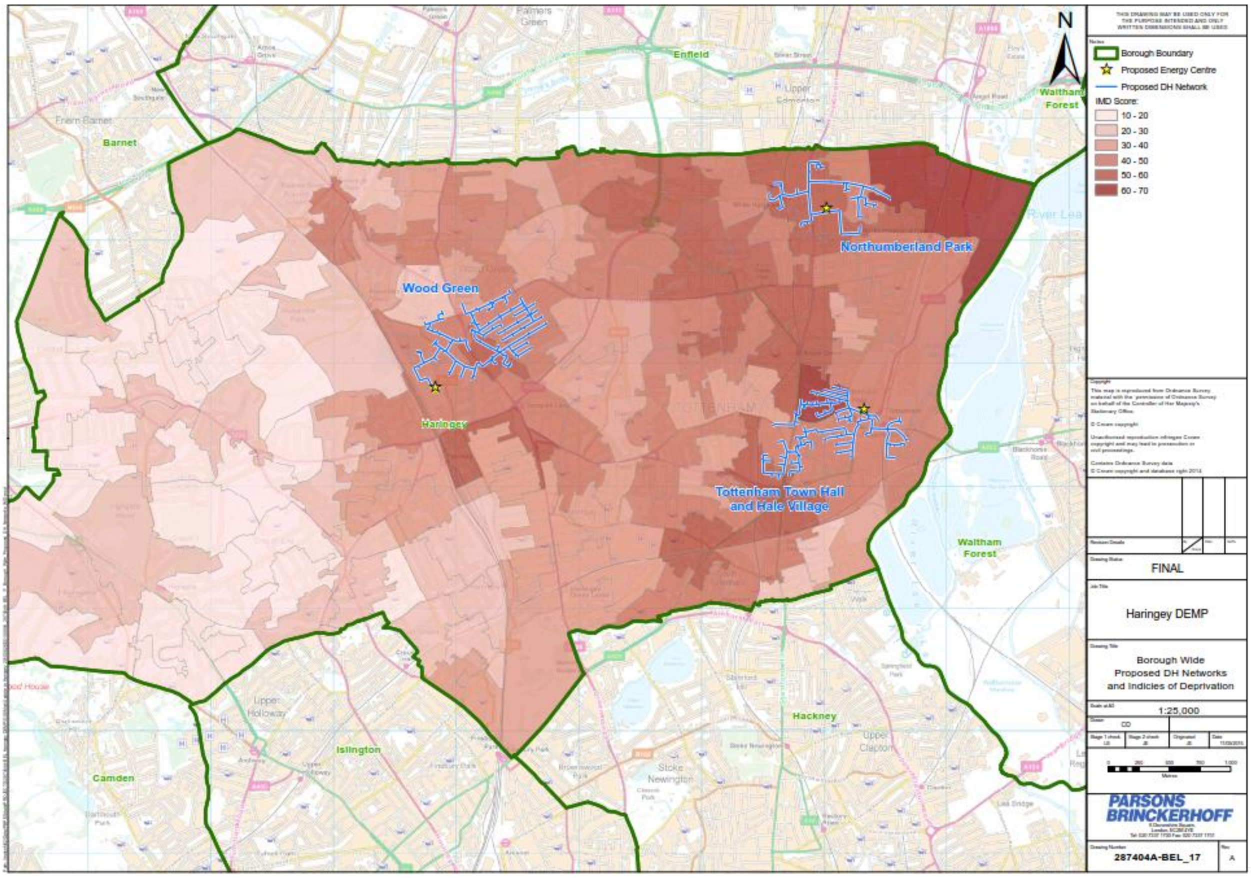
7.3.5 It is likely, given the current structure of the energy supply market, that the different heat distribution networks will be developed by more than one organisation. However, the vision for the borough, and indeed for London itself, is to aggregate these networks into a more coherent system, allowing greater use to be made of large generation facilities (i.e. Barking Power Station, Edmonton incinerator, SELCHP etc.). In order to progress this transition, a means to transfer heat from one 'cluster' to another must be put in place. The proposal to enable this is for the public sector to become a 'heat utility' infrastructure owner, where the transfer of heat across this network allows the initial investment to be repaid. This is thought to best reside with the public sector as initial returns on investment are unlikely to attract the private sector, and also as the local planning authority has a duty to support the hierarchy of the London Plan that requires district energy to be prioritised over individual solutions, implemented via statutory planning policy. The economics of the systems will depend upon the magnitude of the clusters developed, and the speed of expansion of the systems.

7.3.6 This approach of the public sector as heat distribution utility owner is also particularly relevant in the shorter term to areas where the interconnection of development sites is unlikely to proceed unless the approach is 'de-risked' for developers. An example for Haringey in this context might be the interconnection of Hale Village with the proposed scheme at Tottenham Hale (i.e. allowing the sale of Veolia's 'excess' generation above its own site needs). This is considered to be an interesting opportunity partly due to the existence of substantial low-carbon generation plant within Hale Village, and the potential to increase utilisation of this plant through the installation of substantial thermal storage vessels on development sites remote from this plant.

7.4 Deprivation and the potential to address fuel poverty

7.4.1 The following figures illustrate how the proposed schemes intersect with indices for multiple deprivation (IMD) scores across the borough. We would expect areas with high IMD scores to be experiencing high incidences of fuel poverty.

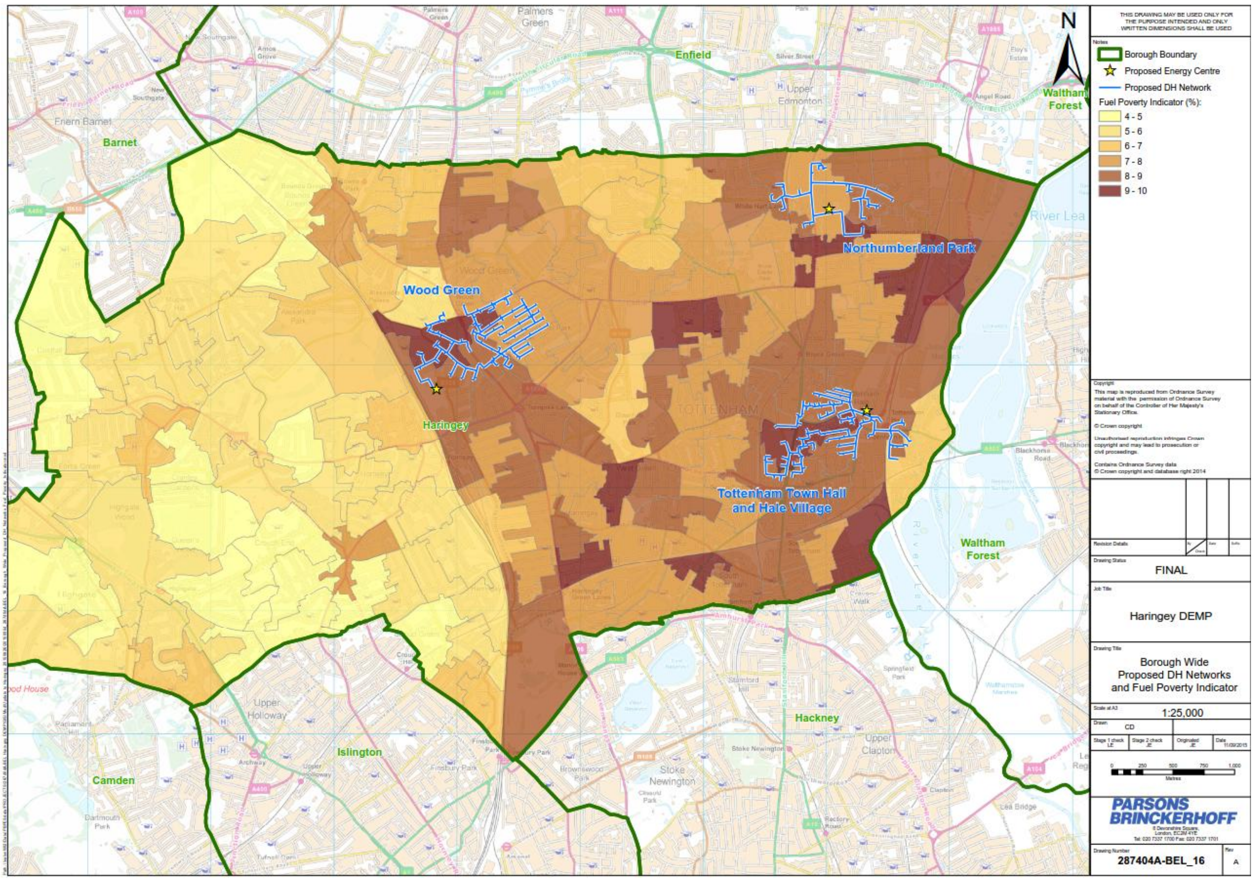
Figure 7-3 Index of multiple deprivation and potential scheme locations



7.4.2 This figure above is based on the ‘English Indices of Deprivation 2010’, which provide a relative measure of deprivation at small area level across England. Areas are ranked from least deprived to most deprived on seven different dimensions of deprivation and an overall composite measure of multiple deprivation. Most of the data underlying the 2010 indices are for the year 2008. The domains used in the Indices of Deprivation 2010 are: income deprivation; employment deprivation; health deprivation and disability; education deprivation; crime deprivation; barriers to housing and services deprivation; and living environment deprivation. Each of these domains has its own scores and ranks, allowing users to focus on specific aspects of deprivation[33].

[33] http://data.gov.uk/dataset/index-of-multiple-deprivation, accessed 18th Sept 2014

Figure 7-4 Index of fuel poverty and network locations



7.4.3 The figure above illustrates data on the extent of fuel poverty in England. These fuel poverty figures are derived from DECC sub-regional statistics[34] from 2012.

7.4.4 The two figures above illustrate that the schemes located in the east of the borough are in areas where there are significant levels of fuel poverty and deprivation. This suggests that these networks should be implemented as a matter of priority in order to meet the Council's social policy objectives.

7.5 Carbon Reduction

7.5.1 The project rationale section quantified the carbon reductions targets that can be assigned to the borough of Haringey. In order to maintain compatibility with these targets, the factors that are adopted in this assessment are those that were also used to calculate these borough-wide emissions.

7.5.2 The estimated carbon emissions reduction target (to achieve mayoral aspirations in 2025) across the borough is 379ktonnes CO_2 per annum. Haringey levels in 2011 were at 840ktonnes/annum, so this implies a saving of around 461ktonnes is required.

[34] https://www.gov.uk/government/statistics/2012-sub-regional-fuel-poverty-data-low-income-high-costs-indicator, accessed January 2015

7.5.3 A summary of the emissions savings that are calculated to be generated by the different kick-start schemes by 2025 is shown below. Emissions are calculated relative to a base case of gas boilers supplying heat.

Table 7-1 Emissions savings in 2025 (kick-start schemes)

	Carbon dioxide savings tonnes p.a. (2025)
Tottenham Hale	1,908
Wood Green	2,059
Northumberland Park	4,207

7.5.4 This table illustrates that 8,000 tonnes CO_2 savings p.a. are predicted through this modelling to be delivered by DE networks in 2025.

7.5.5 This does not take into account various other initiatives in the borough i.e. energy efficiency roll-outs etc. Even under generous assumptions relating to the balance between increasing housing numbers and energy efficient heat supply, it can be seen that there is likely to be significant shortfall between the extrapolated Haringey target and the carbon savings delivered through DE projects. This suggests that efforts both in terms of DE and other mechanisms must be pursued aggressively in order to approach the carbon savings needed.

7.5.6 Other factors beyond Haringey's direct control will also contribute towards carbon savings (i.e. decarbonisation of the grid, Green Deal take-up, etc.). These have not been estimated here.

Delivery

7.6 Background to commercial arrangements for district heating in the UK

7.6.1 Historically the development of district heating in the UK has been, with some significant but isolated exceptions (see below), relatively small scale. Networks were developed by local authorities to serve social housing, funded from public finances and were often not maintained or developed in a commercially sustainable way. More recently there has been a move to develop schemes in partnership with the private sector and specifically towards the creation of Energy Service Companies (ESCOs). This move has been primarily driven by the lack of public funding for infrastructure projects but also by the acceptance that systems need to be managed and maintained in a commercially viable manner, requiring a range of technical and commercial skills not always available in the public sector.

7.6.2 Therefore the process of investigating potential business models for district heating based ESCOs and energy services schemes starts with an acknowledgement that, until recently, there were no private sector companies capable of delivering large scale DH projects connecting existing buildings without specific local authority sponsorship. This is now a growth market, and the potential is such that the opportunities to develop such projects are substantial. A decentralised energy approach provides the opportunities for energy cost and carbon emission reduction under which developers responsible for large new-build projects may build flexible energy systems for the future. The development of such schemes can also act as a catalyst for the decarbonisation of existing buildings in the surrounding area.

7.6.3 There are a few examples of city DH schemes that have successfully developed beyond the “estate project” scale and have delivered significant private sector commercial connections, of new and existing development, in Nottingham, Sheffield and Southampton. The schemes in Sheffield and Southampton are now wholly private sector owned but were originally developed with significant support from the local authority or central government, both in terms of access to funding and in provision of base load, long term connection agreements.

7.6.4 The development of the private sector ESCO market reflects the requirement from planning authorities that energy generation and supply to buildings be considered with the aim of minimising the carbon footprint of buildings overall. This has created a market for ESCOs amongst developers seeking to contract out their carbon reduction commitments under planning permissions. The planning process is likely to remain a key driver in the short-term but there are also more strategic approaches being developed towards the use of district heating in London and other major cities such as Leicester, Coventry and Newcastle. Birmingham in particular is partnering with a private sector firm to develop schemes in the city with a view to developing a city-wide district energy network. Two schemes are currently operational, both of which are based on a core of public sector loads.

7.7 Potential approaches for development of DH

7.7.1 There are a number of potential approaches to the general development of district energy schemes under sponsorship by the public sector; these are summarised in the table below. It should be noted that this is not an exhaustive list of all the potential commercial arrangements possible for public-private partnerships but it does cover the main types of scheme development that have been undertaken to date. It should also be noted that there is no restriction on using different forms of organisation during different phases of the project life. For example the ownership of the Sheffield scheme was originally a mix of public and private but the local authority disposed of its share once the scheme was developed and could be re-financed. This is a good example of a local authority taking some risk early in a project to reduce the costs of finance and then disposing of its interest once these risks have fallen away.

Table 7-2: Approaches to delivering district heating

Description	Funding	Construction	Ownership	O&M	Examples
Public Sector - traditional	Local authority funds Grant funding over public funds	Public procurement of construction contracts by local authority	Local authority direct	Local authority internal or public procurement of O&M contract	Lerwick, Shetland, Islington
Public sector – arm's length organisation	Local authority funds Grant funding over public funds ALMO Borrowing	Public procurement of construction contracts by ALMO	ALMO	ALMO direct or public procurement of O&M contract	Pimlico District Heating Undertaking, Aberdeen Heat and Power
Public Private Partnership – JV company	Part as public sector plus private sector equity plus private sector debt	Public/private sector procurement of construction contracts (depends on JV structure and partner capabilities)	JV Co Ltd	JV Co direct or Public/private sector procurement of O&M contracts (depends on JV structure and partner capabilities	Thameswey Woking, initial Sheffield scheme, Birmingham CC / Cofely GdF Suez
PPP – split responsibilities (eg energy supply private; infrastructure public sector)	Part as public sector plus private sector equity plus private sector debt	Split public/private procurement with interface management	Split public/private	Split public/private procurement of O&M services. Public O&M potentially packaged with private sector partner	Nottingham
Private sector – direct ES contract	Private sector debt/equity Grant funding – limited availability Supported by contract for services	Public procurement for ES Service – fixed scope Private sector construction contracts	Private sector – possible future reversion to public after defined period	Private sector	SSE Woolwich, E.ON Myatt's Field
Private sector – concession	Private sector debt/equity Grant funding – limited availability Supported by concession	Public procurement for concession – fixed area/service variable scope (likely base case fixed scope required). Private sector construction contracts	Private sector – possible future reversion to public after defined period	Private sector	Olympic Park/Stratford City

7.8 Ownership of DE assets, operation, ESCOs

7.8.1 Local authorities have more recently been unwilling to become involved *directly* in the delivery and on-going operation of DE assets. Day to day management of many assets is now outsourced, even if ownership often resides with the Council. This can be attributed to the operation of DE assets not forming the 'core business' of local authorities, and the management of DE plant being a niche area that requires specialist expertise.

7.8.2 However, should Haringey wish to develop a role more akin to that of an ESCO operator then there are some key benefits, which are outlined in the table below.

Table 7-3: Benefits of Haringey as utility services provider

Benefits
Haringey's ability to access low cost finance (Prudential Borrowing or Public Works Loan Board)
Haringey as a utility / ESCo would be a clear partner with whom developers could contract for the delivery of energy to specific schemes
Ability to raise funds via CIL (or Allowable Solutions / S106) for decentralised energy projects with strategic importance (rather than just those that are commercially viable)

Enables the de-risking of projects that could then attract private finance after a period of initial growth

7.8.3 The alternative case for the delivery of DE would likely take the form of another public / private partnership, where the emphasis and equity involvement would likely fall more squarely with the private sector. This model has its own merits, but arguably does not leave sufficient room for long-term planning or strategic investment in line with Haringey's long-term aspirations and policy targets.

7.8.4 The analysis above has shown that there are significant challenges in driving towards the target emissions reductions as required by Regional Planning Policy and Haringey's own commitments. One the one hand, in order to assist achieving these targets as far as possible, (i.e. in order to deliver maximum carbon savings and future-proofed potential on a strategic basis), it is suggested that it is essential for the public sector to be involved in the delivery of projects. This involvement should be gauged to prevent a wholly private-sector, shorter-term, profit-focussed approach that fails to invest in infrastructure that allows larger-scale networks to emerge. On the other hand, we are in a highly constrained economic period, and profitability is also critical. From this perspective, immediate opportunities that appear to have sufficient viability to appeal to market investors should arguably be pursued in preference over other vehicles.

7.8.5 This report addresses a long-term strategic vision for Haringey, and as such the view is taken that whilst the current market constrains potential routes for delivery, a 'preferred' route to delivery is identified, with the aspiration that future market and economic upturn will allow movement towards this preferred delivery method.

7.8.6 The model that is recommended in this study is on this basis is the 'Haringey as heat distribution utility'. This report does not attempt to flesh out the detail of the exact form that this might take, but makes the following broad assumptions on its composition and operation:

Table 7-4: Haringey as heat distribution utility - model attributes

Attribute	Rationale
Public sector led	Allows for strategic investment in commercially marginal opportunities
Involvement of private sector subcontractors	For specialist services such as CHP maintenance, metering and billing, DH network maintenance
Projects partially funded through ring-fenced monies raised through CIL / planning gain	Enabling funds to be raised and projects implemented to match programme requirements of private sector
Links to existing low-carbon plant	Increasing utilisation of existing plant / facilities should allow lower cost heat generation (i.e. with lower fixed cost levels) than entirely new-build schemes

7.8.7 The key attributes of this model that make it suitable for Haringey, are that:

- It allows multiple companies to be involved in the delivery of early phase schemes, and then should enable the aggregation of systems to more efficient, larger models. This is relevant to the aggregation of schemes as highlighted in the vision for the borough where interconnection of High Road West, Spurs, Tottenham Green, Hale Village and potentially St Ann's and Woodberry Down in Hackney in the longer term is proposed.

- Investment in the key 'linking' infrastructure where it is envisaged that the public sector acts as a 'distribution network operator' for heat is arguably not required until individual cluster schemes are established, and when it is hoped that the current market constraints will be somewhat alleviated.

7.8.8 Two variant models of this 'Haringey as utility' concept are briefly outlined below:

7.8.9 Haringey as distribution asset owners - One means through which Haringey could significantly alleviate some of the current key risks and barriers to DH implementation, would be to take on the role of distribution asset owner. This could operate in the same way as other utilities, and would see Haringey recoup its investment costs through charging for the transportation of heat and potentially electricity. This is identical in principle to the role of the asset owner at the King's Cross District Heating Network, and has close similarities to the role of the distribution network operators in the electricity market. .

7.8.10 Haringey as whole system owner - A further step towards full operation as an ESCo would be for Haringey to own not only the heat distribution assets, but also the energy centre assets. This would transfer the majority of risk onto Haringey in terms of commercial exposure, but would allow Haringey to take close to full responsibility for delivery and expansion.

7.8.11 Scheme specific comments

7.8.12 The composition and economic viability of the different networks identified in this report will also have an influence on the delivery vehicle selected for each. The degree to which schemes have the potential to appeal to the private sector will depend on the level of electrical private wire demand that is feasible to connect. The figures identified in this report for kick-start schemes suggest that the Northumberland Park scheme is likely to hold the most appeal to the private sector, assuming that sufficient private wire demands can be identified. However, none of the schemes appears to offer such returns as to offer immediate prospect of fully-private sector delivery. This statement is made on the basis of the high-level analysis, and hence clearly needs to be substantiated with more detailed scheme design development and dialogue with individual site stakeholders.

7.8.13 In all of the schemes identified within this study, new development is proposed as the location for primary energy delivery plant serving loads beyond the development boundary. Developers will be naturally resistant to the space-take requirements for this, and clear strategic vision must steer the process of negotiation with developments coming forward to ensure that a suitable location can be identified within each priority kick-start area identified within this report. A list of suitable sites for each scheme is provided as part of this study.

7.9 Operation of schemes

7.9.1 The requirement for skilled and experienced resources is not restricted to scheme development. There is some evidence of scheme performance deteriorating over time in the UK due to inadequate training and supervision of operations and maintenance. There has also been a tendency towards short-term thinking in relation to maintenance, particularly of CHP units but also of DH assets. Finally whilst short-term contracting for maintenance is undesirable there are also pitfalls in long term arrangements particularly in ensuring performance is incentivised appropriately over the life of the contract, and in dealing with indexation for cost increases over time.

7.9.2 Arrangements will ideally be:

- long term - preferably matched to the expected life of the asset and with provisions for handback of plant at the end of the term in a suitable condition for ongoing operation for at least 12-24 months
- simple - avoiding trying to address all possibilities for the future now but with straightforward management procedures which allow each party appropriate control over changes requested by the other
- flexible - able to adapt straightforwardly to changing market conditions preferably via defined negotiation and modelling processes
- with sufficient provision for oversight and reporting that the asset owners and end-users of the system can be assured they are getting good value over time.

7.10 Funding Mechanisms

7.10.1 The viability analysis conducted as part of this study illustrates that at higher discount rates (equivalent to higher costs of capital) there is a funding gap to be closed to render the recommended schemes viable.

7.10.2 Potential funding mechanisms include:

- Carbon offset funds
- Allowable Solutions
- Planning obligations
- Community Infrastructure Levy
- Council borrowing
- Private sector investment
- Green Investment Bank loans
- Renewable heat incentive support for renewable heat generation

7.10.3 Carbon offset funds

7.10.4 There are a number of measures which developers can adopt to reduce carbon emissions, but local constraints may mean that it is not possible to apply these to a sufficient extent to achieve the emissions targets required by Part L and local policies. As an example, a building overshadowed on its southern side would not be able to install solar panels, and location within a conservation or flood risk area could also affect the range of measures which could be implemented. In this case, a number of councils have allowed developers to offset emissions through contribution into a carbon offset fund.

7.10.5 Schemes vary by local authority, but generally developers pay into the fund based on the magnitude of the emissions which they are unable to design out. This money is ring-fenced for use on carbon reduction schemes elsewhere in the borough. These can range from the installation of loft and cavity wall insulation to district heating systems.

7.10.6 Carbon offset funds in other London boroughs

7.10.7 This section examines the implementation of carbon offset funds in two London boroughs: Islington and Tower Hamlets.

7.10.7.1 Implementation in Tower Hamlets

7.10.8 Tower Hamlets' *Supplementary Planning Document (SPD): Planning Obligations*[35] sets out the council's approach to planning obligations in the borough, and covers the full range of obligations and charges.

7.10.9 In relation to Environmental Sustainability the document sets out the council's ambition of *"ensuring all new homes are built to zero carbon standards (as defined by CLG) by 2016 and all new non-domestic developments are built to zero carbon standards by 2019."* (Tower Hamlets SPD: Planning Obligations)

Where officers consider all opportunities to meet the relevant London Plan carbon dioxide reduction targets on-site have been exhausted, contributions to a carbon offset fund will be sought to meet the shortfall.

Reflecting relevant Government and London Plan policies and guidance as appropriate, (including any further relevant guidance produced by the LBTH), the remaining carbon emissions will be offset through providing new and additional opportunities to reduce carbon emissions from existing housing in the Borough or community energy saving programmes or other initiatives. (Tower Hamlets SPD: Planning Obligations]

7.10.10 The council is also currently examining the feasibility of implementing a decentralised energy network in the borough. In areas identified for decentralised energy networks developers will need to pay a levy towards extending and connecting to it. Where developers are not able to connect, alternative CO_2 reduction measures must be made and a contribution will also be sought.

7.10.11 Tower Hamlets has an adopted borough level CIL charging schedule (applicable since April 2015) and contains 'Strategic energy and sustainability infrastructure' on its Regulation 123 List.

7.10.11.1 Implementation in Islington

7.10.12 The London Borough of Islington has a carbon offset fund in place, implemented through Section 106 agreements. The council's Environmental Design SPD[36] sets out the environmental standards which new developments in the borough must meet. Any

[35] http://www.towerhamlets.gov.uk/lgsl/451-500/494_th_planning_guidance/supplementary_guidance.aspx

[36] http://www.islington.gov.uk/publicrecords/library/Planning-and-building-control/Publicity/Public-consultation/2012-2013/(2012-10-22)-Environmental-Design-SPD-FINAL.pdf

remaining emissions which cannot be reduced onsite can be offset through payments into the carbon offset fund. The current price per annual tonne of CO_2 is £920, based on a cost analysis for retrofitting CO_2 reduction measures in Islington properties. For minor developments a fixed rate of £1500 per house and £1000 per flat is set. The fixed fee is in recognition of the fact that minor schemes are not required to report on emissions to the same level of detail as larger schemes.

7.10.13 For major developments:

"...the financial contribution shall be calculated based on an established price per tonne of CO_2 for Islington. The price per annual tonne of carbon is currently set at £920, based on analysis of the costs and carbon savings of retrofit measures suitable for properties in Islington

The calculation of the amount of CO_2 to be offset, and the resulting financial contribution, shall be specified in the submitted Energy Statement. The spending of carbon offset payments and monitoring of CO_2 savings delivered will be managed by the council."

7.10.14 It can be seen in the sections above that funding a district heating scheme through a carbon offset fund appears to be an implementable undertaking. Haringey could adopt a similar CIL strategy, and funds from this could be used to implement low carbon schemes within the borough, including district heating systems.

7.11 Allowable Solutions

7.11.1 The Government is committed to an 80% reduction in carbon emissions levels by 2050. One element of the approach to delivering these savings was the use of 'allowable solutions' to assist developments achieve zero carbon targets – i.e. allowing developers to invest in off-site carbon-savings solutions. However, the Government has announced that it is not going to further pursue the use of this scheme at a national level.

7.11.2 Planning Obligations – 'Section 106'

7.11.3 Planning obligations, also known as Section 106 Agreements (negotiations that take place under the terms of Section 106 of the Town and Country Planning Act 1990), are legally binding commitments made by developers to mitigate the impacts of a development – for example, greater use of local schools, parks, roads etc – by contributing to the local community. They are used to make otherwise unacceptable developments acceptable in planning terms and payment may either be in cash or in kind (e.g. construction of affordable housing). Regulation 122 of the Community Infrastructure Levy Regulations (see below) defines a planning obligation as follows:

A planning obligation may only constitute a reason for granting planning permission for the development if the obligation is:

(a) Necessary to make the development acceptable in planning terms;

(b) Directly related to the development; and

(c) Fairly and reasonably related in scale and kind to the development.

7.11.4 Community Infrastructure Levy

7.11.5 The ability to apply Community Infrastructure Levies (CILs) came into force on 6th April 2010, with the aim of improving the predictability and fairness of planning obligations. They are fixed, non-negotiable and applied to all new developments (although exceptions can be made in certain circumstances).

7.11.6 A levy is made per square metre of new development, to support the local planning authority's wider local and sub-regional development plans. The magnitude of the levy is proposed by the authority, but they are required to demonstrate that the rate does not put overall development in the area at risk. Authorities must also take account of other funding available for infrastructure projects (for example from central government) and demonstrate that there is a clear funding gap which the levy will fill. Authorities are not obliged to make a levy, and can set it at zero should they wish.

7.11.7 It can be seen that there is some similarity between the CIL and the imposition of planning obligations under the TCPA. The Department for Communities and Local Government defines relationship between the two as:

'The levy is intended to provide infrastructure to support the development of an area rather than to make individual planning applications acceptable in planning terms.'

7.11.8 This means that there may be some site-specific instances when a Section 106 agreement may need to be implemented in addition to a CIL before planning permission is granted. However, the two operate in a complementary way and there are measures in place to ensure that developers are not double-charged. It should also be noted that after 6th April 2013 the ability of councils to implement planning obligations will be very restricted, and so a CIL is recommended. Additional advantages include:

- Their fixed nature, which also makes them less time consuming and complicated than Section 106 agreements, which are open to negotiation between council and developer.
- Typically Section 106 agreements are applied solely to major developments; CIL agreements, however, will allow contributions also to be captured from smaller developments.

<u>CIL in Haringey</u>

7.11.9 Haringey's charging schedule sets out the payments which are to be levied on developers under the Community Infrastructure Levy (CIL). Haringey's CIL Charging Schedule was adopted by decision of Full Council on 21 July 2014 and was implemented on 1 November 2014[37].

7.11.10 The charging schedule, in £ per m^2, is set out in the table below:

[37] http://www.haringey.gov.uk/sites/haringeygovuk/files/haringey_cil_charging_schedule.pdf

Table 7-5 Haringey CIL charging schedule

Use	West	Central	East	Mayoral CIL
Residential	£265	£165	£15	£35
Student accommodation	£ 265	£165	£15	£35
Supermarkets	£95			£35
Retail Warehousing	£25			£35
Office, industrial, warehousing, small scale retail, (use class A1-5)	Nil rate			£35
Health, school and higher education	Nil rate			Nil
All other uses	Nil rate			£35

7.11.11 The areas referred to are illustrated below:

Figure 7-5: Haringey CIL charging zones

7.11.12 Haringey Council collects the Mayoral CIL on behalf of the Mayor. Around £300 million is expected to be raised London-wide from the Mayoral CIL which will be used to help fund the Crossrail transport infrastructure project. The Mayoral CIL will be levied on developments in addition to the Haringey CIL charging schedule.

7.11.13 The funds raised through the Haringey CIL are not solely attributable to energy-related projects. Only a portion of the money raised will be available to help finance district heating or related measures. CIL has not been taken into account in the modelling of options as part of this report.

7.11.14 It should further be noted that the lowest CIL rates in the East of the borough are also where the majority of DH schemes have been identified.

7.11.15 Heat Network Delivery Unit

7.11.16 In March 2013 DECC produced a policy paper called 'The Future of Heating - Meeting the Challenge'. The paper sets out specific actions to help deliver low carbon heating over the next several decades and provides an assessment of the current situation, the barriers and challenges. The paper addresses industry, heat networks, buildings and the grid infrastructure.

7.11.17 For heat networks the following actions were identified:

- DECC will support local authorities in developing heat networks by establishing a Heat Networks Delivery Unit (HNDU) within the Department that will work closely with project teams in individual authorities.

7.11.18 HNDU is managing a fund to invest in the development phase of heat network schemes. The HNDU was launched in 2013, receiving applications from LAs. HNDU support contributes to the cost of procuring technical reports and advice on different phases of a heat network's development. The first four rounds of funding are now closed, and over £9.6m has been allocated[38].

7.11.19 One action on Haringey is therefore to continue to work with the HNDU (and DECC) and ensure that best use is made of the funding available.

7.12 Appraisal of potential options

7.12.1 The funding and ownership options given in the tables in the section above have varying advantages and disadvantages which generally fall under the following headings:

- Cost of funding
- Risk versus control
- Availability of resources/skills

7.12.2 These elements are discussed below:

7.12.3 Cost of funding

7.12.4 The cost of funding is critical for DH projects as the cost of infrastructure is generally high and the life of the system long. This has been recognised by central government and also by development agencies that have set up, or are setting up, a number of funding arrangements including grant funding and low-cost loans for low-carbon infrastructure projects. There has historically been a mismatch between the nature of returns for these projects and the needs of private sector finance. Due to the lack of regulatory structure and high costs of market entry DH projects are treated

[38] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/441107/Rounds_1-4_Successful_Local_Authorities_and_funding_amounts.pdf, accessed 15th Sept 2015

individually (i.e. project financed) and the costs of private sector funds is driven by competition with other generally faster return projects rather than as a low-risk, long-term investment.

7.12.5 Generally the public sector has better access to grant funding and funding from other public sector organisations at lower cost than the private sector. The private sector usually has access to more funding from the debt markets albeit that this is now less easy to obtain and available at a higher rate than has previously been the case. The private sector generally has a shorter timeframe for economic analysis and a stronger focus on pure financial returns than the public sector, which are often more able to take account of the value of other potential returns such as environmental and social improvements in their overall appraisal of projects.

7.12.6 Risk versus control

7.12.7 Public sector organisations are generally risk averse and there has historically been a tension between the desire of local authorities to move all risk to the private sector and the desire to retain control over the development of potentially high profile and high impact projects. If there is a full transfer of risk to one party then that party will, naturally, require full control over management of the risks and will be unwilling to allow outside influence on the operation and development of a project.

7.12.8 The transfer of risk also has implications for the costs of funding and a realistic approach to risk needs to be adopted to give a project a chance of proceeding. The principle by which an ESCo should operate in terms of dealing with risk is the same as any other business operation. This is to allocate the risks to the party most familiar with the specific risk and by implication most able to deal with it as a result of their normal operational practices and structures. The means by which risk is dealt with (transfer, distribution, mitigation and tolerance) aims to reduce the possibility of occurrence and impact as far as is practically possible, thereby minimising obstacles to the long-term financial stability of the organisation ultimately responsible for the projects.

7.12.9 Responsibility for risk has important implications financially for the partners engaged in the development of the ESCo; where risk is allocated within a partnership also broadly determines where the financial benefits are distributed. Capital and operational risks will have a proportion of finance or a share of profits associated with them; this is where the objectives of the cluster development ESCo and the strategic aims of Haringey need to be considered.

7.12.10 Availability of resources and skills

7.12.11 No matter which approach is taken, the delivery of schemes must be achieved safely, to programme and to a quality specification. Achievement of this requires the use of high quality resources, with sufficient experience of delivery of this type of scheme. What must be noted is that, even where an organisation has an excellent track record in project delivery, the specific personnel who will be in key positions will have a significant impact on actual project outcomes. Whichever approach is taken it is important to have the ability to monitor progress and quality – the self-interest of a concessionaire will not necessarily make up for lack of experience of key people and there will be some reputation risk whatever the structure adopted for delivery.

7.13 Risks and opportunities

7.13.1 PB has compiled an initial risk / opportunity database appropriate for this stage of plan development. The following is a summary of key risks and opportunities identified at this stage.

Table 7-6 Selection of key risks / opportunities

Risk / opportunity	Potential mitigation / strategic approach to enhance opportunity
Is there sufficient high-level political borough commitment to district energy? Is there sufficient political stability to see this type of project implemented?	Engage early with senior officers of local authority, and keep officers updated on progress / intentions / benefits of investment
Is there sufficient officer-level resource for the development of schemes.	Current HNDU funding is assisting this, but this availability should be recognised as a risk on-going
The density / quantum of development in certain areas of the borough represents a good opportunity for DE implementation	Ensure that maximum benefit flows to public sector schemes from the high development density which suits DH roll-out
Will additional generation plant negatively impact air quality in the borough?	There will inevitably be some local increase in emissions from large combustion plant. Overall impacts must be evaluated against reduction in emissions from local boilers. In the longer term, the use of heat pumps or the import of heat from more remote locations could reduce local air-quality impacts. Ensure that where possible both new-build scheme maximise use of high-quality plant with appropriate emissions abatement technologies, and connect up retrofit properties wherever viable thereby avoiding the continuing use of older boiler stock.
Schemes crossing administrative boundaries could lead to enhanced cross-borough working practices	Co-ordination and collaboration with Hackney with regard to Woodberry Down, and the potential links to Waltham Forest from Tottenham Hale should be explored.
Will it be possible to make a convincing commercial case for developers to connect?	Ensure that all benefits to developers are communicated, and that the business case for schemes are built upon assumptions that allow a commercial case for developers to be made.
This type of project should provide opportunity for the borough to reduce carbon emissions, stimulate regeneration and create jobs	These benefits can all be generated, if individual schemes are delivered correctly.

Risk / opportunity	Potential mitigation / strategic approach to enhance opportunity
There is the potential to reduce the cost of providing heat, both for the Council, and for residents. This could help to lift residents out of fuel poverty	Ensure that price of heat is pegged to utilities costs to ensure that any savings for residents are able to be maintained.
Can the technical difficulties of the physical installation be overcome?	Ensure that appropriate phases of design are completed, and that contractors and consultant engineers with appropriate experience are employed.
Will the DH systems installed match the needs of residents?	A correctly designed and financed system will deliver benefits to residents.
High capital up-front costs cannot easily be raised	Ensure funding approach is progressively developed as scheme moves forward through design stages – i.e. ensuring that early visibility of approximate costs is given to budget holders, and these estimates refined as the project develops.
Will the timeline of the DH networks match developer requirements?	It is essential that development is not constrained by the availability of heat from a DH network, and hence DH systems must be progressed to match site requirements, or alternative interim measures adopted.
First scheme success is essential to on-going programme roll-out. Failure will lead to difficulty in further scheme development	Start roll-out with small, manageable and low-risk scheme

7.13.2 Given that the schemes identified here are unlikely to appeal directly to the private sector (and delivery by the private sector may give rise to tensions between the Council's wider aspirations and the private sector's need for shorter-term profitability) there is a need to identify suitable delivery vehicles for the projects identified. These delivery vehicles should ideally combine the expertise of the private sector, the access to finance of the public sector, and ensure that the long-term objectives of the schemes not subverted by shorter-term needs. The most suitable vehicle for this type of organisation will require project-specific investigation and it would be recommended that as these schemes are moved forward, that independent expert advice is sought to identify the shape of the vehicle that best reconciles Haringey's objectives, the project risk profile, and the current state of the market.

7.14 Customer charters

7.14.1 One further item which should be considered is the necessity for consumer charters. An important aspect of developing public trust in the value / reliability and safety of DH systems is the provision of a standard customer care charter for schemes, which could potentially be included in DE-related planning conditions.

7.14.2 The Association of Decentralised Energy (formerly the Combined Heat and Power Association (CHPA)) has helped to establish the 'Heat Trust' - a Heat Customer Protection Scheme which includes approving ESCO customer care charters and the provision of a dispute arbitration service. During its formation, this was described as follows:

"The Independent Heat Customer Protection Scheme aims to establish a common standard in the quality and level of protection for household customers and micro-businesses, i.e. the end-users of district heating networks" (Executive summary, Independent Heat Customer Protection Scheme, May 2014)

7.14.3 "The Scheme sets out a number of provisions related to heat supplier obligations and service standards. These requirements are comparable to the quality and performance standards for regulated utilities and draw on legislation and industry best practice. As members of the Scheme, suppliers agree to abide by the Scheme Rules and Bye-Laws. The Scheme includes rules on the following:

- Heat customer obligations
- Support for vulnerable heat customers
- Heat supplier obligations
- Heat customer service and reporting a fault or emergency
- Joining and leaving procedures
- Heat meters
- Heat Interface Units
- Heat bill and heat charge calculations
- Heat bill payment arrangements and the management of arrears
- Suspension and resumptions of service processes
- Complaint handling and independent complaint handling
- Privacy policy and data protection[39]"

7.14.4 Heat Trust was formally established in March 2015 after two years of collaboration between industry, consumer groups and government. The scheme will be run by an independent and impartial steering committee[40]. It is recommended that all schemes developed and implemented by Haringey participate in this initiative.

7.15 Policy background

7.15.1 This section provides a brief overview of the policy framework which currently applies to the development of district energy (DE). The following items are discussed:

[39] http://www.heattrust.org/index.php/the-scheme, accessed 6th October 2015
[40] http://www.heattrust.org/index.php/about, accessed 6th October 2015.

- Climate Change Act
- UK government energy policies and initiatives, comprising:
    - Energy Companies Obligation (ECO)
    - Renewable Heat Incentive (RHI)
    - Renewables Obligation (RO)
    - CHP Quality Assurance
    - Zero Carbon Homes Policy
    - Building Regulations
    - Licence Lite
    - European Union Emissions Trading Scheme (EU ETS)
    - Climate Change Levy (CCL)
    - Carbon Reduction Commitment (CRC) Energy Efficiency Scheme
    - Energy Saving Advice Service
    - Green Deal
    - Energy related products and energy labelling directives (ERPD)
    - Enhanced Capital Allowances (ECA)
    - Feed in Tariffs (FITS)
    - Microgeneration Certification Scheme
    - The Standard Assessment Procedure (SAP)
    - Smart Meters
- Regional and local energy policies
    - The London Plan
    - London Plan Supplementary Planning Documents (SPDs)
    - Climate Change Mitigation and Energy Strategy (CCMES)
    - London Heat Map and District Heating Manual
    - Upper Lea Valley Opportunity Area Planning Framework
    - Haringey Sustainable Design and Construction Supplementary Planning Document (SPD)
    - Haringey Local Plan Strategic Policies 2013-2026
    - Haringey Draft Site Allocations Development Plan Document
    - Haringey 40:20
    - Haringey housing investment and estate renewal report and strategy

7.16 Climate Change Act

7.16.1 This domestic Act passed in 2008 commits the UK to achieve an 80% reduction in carbon emissions by 2050 relative to a 1990 baseline. This is achieved through a series of carbon budgets each five years in length which define how much the UK can emit.

7.16.2 The Act also set up the Committee on Climate Change which advises government, providing independent advice on how the carbon budgets can be met. These recommendations provide the basis for other policies which implement the UK's emissions reduction strategy.

7.17 UK Government energy policies and incentives

7.17.1 The Government has a range of energy policies in place to implement the low carbon agenda. The table below highlights some of the policies in place that are particularly relevant to DE and low carbon energy provision.

Table 7-7: Polices and Incentives in Place to Support Heat Networks

Policy	Detail
Energy Companies Obligation (ECO)	ECO aims to improve the energy efficiency of hard to treat properties and provides support for vulnerable and low-income households. Connections to heat network schemes are eligible for ECO financial support in certain circumstances.
Renewable Heat Incentive	The RHI provides funding for renewable heat at the commercial and industrial scale with funding through a tariff paid for each kilowatt hour. Heat networks are eligible.
Renewables Obligation	Heat from a renewable CHP plant can claim, in some cases, a 0.5 Renewable Obligation Certificate uplift for Good Quality CHP, although this band closes on 31st March 2017. This may be replaced by a Feed-in-tariff scheme and a specific RHI tariff for Good Quality CHP.
CHP Quality Assurance	This scheme seeks to ensure that the support available for CHP is targeted to schemes delivering genuine energy saving benefits compared to separate generation of heat and power.
Zero Carbon Homes policy	This policy envisages that low carbon heat networks could be employed to help developers meet the zero carbon standard in England as it is neither feasible nor cost-effective to do so in all cases solely through on-site measures. This policy was withdrawn in the summer of 2015.
Building Regulations	Regulations set standards for new buildings in terms of carbon emissions, and this indirectly encourages low carbon heat network development. Developers are able to meet their regulations requirements in the most cost effective way they choose including adopting good fabric energy efficiency standards and/or connecting developments to heat networks.
Licence Lite	Ofgem has proposed licensing arrangements to enable smaller scale electricity generators to gain better access to the electricity supply market and obtain a higher price for their power. Obtaining a good price for the electricity produced in CHP plants (which provide heat to networks) can be critical to the viability of DE systems.
EU ETS	Combustion plants over 20 MW (thermal input) are included in the EU ETS which means larger boiler or CHP installations supplying a heat network over this size require EU ETS permits.

Table 7-8: Polices in Place to Support Heat and Cooling in Buildings

Policy	Detail
Climate Change Agreement	Climate change agreements allow energy intensive businesses to obtain a discount from the CCL in return for making improvements to their energy efficiency or reducing carbon emissions.
Climate Change Levy (CCL)	CCL levied on fossil fuels is designed to encourage sites to switch to lower carbon forms of heating. Sites achieving Good Quality CHP are eligible for relief. This scheme is being removed with the transitional period starting from 1st August 2015. It is unclear how long the transitional period is likely to continue.
Carbon Reduction Commitment (CRC) Energy Efficiency Scheme	Organisations consuming more than 6,000MWh of electricity per qualifying year are required to participate in the CRC scheme which aims to encourage energy efficiency by taxing carbon emissions. Within this report a cost of £15/tonne has been used in 2015, rising to £30 in 2030, and continuing constant at £30 after this date.
Energy Saving Advice Service	Telephone-based service offered by the Energy Saving Trust (EST) on behalf of DECC offering impartial energy saving advice to homes and businesses. The Service will be supporting the Green Deal and ECO as those schemes develop.
Green Deal	This programme is designed to help improve the energy efficiency of homes and businesses by making improvements with some or all of the cost paid for from the savings on their energy bills. Energy-saving improvements for heating include insulation, draught-proofing, double glazing and condensing boilers and micro-CHP. The government has stopped funding the Green Deal Finance Company (GDFC) which was set up to lend money to Green Deal providers.
Energy Related Products and Energy Labelling Directives (ERPD)	The ERPD sets minimum performance requirements for heating and hot water products. The EU Regulations came into force in late 2013, with the minimum performance standards taking effect in 2015 and 2017. The ELD will introduce a labelling system for energy using products based on their efficiency which from 2013 includes labelling of heating and hot water systems. Products are rated from G to A+++. Compliance with the labelling requirements by February 2015 is mandatory.
Enhanced Capital Allowances (ECA)	The Energy Technology List contains a range of energy efficiency heating technologies that qualify for an ECA, which can be installed in a commercial property including boiler equipment, CHP, heat pumps, HVAC equipment and controls.
Feed in Tariffs (FITs)	Although primarily a mechanism to support renewable electricity from microgeneration, FITs are also used to support domestic micro-CHP (under 2 kWe) and installations that are certified under the Microgeneration Certification Scheme.
Renewable Heat Incentive (RHI)	The (non-domestic) RHI provides tariff-based financial support for renewable heating in commercial, public, not-for-profit and community buildings over a 20 year period.
Energy Performance of Buildings Directive	This directive aims to drive the reduction of energy use by requiring all buildings developed after 2020 to be nearly zero energy, or after 2018 for public buildings. Other key measures include Display Energy Certificates for larger public sector buildings to show actual energy use; and Energy Performance Certificates that display energy efficiency ratings. They are also used to underpin the Green Deal, ECO, RHI and FiTs.
Building Regulations	The Building Regulations (which will uplift standards with each revision) implement the Energy Performance of Buildings Directive and ensure that buildings are constructed to a high standard. Through energy efficiency standards the aim is to decarbonise new buildings.
Microgeneration Certification Scheme	MCS certifies renewable energy generating technologies up to $45kW_{th}$ and up to $50kW_e$. It is primarily aimed at consumer protection and acts to drive industry standards. Certification is required by a number of government policies, including the RHI, FiTs and Green Deal.
Smart Meters	Every home and smaller business in Great Britain is to have smart electricity and gas meters. Roll-out is expected to start in 2014 and be standard across the country by the end of 2019.

7.17.2 In December 2011 the UK Government produced the report The Carbon Plan: Delivering our Low Carbon Future as required by the Climate Change Act which outlined the government's approach to energy and climate change, outlined its strategy to achieve carbon budgets in each sector and outlined in detail how it intends to deliver the fourth carbon budget for the period 2023 to 2027.

7.17.3 The report suggests that the 2050 carbon emissions reduction target is likely to require reducing emissions from buildings to near zero by 2050, and up to a 70% reduction in emissions from industry – the majority of which are heat related.

The Future of Heating – Meeting the Challenge[41]

7.17.4 In March 2013 DECC produced a policy paper called 'The Future of Heating - Meeting the Challenge'. The paper sets out specific actions to help deliver low carbon heating over the next several decades and provides an assessment of the current situation, the barriers and challenges. The paper addresses industry, heat networks, buildings and the grid infrastructure.

7.17.5 For heat networks the following actions were identified:

- DECC will support local authorities in developing heat networks by establishing a Heat Networks Delivery Unit (HNDU) within the Department that will work closely with project teams in individual authorities.
- DECC will provide funding over two years to contribute to local authorities' costs in carrying out early stage heat network development. This will enable local authorities to bring forward projects to the stage where they are suitable for investment by the Green Investment Bank and commercial lenders
- DECC will seek to endorse an industry-led consumer protection scheme for heat network users later this year, and encourage the heat networks industry to work with consumer groups in developing this practice
- DECC will implement Article 9 of the Energy Efficiency Directive, which covers heat metering
- DECC will work with the Low Carbon Innovation Coordination Group (including the Carbon Trust, BIS, the Energy Technology Institute, the Technology Strategy Board and the Scottish Government) to identify the key technological solutions that require innovation support
- DECC will consider further how heat networks can be better supported as part of the next Renewable Heat Incentive policy review in 2014.

7.17.6 For buildings the following actions were identified:

- DECC will introduce a voucher scheme for installer training to build up the installer base in preparation for the domestic Renewable Heat Incentive (RHI)
- DECC will pilot a green apprenticeship scheme over the coming year, with the aim of offering 100 places in the renewable heat sector
- DECC will support development of a new consumer guide produced by industry and consumer organisations, improving the way low carbon heating is

[41] https://www.gov.uk/government/publications/the-future-of-heating-meeting-the-challenge

communicated to consumers and providing advice to installers and intermediaries such as local authorities

- DECC will explore what role tighter standards on building emissions and heating systems could play in achieving the goal of decarbonising heat in all buildings between 2020 and 2050.

7.17.7 At a national level government is encouraging consideration of low carbon heat networks through the National Planning Policy Framework. The framework expects local planning authorities to identify opportunities for development of decentralised energy supply systems and for co-locating heat customers and suppliers.

7.17.8 Para 94 of the NPPF states "In determining planning applications, local planning authorities should expect New development to comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable."

7.18 Regional and local energy policies

Outline details on the policy framework for London are summarised below.

The London Plan[42]

7.18.1 The London Plan is the strategic plan for London which sets out an integrated economic, environmental, transport and social framework for the development of the capital to 2031. London boroughs' local plans need to be in general conformity with this plan and its policies guide decisions on planning applications by councils and the Mayor. Further Alterations to the London Plan were published on March 10th 2015, and are operative as formal amendments.

London Plan Supplementary Planning Documents (SPDs)[43]

7.18.2 SPDs provide further detail on policies in The London Plan where detailed guidance is required to support implementation. The London Plan SPD that is most relevant to planning for decentralised energy is the Sustainable Design and Construction SPD (April 2014), which includes emission standards for CHP and biomass installations. In addition to advising of standards this document also direct the reader to additional resources where required.

Climate Change Mitigation and Energy Strategy (CCMES)

7.18.3 The Mayor has a duty to prepare and publish a Climate Change Mitigation and Energy Strategy which after consultation was published in 2011. The document sets a target to reduce carbon emissions by 60% of 1990 levels by 2025 by retrofitting homes and public sector buildings with energy efficiency measures, and aiming to supply 25% of London's energy from decentralised energy sources.

[42] http://www.london.gov.uk/priorities/planning/london-plan
[43] http://www.london.gov.uk/priorities/planning/supplementary-planning-guidance

London Heat Map and District Heating Manual[44]

7.18.4 The Mayor's Decentralised Energy Programme has produced the London Heat Map and a District Heating Manual for London to support the initiatives provided by City Hall to promote the Mayor's decentralised energy target.

7.18.5 The London Heat Map, which is regularly updated, provides spatial intelligence on factors relevant to the identification and development of decentralised energy opportunities. Local authorities can use the map as the starting point to developing Energy Master Plans to inform decentralised energy policies in their local development frameworks.

7.18.6 The District Heating Manual for London provides practical guidance for developers, network designers and planners with the aim of creating a consistent framework for delivering efficient, interconnecting, district heating networks. One aspect of the document addresses in the planning guidance section is the factors to consider when there is a timing mismatch between the construction of a building and availability of district heating, this can in include future proofing and grace periods.

7.18.7 Also published by the Decentralised Energy Project Delivery Unit (DEPDU) is the London Vision Map – showing identified future opportunities for district heating networks. This is reproduced below.

[44] http://www.londonheatmap.org.uk

Figure 7-6: Vision map for London

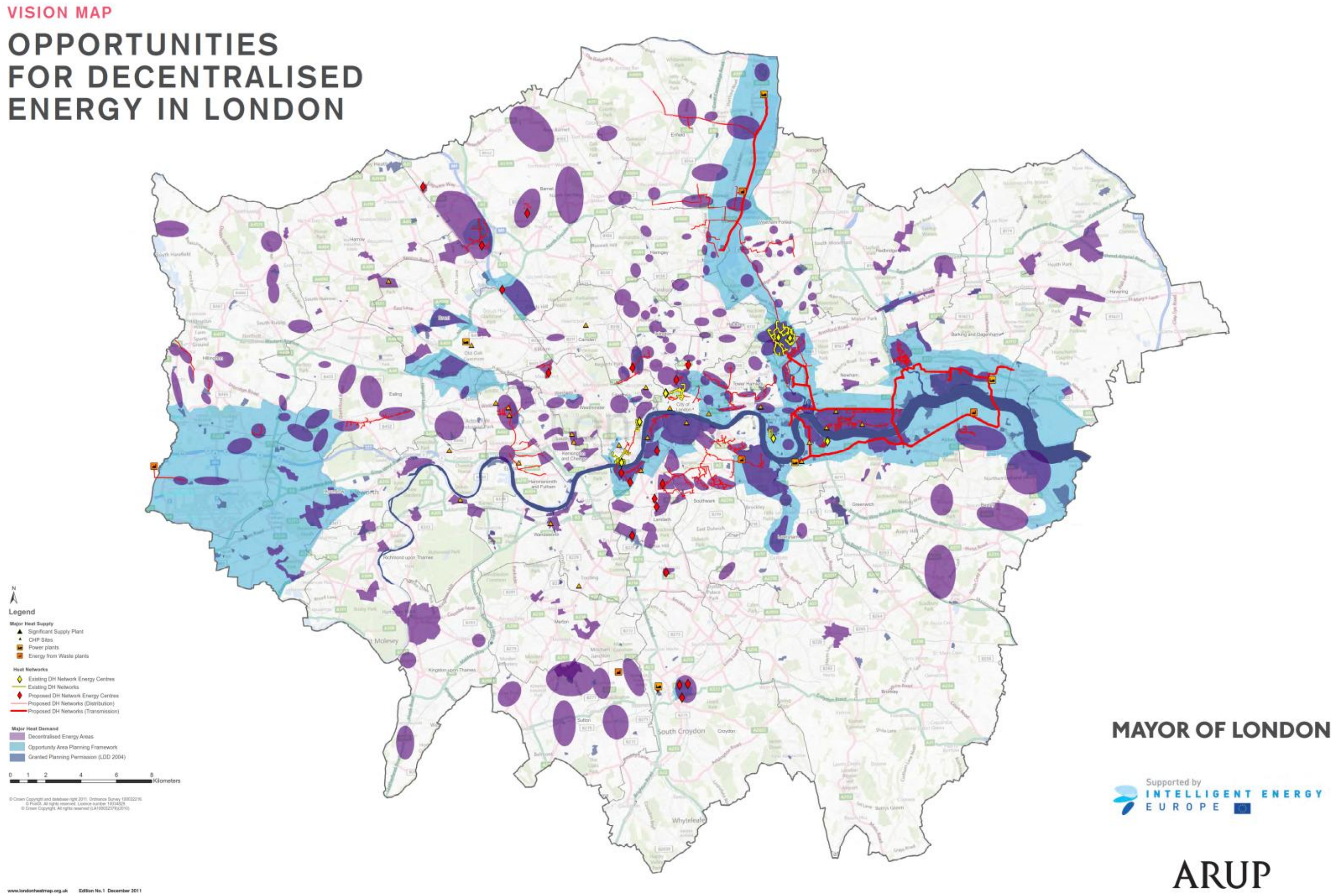
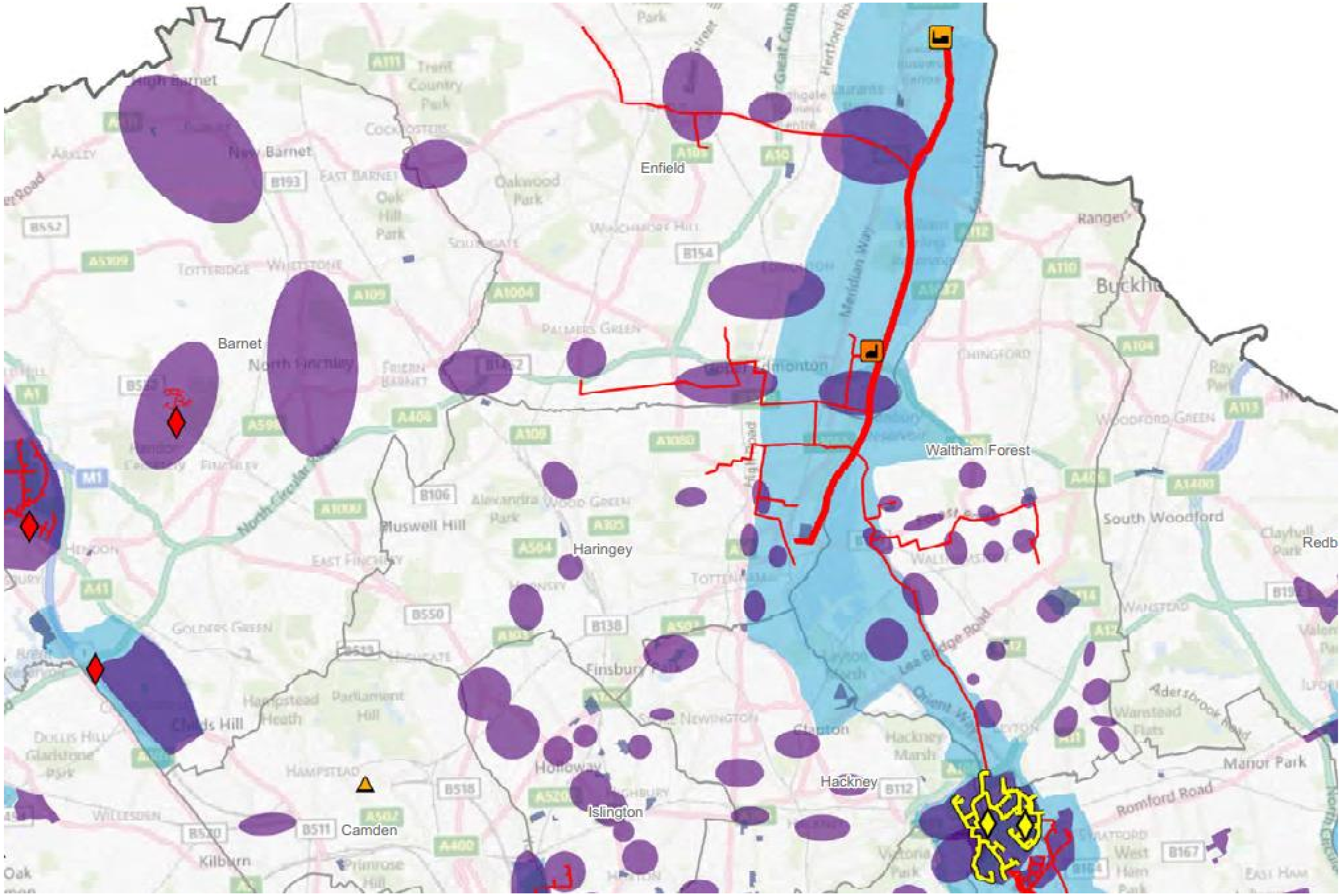


Figure 7-7: London vision map – focus on Haringey



Upper Lea Valley Opportunity Area Planning Framework

7.18.8 The Upper Lea Valley OAPF identifies the opportunity of delivering a sustainable heat network within the Upper Lea Valley, which includes part of the borough of Haringey. The preferred supply is from the Edmonton Eco Park, and the scheme would potentially, in the long term, be connected to broader, London wide networks including the Olympic Park, Royal Docks and London Riverside.

ETI's Smart Systems & Heat (SSH) Programme

7.18.9 Haringey, along with the London boroughs of Islington and Camden, was shortlisted as one of eleven areas for the Energy Technologies Institute's (ETI's) Smart Systems and Heat (SSH) programme.

7.18.10 The ETI is currently developing a software package called *EnergyPath*, which is aimed at providing local authorities with a prioritised pipeline of transition projects suited to the area which will move it towards meeting carbon reduction targets.

7.18.11 Three of the participating areas, Newcastle City Council, Bridgend County Borough Council and Greater Manchester Combined Authority were chosen in March 2015 to be used as test beds both for the use of the *EnergyPath* software and for the use of new technologies. The chosen areas will need to put in at least 50% of the total finance required, with the balance being met by the ETI.

Haringey Sustainable Design and Construction Supplementary Planning Document (March 2013)

7.18.12 The Haringey SPD[45] provides guidance to ensure that development within the borough is as sustainable as possible, including in relation to energy. It includes the following:

- "*Major development proposals should include a detailed energy assessment to show how a reduction in energy use and carbon dioxide (CO_2) emissions from the development will be achieved…. The statement should show the following:*
    - *Proposals to further reduce CO_2 emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP).*

7.18.13 As well as a mandate to consider decentralised energy networks and combined heat and power, the document provides a map of potential decentralised energy networks within the borough, as shown below.

[45] http://www.haringey.gov.uk/sustainable_design_and_construction_spd_adopted_march_2013.pdf

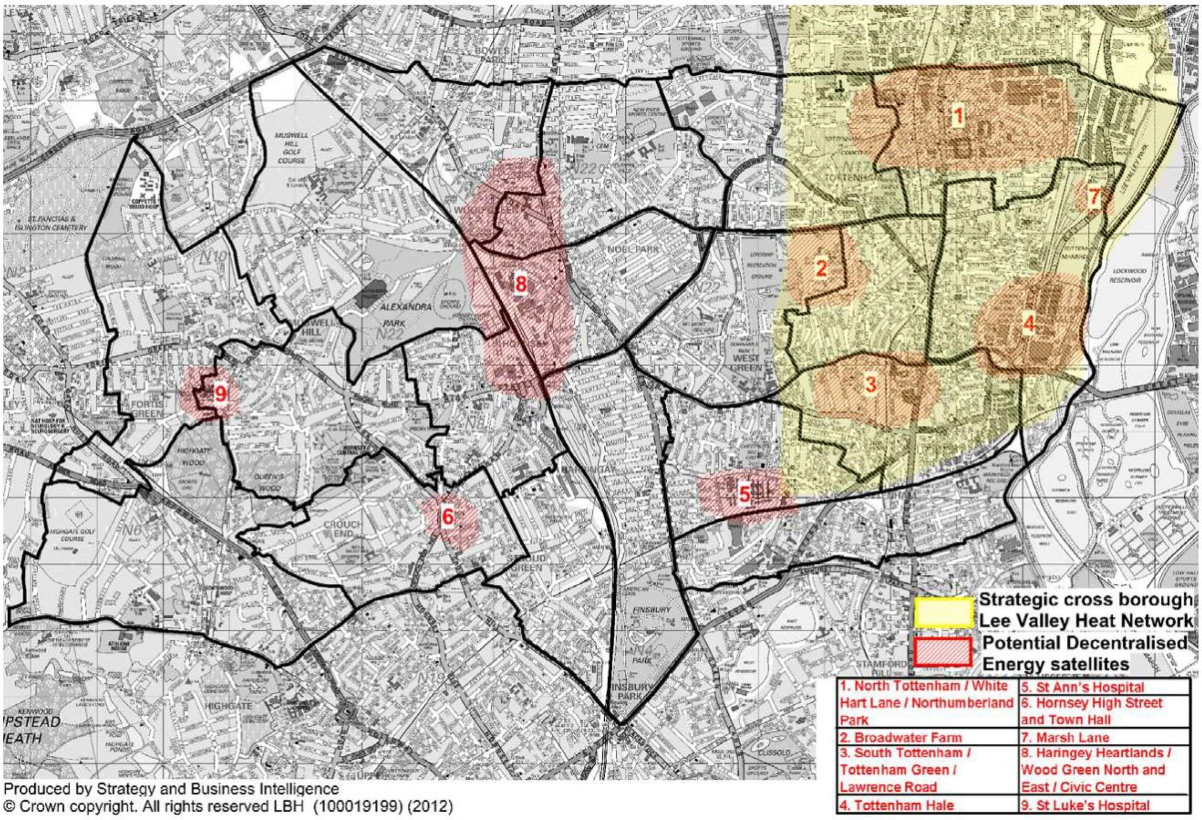


Figure 5: Haringey's potential decentralised energy network

<u>Haringey Local Plan Strategic Policies 2013-2026 (adopted March 2013)</u>

7.18.14 Formerly the Core Strategy, the Local Plan sets out the council's vision and key policies for the borough up to 2026. It includes the following objective:

- *"To increase energy efficiency and increase the use of renewable energy sources through establishing decentralised energy networks at Tottenham Hale and Haringey Heartlands and other places across the borough as opportunities allow."*

7.18.15 Furthermore, Chapter 2 of the document identifies the requirement for an energy centre at the Haringey Heartlands site and a decentralised energy hub within the Seven Sisters Corridor.

7.18.16 Strategic Policy 4, *Working towards a low carbon Haringey,* sets out the measures which the Council will promote and require to reduce carbon emissions. These include:

- *"a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;*
- *b. Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;*

- *c. Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and*
- *d. All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy regeneration, which can include connections to local sources of decentralised renewable energy."*

7.18.17 Furthermore, the document provides details of the initial sites identified by the Council for potential decentralised energy hubs. These include the following:

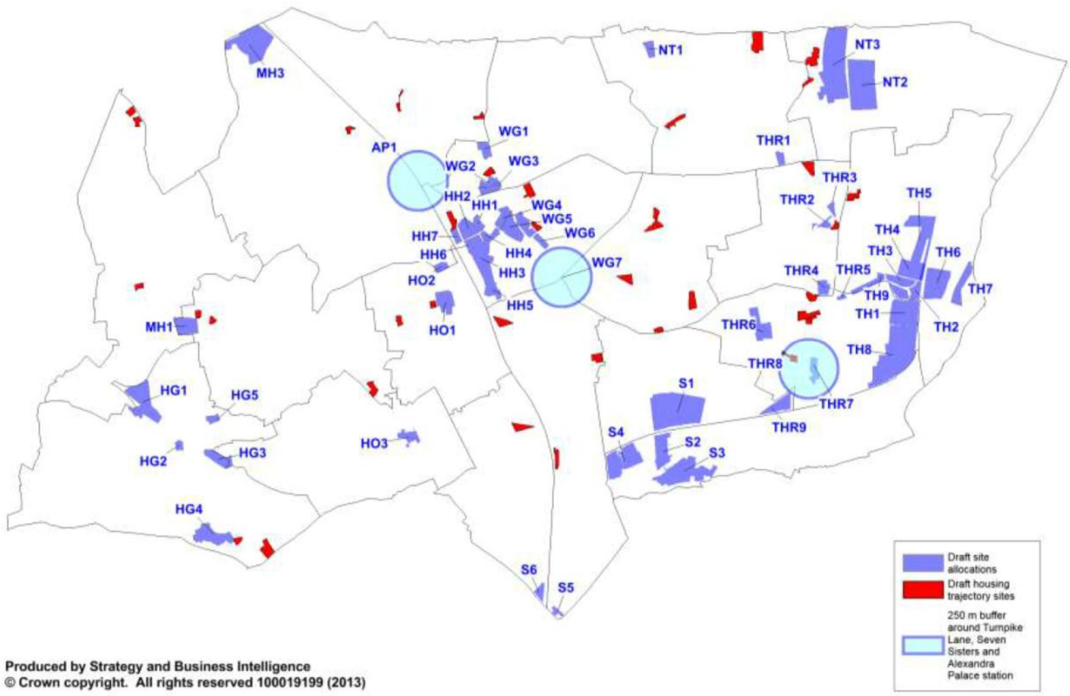
- Haringey Heartlands and Tottenham Hale growth areas
- A south-east hub focussing on the St. Ann's hospital site, Lawrence Road and Broadwater Farm complex
- A northern hub around Northumberland Park

<u>Haringey Draft Site Allocations Development Plan Document</u>

7.18.18 The Haringey Site Allocations DPD identifies larger, more strategic sites within the borough, to ensure that:

- *"The appropriate level of development occurs on the site;*
- *A positive approach to design is taken;*
- *Infrastructure is provided in a timely manner to serve the growing local community."*

7.18.19 A map of the draft site allocations, as presented in the document, is provided below:



7.18.20 The document provides a list of potential future development sites within the borough and as such allows clusters of new development to be identified where district energy networks could be implemented.

Haringey 40:20

7.18.21 Haringey was the first local authority to sign up to the Friends of the Earth pledge to reduce carbon emissions by 40% by 2020 (over a 2005 baseline). To facilitate this, the council launched Haringey 40:20 - bringing together residents, businesses, social enterprises and charity groups across Haringey - and the Carbon Commission - an independent expert group - to support the Council's ambitions.

7.18.22 The *Haringey Carbon Commission Report*[46] sets out strategies which could be undertaken within the borough to meet this goal. Its recommendations include establishing and investing in:

7.18.23 *"An energy supply company formed as a mutual with a remit to operate across a number of north London boroughs to invest in, and deliver schemes….. The company will finance and deliver heat network services, serving residential, public and commercial buildings."*

7.18.24 In terms of heat supply technology, the report advises that:

7.18.25 *"In the short-term, the supply will be powered by gas-fired combined heat and power plant… However in the longer term it will be ultra-low or zero carbon powered by waste to energy technology managed by the North London Waste Authority. A partnership has between Haringey, Enfield, Waltham Forest and GLA has already been established to develop plans."*

Haringey Housing Investment and Estate Renewal Report and Strategy

7.18.26 This document sets out the Council's strategy for investing in and updating its housing stock. This includes potential redevelopment of some of the Council's larger housing estates, which could provide the opportunity for the integration of district energy systems.

7.19 Current barriers to deployment

7.19.1 As noted in the heat demand analysis (section 3), at the level of technical potential, it would appear that there are a number of opportunity sites within the borough's built environment to implement district heating. However, if this is the most efficient and economical solution, why has it not happened already?

7.19.2 This section draws on recent research commissioned by DECC[47], and PB's own experience of DE implementation.

7.19.3 Factors with the greatest impact on DE deployment identified in DECC's report are replicated below in Table 7-9. The colours and number of asterisks after each point reflect the relative impact on heat network projects.

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46 http://www.haringey4020.org.uk/haringey_carbon_commission_report.pdf

47 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191542/Barriers_to_deployment_of_district_heating_networks_2204.pdf, March 2013, accessed 14th June 2013, research study by BRE, University of Edinburgh and the Centre for Sustainable Energy for DECC.

Table 7-9 Barriers to establishing a heat network (Exec Summary, table 1, DECC, 2013)

	Local Authority Led	Property Developer Led
Objective setting and mobilisation	• Identifying internal resources to instigate scheme and overcome lack of knowledge (**) • Customer scepticism of technology (*)	• Persuading building occupants to accept communal heat (mandated by the planning authority) (*)
Technical Feasibility and Financial Viability	• Obtaining money for feasibility/viability work (***) • Identifying and selecting suitably qualified consultants (**) • Uncertainty regarding longevity and reliability of heat demand (*) • Uncertainty regarding reliability of heat sources (*) • Correctly interpreting reports prepared by consultants (*)	• Selecting suitably qualified consultants (**) • Uncertainty regarding longevity and reliability of heat demand e.g. lack of heat demand in new buildings (*) • Uncertainty regarding reliability of heat sources (*)
Implementation and Operation	• Paying the upfront capital cost (***) • Obtaining money for independent legal advice (***) • Lack of generally accepted contract mechanisms (**) • Inconsistent pricing of heat (**) • Up-skilling LA procurement team on DH (*)	• Concluding agreement with energy services provider including obtaining a contribution to the capital cost (**) • Lack of generally accepted contract mechanisms (**) • Inconsistent pricing of heat (**)

7.19.4 Table 7-9 highlights that it is the upfront capital costs for both study work, legal fees and the installation costs of networks that are the most frequently cited barrier to DE installation. This can be condensed arguably into the statement that it is the risk of investment and the difficulty of sourcing capital for DE systems that is the most significant barrier to DE deployment currently. A key challenge of this study is therefore to identify how, and where, efforts should be applied to help overcome these barriers (particularly of raising capital for initial deployment) to allow deployment to accelerate.

7.19.5 Table 7-9 seems to represent the key barriers to DE once a scheme has been identified, but for the built environment in Haringey a further set of challenges could also be associated with the identification of suitable networks for feasibility / viability testing:

- Difficulties in creating and maintaining a database of DE compatible installations
- Lack of powers of intervention when buildings are not part of the planning system (i.e. for existing sites which are not submitting a relevant planning application for refurbishment or other reasons)

- Identifying appropriate thresholds of heat density when a heat network might become viable.

7.19.6 Means of moving towards a system that circumvents or overcomes these issues are suggested in section 7 (Delivery).

7.20 Points of planning intervention

7.20.1 The implementation of district heating networks can be incentivised at the planning stage, with measures implemented to encourage the connection of new developments.

7.20.2 There is a strongly DH supportive existing regional planning framework (The London Plan), and local policies that also support renewable energy and community heating infrastructure. It is therefore suggested that it is the *implementation* of these policies that must now be robustly carried forward. There is technical guidance available from the GLA and the document 'District Heating Manual for London'. The council should ensure that officers are comfortable dealing with the technical aspects of applications, and that they are aware of the advice available from other bodies in assessing development plans coming forward.

7.20.3 The assumption made in this report is that planning policy and its requirements related to energy provision and secondary systems can only be applied to new developments or major refurbishments requiring planning consent. This suggests that the only means of implementing change in buildings which do not pass across the planning authority's desk will be through creating sufficient commercial incentive to instigate change.

7.20.4 High infrastructure costs will be a barrier to viable DH scheme development across the borough of Haringey, so it is important that planning policy seeks to reduce these costs wherever possible by requiring developments of an appropriate scale to make suitable provision to enable their connection to a DH scheme, should one come forward at a later date. At a basic level, this means clusters of buildings, for example on housing developments or business parks, should have communal heating served from a central boiler house. This reduces the extent of DH network infrastructure requirement in the event of a wider DH scheme coming forward that links these developments, as there is a single point of connection from which each development can be served.

7.20.5 In addition to communal systems, the following features would facilitate connection to, and improved performance of, a district heating network:

- Plant rooms that are easily accessible from the nearest public highway, ensuring that the connection route from the plant room to the site boundary is safeguarded

- Space provision within plant rooms for installation of the plate heat exchanger and pipework for interfacing the DH network with the secondary systems served from the plant room. This would preferably be in a part of the plant room close to the nearest highway

- In larger developments, oversized plant rooms with enough space for additional prime movers and, possibly, thermal storage that could serve a future DH scheme

- Secondary system designs that complement the optimisation of DH network design and subsequent reduction of network costs. Specifically:
  - Low loss headers and DH stab-in points downstream of the header to enable hydraulic prioritisation of DH heat over boiler heat in the event of a baseload network connection in which heat from a DH network could be supplied alongside top-up boiler heat
  - Variable flow, variable temperature secondary system circuits to keep return temperatures low throughout the year
  - Large surface area heat emitters (e.g. underfloor heating) to improve return temperatures.

7.20.6 If required at the planning stage, there is no reason why ensuring the criteria highlighted above should not be borne within developers' initial costs; attempting to retrofit such systems at a later date is much more expensive. It is therefore essential that the Council engages with developers at the earliest stage of the planning process, and also that such requirements are enshrined within planning policy. This is expanded upon in the section below. The cumulative impact on a DH network that connects several developments with the features listed above would be significant in terms improving efficiency.

7.21 Specific policy recommendations

7.21.1 Haringey adopted its Local Plan Strategic Policies in March 2013, and is now looking to use the outputs of this report to inform the drafting of its Development Management Policies DPD, Site allocations DPD, and specific Area Action Plans.

7.21.2 It is clear that policy has a role to play in the encouragement of decentralised energy system growth, and this section attempts to address the questions:

- 'What further policies should be added to existing adopted documents to enhance the growth of decentralised energy?'
- 'What can LBH do to support the implementation of planning policies by effective Development Management?'

7.21.3 These questions must be addressed in the context of the NPPF, the London Plan, and the existing policies within Haringey's Local Plan Strategic Policies related to energy. In particular, Policy SP4 already has the following requirements:

Local Plan, Strategic Policy SP4, para 2
The council will promote low- and zero-carbon energy generation through the following measures:

a. *Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network.*

7.21.4 This is compatible with the London Plan Policy 5.6 (Decentralised Energy in Development Proposals), which states:

London Plan Policy 5.6 (Decentralised Energy in Development Proposals)
Planning decisions

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B. Major development proposals should select energy systems in accordance with the following hierarchy:

a) Connection to existing heating or cooling networks

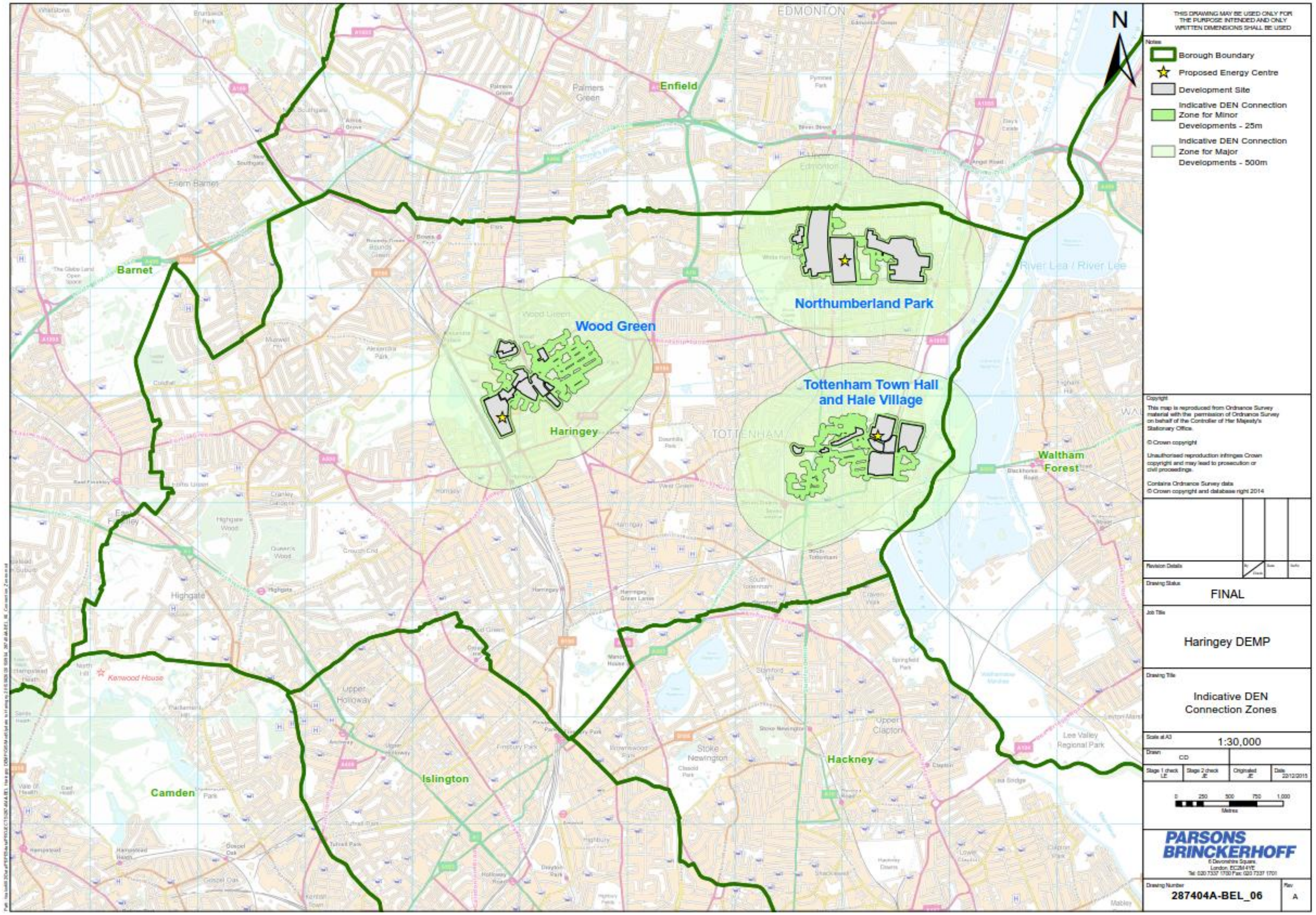
b) Site wide CHP network

c) Communal heating and cooling

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

7.21.5 One role of this Energy Masterplan is to add further definition to the potential DENs identified in the Council's adopted Local Plan Strategic Policies. The figure below illustrates suggested 'DEN connection zones' based on threshold distances from the networks developed as part of this study and key site allocations.

Figure 7-8 Indicative DEN connection zones



7.21.6 DMP DPD - Distance / load thresholds for DEN zones – It is clear that over many years, development geographies may shift, and new opportunities for DEN formation may emerge. Policy should be flexible enough to support this. Hence it is recommended that two methods are used to identify where it is expected that DEN connection will be viable. First, DEN zones should be identified as per the recommendations of this report. Second, a further threshold of distances should be applied to developments of different scales. The suggested combination of loads / distances for these sites is as follows:

Table 7-10 Distance / scale threshold[48]

Site scale	Distance to DEN zone or existing or planned DEN, within which viability of connection is expected
Minor	25m
Major	500m
Strategic[49]	Under all circumstances required to explore opportunities for connecting to existing or planned DENs or forming own DEN.

7.21.7 A further aspect of DEN formation that policy documents can clarify, is the level of financial contribution expected from developers for decentralised energy projects. PB would recommend in this context that it is made explicit that CIL receipts will be used to fund key 'strategic energy supply and distribution infrastructure for decentralised energy projects', and that further contributions will be sought from developers related to the funding of final connections / other local decentralised energy equipment through other mechanisms (such as S.106 Agreements) to allow the development to accept heat from a network.

7.21.8 DMP DPD - Potential contributions and viability - At the time of writing this masterplan report, viability assessments are on-going for key sites and hence it is not possible to comment on overall viability levels. However, for all sites where DEN connection is required, it is recommended that contributions from developers (in addition to CIL) should be based around:

- a minimum level of contribution that is calculated according to a transparent avoided cost formula (i.e. the cost that the developer saves by avoiding the need to put in their own primary plant and connect to grid energy infrastructure
- potential additional contributions (subject to viability) based around connection costs (i.e. strategic spine main to development site); calculated by dividing the total residual final connection network cost (minus ECO funding) by the new-build heat demand and allocating cost on a kWh demand basis.

7.21.9 DMP DPD – timing of network emergence - It would also be recommended that policy documents clarify what the expectation on developers will be when there is a 'gap' between the date that a development requires heat, and the anticipated start of operation of a DEN. It would be PB's recommendation here that a 'grace'

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[48] See appendices for methodology illustrating the calculation of these distances
[49] The Mayor must be consulted on planning applications that are of potential strategic importance to London, as defined by the Government and set out in The Town and Country Planning (Mayor of London) Order 2008. In practice, such applications include those developments which are particularly large (in terms of height, floor space and number of homes contained within), those close to sites of acknowledged importance or those involving major infrastructure works.

period is allowed (perhaps 5 years) during which the development is allowed to operate on gas-fired boilers only. During this period developments may be granted exemption from providing on-site renewable energy generation. It is recommended that consideration be given to use of Planning Agreements to ensure the design of the development complies with design guidance to enable on-site alternative primary plant (i.e. CHP or other technologies) to be installed after the expiry of the 'grace' period. There is a question to be considered here about compliance with planning and Part L Building Regulations. By allowing a 'grace' period, Haringey would effectively be looking to reserve their position in terms of making sure the development is connection-ready, but also need to make sure that the development meets minimum standards for Part L without 'unnecessary' expenditure on 'alternative' technologies which could become a financial barrier to connection later on. So it is recommended that Haringey need to consider relaxing any requirements for CSH or BREEAM that would result in a building <u>exceeding</u> Part L during the grace period, whilst ensuring compliance with Part L as a minimum is achieved.

7.21.10 DMP DPD – Secondary system design - It is also recommended that the DMP DPD includes secondary system design guidance. This should be based around the design criteria contained within the District Heating Manual for London. It is important that this policy is also implemented for refurbishment applications, such that existing buildings can be progressively converted to low-temperature compatible systems, which will ultimately allow the more efficient use of secondary heat sources as networks are able to operate more consistently at lower flow temperatures.

7.21.11 PB recommends that the Council sets out in detail its requirements for new energy centres and primary distribution infrastructure in its draft AAPs and Site Allocations DPDs, including identifying suitable locations for energy centres within major sites. The EMP can assist by providing a general indication of the physical size (footprint) of an energy centre (see section 9.2) and identifying any particular constraints that should be considered when assessing suitable locations (such as access to the energy centre, proximity to major heat anchor loads, acoustic attenuation and flue heights). In selecting locations for energy centres, the Council will need to consider the potential impact on site viability, and ensure the requirement to provide an energy centre does not become a barrier to development. PB recommends the Council considers the circumstances in which it may be appropriate to relax other planning requirements for a development site that accommodates an energy centre in order to offset the land take and construction costs.

7.21.12 Implementation - As a general recommendation, PB would note that policy effectively does not exist unless it is implemented. Thus DE policy must be sufficiently clear to be implementable without requiring unrealistic resources to decipher or interpret the policy itself. Further to this, allowing a single officer to hold the required expertise in any given policy area is also a risk to consistent policy implementation. Hence the recommendation would be to ensure that policy is both sufficiently clear and transparent, and also that adequate training and guidance is given to a sufficient range of officers to ensure continuity in policy application.

7.21.13 Early integration in design briefs - One means of increasing the likelihood of successful emergence of DENs is to ensure that they feature early on individual project development cycles. Key stages where this is possible, are within pre-applications discussion and at the point of design brief issue. Inclusion of indicative network routes and energy centre locations at this stage can significantly help to raise awareness of requirements and ease progress of schemes through to implementation.

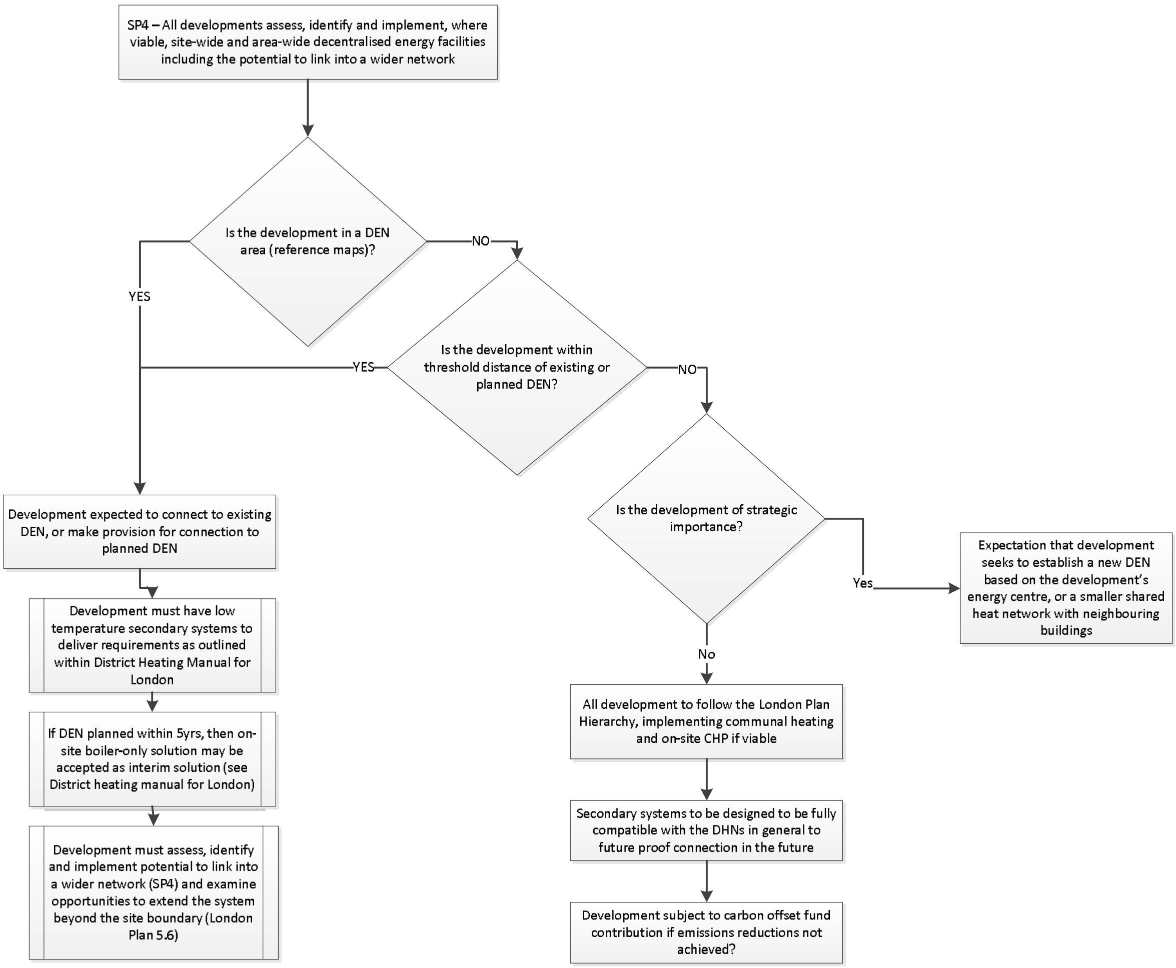
7.21.14 Internal database of 'DH ready' properties - A recommended internal action for Haringey is to maintain a database of 'DH-ready' properties as they are processed through the planning system. This should allow small clusters of heat demands to be linked as greater numbers of 'DH-ready' properties are identified and mapped. GIS mapping of these opportunities is recommended.

7.21.15 Clarity on 'zero carbon' - SP4 states 'all new residential development shall be zero carbon from 2016 onwards'. Additional planning guidance could be adopted to indicate how 'zero carbon' is defined or what the status of this is, given the Government's announcement to discontinue movement towards this notion. Clarity would be useful for applicants in terms of energy statement preparation, and also useful for Haringey in terms of providing a methodology for calculating any shortfall in emissions reduction that could be used to calculate contributions to a 'carbon offset fund', if this is adopted.

7.21.16 Treatment of non-DEN area / windfall sites - It is important that carbon savings are delivered across all new developments in the borough. The use of a carbon offset fund would help to ensure that carbon savings can be delivered even where on-site measures are proven to be unfeasible or unviable. On this basis, it is therefore recommended that a carbon-offset fund is set up. However, this must be qualified by viability considerations. Equally, it should also be noted that identified DEN / non-DEN areas should be subject to regular review, to ensure that new development appropriately contributes to DEN growth.

7.21.17 The flow chart below illustrates a basic guide that could be created to help guide officers and applicants through expectations for DE connection.

Figure 7-9 Illustrative flow chart of DEN planning expectations


SP4 – All developments assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network
Is the development in a DEN area (reference maps)?
YES
NO
Is the development within threshold distance of existing or planned DEN?
YES
NO
Development expected to connect to existing DEN, or make provision for connection to planned DEN
Development must have low temperature secondary systems to deliver requirements as outlined within District Heating Manual for London
If DEN planned within 5yrs, then on-site boiler-only solution may be accepted as interim solution (see District heating manual for London)
Development must assess, identify and implement potential to link into a wider network (SP4) and examine opportunities to extend the system beyond the site boundary (London Plan 5.6)
Is the development of strategic importance?
Yes
Expectation that development seeks to establish a new DEN based on the development's energy centre, or a smaller shared heat network with neighbouring buildings
No
All development to follow the London Plan Hierarchy, implementing communal heating and on-site CHP if viable
Secondary systems to be designed to be fully compatible with the DHNs in general to future proof connection in the future
Development subject to carbon offset fund contribution if emissions reductions not achieved?

SECTION 8

CONCLUSIONS AND RECOMMENDATIONS

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

8.1.1 The implementation of district heating within Haringey has a role to play in the decarbonisation of energy supply and alleviation of fuel poverty within the borough. It must be seen in the short-term as an enabling technology that will unlock the potential for greater carbon savings to be delivered at later dates, with the implementation of 'green' CHP or other heat sources (including 'secondary heat').

8.1.2 The heat density analysis undertaken as part of this report shows clearly where the significant demands within the borough are situated. As the nature of intended developments becomes more defined both in quantum and location it may be that certain areas are shown to become more attractive from a DH perspective. Thus the wide-area schemes outlined within this report should be seen more as 'DE opportunity areas' in which the implementation of district heating is recommended to be taken forward, rather than detailed recommendations on the actual loads to connect and systems to implement.

8.1.3 Economic analysis of the notional kick-start schemes analysed shows that the Northumberland Park and Wood Green schemes deliver the strongest performances across analysis of both export-only and private wire scenarios. However, the rates of return delivered by these schemes in this high-level analysis suggest that private sector interest in financing the delivery of these schemes is likely to be limited.

8.1.4 Areas identified as suitable for DH implementation should be borne in mind throughout the planning process, with the aim of ensuring that networks are encouraged to evolve and do not develop in a piecemeal, or technically incompatible fashion which prevents interconnection. Haringey must also consider the role which it wishes to adopt in the implementation of district heating within the borough – as has been described in Section 7 – and which path is likely to prove most successful for DE in the borough with a view to unlocking the potential for carbon savings and fuel poverty alleviation. This report supports a path towards a long-term strategic vision, where a means of aggregating systems and unlocking economies of scale and technologies of scale must be found.

8.1.5 As well as engaging with developers, it is also advised that Haringey engage with RSLs to establish the feasibility of connecting their properties to a decentralised energy network, and what their appetite for doing so is. The process of engagement is perhaps best carried out through appointing an internal champion for district heating within the council, responsible for external and internal liaison.

8.2 Recommendations

8.2.1 High Road West / Northumberland Park area

- It is recommended that Haringey consult with LVHN Ltd on the timing of development of the network and the phasing of development within Haringey in order to establish if, and at what juncture, the LVHN could contribute to the supply of heat for the area, and evaluate how this matches with the development timing of Northumberland Park, Spurs and High Road West sites in particular.

- Finalise the energy centre location for the area (assumed to be within the Spurs development within this document). The design for this must depend on detailed discussions around phasing, capacity, location of top-up and standby plant and degree to which expansion is intended.

- Create plans (if not already in place) for the distribution of heat to the key development sites so that building design can take these infrastructure plans into account in their developing designs – this should be in the form of points of connection and any requirements for capacity to be reserved across the sites.

- Ensure that the Estate Renewal works are optimised in terms of integration with a DEN strategy for the area, and that refurbishments / improvements are carried out in design compliance with this solution.

- Evaluate the technical solution to the Moselle crossing if required, and also integrate DH pipework planning into any highways renewal work that would allow a DH crossing of Tottenham High Road.

8.2.2 Wood Green

- An energy centre site should be identified for this scheme through discussions with developers (this report has identified several sites that could perform this function).

- Ensure that in any pre-application discussions taking place with developers of sites emerging in this area that developers are aware of this potential network and are taking account of it as the services and architectural design progress.

- Start collating energy usage and heat supply plant information on all public sector and private buildings in the area in order to assess technical compatibility for connection, and to ensure that potential opportunities for buildings to avoid boiler replanting are not missed.

- Commission further detailed feasibility work around this scheme, particularly in terms of energy centre design requirements, such that dialogue with developers can be informed by more detailed information on spatial requirements and access for major plant items.

8.2.3 Tottenham Hale

- It is recommended that as developments come forward in this area, Haringey actively provides information to developers on potential neighbouring development sites, and ensures that the onus is on the developer to provide energy centre space and connection to a wider-area network. Discussions to secure a scheme energy centre should be held with all of the main developments in the area, particularly those emerging early, such that a scheme nexus can be established and thereby facilitating discussions with later phase development. It is recommended that a scheme based around gas-fired CHP is developed initially, but with consideration given in energy centre selection as to how biofuel storage and bio-fuel CHP expansion could be integrated. It is advised that it may be useful in this context to carry out more detailed energy master-planning / modelling for this particular area, such that reasonable confidence in primary plant capacities and physical dimensions can inform discussions with developers bringing schemes forward.

- The Tottenham area is also potentially an area where maximisation of plant utilisation currently installed in Hale Village could deliver relatively low-cost energy to multiple sites in the area, when coupled with a distributed thermal store strategy. This has not been investigated in detailed in this study, and would be subject to negotiation with Veolia, the current plant operators of the Hale Village site. However, it is recommended that this concept is explored further.

8.2.4 St Ann's Hospital Area

- Identified heat densities in this area are lower than in the core DH centres listed above. From this perspective, this area is not identified as a short-term priority for Haringey. However, the proximity of Woodberry Down in Hackney leads to the longer-term recommendation that as significant development starts to emerge in the St Ann's area, potential aggregated supply systems across these two areas, and potentially also linking to the Tottenham Green area be investigated in more detail.

8.2.5 Hornsey

- It is recommended that Haringey ensures that secondary system designs for developments coming forward in these areas are made compatible with DEN operation, but that implementation of a DEN should be reassessed in the medium to longer term when an increased mass of DEN-compatible buildings has emerged.

8.2.6 Planning policy – various elements are recommended for inclusion in the draft consultation documents that are currently in preparation. These include:

- Providing geographic zones where there is a clear expectation on developers to connect to DENs
- Providing a threshold distance to networks or DEN zones for different development scales where there is a clear expectation of connection
- Ensuring that local policy requires DH schemes to adhere to the standards contained within the District Heating Manual for London to ensure appropriate temperature and pressures are implemented across schemes as they are developed.
- Clarifying the expectation on developers for interim periods where networks are expected to emerge after a development requires heat.
- Considering inclusion of a carbon offset fund to ensure that developments not coming forward in DEN areas also contribute to carbon emissions reductions in the borough
- Providing clarity on the demarcation between CIL funding of strategic network elements (e.g. spine mains), and S106 agreements which may seek contributions towards final connection elements of network costs.

9 APPENDICES

9.1 Appendix A - Guidance for evaluating whether a new Development site should connect to a DEN

This note attempts to provide outline, indicative guidance to planners with regard to whether a new development coming forward in the vicinity of a decentralised energy network should be expected to connect to that network.

This analysis is based around:

- The expectation that new development loads will connect to the DEN when this is technically feasible and viable
- The assumption that the connection of new loads to the system improves the overall economic performance of the network and thereby maximises the overall benefit that the DEN brings to the area[50]. In circumstances where there is a marginal benefit to the overall DEN system, the expectation would still be that connection is made to the DEN, on the basis that there would be an overall environmental improvement from sourcing heat from the DEN.

Assessment of likelihood of delivering value to the DEN is based around outline calculation of whole life value of connection. Analysis is undertaken on the basis of the same assumption as the overall assessment of viability of the DEN – e.g. at 6% discount rate over 25 years. This takes into account the following elements:

- The estimated capital cost of the installation of the district heating pipework connection to the Development site
- An estimated notional avoided cost of plant that is related to the estimated peak load of the connection
- An estimated capital cost of a heat exchanger installed in the Development site
- The sale of heat to the Development at a rate equivalent to the alternative means of heat generation – assumed to be gas boilers
- An estimated average marginal cost of heat generation and supply to the point of connection
- An estimated additional network maintenance costs for the district heating pipework connection
- Additional heat billing / administration charges borne by the DEN operator

This list is not intended to represent a comprehensive analysis of the costs / benefits of connection. One factor that is not represented here, for example, is the degree to which load profile (diurnal / seasonal) impacts the viability of a particular connection. Equally, the value of space savings from the reduced size of plant under a DEN connection scenario is also not evaluated. However, the results presented here are based on what are considered to be reasonable assumptions (listed below). Should the chart below indicate that connection appears viable, the presumption will be that the Development should connect to the DEN, unless detailed and robust evidence can be provided that demonstrates why connection is not technically or economically viable.

The analysis is based around domestic properties. The analysis for properties is presented on a 'number of properties' basis for ease of use.

This chart should be utilised as follows:

[50] This must assume that the ESCo / Network operator's margin is fixed, and that benefits of additional connections are passed onto other customers on network.

1. Identify the annual heat demand figure for the potential connection and find the value most closely matching this demand on the x-axis above.
2. Identify the pipework distance required to connect the load to the DEN on the y-axis of the chart, and identify the colour-scale level of connection viability from the intersection of these two values.
3. Refer to the illustrative scale of viability below the main chart to obtain an indication of likely viability of connection from the colour scale displayed.

Assumptions:

- Viability defined as achieving a positive NPV at 6% discount rate over 25 years
- Heat sales price from values calculated within this report for new domestic properties
- The resulting heat sale price is 10.83p/kWh
- Maintenance cost of additional DH pipework link based on 2% of DH link capital cost
- Peak demands calculated based on a 12% load factor and an additional 10% margin
- Avoided boiler installation costs based on Spons 2010, Mechanical and Electrical Services Price Book, 2010, All-in rates for boiler installation, adopting the lower end of price range (£65/kWth)
- Avoided boiler costs based around assumed boiler configuration of 3 boilers sized at 50% of peak demand.
- Incurred HX costs based around price trends derived from budget and tender prices received by PB.
- DH pipework costs based on tendered prices received by PB
- Connection design costs estimated as having a fixed element of £7.5k and variable element of 1% of pipework capex
- An annual fixed billing / administration cost for each customer of £150 p.a.

New Domestic Developments

New domestic properties have been assessed on the basis that the DEN operator would take on the billing and metering responsibilities associated with heat supply (and maintenance of hydraulic interface units).

The graph below illustrates the level of viability of the connection of new domestic developments:

Figure 9-1 Domestic development indication of connection viability

Results show NPV @ 6% over 25 years for DEN operator	Number of properties																																	
Distance of potential load from DEN (m)	5	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	300	400	500	600	700	800	900	1000
25	-6	14	51	89	125	162	198	236	273	309	346	383	421	458	495	531	570	607	644	681	720	757	794	832	870	907	1095	1472	1849	2226	2604	2984	3363	3742
50	-25	-5	32	69	106	143	177	215	251	288	324	361	399	436	473	508	546	583	620	658	696	733	771	808	846	884	1069	1446	1822	2199	2574	2955	3333	3712
75	-45	-24	12	49	86	123	154	192	229	265	302	339	376	413	451	483	521	558	596	633	671	708	746	783	821	859	1042	1420	1793	2170	2543	2923	3302	3681
100	-65	-44	-8	29	66	102	131	169	206	243	279	316	354	391	428	458	496	534	571	608	646	684	721	758	797	834	1016	1393	1764	2142	2512	2892	3271	3650
150	-84	-64	-28	9	46	82	109	147	183	220	256	294	331	368	406	433	472	509	546	583	622	659	696	734	772	809	989	1366	1736	2113	2481	2861	3240	3618
200	-124	-103	-68	-31	6	42	64	102	138	175	211	248	286	323	360	384	422	459	497	534	572	610	647	684	722	760	935	1312	1678	2056	2419	2799	3177	3556
250	-163	-142	-109	-71	-34	2	18	56	93	130	166	203	241	278	315	334	373	410	447	484	523	560	597	635	673	710	881	1259	1621	1998	2356	2737	3115	3494
400	-202	-181	-149	-111	-75	-38	-27	11	48	84	121	158	196	233	270	285	323	360	398	435	473	511	548	585	623	661	828	1205	1564	1941	2294	2674	3053	3432
600	-320	-299	-269	-232	-195	-158	-162	-124	-88	-51	-15	23	60	97	134	136	175	212	249	286	325	362	399	437	475	512	667	1044	1391	1769	2107	2488	2866	3245
800	-477	-457	-430	-392	-355	-319	-343	-305	-269	-232	-195	-158	-121	-84	-46	-62	-23	14	51	88	127	164	201	239	277	314	452	829	1162	1539	1859	2239	2617	2996
1000	-635	-614	-590	-553	-516	-479	-524	-486	-449	-413	-376	-339	-301	-264	-227	-259	-221	-184	-147	-109	-71	-34	3	41	79	116	237	614	933	1310	1610	1990	2368	2747
1200	-792	-771	-751	-713	-676	-640	-704	-667	-630	-593	-557	-520	-482	-445	-408	-457	-419	-382	-345	-307	-269	-232	-195	-157	-119	-82	22	400	703	1081	1361	1741	2119	2498
1400	-949	-929	-911	-874	-837	-800	-885	-847	-811	-774	-738	-700	-663	-626	-589	-655	-617	-580	-543	-505	-467	-430	-392	-355	-317	-279	-192	185	474	851	1112	1492	1870	2249
1600	-1107	-1086	-1072	-1034	-998	-961	-1066	-1028	-991	-955	-918	-881	-844	-806	-769	-853	-815	-778	-741	-703	-665	-628	-590	-553	-515	-477	-407	-30	245	622	863	1243	1622	2000
1800	-1264	-1243	-1232	-1195	-1158	-1121	-1247	-1209	-1172	-1136	-1099	-1062	-1024	-987	-950	-1051	-1013	-976	-939	-901	-863	-826	-788	-751	-713	-675	-622	-245	15	393	614	994	1373	1751
2000	-1421	-1400	-1393	-1355	-1319	-1282	-1427	-1390	-1353	-1316	-1280	-1243	-1205	-1168	-1131	-1249	-1211	-1174	-1136	-1099	-1061	-1024	-986	-949	-911	-873	-837	-459	-214	163	365	745	1124	1502
2500	-1578	-1558	-1553	-1516	-1479	-1442	-1608	-1570	-1534	-1497	-1461	-1423	-1386	-1349	-1311	-1447	-1409	-1372	-1334	-1297	-1259	-1222	-1184	-1147	-1109	-1071	-1051	-674	-443	-66	116	496	875	1253
3000	-1972	-1951	-1954	-1917	-1880	-1844	-2060	-2022	-1986	-1949	-1912	-1875	-1838	-1801	-1763	-1942	-1904	-1867	-1829	-1792	-1754	-1716	-1679	-1642	-1603	-1566	-1588	-1211	-1017	-639	-506	-126	252	631
4000	-2365	-2344	-2356	-2318	-2282	-2245	-2512	-2474	-2437	-2401	-2364	-2327	-2290	-2252	-2215	-2437	-2399	-2361	-2324	-2287	-2249	-2211	-2174	-2137	-2098	-2061	-2125	-1748	-1590	-1213	-1129	-749	-370	9

Illustrative scale of viability

Negative NPV - connection unlikely to be viable												Marginally positive NPV - connection likely to be viable							Positive NPV - Connection very likely to be viable					Connection extremely likely to be viable									
-2365	-2006	-1826	-1646	-1467	-1287	-1108	-928	-748	-569	-389	-210	-30	150	329	509	688	868	1048	1227	1407	1586	1766	1946	2125	2305	2484	2664	2844	3023	3203	3382	3562	3742

It can be seen from the chart above that viability is achieved for 10 and 100 units at distances of around 25m and 500m, and these distances have therefore been adopted in the thresholds for major and minor development scales within this report. All strategic developments should explore opportunities for connection to, or establishing decentralised energy networks.

9.2 Appendix B - Summary of key attributes of DE scheme energy centres

9.2.1 This appendix summarises some of the key attributes of the energy centres identified as being required for the supply of heat to DEN schemes proposed:

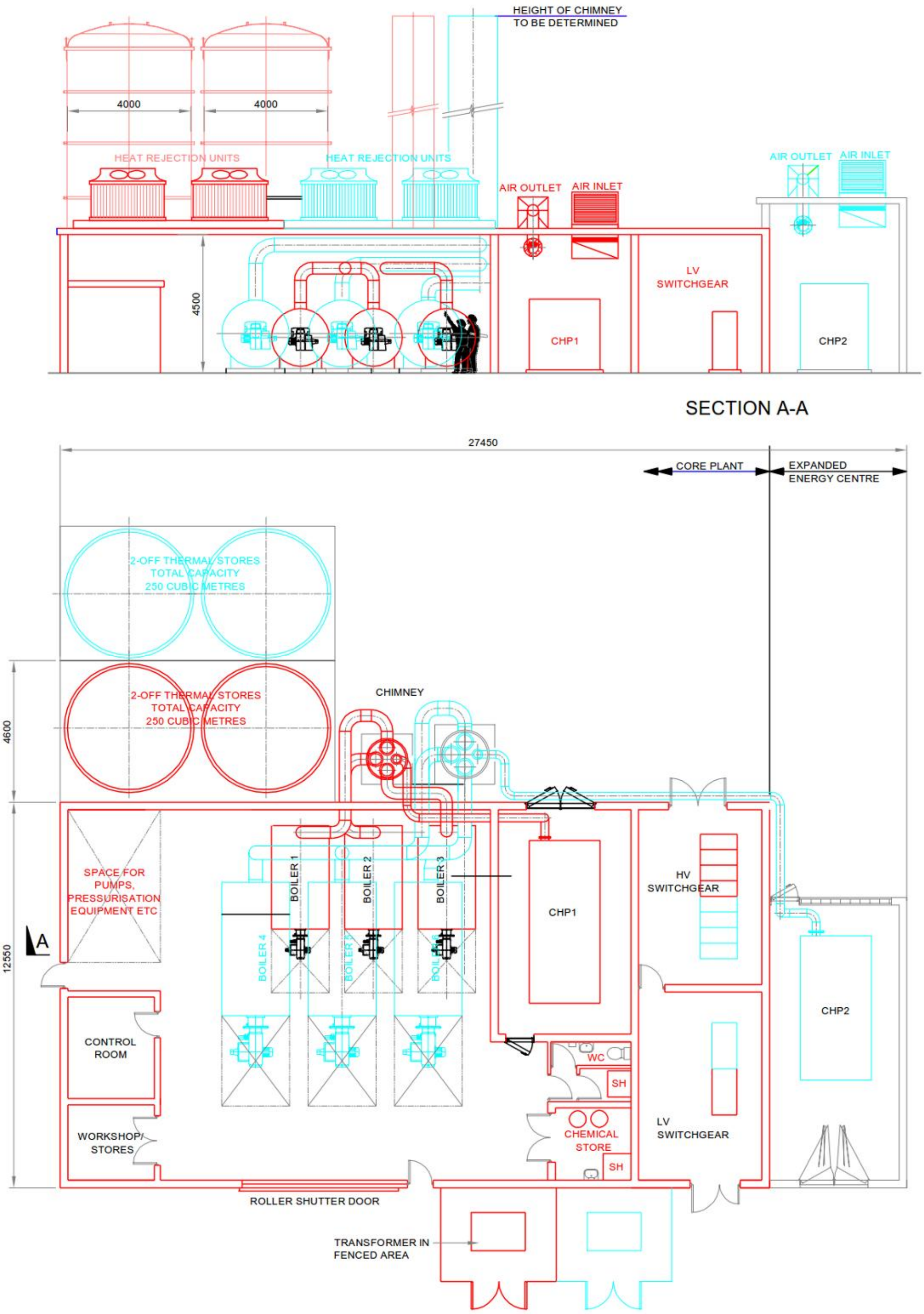
Table 9-1 Key attributes of kick-start DENs proposed

Scheme	CHP size (kWe)	Thermal storage capacity (cubic metre vessel capacity)	Fuel storage capacity (renewable CHP) (cubic metres)	Energy centre footprint (initial) (m^2)	Energy centre footprint (with fuel storage capacity) – does not include delivery vehicle areas (m * m)
Northumberland Park	2 no. 1,560kWe	300	140	825	925
Tottenham Hale	1,560kWe	170	70	540	620
Wood Green	1,560kWe	170	70	540	620
Hornsey	600kWe	70	30	310	380

9.2.2 Two indicative EC areas are shown in the last two columns of the table above. These reflect two scenarios (reflecting kick-start space requirements at scheme build-out) –the initial area requirement is for development based around gas-fired CHP. The second includes an additional notional area for biofuel tanks and ancillary requirements to allow for the conversion to a biofuel supply solution (based on an approximate storage volume for 6 days operation). It must be noted that there are a number of additional considerations to take into account in devising a biofuel / glycerol solution, including delivery areas / chemical storage requirements, which are too site-specific to be meaningfully included here. Equally, it must be noted that there inevitably site-specific constraints that will modify the floor area / arrangements possible, and hence for both scenarios please note that these figures are only indicative.

9.2.3 A general schematic is provided below, showing the expected layout.

Figure 9-2: Indicative general arrangement (1500kW engines)



9.3 Appendix C - Energy Supply Potential

9.3.1 Conversion technology choices (generalised analysis)

9.3.2 This section provides an analysis of the available heat supply technologies, together with an assessment of their viability for the provision of heat to decentralised energy schemes within Haringey.

9.3.3 The following technologies are reviewed:

- Natural gas fired CHP
- Biogas fired CHP
- Biomass gasification CHP
- Solid biomass CHP
- Municipal Solid Waste (MSW) or Refuse Derived Fuel (RDF) CHP

Natural gas-fired CHP

9.3.4 This is the most commonly used type of CHP, as such the technology is well developed and readily available. Two main engine types are available – reciprocating engines, which are generally available in sizes from around 10kW output up to a typical maximum of 4-5MW, although engines of up to 10MW are available, and gas turbine engines, which are available from around 1WM output to the scales found in utility power stations.

Biogas –fired CHP

9.3.5 Reductions in the carbon content of heat may be made through burning biogas, rather than natural gas, within a reciprocating or gas turbine engine. The main sources of biogas are listed below:

- Landfill gas: Landfill sites produce a mixture of gases, with methane a significant component (generally around 50%). This may be burned within a specially adapted CHP engine. However, yields are often variable and unpredictable.
- Anaerobic digestion: An organic feedstock, generally sewerage, food or animal waste, is diluted with water to form a slurry, and fermented within a temperature-controlled digester. A methane rich biogas is produced, consisting of around 60% methane, 40% CO_2 and traces of other gases[51].

9.3.6 As there are no landfill sites within the borough, this energy source may be discounted. It is unlikely, given the urban nature of the borough, that an AD plant will be an appropriate addition. However, an alternative solution would be the use of biomethane produced offsite.

9.3.7 Under this process, gas is produced offsite, near the source of the feedstock, cleaned to remove CO_2 and other impurities, leaving just methane, and injected into the National Transmission System.

[51] http://www.biogas-info.co.uk/index.php/what-is-anaerobic-digestion.html

9.3.8 The process is administered through the Green Gas Certification Scheme (GGCS), part of the Renewable Energy Association (REA). The GGCS tracks (contractually, rather than physically) the passage of biogas through the national gas grid, from point of injection through to its end use. This eliminates the possibility of double counting of biogas sales, providing certainty for end users that what they are buying is effectively green gas.

Biomass gasification CHP

9.3.9 Biomass gasification is a further source of biogas, and involves heating wood-based biomass in a controlled atmosphere to form a synthetic "wood gas" or syngas. The following key items of plant would be required:

- Wood store
- Fuel transfer systems
- Gasifier
- Gas cleaning equipment
- Gas storage tank
- CHP engine
- Selective catalytic reduction (SCR) NOx
- Ground based enclosed flare stack

9.3.10 The following points should furthermore be noted:

- Although there are several UK suppliers which can provide syngas-compatible engines, in dealing with small scale gasification CHP technology PB has not yet encountered a system that can demonstrate acceptable levels of availability. The technology is beset with issues surrounding fuel handling and specification; this results in the consequent production or tar in the system, leading to regular significant maintenance to clean the plant. For this reason an availability of 55% can be considered as representative.
- For the Haringey environment, air quality implications and fuel transport implications of this technology would be significant, and it is considered to be unlikely to be suitable for the borough except in industrial areas.

Solid biomass CHP

9.3.11 Solid biomass engines take two forms - either steam turbines, in which the working fluid is water - or an organic Rankine cycle (ORC) engine, which uses an oil as the working fluid. In general, the latter are smaller (owing to the denser fluid), permit lower temperatures and pressures to be used, and as a result have less stringent safety requirements and are lower cost.

9.3.12 A variety of fuels may be burned, these include wood chip, wood pellets (made from compressed sawdust or other wood products), crop residues such as straw and crops grown especially for energy use such as miscanthus or short-rotation coppice.

9.3.13 Generally, the main items of plant required are:

- Biomass fuel store and fuel transfer mechanism

- Biomass Boiler and ancillary equipment to raise steam from wood fuel
- Steam Turbine and ancillary steam plant
- Alternator and ancillary electrical equipment
- Steam to low temperature hot water heat exchanger

9.3.14 A key consideration in relation to biomass systems is the availability of a ready supply of fuel, together with access requirements for delivery. Similarly to biomass gasification technology, installations of this nature are only likely to be acceptable in industrial areas of the borough.

Glycerol CHP

9.3.15 Glycerol, or glycerine, is a by-product of biodiesel production. For every tonne of biodiesel produced, around 100kg of crude glycerine is formed; this has a high salt content and must be refined prior to use.

9.3.16 Within the UK there are very few refineries with the capability to refine glycerine, so the supply is currently limited and of relatively high and potentially volatile price.

9.3.17 The fuel is burned in a modified diesel CHP engine. There are only a very small number of units currently operating on this fuel in the UK or the world, and hence this must be considered an innovative technology that is essentially unproven, and without established supply chains at this stage.

Municipal Solid Waste (MSW)

9.3.18 MSW involves burning household waste to generate heat and electricity. Although there are no plants located within the borough of Haringey, the Edmonton Incinerator, located on the London EcoPark in the neighbouring borough of Enfield, could be a potential heat source.

Electrical substations

9.3.19 A study is currently underway within the neighbouring borough of Islington to investigate the potential to extract heat from a UKPN electrical substation. The viability of this approach is yet to be proven and arrangements agreed with UKPN to ensure that electrical power supply can be maintained at current service levels. This technology combination must also be considered suitable primarily for the medium term.

9.3.20 It should also be noted that when new substations are installed, these are likely to offer greater ease of integration if the heat recovery mechanisms can be designed into the plant.

London Underground

9.3.21 The following tube stations are located within or on the borders of the London Borough of Haringey:

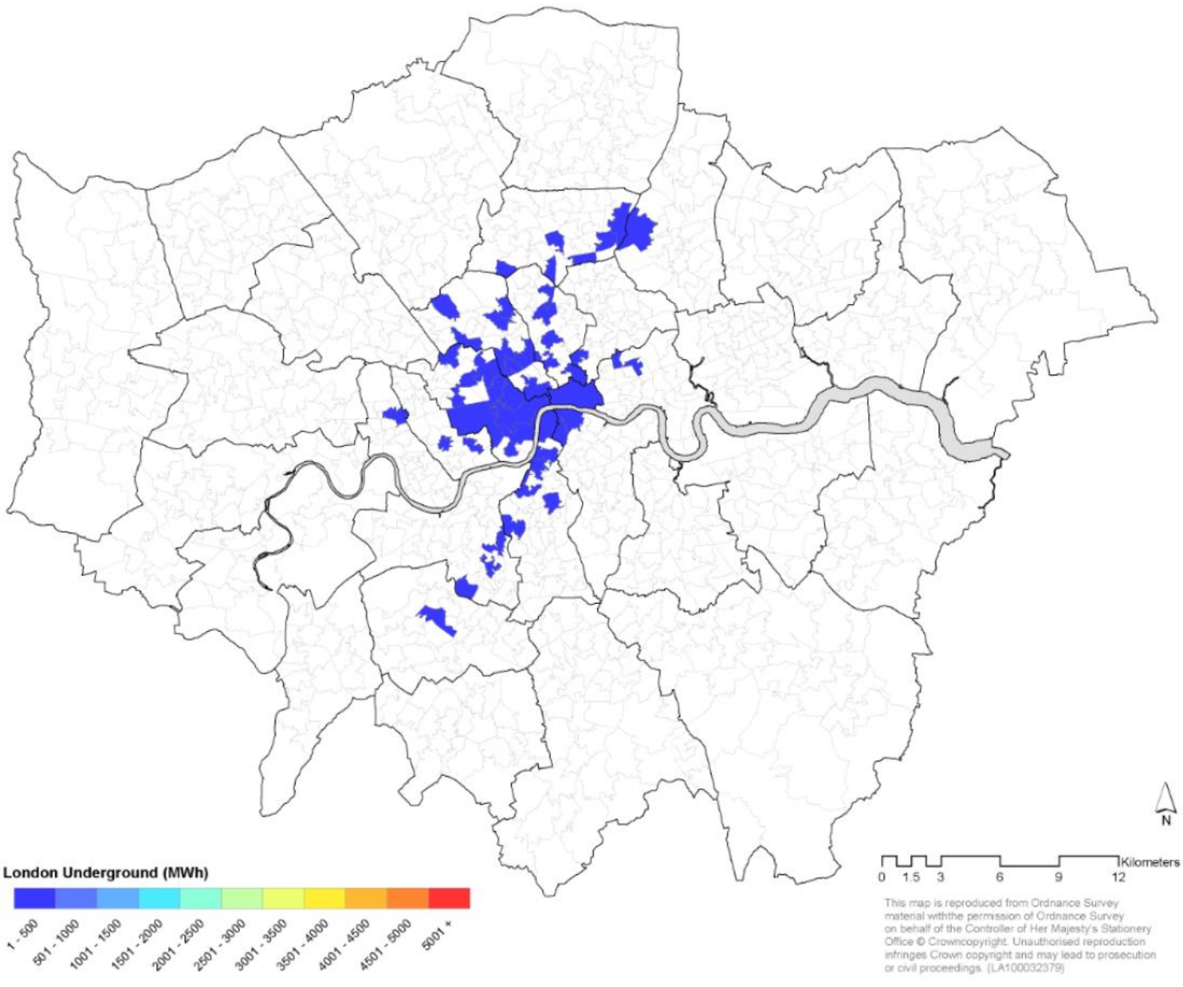
- Bounds Green
- Wood Green
- Turnpike Lane

- Manor House
- Finsbury Park
- Seven Sisters
- Tottenham Hale

9.3.22 In addition, there are also ventilation shafts between these stations (located on the Victoria and Piccadilly lines) from which air - and thus heat – might be extracted. The location of these shafts is considered to be sensitive and is thus not freely available. However, the plan below[52] provides an approximate indication of the location of sites within the borough, and an approximate quantum of heat available from these sources.

9.3.23 The Borough of Islington is also currently undertaking a project to extract heat from an existing tube ventilation shaft to supply the Bunhill district heating network.

Figure 9-3: Heat density map for London Underground sources.



[52] Obtained from *London's Zero Carbon Energy Resource: Secondary Heat, Report Phase 1*, January 2013.

Power stations

9.3.24 Although there are no power stations or waste facilities within the borough of Haringey itself, the nearby boroughs of Barking and Dagenham and Enfield have the Barking Power Station and Edmonton Energy from Waste Facility could provide heat in the longer term.

9.3.25 Barking Power Station is a 1000MW combined-cycle gas turbine plant located to the south-east of the borough of Barking and Dagenham. Although some distance from Haringey, it could be considered as a potential source for supplying a wider scheme via the Olympic Park network. The Power Station is in the process of increasing its capacity by 470MW, with the new development designed with the possibility for heat offtake for district heating purposes. The use of heat from Barking Power Station would, however, be very much a longer-term vision.

9.3.26 A more realistic proposition in the medium term would be the use of heat from the Enfield energy from waste facility – located on the Edmonton Ecopark, which is located close to the north-eastern border of the borough of Haringey. The EcoPark receives waste from the 1.7M households which are serviced by the North London Waste Authority (NLWA), and the EfW facility processes around 550,000 tonnes of waste per year, producing around 40MW of electricity,

9.3.27 The current plant is set to continue operation until 2020, when it will reach the end of its useful life and be decommissioned[53]. However, as set out in the EcoPark SPD, the provision of heat for district heating purposes would be a key priority, with the potential for the site to become a major provider of heat to the Lee Valley Heat Network. A supply of at least 15MWth of heat is considered to be available, based on an understanding of the site's operations. It is proposed that, during the decommissioning phase, heat be provided from boilers located within an onsite energy centre.

9.3.28 As described in Haringey's Carbon Commission report, a partnership has already been established between the boroughs of Haringey, Enfield and Waltham Forest and the GLA to develop these plans.

Watercourses/ reservoirs

9.3.29 Although less widespread than air and ground source heat pumps, heat can also be extracted from water via heat pumps. Water has the following advantages when compared to air and ground source heat pumps:

- Flow of water provides constant provision of heat
- Greater thermal capacity (and thus greater scope for heat extraction) when compared to air source heat pumps
- Lower installation costs versus ground source heat pumps (no need to dig trenches or boreholes)

9.3.30 Haringey has significant water resources available in the reservoirs along its eastern borders, within the London Borough of Waltham Forest. Owing to the location of this source, it is likely to be best suited to the supply of buildings in the East of the borough. DECC has commissioned this map at the national level (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/353

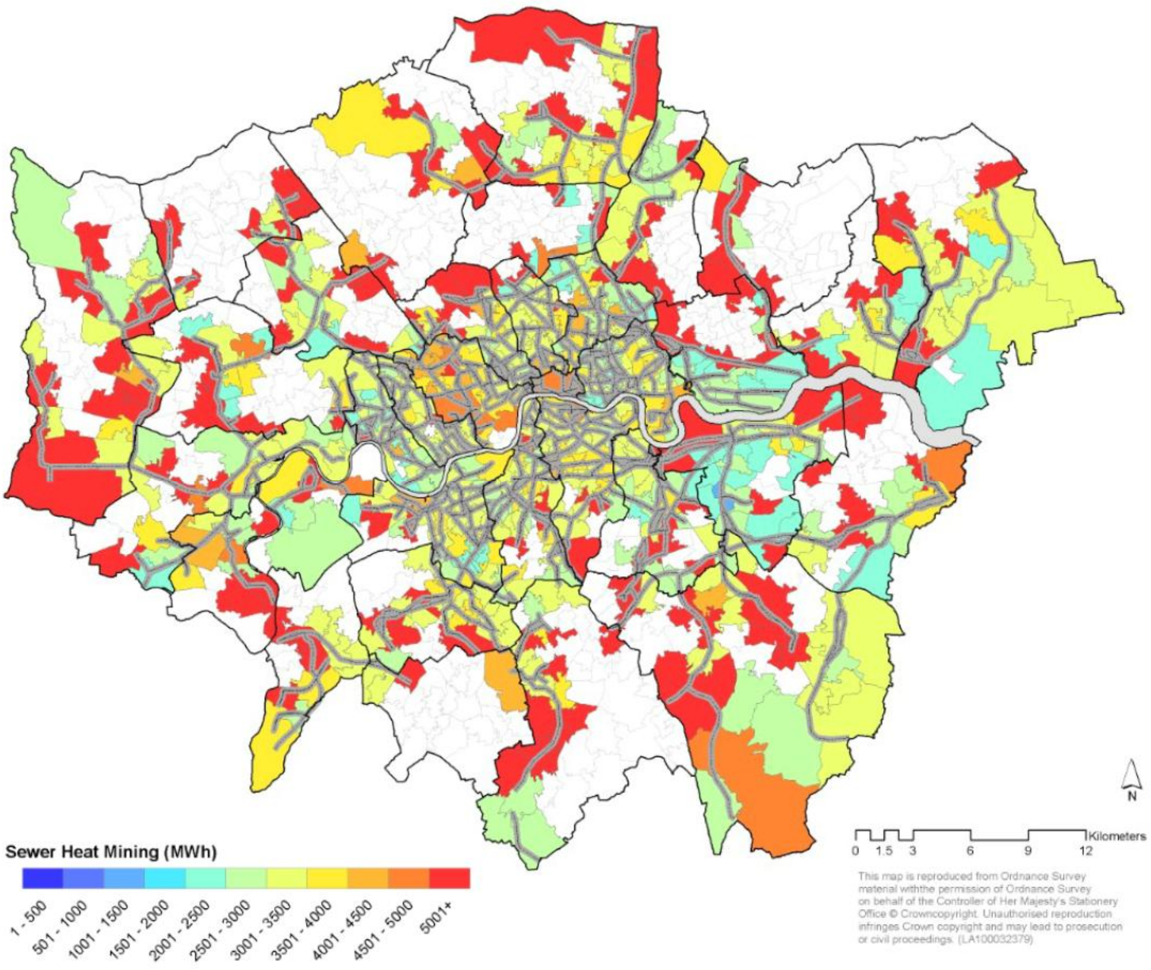
[53] Edmonton EcoPark Planning Brief SPB – Adopted May 2013

979/decc_water_source_heat_map.pdf), illustrating that within London both the Thames and the River Lea provide 'hotspot's for potential extraction of heat for use in heat pumps.

Sewer heat mining

9.3.31 The map below shows the location of Thames Water trunk sewers within London together with the heat which might be extracted. As can be seen, although there is some incursion into the edges of the borough, the amount of heat which could be obtained is relatively low.

Figure 9-4 Sewer heat ming map



9.3.32 The following table comments on future supply potential for different technologies:

Table 9-2 Supply capacities prognosis

Heat source	Status 2015 / supply potential	Status 2025 / supply potential	Status 2050 / supply potential

Heat source	Status 2015 / supply potential	Status 2025 / supply potential	Status 2050 / supply potential
Gas-fired CHP	Mature, approx. 37% electrical efficiency, significant supply potential – linked to opportunities for viability installations	As per current status quo, anticipated minor efficiency improvements	As per current status quo, anticipated minor efficiency improvements
Biofuel CHP (biodiesel / glycerol / etc.)	Established at larger scales (i.e. >2MWe), ~37% electrical efficiency, emerging at smaller scales through individual innovative companies. Fuel supply chains still emerging / innovative / small scale for required fuels	Anticipated to be market-proven through sufficient demonstration projects, fuel chains anticipated to be formative, but established. Fuel storage and emissions treatment technologies required anticipated to limit extend of installations. Anticipated increase in electricity prices favours CHP technology.	Anticipated to be established with competitive fuel supply chains and multiple suppliers for prime movers and ancillary fuel delivery plant.
Hydrogen fuel cells	Emerging, innovative technologies, ~38% efficiency	Anticipated to be still emerging, and requiring subsidy to be cost-competitive	Anticipated to be approaching cost-competitive as a technology, but hydrogen distribution networks not anticipated to be developed except in isolated instances
Heat via DHNs sourcing heat from outside the borough	Established technology, emerging networks in neighbouring boroughs	LVHN should be firmly established. Expansion of the Olympics network also anticipated to be in place.	Larger, London-wide network spines should be established, enabling transfer of heat in transmission mains over larger distances.
Ground source heat pumps	Established technology, requiring subsidy to be competitive with alternative forms of generation. The amount of heat which may be available from GSHPs varies between MSOAs, from less than 0.5 GWh/annum to more than 5GWhnnum.	Greater sophistication in holistic design anticipated to deliver cost efficiencies in somewhat increased numbers of developments, and grid decarbonisation improves carbon balance. Anticipated electricity price rises erodes profitability of heat pump installations.	Further performance improvements anticipated, and stronger design team familiarity with the technology. End of pump-priming subsidies leaves technology to compete in market.

Heat source	Status 2015 / supply potential	Status 2025 / supply potential	Status 2050 / supply potential
Air source heat pumps	Established technology, subsidy required to deliver cost savings to end users in most cases. Over 5GWh of heat per annum could be achieved in most MSOAs in Haringey.	Higher temperature heat sources (i.e. building cooling / water courses) for other heat pump technologies complete for large-scale schemes, but ASHP anticipated to be deployed on a more widespread basis in smaller properties / situations where other technologies cannot easily be installed. Anticipated electricity price rises erodes profitability of heat pump installations.	Further performance improvements anticipated, and stronger design team familiarity with the technology. End of pump-priming subsidies leaves technology to compete in market.
Reservoirs and watercourses	Linked to heat pump technology. Excellent potential in water-side new-build properties with appropriate secondary system design.	Anticipated to supply increasing numbers of suitably located properties as refurbishments / new-builds allow. Anticipated electricity price rises erodes profitability of heat pump installations.	Anticipated that pump-priming subsidies finish and that technology must compete on market-based performance.
London Underground	Technical constraints / difficulties of working with LU render this option costly	Technology proven, but cannot compete on market basis against alternatives. Limited locations where applicable. It is estimated that btween 0.5 and 1GWh may be able to be achieved annually in around 5 MSOAs in the borough.	Technology proven, but cannot compete on market basis against alternatives. Limited locations where applicable It is estimated that between 0.5 and 1GWh may be able to be achieved annually in around 5 MSOAs in the borough.
Sewer heat mining	Unproven in the UK. Innovative, tes-bed technology	Limited number of test-cases installed	Low numbers of installations anticipated. Minor impact on overall heat supply market. Limited heat available. Between 2 and 5 GWh may be available in around 10 MSOAs around the edge of the borough

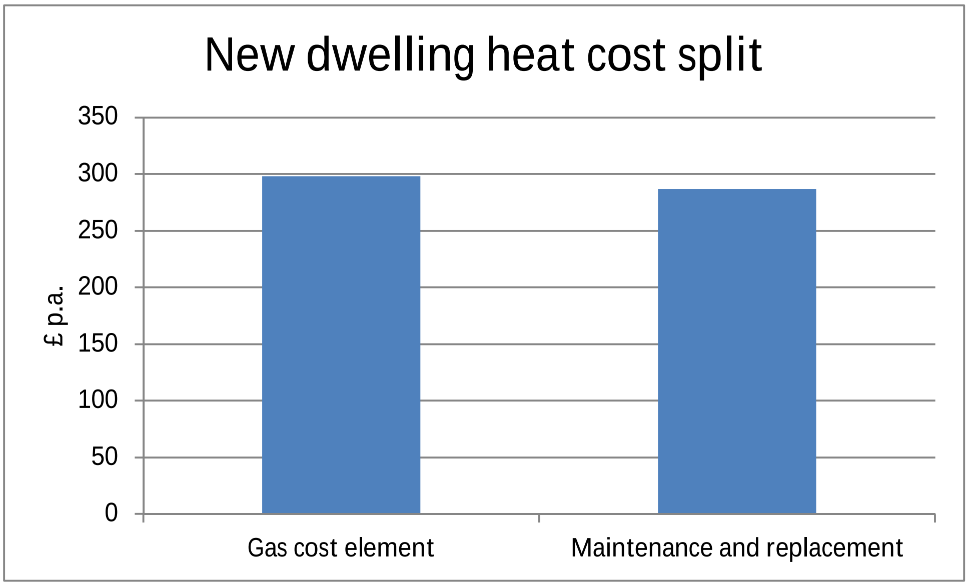
9.4 Appendix D - Heat sales price calculations

Table 9-3 Calculation of new domestic heat sales price

Parameter	Value	Unit
Annual average gas bill	6,000	kWh
Assumed seasonal efficiency (new boilers)	90%	GCV seasonal efficiency
Units of heat delivered	5,400	kWh heat
Gas unit cost (QEP, March 2014)	4.97	p/kWh
Gas cost	298.2	£ p.a.
Gas boiler replacement cost	2,500	£
Replacement interval	15	years
Replacement cost annualised	167	£
Annual gas boiler maintenance	120	£ p.a.
Total cost of heat delivery via gas boiler	585	£ p.a.
Total unit cost of heat (all inclusive)	10.83	p/kWh
Proposed heat sales cost (heat from gas cost minus 10%)	**9.75**	**p/kWh**

9.4.1 The following chart illustrates the constituent elements of these figures:

Figure 9-5 Elements of new-build domestic heat cost



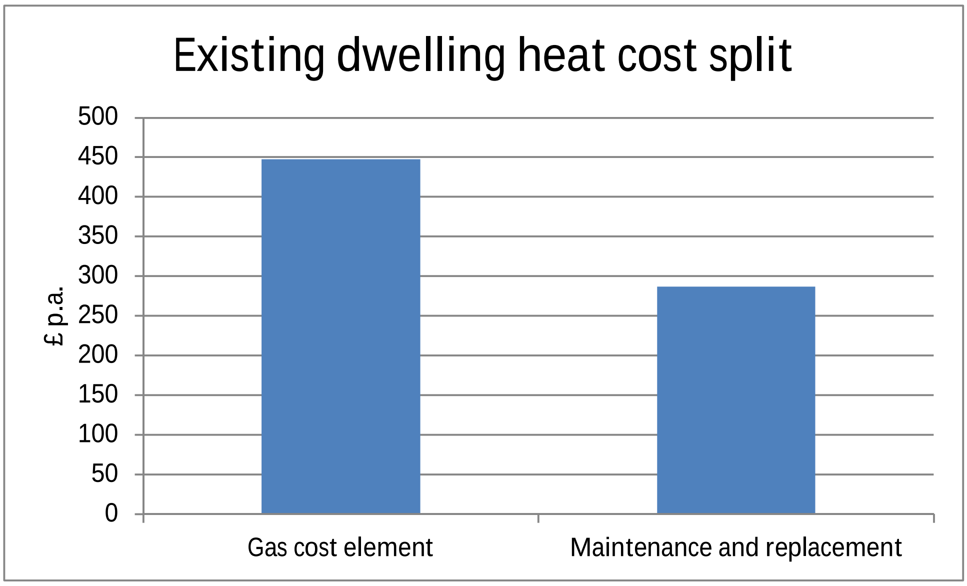
9.4.2 The same calculation has also been carried out for existing domestic customers. This process assumes a higher typical gas volume (due to poorer quality construction of dwellings), and a reduced boiler efficiency. The split derived for existing domestic customers is as shown below:

Table 9-4 Existing domestic customer cost split

Parameter	Value	Unit
Annual average gas bill	9,000	kWh
Assumed seasonal efficiency (existing boilers)	80%	GCV seasonal efficiency
Units of heat delivered	7,200	kWh heat[54]
Gas unit cost (QEP, March 2014)	4.97	p/kWh
Gas cost	447	£ p.a.
Gas boiler replacement cost	2500	£
Replacement interval	15	years
Replacement cost annualised	167	£
Annual gas boiler maintenance	120	£ p.a.
Total cost of heat delivery via gas boiler	734	£ p.a.
Total unit cost of heat (all inclusive)	10.19	p/kWh
Proposed heat sales cost (heat from gas cost minus 10%)	**9.17**	**p/kWh**

9.4.3 It is recognised that major domestic applications within Haringey would be obliged to install a communal heating system (potentially with CHP). However, for this type of installation, the current benchmark that is used for setting heat sales price is a gas-boiler alternative. Hence, whilst the calculation above may not reflect the technology delivery required under a BAU scenario, the price point and methodology is considered appropriate in the context of this report.

Figure 9-6 Existing dwelling split between fixed and variable heat cost elements



9.4.4 For existing residential blocks, therefore, a heat sales price that reflects the smaller portion of 'fixed cost' elements has been adopted.

[54] Estimated typical consumption for an existing representative 2-bed dwelling

9.4.5 Heat sales prices for non-domestic customers have been based on the assumption that replacement and maintenance costs reflect 20% of overall heat unit prices. The avoided costs for non-domestic customers have been based on a non-domestic gas tariff. Existing non-domestic customers are assumed to be incentivised to connect by avoiding boiler maintenance and replacement costs i.e. the heat sales price adopted for this sector reflects only gas unit costs and boiler efficiency.

Table 9-5 Non-domestic heat price

Parameter	Value	Unit
Unit of heat	1	kWh heat
Assumed seasonal efficiency (new boilers)	85%	GCV seasonal efficiency
Units of heat delivered	1	kWh heat
Gas unit cost	3.20	p/kWh
Gas cost per unit of heat	3.77	p/kWh
Gas cost as % of total heat cost (before maintenance and replacement elements)	80%	%
Total heat cost	4.71	p/kWh

9.5 Appendix E – Capex, Maintenance and Replacement

9.5.1 Capex estimates for each scheme have been developed, with the following items of plant and fees considered:

- Energy centre and plantroom, comprising:
  - Energy centre building
  - Controls & instrumentation
  - Electrical works
  - CHPs
  - Flue
  - Gas boiler
  - Utilities
  - Pipework - water
  - Pipework - gas
  - Pumps
  - Thermal Store
  - Ventilation system
  - Pressurisation/expansion
  - Sidestream filter
  - Degasser
  - Softening plant
  - Professional services fees (engineering)
  - Professional services fees (legal / planning / permitting / landscaping / etc.)
  - Commissioning
- District heating network
  - Main spine
  - Conversion of blocks of flats with individual boilers to communal systems (description below)
  - Hydraulic interface units (HIUs) (for existing conversions only – i.e. for new sites, developers would be assumed to install on-site distribution and HIUs as their 'counterfactual' solution)

A summary of CAPEX figures adopted in modelling is provided below.

9.5.2 The following maintenance/annually recurring costs were included within modelling:

- Energy centre maintenance
- Controls and instrumentation maintenance
- Gas boiler insurance and maintenance
- Pump maintenance
- CHP maintenance
- Ventilation system maintenance
- District heating network maintenance
- Billing costs
- Heat interface unit maintenance

9.5.3 Replacement expenditure

9.5.4 The following replacement expenditure was included within modelling:

Table 9-6 Replacement cost assumptions

Item	Replacement year	Replacement cost as percentage of CAPEX
Heat Source 1	15	80%
Heat Source 2	15	80%
Controls & instrumentation	20	80%
Electrical works	25	50%
Gas boiler	25	60%
Pumps	15	80%
Ventilation system	20	60%
Pressurisation/expansion	20	70%
Sidestream filter	20	60%
Degasser	25	60%
Softening plant	20	70%
HIU	20	85%

9.5.5 Capex figures – Northumberland Park kick-start

Description	Northumberland Park
Capex items	
CHP engines	£1,324,000
Energy centre building	£1,189,000
Metering, controls and instrumentation	£663,000
Electrical installation works (inc fire alarm, lighting, CHP connection, G59 etc.)	£702,000
Gas boilers and mechanical installation	£1,214,000
Flues	£316,000
Internal and external utility connections (estimated)	£574,000
Mech plant items (pumps, thermal stores, pressurisation)	£463,000
Ventilation plant (AHU, ductwork, filters etc.)	£113,000
Water treatment items (degasser, softening, sidestream filter)	£39,000
Professional services fees (design from outline to construction level drawings and specs)	£750,000
Legal services for contract close, and planning element studies (i.e. ecological, air quality etc.)	£750,000
Commissioning	£20,000
Plot-level substations (interface to site distribution)	£1,250,000
District heating distribution network	£2,136,000
Main contractor prelims	£841,000
Contingency	£1,359,000
Total	**£13,703,000**

9.5.6 Capex figures – Hornsey

Description	**Hornsey**
Capex items	
CHP engines	£407,000
Energy centre building	£440,000
Metering, controls and instrumentation	£105,000
Electrical installation works (inc fire alarm, lighting, CHP connection, G59 etc.)	£35,000
Gas boilers and mechanical installation	£138,000
Flues	£36,000
Internal and external utility connections (estimated)	£291,000
Mech plant items (pumps, thermal stores, pressurisation)	£115,000
Ventilation plant (AHU, ductwork, filters etc.)	£13,000
Water treatment items (degasser, softening, sidestream filter)	£4,000
Professional services fees (design from outline to construction level drawings and specs)	£110,000
Legal services for contract close, and planning element studies (i.e. ecological, air quality etc.)	£130,000
Commissioning	£4,000
Plot-level substations (interface to site distribution)	£480,000
District heating distribution network	£301,000
Main contractor prelims	£147,000
Contingency	£284,000
Total	**£3,040,000**

9.5.7 Capex figures – Wood Green

Description	Wood Green
Capex items	
CHP engines	£662,000
Energy centre building	£650,000
Metering, controls and instrumentation	£458,000
Electrical installation works (inc fire alarm, lighting, CHP connection, G59 etc.)	£351,000
Gas boilers and mechanical installation	£677,000
Flues	£176,000
Internal and external utility connections (estimated)	£431,000
Mech plant items (pumps, thermal stores, pressurisation)	£276,000
Ventilation plant (AHU, ductwork, filters etc.)	£63,000
Water treatment items (degasser, softening, sidestream filter)	£38,000
Professional services fees (design from outline to construction level drawings and specs)	£539,000
Legal services for contract close, and planning element studies (i.e. ecological, air quality etc.)	£638,000
Commissioning	£10,000
Plot-level substations (interface to site distribution)	£1,050,000
District heating distribution network	£1,360,000
Main contractor prelims	£549,000
Contingency	£862,000
Total	**£8,790,000**

9.5.8 Capex figures – Tottenham kick-start

Description	Tottenham Kick-start
Capex items	
CHP engines	£662,000
Energy centre building	£780,000
Metering, controls and instrumentation	£443,000
Electrical installation works (inc fire alarm, lighting, CHP connection, G59 etc.)	£351,000
Gas boilers and mechanical installation	£639,000
Flues	£167,000
Internal and external utility connections (estimated)	£421,000
Mech plant items (pumps, thermal stores, pressurisation)	£271,000
Ventilation plant (AHU, ductwork, filters etc.)	£60,000
Water treatment items (degasser, softening, sidestream filter)	£38,000
Professional services fees (design from outline to construction level drawings and specs)	£509,000
Legal services for contract close, and planning element studies (i.e. ecological, air quality etc.)	£603,000
Commissioning	£10,000
Plot-level substations (interface to site distribution)	£750,000
District heating distribution network	£614,000
Residential conversion costs if applicable	£0
Main contractor prelims	£527,000
Contingency	£858,000
Total	**£7,703,000**

9.6 Appendix F – Preferred Solutions Project Plans

The following notional delivery plans are based around the assumption that contractors would develop the scheme design, under the supervision of an owner's engineer / concept guardian.

Figure 9-7 Notional Project Delivery Plan - Northumberland Park

Notional project plan

Northumberland Park area

Example based on contractor development of designs with owner's engineer appointment (i.e. no ESCO involvement)

		2016				2017				2018			
Activity		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Feasibility study & business case													
	Develop outline technical design												
Owner's engineer													
	Appointment of owner's engineer												
	Preparation of design documents for contractors to price												
Procurement of contractor for design development / implementation													
	Issue procurement documentation												
	Receipt of offers and tender adjudication												
	Haringey internal sign-off												
	Appointment of contractor								X				
Scheme construction													
	Design development												
	Ordering of long lead-time items (i.e. CHP)												
	Commissioning												
Commence operation													X

Figure 9-8 Notional Project Delivery Plan - Wood Green

Notional project plan

Wood Green

Example based on contractor development of designs with owner's engineer appointment (i.e. no ESCO involvement)

		2016				2017				2018				2019			
Activity		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Feasibility study & business case development																	
	Procure consultant																
	Develop business case & outline technical design																
Owner's engineer																	
	Appointment of owner's engineer																
	Preparation of design documents for contractors to price																
Procurement for contractor design development / implementation																	
	Issue procurement documentation																
	Receipt of offers and appointment of contractor																
	Haringey internal sign-off																
	Appointment of contractor												X				
Scheme construction																	
	Design Development																
	Ordering of long lead-time items (i.e. CHP)																
	Commissioning																
Commence operation																	X

Figure 9-9 Notional Project Delivery Plan – Tottenham Hale

Notional project plan

Tottenham Hale

Example based on contractor development of designs with owner's engineer appointment (i.e. no ESCO involvement)

		2018				2019				2020				2021	
Activity		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Feasibility study & business case development															
	Procure consultant														
	Develop business case & outline technical design														
Owner's engineer															
	Appointment of owner's engineer														
	Preparation of design documents for contractors to price														
Procurement for contractor design development / implementation															
	Issue procurement documentation														
	Receipt of offers and appointment of contractor														
	Haringey internal sign-off														
	Appointment of contractor										X				
Scheme construction															
	Design Development														
	Ordering of long lead-time items (i.e. CHP)														
	Commissioning														
Commence operation															X

9.7 Appendix G – NPV outputs

9.7.1 This table summarises the NPV outputs of modelling under the Export only scenario

Table 9-7 NPV outputs

		Tottenham Hale NPV results, £k, 25 and 40 yrs	Wood Green NPV results, £k, 25 and 40 yrs	Northumberland Park NPV results, £k, 25 and 40 yrs	Hornsey NPV results, £k, 25 and 40 yrs
		Option A 1560 CHP unit, based on Edina 2020V16	Option A 1560 CHP unit, based on Edina 2020V16	Option A 2 no. 1560 CHP unit, based on Edina 2020V16	Option B 600kWe CHP unit, based on Edina 2016V12
NPV 25 yrs	3.5%	-£2,412	£1,341	£3,071	-£3,223
	6.0%	-£3,439	-£596	-£587	-£3,085
	9.0%	-£4,320	-£2,214	-£3,635	-£2,998
	12.0%	-£4,947	-£3,338	-£5,741	-£2,955
NPV 40yr	3.5%	-£1,031	£3,961	£6,597	-£3,398
	6.0%	-£2,805	£613	£1,094	-£3,170
	9.0%	-£4,061	-£1,717	-£2,920	-£3,034
	12.0%	-£4,837	-£3,127	-£5,426	-£2,971

9.8 Appendix H – Scheme heat demand profiles

The following charts illustrate the scheme heat demand profiles as developed for each kick-start network:

Figure 9-10 Northumberland Park Heat Demand Profile

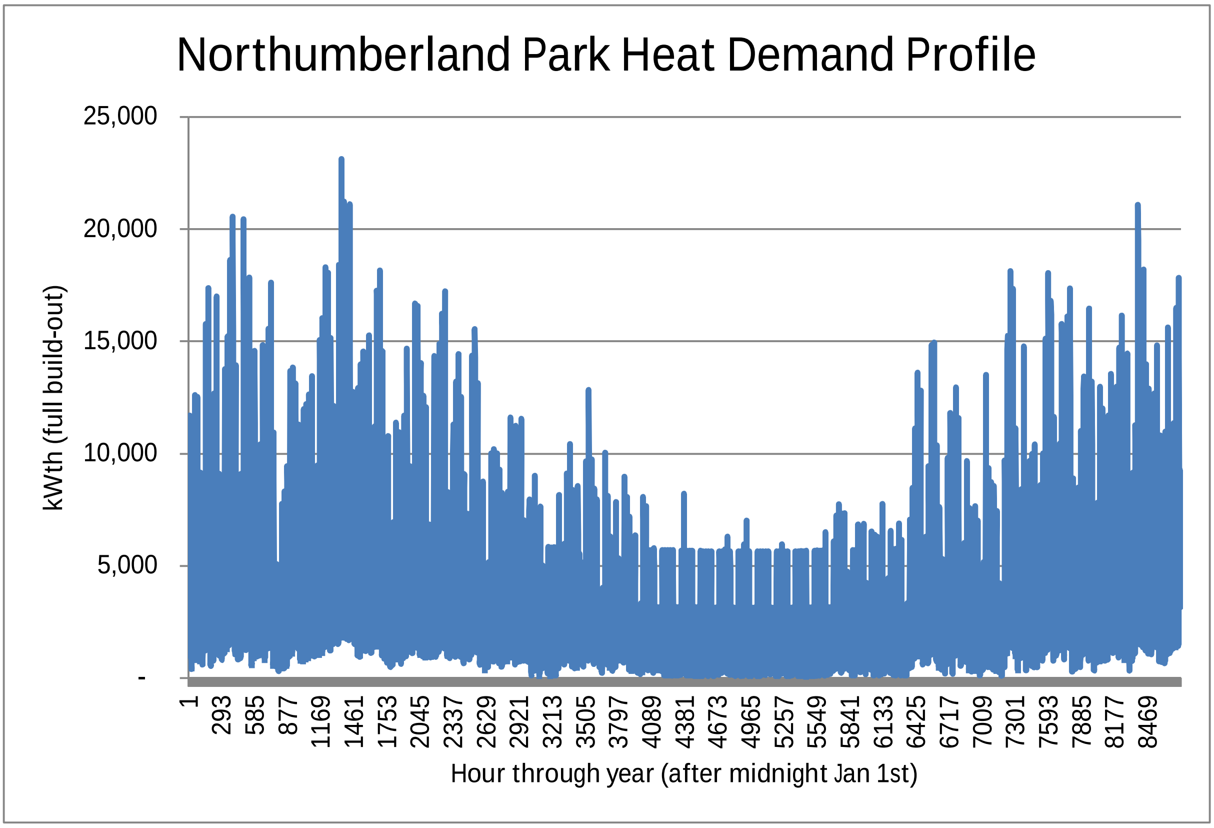


Figure 9-11 Hornsey Network Heat Demand Profile

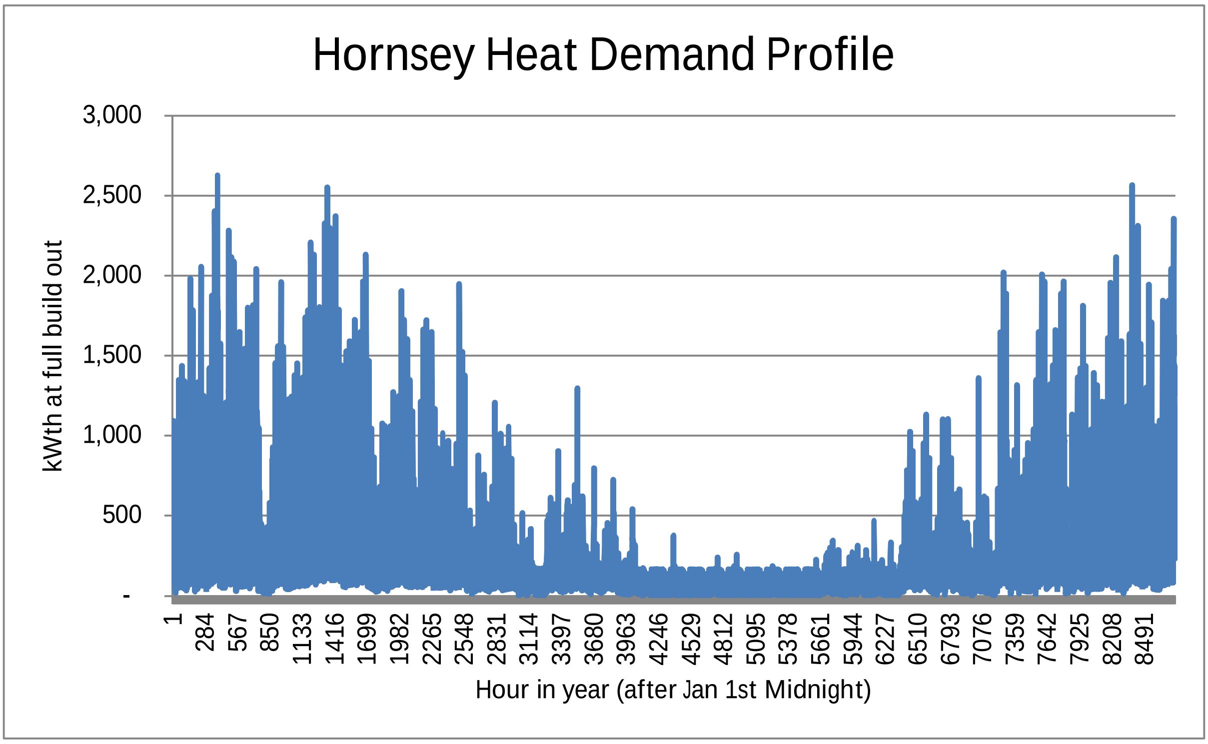


Figure 9-12 Tottenham Hale scheme heat demand profile

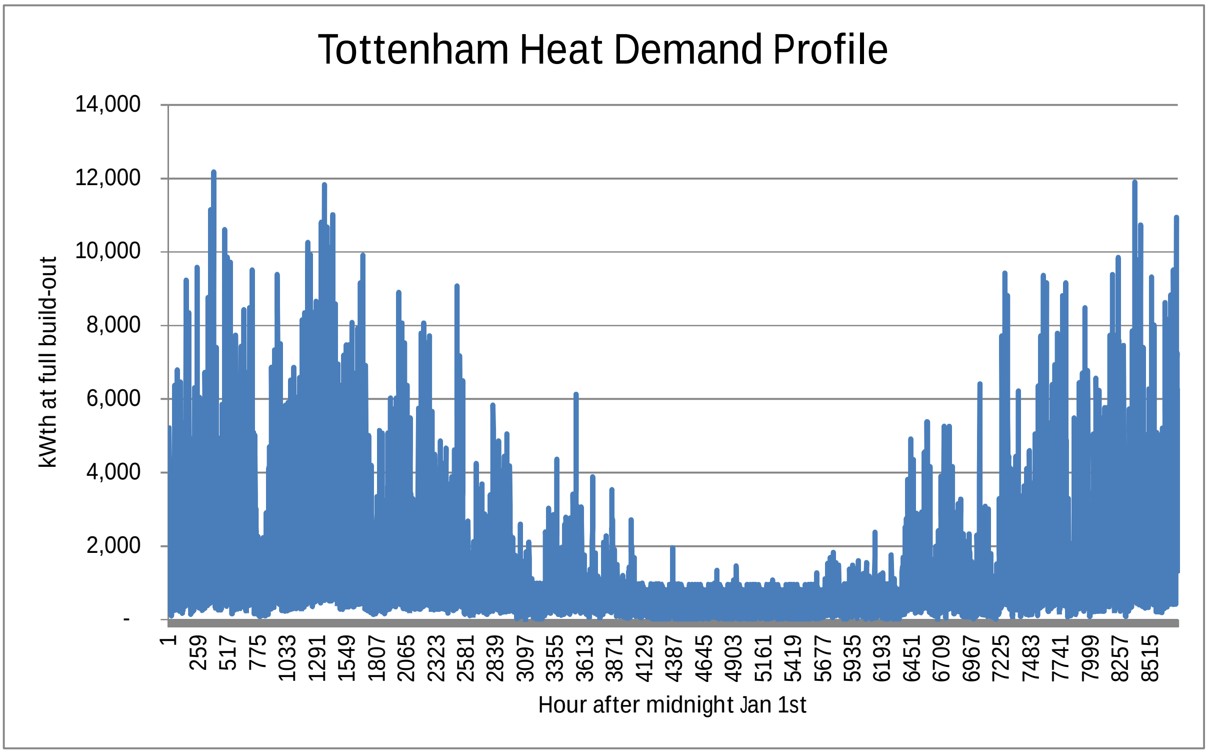
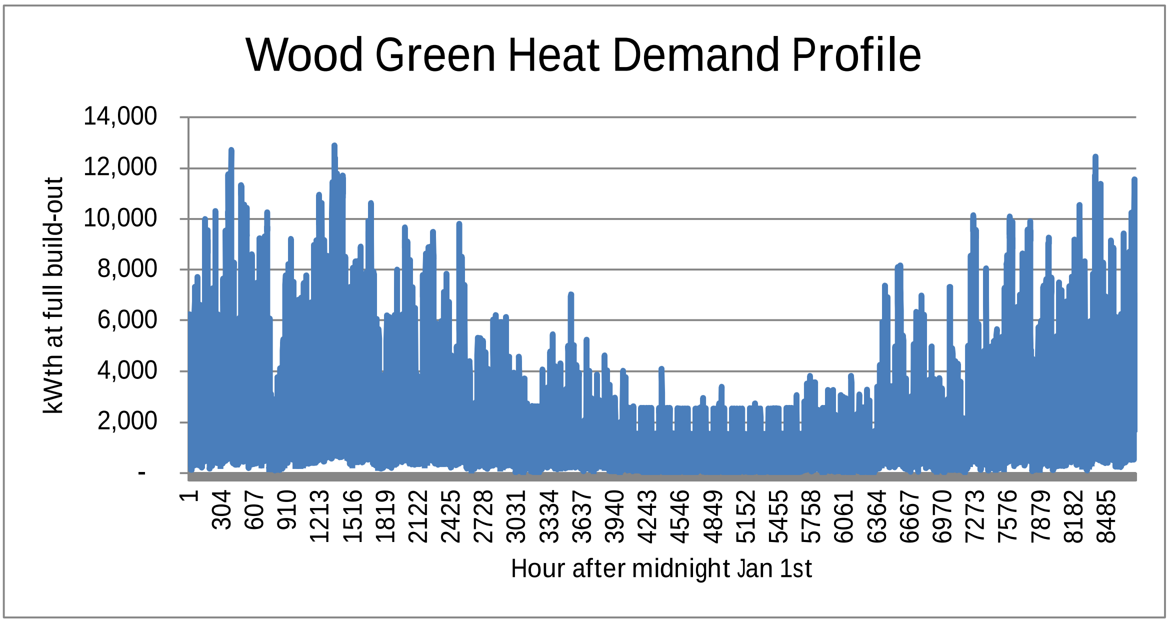


Figure 9-13 Wood Green Heat Demand Profile



9.9 Appendix I – Main spine and branch delineation

The following charts indicate the delineation used (and network diameters) between main spine and branch.

Figure 9-14 Main spine and branches - Northumberland Park

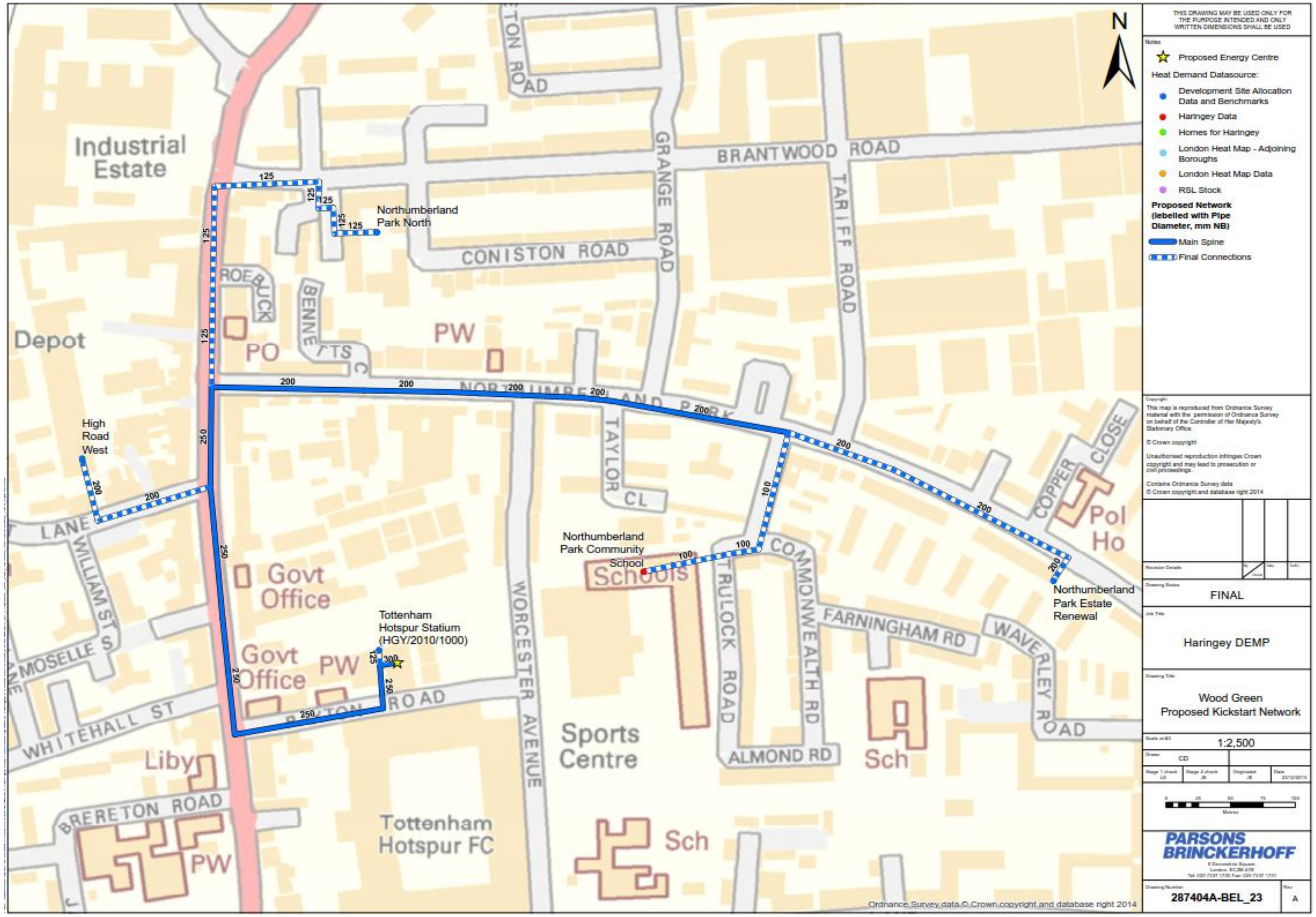


Figure 9-15 Main spine and branches - Wood Green

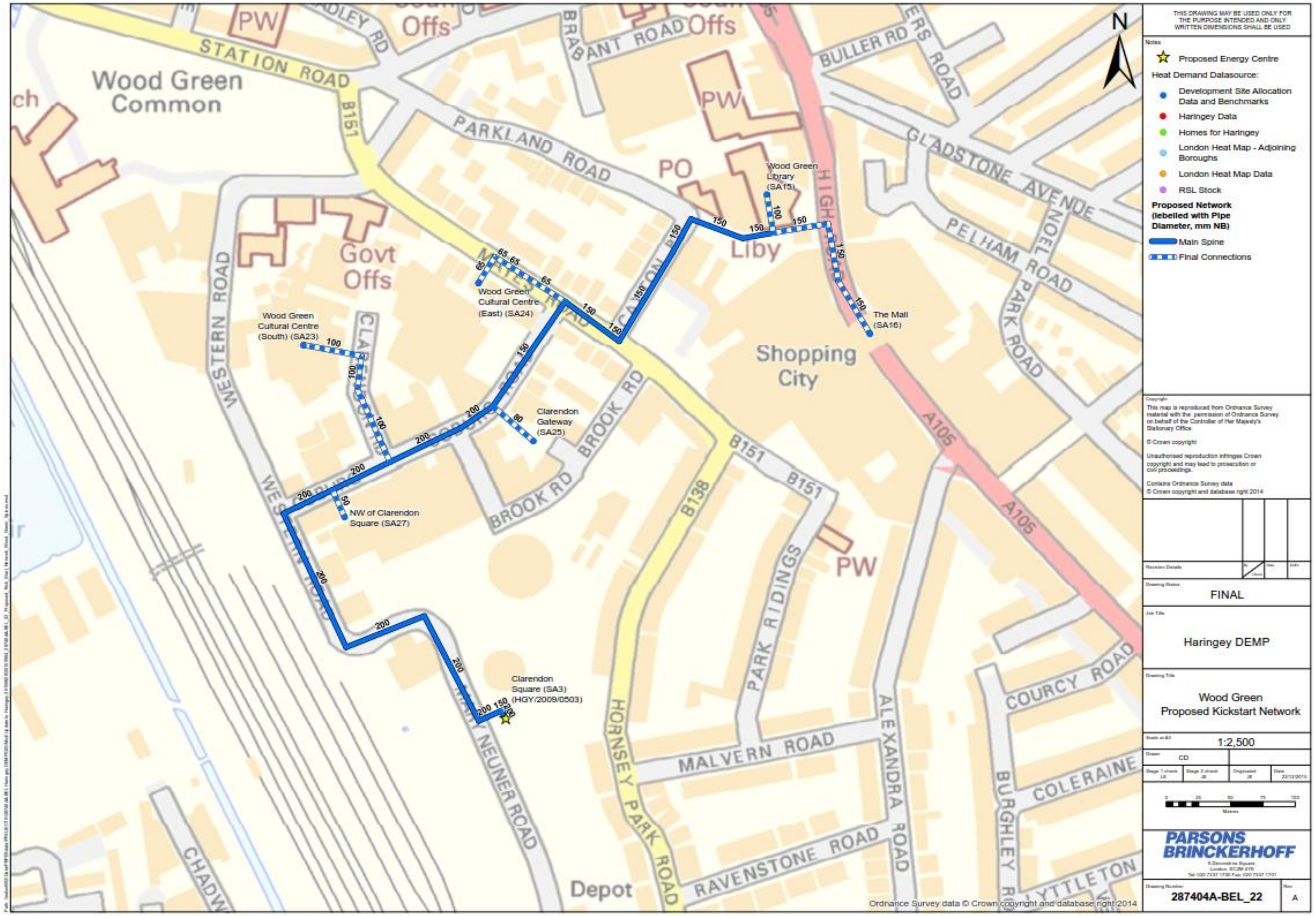


Figure 9-16 Main Spine and Branches - Tottenham Hale

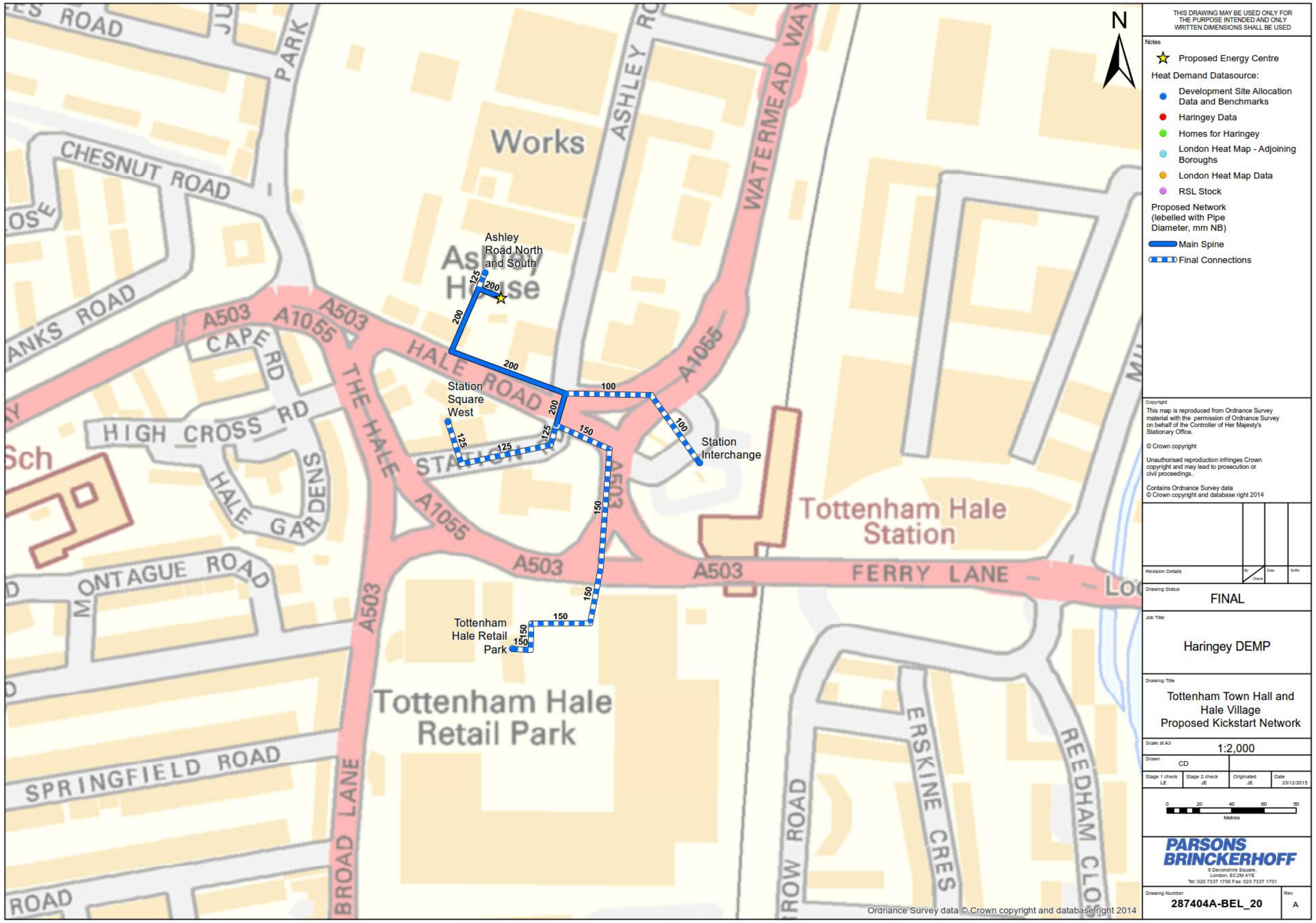


Figure 9-17 Main spine and branches - Hornsey