Upper Lea Valley Decentralised Energy Network

Waltham Forest Satellite Schemes

Nov 2012

FINAL

PARSONS BRINCKERHOFF

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Waltham Forest Satellite Schemes

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CONTENTS

List of Abbreviations

AAP	Area Action Plan
AMR	Annual Monitoring Report
BRE	Building Research Establishment
CCGT	Combined cycle gas turbine
CCL	Climate Change Levy
CEM	Contract Energy Management
CHP	Combined Heat and Power
CIBSE	Chartered Institute of Building Services Engineers
CIL	Community Infrastructure Levy
CRBO	Community Right to Build Order
DCLG	Department for Communities and Local Government
DEN	Decentralised Energy Network
DG	Distributed generation
DH	District Heating
DNO	Distribution network operator
DPCR	Distribution Price Control Review
DPD	Development Plan Documents
DUoS	Distribution use of system
EfW	Energy from Waste
EPN	Eastern Power Networks
ESCo	Energy Services Company
ETC	Environmental Technologies Complex
FTE	Full Time Equivalent
GCV	Gross calorific value
GFA	Gross Floor Area
GLA	Greater London Authority
HTHW	High temperature hot water
HV	High voltage
IWMF	Integrated Waste Management Facility
ktpa	Kilo tonnes per annum
kWth	Kilo watt thermal (i.e. heat output)
LBWF	London Borough of Waltham Forest

LDDs	Local Development Documents
LDO	Local Development Order
LPN	London Power Networks
MSW	Municipal Solid Waste
MUSCo	Multi-utility Services Company
MW(e)(th)	Mega-watt (electrical) (thermal)
NDO	Neighbourhood Development Order
NDP	Neighbourhood Development Plan
NHER	National Home Energy Rating
NLSA	North London Strategic Alliance
NLWA	North London Waste Authority
NLWP	North London Waste Plan
NPV	Net present value
OAPF	Opportunity Area Planning Framework
PB	Parsons Brinckerhoff
PPA	Power Purchase Agreement
PPA	Planning Performance Agreement
PPS	Planning Policy Statement
RDF	Refuse Derived Fuel
RHI	Renewable Heat Incentive
ROC	Renewable Obligation Certificate
RRP	Resource Recovery Plant
SIGE	Spark ignition gas engine
SPD	Supplementary Planning Document
SPG	Supplementary Planning Guidance
SPV	Special purpose vehicle
SRF	Solid Recovered Fuel
TfL	Transport for London
UKPN	United Kingdom Power Networks
ULV	Upper Lee Valley
WID	Waste incineration directive

EXECUTIVE SUMMARY

Context	The North London Strategic Alliance (NLSA) has commissioned Parsons Brinckerhoff Energy Solutions (PB) to conduct a series of decentralised energy feasibility studies in Haringey and Waltham Forest. There are two key objectives of these studies: • To investigate the short-term viability of CHP installation • To inform the potential development of the Upper Lee Valley (ULV) Decentralised Energy Network (DEN) This study investigates CHP feasibility within Waltham Forest at: • Blackhorse Lane • Walthamstow Town Centre This study has been undertaken at a time when there is a national target for carbon dioxide emissions reduction of 80% by 2050, relative to 1990 levels, and the Mayor of London has set a target to supply a quarter of London's energy from decentralised sources by 2025.
Approach	Data was collected from a number of sources, but mainly from the AAP managers and Energy Manager at London Borough of Waltham Forest (LBWF). PB conducted site visits which identified that there was no suitable plant room in an existing, council owned property to house a CHP engine of the scale required to serve the heat networks assessed. Heat demands were calculated based on historic gas meter readings for existing buildings and benchmark data for new development. Outline network designs were produced for each assessed network with a notional energy centre location selected. The performance of suitably sized CHP engines was modelled to identify the optimal size to provide the best financial returns. An assessment was made of the preferred start date of each scheme based on the expected phasing of new developments. A whole life cost approach was used to provide an assessment of the financial performance of each scheme. The potential carbon emissions savings from the scheme were calculated. Variations, generally reduced versions, of some of the schemes were also assessed where it was identified that these variants may provide better performance.

<table>
<tr><td>Results</td><td>

All schemes have been assessed on the basis of the capital costs and operational performance of the installation, also taking into account potential developer contributions (where developers would avoid the need to install their own plant). The figure adopted for developer contributions in this analysis has been based around typical avoided costs of a gas-boiler installation (£100/kW_{th} capacity).

Both Blackhorse Lane North and South schemes show positive whole life cost results at a 3.5% discount rate. The Walthamstow Town Centre scheme shows a negative NPV mainly due to the larger area over which the scheme is spread.

<table>
<tr><th>Scheme name</th><th>CHP engine size [kW_e]</th><th>carbon savings [tonnes CO_2 p.a.]</th><th>capital cost [£m]</th><th>start date</th><th>25 year NPV, 3.5% discount rate [£k]</th></tr>
<tr><td>Walthamstow Town Centre</td><td>1,200</td><td>1,700</td><td>4.4</td><td>2014</td><td>-448</td></tr>
<tr><td>Walthamstow Town Centre - reduced</td><td>600</td><td>747</td><td>2.1</td><td>2014</td><td>-230</td></tr>
<tr><td>Blackhorse Lane North</td><td>800</td><td>1,200</td><td>2.1</td><td>2013</td><td>633</td></tr>
<tr><td>Blackhorse Lane South</td><td>800</td><td>1,252</td><td>2.3</td><td>2017</td><td>1,034</td></tr>
</table>

Variations on the Town Centre scheme were assessed including a reduced scheme concentrated at South Grove. This reduced scheme provides a better financial performance but at the loss of just over 30% of the carbon savings.

A proposal to increase the connection charge for the Walthamstow Town Centre provided an assessment of the level of charge required to achieve a financially viable scheme. For the full network option modelled the charge would need to reflect an avoided cost of low-carbon plant installation (around £200/kWth capacity). This is considered justified since, in the absence of a decentralised energy supply system, developers would be obliged to meet planning and building regulation compliance with the use of low-carbon energy supply plant.

</td></tr>
<tr><td>Conclusions and Recommendations</td><td>

These results illustrate that there is significant opportunity to implement DE in LBWF, delivering substantial carbon dioxide emissions savings. These consolidated loads would also be valuable to a wider decentralised energy network when it is viable to connect the wider area network to these satellite schemes.

The financial performance of these schemes is heavily reliant on future development and the best returns are generated where the capital investment in the scheme is timed closely with the realisation of these developments. None of the schemes provides the opportunity, in our assessment, for a privately financed operation. These schemes will therefore likely require public investment.

</td></tr>
</table>

	Both Blackhorse Lane schemes show global whole-life cost efficiency improvements as required by Treasury Green Book assessment criteria. BHL North scheme is the most imminent whilst BHL South is likely to develop more slowly. The Walthamstow Town Centre scheme, although the largest in terms of potential heat demand served and therefore carbon emissions reduced, is also the largest in terms of the area over which it is spread. This wide geographic spread of demand results in the highest costs to connect the demand which in turn leads to a need for a higher level of connection charge in order to fund the network installation. Since the Blackhorse Lane North scheme is the most advanced in terms of new development, there needs to be a concerted effort to catch near-future developments in terms of planning policy and individual applications. This study provides an evidence base that there is a viable scheme on which such policy and application discussions could be based. There is also a need to engage with the management company, owners and /or residents and occupants of Papermill Place, if there is no existing planning condition, to encourage connection.
Next Steps	Common to all three clusters • identify funding routes for capital investment (via liaison with the Decentralised Energy Project Delivery Unit) • decide on preferred route to implementation, operation and ownership of network – as all three schemes will require public sector support in their implementation, a single vehicle could be considered to deliver all three (and potentially other schemes such as in the Town Hall / Wood Street area). • develop detailed business case • develop policy and planning conditions on new development to encourage connection Initial focus on Blackhorse Lane North • engage with developers or management company at Papermill Place to negotiate connection • with policy in place and more certainty on loads willing to connect, conduct detailed outline design and business case development Prepare the ground for Walthamstow Town Centre and Blackhorse Lane South • identify and engage with further existing buildings in close proximity to the proposed routes to build potential demand • prepare a detailed business case including realistic assessment of existing building loads that would be willing to connect within the first 5 years of each scheme.

1 INTRODUCTION AND STRATEGIC CONTEXT

1.1 Background

1.1.1 The North London Strategic Alliance (NLSA) has commissioned Parsons Brinckerhoff Energy Solutions (PB) to conduct a series of decentralised energy feasibility studies in Haringey and Waltham Forest.

1.1.2 There are two key objectives of these studies:

- To investigate the short-term viability of CHP installation
- To inform the potential development of the Upper Lee Valley (ULV) Decentralised Energy Network (DEN)

1.2 Scope

1.2.1 This feasibility study into the potential to install gas-fired CHP in Waltham Forest is based around site surveys of the area, and analysis of the environmental and economic benefit that the technology could deliver. This study does not address delivery vehicles and financing for the project. These aspects of implementation are being considered in a separate workstream being undertaken by the GLA.

1.2.2 The scope of the work covers:

- information request
- surveys
- gas fired CHP installation assessment
- network modelling
- economic performance

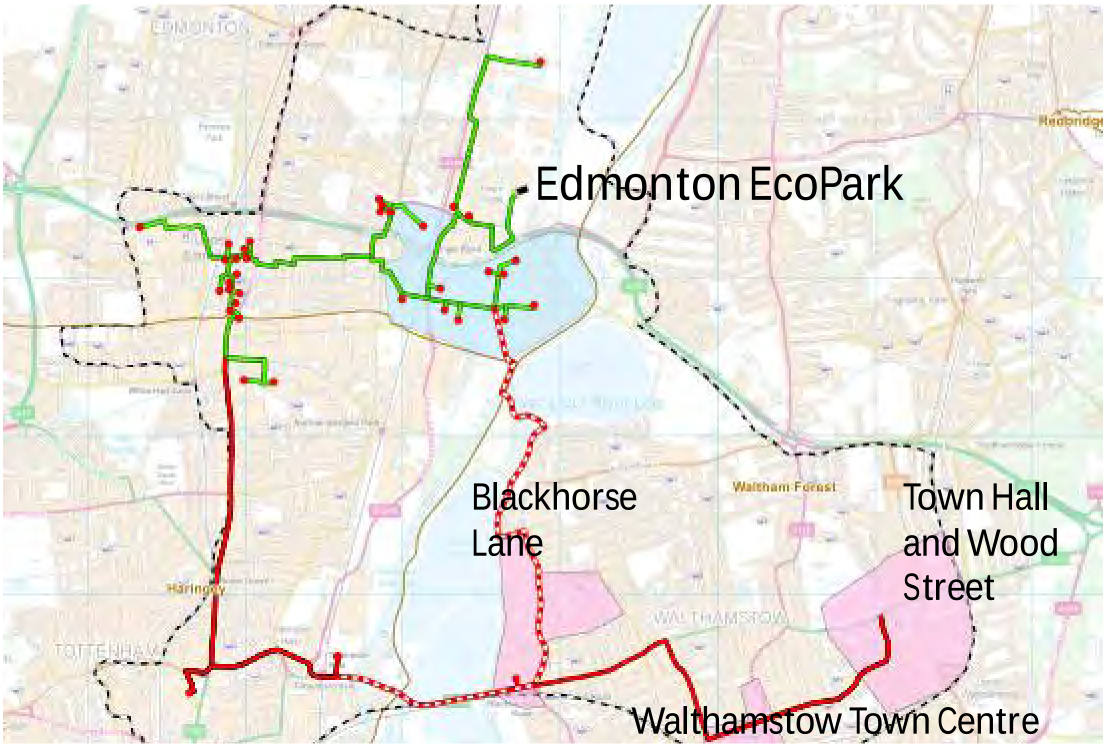
1.2.3 With the following outcomes:

- network routes
- net present value - viability

1.3 Strategic Context

1.3.1 The following map illustrates (on an indicative basis only) the ULV DEN concept being developed in conjunction with these local feasibility studies.

Figure 1-1: DEN Strategic Overview



1.3.2 This map shows the location of the initial primary heat source of the DEN (Edmonton EcoPark), broad indications of the proposed directions for the strategic network growth (green and red lines). It illustrates the comparative location of the various satellite schemes being analysed by PB, and the GLA. The dotted red lines show two alternative routes to Blackhorse Lane from the Meridian Water Development and Tottenham Green. The comparative viability of these routes should be assessed as the ULV network expands.

1.3.3 PB is investigating CHP feasibility at:

- White Hart Lane
- Tottenham Hale Village (site-wide DH and CHP already installed – PB investigating potential to connect to DEN at a later date)
- Tottenham Town Hall
- Blackhorse Lane
- Walthamstow Town Centre

1.3.4 The GLA / Decentralised Energy Project Delivery Unit (DEPDU) is investigating CHP feasibility at:

- Waltham Forest Town Hall
- Wood Street AAP

1.4 Waltham Forest Context

1.4.1 As conclusions to the pre-feasibility study, the Waltham Forest schemes (assessed under this study) were identified as:

- Having potential to host viable local networks based around local gas-fired CHP
- Areas for future connection to the wider ULV strategic network as the DEN expands.

1.4.2 Whole life cost assessments were carried out at a very high level and provided the net present values presented below. The results for the full list of schemes assessed at pre-feasibility stage are appended at APPENDIX C:

Table 1-1 Results from pre-feasibility study

Scheme name	Location designation on ULV area map (e.g. covering whole ULV)	Proposed technology for individual scheme	Anticipated level of carbon savings (tonnes CO2 p.a.)	Estimated capital cost (£m)	Assumed date by which complete	25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)
Walthamstow Town Centre	25	1.2MWe CHP approx	1,545	3.6	2020	948
Blackhorse Lane North	1	526kWe CHP	773	1.9	2016 start 2013	-340
Blackhorse Lane South	2	635kWe CHP	903	2.1	2018 start 2013	428

Note: the Town Centre scheme assumed all retail outlets connect, and that connections were made in Year 1 of the project lifecycle

1.4.3 The specific recommendations from the pre-feasibility study relating to each of the schemes assessed here were:

Blackhorse Lane

- develop local strategic priorities
- develop how a local network could be funded and implemented

Walthamstow Town Centre

- aim to incorporate Station Car Park and High Street developments in emerging network
- locate energy centre to north e.g. around Goddarts House

2 APPROACH AND ASSUMPTIONS

2.1 Data collection

2.1.1 An inception meeting was held at which sites included in the pre-feasibility study notional networks were identified and discussed. This information was then collated alongside the AAP sites lists.

2.1.2 A full assets database was provided by Ascham Homes which helped establish ownership of a number of sites and also the heating systems installed.

2.1.3 A further information request was issued to AAP managers and the Waltham Forest Energy Manager. These requested further details of the heating systems and energy demands at existing sites, and proposed scale of development and phasing for future development sites. These information requests generated timely, full and informative responses.

2.1.4 Some further sites were added as a result of site visits, proposed routes surveys, and online research.

2.1.5 The information from all these sources was combined and some further points of clarification put to the relevant point of contact.

2.2 Site Visits

2.2.1 Site visits were undertaken to existing buildings that may have had the potential to house an energy centre. None were identified that could. No plant room was deemed large enough to offer this opportunity.

2.3 Site selections

2.3.1 Some potential sites were excluded from the analysis on the basis of the information provided. Generally only existing sites were excluded. The most common reason for exclusion was identification of existing heating systems which were incompatible.

2.3.2 Our assessment is based on assessing the viability of an initial network that would be within the control of LBWF to implement. Only existing buildings that are either in Council ownership or over which the Council has a significant level of control have been included. New development could be required to connect through the planning system. Existing buildings outside the control of the council also offer far less certainty in terms of a long term demand since they are more likely to change ownership and/or use within the period over which we have assessed financial viability (25years).

2.3.3 Where sites were assessed but excluded they have been noted in the ‘Excluded sites’ sections.

2.4 Load estimation

2.4.1 LBWF provided PB with a breakdown of the land area and usage types for each development site. As there was no building floor area data available, PB applied a plot ratio of 1.25:1 to the total land area (i.e. development land area x 1.25 = building floor area) based on a typical plot ratio for a town centre. In certain circumstances, for example a school, where it is likely that some of the development land area is for car parking or a playing field, a lower plot ratio was used.

2.4.2 Where there is residential usage, LBWF provided details of the number of dwellings (predominately flats) scheduled as part of that development. PB calculated the heating and hot water demand for these flats by applying annual energy demand benchmarks for a 2.5 bedroom flat, i.e. by taking the mid-point between one and two bedroom flat benchmarks. Although it is likely that there will be some two and three bedroom flats in the new developments, an average of 2.5 bedrooms per flat was deemed appropriate in the absence of more specific data.

2.4.3 The non-residential heating and hot water demand was calculated on the basis of the floor area calculated from the difference between the floor area of the flats (based on the BRE floor area for the mid-point between a one and two bedroom flat as noted above) and the overall development floor area. Where there were several non-residential usage types, the floor area was divided equally among them, except for several cases where it is clear that one usage type will take up more floor area than another, for example where there is provision for a cafe and a health centre (where it was assumed that the health centre would occupy more floor area than the café).

2.4.4 LBWF provided guidance as to when development is likely to come forward for each site, usually in five to ten year windows. PB used this information to divide load over the appropriate timeframe for each development. Benchmarks were then applied according to the anticipated construction completion date for each load. It is assumed that planning consent for each load would be sought one year in advance of completion and, as such, for development that is on the cusp of a new Building Regulation period (i.e. construction completed in 2016), it is assumed that planning consent would already have been secured by the time the new Regulations come into force and the development would therefore be subject to the previous Building Regulations.

2.4.5 Benchmarks for residential buildings were derived from 1998 NHER data[1] with percentage improvements to represent increased energy efficiency standards with each set of Building Regulations to 2016. For non-residential development the same CIBSE TM46[2] benchmarks were used as a baseline.

2.4.6 Annual boiler gas consumption data was used for existing buildings, multiplied by an assumed boiler efficiency of 75 percent, to determine the annual heating demand. Boiler gas data was provided by LBWF.

2.5 Network outline designs and energy centre locations

2.5.1 The energy centre locations selected are notional although based on assessment of high-level technical and commercial constraints. These locations are flexible and should not be taken as definitive. As any scheme design develops, more detailed assessment of the merits of each energy centre site option should be made.

2.5.2 The network routes indicated in our outline designs are based on an initial assessment of viable routes in terms of land ownership, physical barriers to routing and an optimal network design to minimise network length (and thereby cost and heat losses).

[1] NHER is software that calculates energy demand of residential dwellings to the SAP methodology required by buildings regulations

[2] TM 46 is a CIBSE guide that includes benchmarks for energy use in non-domestic buildings

2.5.3 It is not possible to determine definitively the optimum routing for a network that will serve, as yet, undeveloped buildings. As masterplanning and individual site plans develop, it will be necessary to adapt network routes to development layouts.

2.5.4 Energy centres are best located centrally within the area of most concentrated heat demand to reduce the length of network connections to large loads. However, this consideration needs to be measured with the wider needs of the DEN.

2.5.5 There is a need to strategically locate energy centres for connection to the DEN as and when required. In our selection of notional energy centre locations we have referred to the current proposals for the routing of the DEN (as shown in Figure 1-1) and tried to select locations closer to the point of connection to the proposed DEN. However, there is currently uncertainty in terms of final selection of DEN route, and given the long time-scales involved, there is potential for change of routing of the DEN.

2.5.6 Nevertheless the principle of safeguarding the ease of this connection applies, and this aspect of the study should not be wholly disregarded in favour of shorter term priorities. In any future modelling or outline designs care should be taken not to ignore this strategic influence on energy centre location in response to other factors more important to the individual satellite scheme itself.

2.5.7 Both energy centre location and network routes can be significantly influenced by the phasing of development with significant benefits gained through locating an energy centre amongst the earliest development to come forward.

2.5.8 Energy centres should be located in an area that provides good access for deliveries, utility connections, installation and maintenance. Space for delivery vehicles to park and turn around will ensure minimal impact to local highways. Delivery access requirements include lubrication oil changes at regular intervals i.e. bi-weekly depending on operational regime, other general maintenance access, and the ability to swap out components in the event of failures.

2.5.9 The key assumption regarding routing for all the satellite schemes assessed in this report is that the primary network will provide heat from the energy centre to a substation within each new development. It is assumed that the cost of delivering heat from the substation to the end user will be borne by plot developers. Additional capital cost items would include any additional network, heat exchangers, risers & laterals and internal (secondary) systems. For existing buildings a connection would be required to the plant room of that building.

2.5.10 This infrastructure should be designed in line with district heating best practice, for example by ensuring that secondary systems maximise the differential between flow and return temperatures. The GLA is currently developing a ‘Decentralised Energy Manual’ containing some of these principles and publication is expected in early 2013.

2.5.11 Further assessment of suitable energy centre locations (beyond this study) will, necessarily, include commercial factors. The value of the land/floor area taken up by an energy centre needs to be accounted for in any commercial negotiations with landowners. Where a larger, new development requires an energy centre to serve its own needs there is a potential economy of increasing the size of this to serve a wider heat network. The operation of a heat network itself is a commercial activity that will need to pay for the space it uses.

2.6 Energy centre design/layout

2.6.1 Although it is not possible to provide an energy centre layout and dimensions until a scheme specific design has been finalised, a notional layout and dimensions are provide below for an energy centre serving a scheme of similar scale to those in LBWF.

Figure 2-1: Notional energy centre – Plan

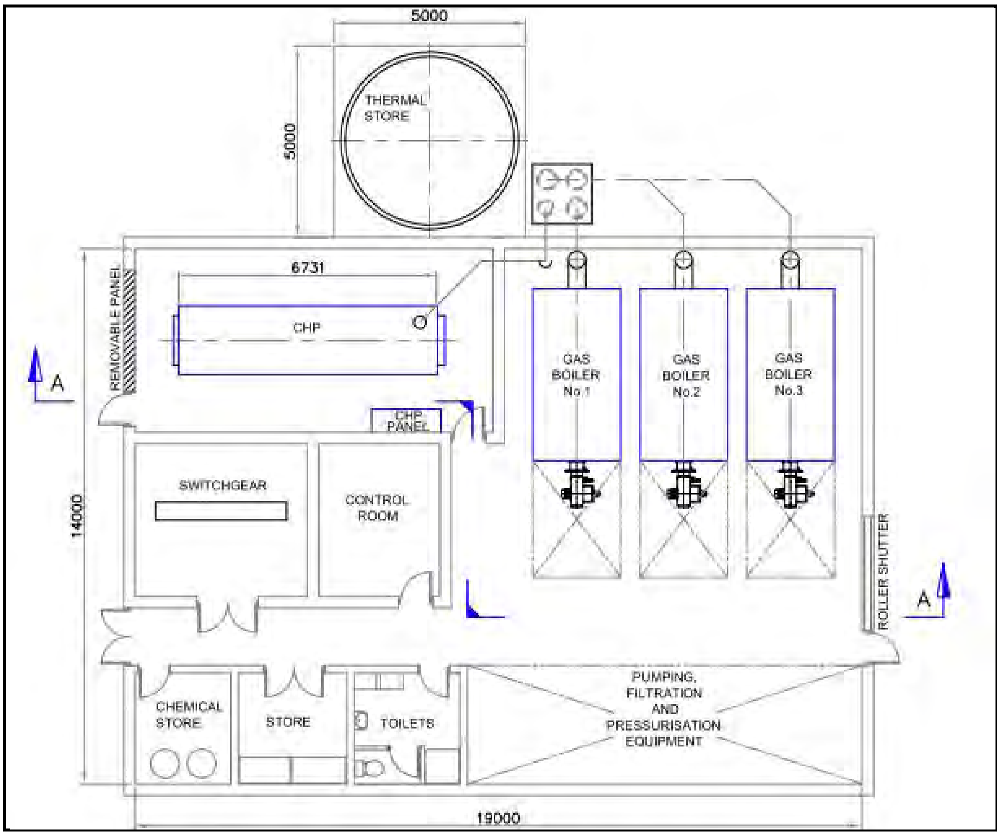
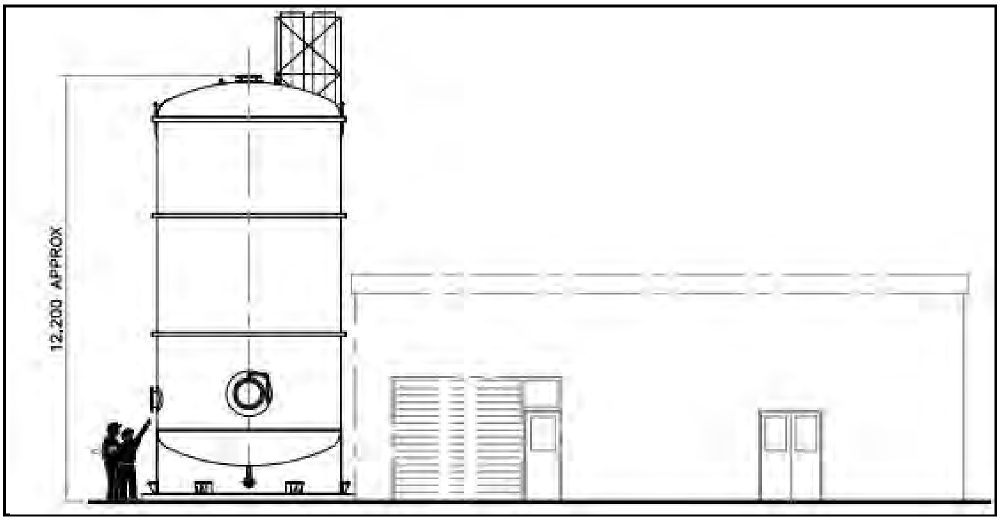


Figure 2-2: Notional energy centre - End elevation



The dimensions of this notional energy centre are 19 x 14 x 5 metres (L x B x H) with an additional 5 x 5 x 12 (L x B x H) for the thermal store. This houses a 1131kW CHP engine and 3500kW of boilers.

2.7 Utility price assumptions

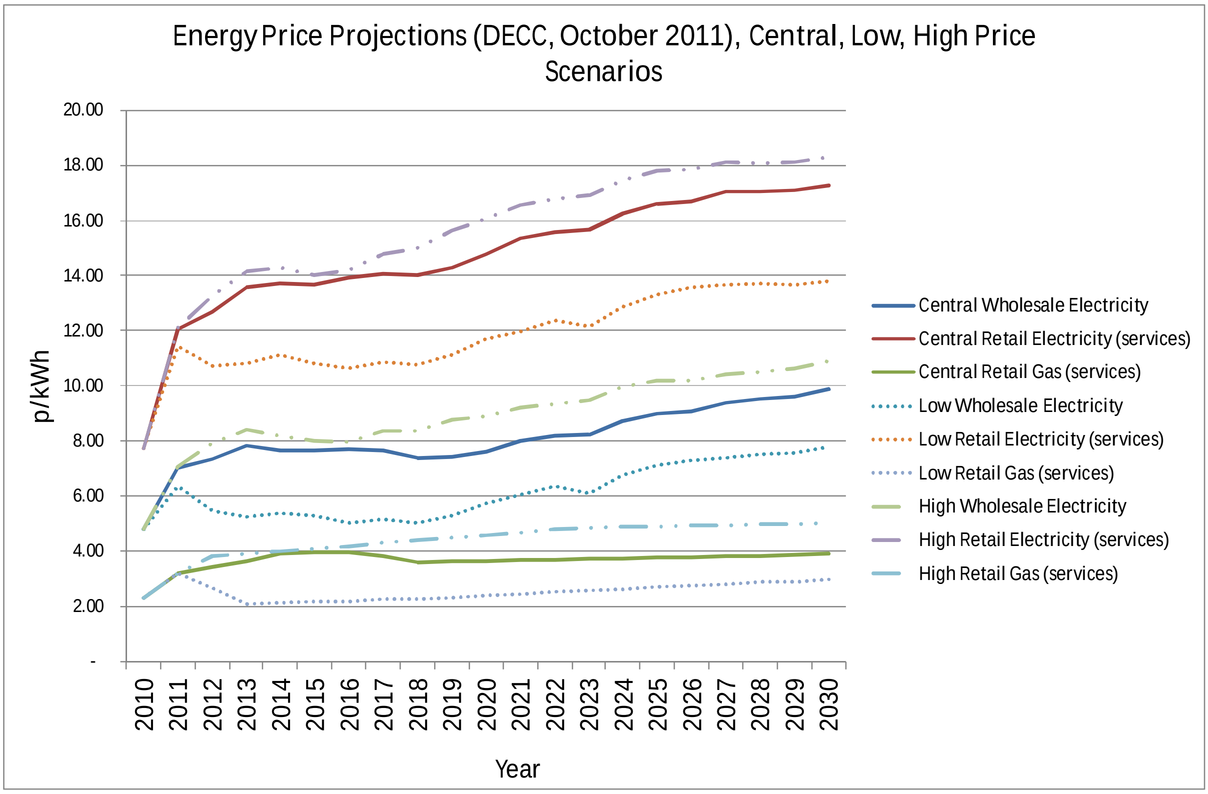
2.7.1 In order to ensure that there is a comparable basis between satellite schemes, a single set of utility price assumptions has been adopted in modelling of plant operation.

2.7.2 PB has adopted the view that currently contracted utility prices do not necessarily form an indicative basis of future prices. We are going through a period of significant volatility in energy markets, both in terms of physical generation assets changing and regulation developing to support the low-carbon agenda. On this basis, the DECC forward projections (October 2011) of energy prices as listed in the appendices of this report have been adopted in modelling.

2.7.3 The key energy streams that are utilised in modelling of options are the prices of electricity (wholesale and retail), and retail gas prices. The retail prices for electricity and gas are used as the basis for the projection of gas costs for energy centre plant operation and power import. The wholesale electricity price is used as a basis for valuing electricity export.

2.7.4 The low, central, and high scenarios for these three utility streams are displayed below:

Figure 2-3: Energy price projections graph



2.7.5 This figure illustrates that under all scenarios there is a general upward trend anticipated in energy prices. This upward movement is likely to favour CHP installations, as the differential between gas and electricity prices is generally increasing. It is the differential between gas and electricity prices that drives the profitability of gas-fired CHP, and hence these price trends should help CHP to emerge.

2.7.6 A separate section at the end of each results section provides a sensitivity analysis of the impact of variation of energy prices above, or below, these assumptions.

2.7.7 There is currently on-going work in the development of a 'licence lite' route for electricity sale from distributed generators such as CHP units. This is still at an early stage of development, and the impact of this route on electricity sales values cannot be forecast with any degree of precision. For this reason, a watching brief approach is recommended in relation to this development area.

2.8 Options modelling

2.8.1 PB developed occupancy/usage based hourly heat load profiles for space heating and hot water demand for each of the building usage types. The calculated annual heating demand for each building was then distributed across each hour of the year according to the relevant load profile. PB's modelling reflects the fact that the use of space heating demand is affected by ambient temperature by using a base temperature (15.5°C) within an hourly degree day series to determine when there would be a space heating requirement. When ambient temperature rises above the base temperature, space heating is assumed to be switched off, and below it, it is switched on (also taking into account predicted occupancy patterns). Hot water usage is unaffected by ambient temperature.

2.8.2 Hourly demands for each building are combined to give a total demand across the network for every hour of the year. This site-wide demand profile is then input into PB's low carbon energy options analysis tool, where the operation of three plant configurations is modelled against the demand profile.

2.8.3 The operating performance characteristics of CHP units is contained in an extensive database that PB has built up covering a wide range of plant types (gas engines, gas turbines, biomass boilers) and capacities (from tens of kWes to multi-MWe units).

2.8.4 The model combines the capital, maintenance and replacement cost of primary plant. The model uses the demand profile and plant operating performance characteristics to generate an energy balance and economic outputs. Those outputs include CHP and top-up boiler fuel consumption; electricity generated and required by the energy centre; electricity imported from, and exported to, the grid; and the NPV of each option at a range of discount rates. The model also quantifies the emissions from the CHP plant and boilers, and those associated with the imported power.

2.8.5 The average heat sales price for district heating options was set to equal the p/kWh cost of generation. This comprises the lifetime capital, replacement and maintenance, electrical import (covering parasitic demands for heat generation only), and fuel cost under the base case.

2.8.6 PB has modelled three heat supply options for each scheme – two CHP district heating options and a base case in which heat is supplied to each building by on-site gas boilers. In all options, gas boilers have been sized to meet peak demand such that there is resilience at all times.

2.8.7 In order to determine the CHP engine sizes to model, PB used a simple rule of thumb as a starting point – that the engine should serve 70 percent of heating demand with 6,000 run hours – and ran two variations around this value to identify the optimal engine size (in terms of best economic results). Thermal storage was included in the two decentralised options to allow for increased utilisation of the CHP.

2.9 Scheme start date and connection charges

2.9.1 Where a new development is designed from the outset to connect to a DH network there will be savings achieved by the developer on heating plant that would have been required without a DH connection. It is reasonable to assume that a capital contribution could be sought in lieu of the requirement for customers to supply their own heat plant and the associated space and infrastructure within each building, when a new development connects to the DH network.

2.9.2 A value of £100 per kW peak has been used as a base value for this contribution level in PB's analysis. This value has been derived from a typical cost figure[3] for boiler plant, that does not reflect the value of the space saving achievable through connection to a DH system (a heat exchanger substation installation is physically smaller than a boiler plant room), nor the cost of implementing a low-carbon heat supply solution for the developer.

2.9.3 This report considers the potential for LBWF to levy connection charges set at a higher level than the £100/kW noted above. This could be justified on the basis that under Building Regulations and Planning Requirements, a development would be required to have low carbon supply plant on site. On a generalised basis, this additional cost (over 'base-case' costs of a standard solution) has been calculated for dwellings in the CLG report "Cost of building to the Code for Sustainable Homes – updated cost review", 2011.

2.9.4 The costs reported in Figure 7 (and Table 19) of that document illustrate that there is a significant margin of cost to achieve higher levels of Code for Sustainable Homes. Whilst the cost figures expressed are on a cost per dwelling basis, it can be seen that the 'extra-over' costs for higher levels of the code are significant, and could easily double the £100/kW figure adopted by PB as a base value in this study. On an indicative basis, for example, it is noted in Table 19 of the 'cost report' that to achieve Code Level 4 the extra over cost per dwelling for energy compliance is £3,421. For a reasonably sized development, it can be calculated that average peak demand per dwelling is between $5kW_{th}$ and $10kW_{th}$. Therefore the extra over cost would be equivalent to somewhere between $£342/kW_{th}$ and $£684/kW_{th}$. On this basis an increase of the 'connection charge' figure to £200/kW appears reasonable and justified.

2.9.5 The impact of levying higher connection charges is presented, particularly for the Walthamstow Town Centre Scheme, in section 5.19. However, this level of increase must also be balanced against general viability considerations and the ability to negotiate this contribution from developers.

2.9.6 One of the key considerations in this analysis is when to develop the scheme. In a discounted cash flow analysis, the present value of heat sales revenue is reduced for future revenues. The further a revenue (or cost) is in the future, the greater the level of 'discount' to represent a present value. . This reflects the saying 'a bird in the hand

[3] Derived from Spon's Mechanical and Electrical Services Price Book, 2010, gas-fired boilers all-in rates including ancillaries.

is worth two in the bush' – i.e. revenue that is more certain in the shorter term is given a higher 'present value' than revenue that is further in the future, and inherently less certain. Where the majority of the heat load is planned for development over a period of several years, it may be preferable to delay construction of the network until more of the load is established.

2.9.7 If network implementation for a scheme is delayed, where heat load density is not created by early development, it is possible that some of the early stage development will not be able to connect to the network straight away and would initially need to supply their own heat. In this scenario it would be appropriate to apply a planning condition that requires the development to be 'DH' ready, and to connect to the network within a certain time period (5 years, for example). Under this scenario, the avoided costs for the development would be greatly reduced.

2.9.8 It is still arguably appropriate to level some element of 'connection charge', under this scenario, as this could represent the difference in cost between a gas-boiler only solution and an individual low-carbon heat supply solution (that would be required in the absence of a DEN connection). The avoided costs could equate in this instance, for example, to the cost of a small building-based CHP unit. However, in the analysis conducted in this report, no connection charge has been assumed for these buildings falling under this scenario.

2.9.9 It should be noted that, where individual low-carbon heat supply solutions are required to meet Building Regulations standards it may not be possible to delay their installation, awaiting a DEN connection. This issue could be mitigated through planning policy that requires Building Regulations standards to be achieved without the use of low carbon heat systems. Viability of such a technical solution cannot be assumed.

2.9.10 PB only applied connection charges where a new development could connect to the scheme without being required to supply their own heat at any stage (note that no connection charge was applied to existing loads).

2.9.11 In our analysis, the preferred options presented represent schemes for which project construction occurs at the latest point possible without losing the majority of connection charge revenue. These start dates are notional due to the uncertainty of the actual development schedule of loads included in the network. As such, the dates offered as the preferred start date should be considered indicative, based on the load build-up used in this modelling.

2.10 Emissions factors

2.10.1 Emissions projections for the schemes analysed have been calculated on the basis of the emissions factors contained within the current Building Regulations approved documents[4]. These are:

[4] Building Regulations Part L2A references the emissions factors with SAP2009, table 12, http://www.bre.co.uk/sap2009/page.jsp?id=1642, accessed January 2012.

Table 2-1: Emissions Factors

Fuel type	Emissions factor ($kgCO_2$ / kWh)
Mains gas	0.198
Heating oil	0.274
Wood chips	0.009
Wood pellets	0.028
Electricity (import)	0.517
Electricity (expot)	0.529

2.11 Replacement cost assumptions

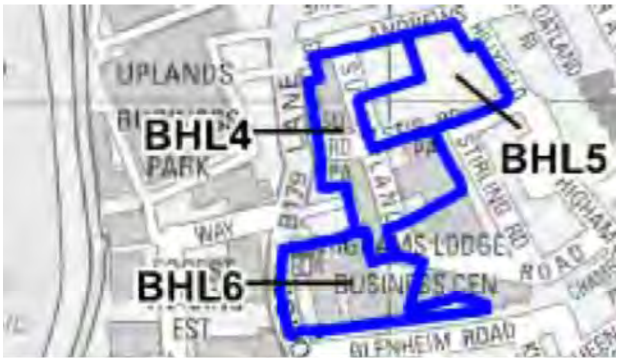
2.11.1 Replacement costs have been assumed for CHP and gas boilers. CHP replacement is assumed to be 70 percent of the original unit cost every 15 years to account for the fact that the replacement operation should only involve a fraction of the original unit's installation works cost. Boiler replacement is assumed to be 100 percent of the unit cost every 20 years.

3 BLACKHORSE LANE NORTH

3.1 Overview

3.1.1 Blackhorse Lane North (BHL North hereafter) is located in the industrial corridor to the north west of Walthamstow Town Centre and east of High Maynard Reservoir. The area action plan (AAP) for the area shows several key development sites, around which the load assessment for this area has been based. A map showing the location of these sites from the AAP is presented below.

Figure 3-1: BHL North development sites



3.1.2 Planned development, if it is at an early enough stage, is particularly good for district heating as it can be optimised to work with a scheme. Secondary systems can be designed to maximise the differential between flow and return temperatures; residential buildings can be designed for a communal system, rather than individual gas boilers; planning conditions can be used to ensure compatibility; and the avoided cost of alternative heating infrastructure (e.g. boilers) can be levied as a capital contribution to the overall scheme. This report has adopted a level of avoided cost that approximates the cost of a boiler installation. However, in the current planning / Building Regulation context boiler-only installations do not generate carbon savings sufficient to ensure compliance. The avoided cost figure therefore is much lower than the cost that developers would otherwise have faced through the need to install their own CHP or other low-carbon plant. This saving should therefore provide an incentive for developers to connect to the DH scheme.

3.1.3 The development loads at BHL North are a mix of residential, business and community uses.

3.1.4 The majority of the loads considered for inclusion in the scheme at BHL North are planned new development. Details of the likely use type, scale and phasing of this development were provided by the Area Action Plan Manager.

3.1.5 Papermill Place – a 323 dwelling residential development – is the only exception. Discussion with LBWF confirmed that construction for the third and final phase of Papermill Place has now been completed, other than a 'pocket park', which is not yet finished. As the development is now complete, boilers will be required as there is currently no DH network to connect to. Following discussion with LBWF it is concluded that Papermill Place could not connect to a DH network until these boilers are scheduled for replacement (approximately 15 years into the project lifecycle). A connection date of 2027 has therefore been used for this assessment.

3.2 Excluded sites

3.2.1 Hillyfields Primary School was excluded from the outline network assessed because connection could not be assumed since it is an Academy School, and therefore not in Council control.

3.2.2 Dunhills, identified by LBWF officers, has been excluded on the basis that it is outside the Council's control and offers less long term demand certainty, as discussed in 2.3.2 above.

3.2.3 The Billet Works site (BHL 7) has also been excluded from this scheme analysis due to the combination of its distance from the other loads of the Blackhorse Lane area and its heat demand.

3.3 Overall demand projections for schemes considered potentially viable

3.3.1 From the information received and load assumptions listed above, PB calculated annual heating demand and developed appropriate demand profiles on an hourly basis that represent typical requirements for heat from the buildings selected for the scheme. Annual demands for loads in BHL North are presented in Table 3-1.

3.3.2 Note that the usage type presented for each development site is based on information provided to PB by LBWF. At this stage, these uses should be considered as indicative and, as such, the benchmarks used may be subject to change as the development schedule for each site progresses.

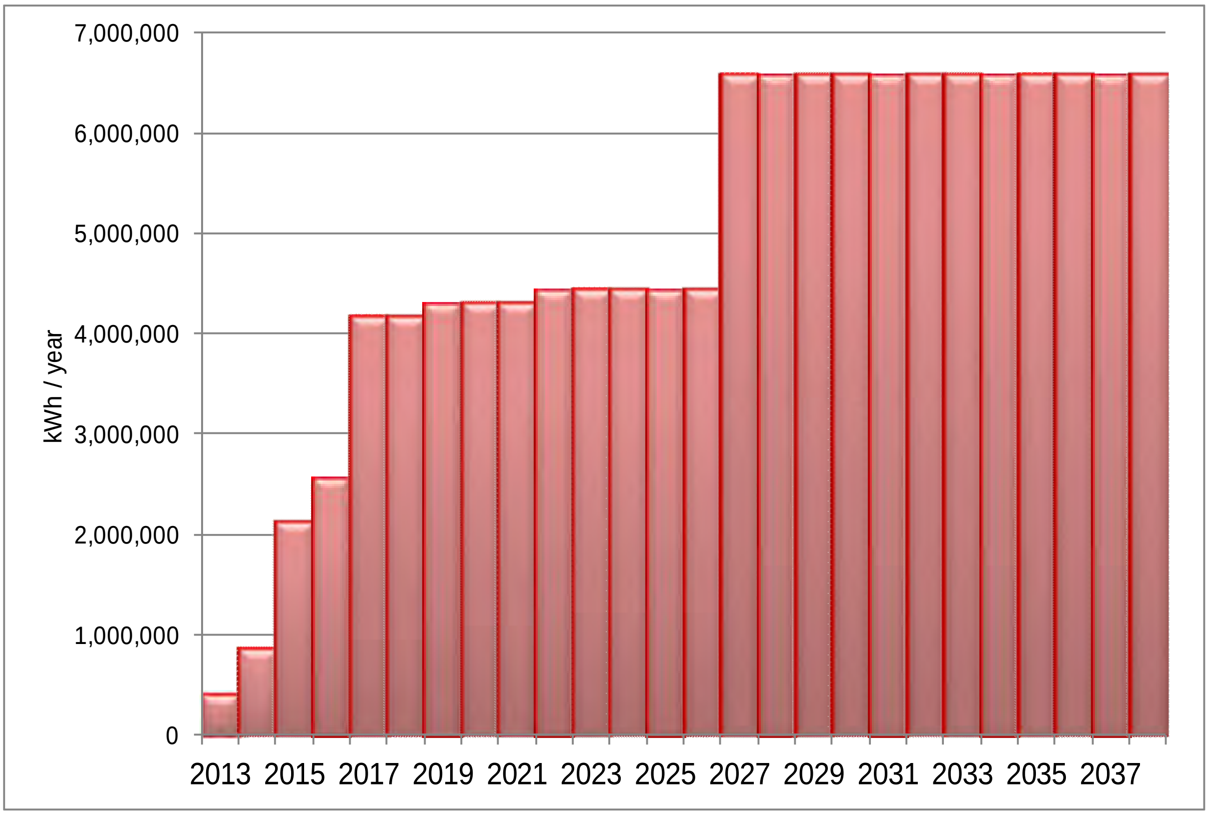
Table 3-1: BHL North heat demands

Corresponding AAP Area	Name	Type	Calculated heating demand (kWh)	Peak heating demand (kW)
BHL 4	Sutherland Rd council ow ned	Residential	207,985	139
BHL 4	Sutherland Rd council ow ned	Office	104,026	131
BHL 4	Sutherland Rd council ow ned	Health Centre	89,600	96
BHL 4	Sutherland Rd Path	Residential	103,992	70
BHL 4	Headbourne	Residential	233,983	157
BHL 4	Meat Processors	Office	194,880	168
BHL 4	Sanger	Residential	65,239	44
BHL 4	Sanger	Office	276,488	347
BHL 4 (ext)	Essex Cordage Works & Sutherland House	Residential	145,539	142
BHL 4 (ext)	Essex Cordage Works & Sutherland House	Light Industrial	119,952	138
BHL 4 (ext)	Unity Works	Residential	467,966	313
BHL 4 (ext)	Unity Works	Office	516,964	649
BHL 6	Webb's Industrial Estate	Residential	1,299,905	870
BHL 6	Webb's Industrial Estate	Office	73,920	93
BHL 6	Webb's Industrial Estate	Retail	40,656	46
BHL 6	Webb's Industrial Estate	Community Centre	92,400	84
BHL 5	Papermill Place Devlt.	Residential	2,143,966	1,844
N/A	Dilw yn Court	Care Home	397,696	278
		Total	**6,575,156**	

3.3.3 LBWF informed PB, after these calculations were complete, that some of the areas identified originally as office space were likely to actually come forward as light industrial with small areas of office included. We have not remodelled these numbers since the difference in energy demand of office space compared to light industrial uses is relatively small and would not have a significant impact on the results of our analysis.

3.3.4 All of the loads selected for inclusion in the scheme at BHL North are new development with the exception of Papermill Place, as previously discussed. The build-up of load over time at BHL North is shown in Figure 3-2 and is based upon the likely timeframe for development provided by LBWF for each site. It shows how most of the heat load comes forward over the next five years, with all development complete within ten years. Papermill Place will not be available for connection for 15 years, as discussed previously.

Figure 3-2: BHL North - Load build-up over time



3.4 Scheme start date

3.4.1 As the majority of the heat load in BHL North is planned for development over a period of several years, it may be preferable to delay construction of the network until more of the load is established.

3.4.2 The results represent the preferred scheme development schedule following these modelling iterations with a start date as stated in 3.11.1 below.

3.5 CHP energy centre location

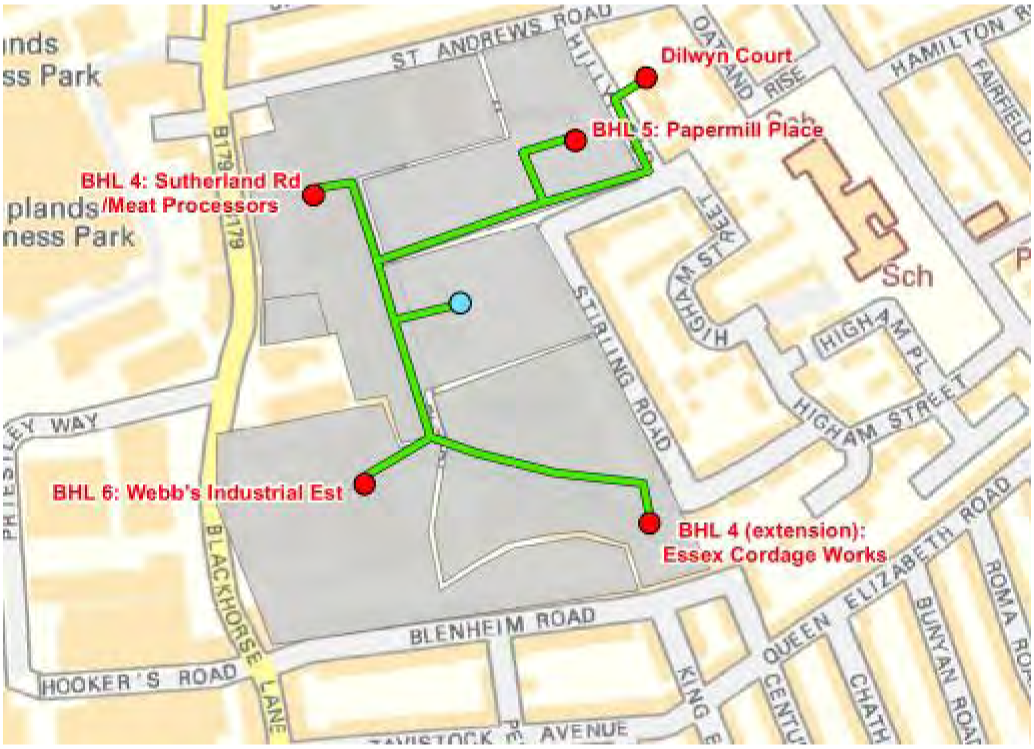
3.5.1 The DEN will enter Waltham Forest from Forest Road, so a site close to the south of the BHL North site would be favourable. This will minimise the extent of a connection between the DEN and BHL North interface.

3.5.2 As previously discussed (at section 2.5) the energy centre locations identified in this study are notional and only based on the technical and physical constraints. No commercial factors, in terms of the land use displaced, have been assessed.

3.6 District Heating Routing

3.6.1 PB has developed a preliminary network route for BHL North based on the spatial distribution of development areas included in the AAP (see Figure 3-1). The network route modelled for BHL North is shown in Figure 3-3. Development areas are shown in grey and labelled. The notional energy centre is shown as a blue dot.

Figure 3-3: BHL North preliminary network route



3.7 Options modelled

3.7.1 PB has modelled three heat supply options for BHL North. The basis of these options is discussed at 2.8.6. The key plant items included in each option are detailed in Table 3-2.

Table 3-2: BHL North option plant modelled

	Base Case	Option A	Option B
CHP (kWe)	-	800	889
Boilers (kWth)	6,000	6,000	6,000
Thermal Store (m^3)	-	90	90

3.8 Capital cost estimates

3.8.1 A summary of the capital cost of each modelled option is presented in Table 3-3. A full breakdown of cost items for each option is presented in Appendix B.

Table 3-3: BHL North option total capital costs

Base Case (£k)	£165
Option A (£k)	£2,144.8
Option B (£k)	£2,449.7

3.9 Maintenance cost estimates

3.9.1 Maintenance costs were included for gas boilers and CHP annual maintenance in all options. A summary of those costs is presented in Table 3-4.

Table 3-4: BHL North annual maintenance costs

	CHP Maintenance	Gas Boiler Maintenance
Base Case (£k)	-	£20
Option A (£k)	£65.3	£15
Option B (£k)	£70.7	£15

3.10 Replacement cost estimates

3.10.1 Replacements costs were included for gas boilers and CHP engines in all options. A summary of those costs is presented in Table 3-5.

Table 3-5: BHL North replacement costs

	CHP Replacement	Gas Boiler Replacement
Base Case (£k)	-	£150
Option A (£k)	£298	£150
Option B (£k)	£482	£150

3.11 Results

3.11.1 PB modelled the performance of the two CHP options against the base case. Results are presented for a range of discount rates. In all cases, the DECC central utility price scenario was used (see Section 2.7). The preferred project start date for this scheme is 2014, with construction in 2013.

3.11.2 Results are presented for both the cost of heat generation, i.e. without the inclusion of heat sales in the district heating options, and for commercial performance, i.e. including heat sales in the district heating options.

3.11.3 Figure 3-4 shows the difference between the cost of heat generation for CHP options compared to the base case at a range of discount rates.

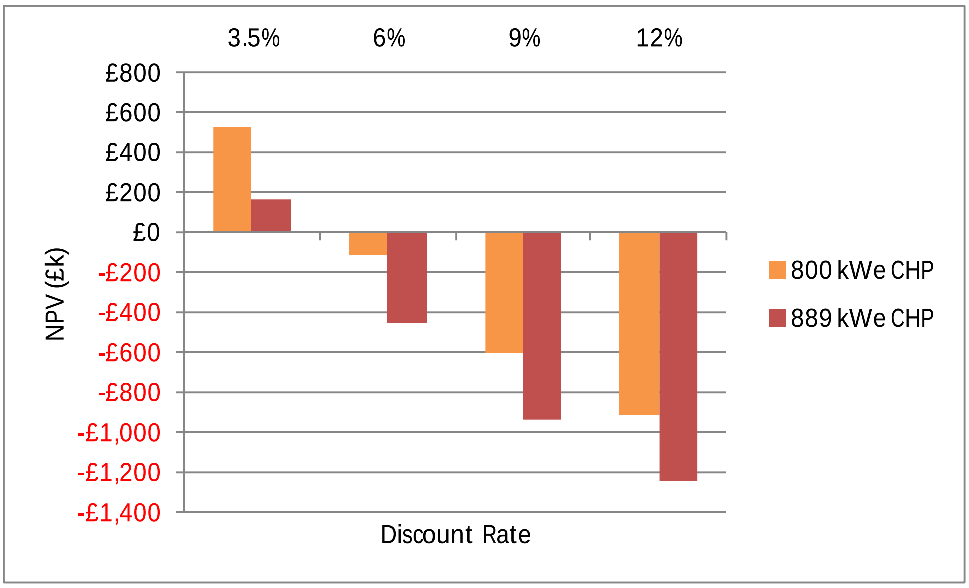
Figure 3-4: BHL North – comparison of option heat generation cost against the base case

3.11.4 Figure 3-4 (and Figure 4-4 and Figure 5-4 later) shows the marginal cost or cost benefit of the two CHP served DH options versus the cost of supplying heat to the same buildings under the existing approach of individual gas boilers. The £0 point on the y-axis therefore represents the base case with bars indicating the NPV benefit (positive values) or disbenefit (negative values) of the CHP options as compared to the base case.

3.11.5 This graph shows how both CHP options generate heat more cheaply than the base case at a discount rate of 3.5 percent over the 25 year project lifetime. As the discount rate increases, the performance against the base case worsens as a result of the decreasing net present value of future annual operating cost reductions, such that at higher discount rates it cannot offset the capital cost of the DH network.

3.11.6 Figure 3-5 shows the commercial performance of the two district heating options over the 25 year project lifetime, i.e. including heat sales.

Figure 3-5: BHL North – NPV performance of CHP options



3.11.7 This graph shows how a district heating network with an 800kWe CHP delivers a positive NPV of c. £500k at a discount rate of 3.5 percent. The 889kWe engine also delivers a positive NPV at a 3.5 percent discount rate, but does not perform as well as the smaller engine.

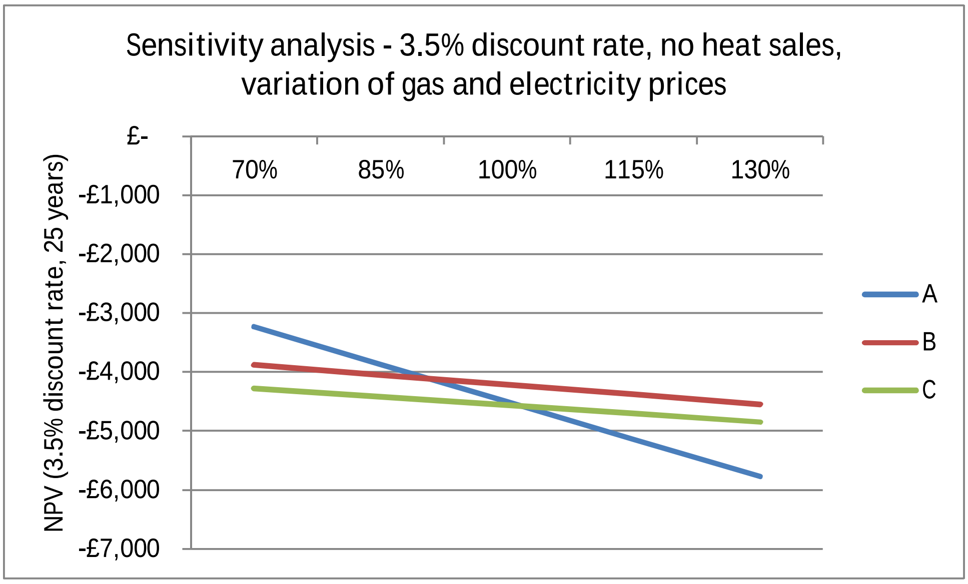
3.12 Sensitivity Analysis on energy prices

3.12.1 This chart shows the impact of higher and lower energy prices on the whole life assessments presented above. With higher energy prices, the relative performance of the district energy options (B and C) improves compared with the base case (A) of current gas heating.

3.12.2 The graph illustrates how, as energy prices rise or fall by a given percentage level (as shown on the x-axis) the net present values of the different schemes are impacted. This shows that as energy prices rise, all of the options need to spend more money on energy provision, hence all of the NPVs fall. However, within this trend, the comparative cost of the provision of energy is different for the different options. The CHP options become comparatively less costly than the 'base case' as energy prices are increased by 30%, for example.

3.12.3

Figure 3-6: BHL North – NPV sensitivity to energy price variation



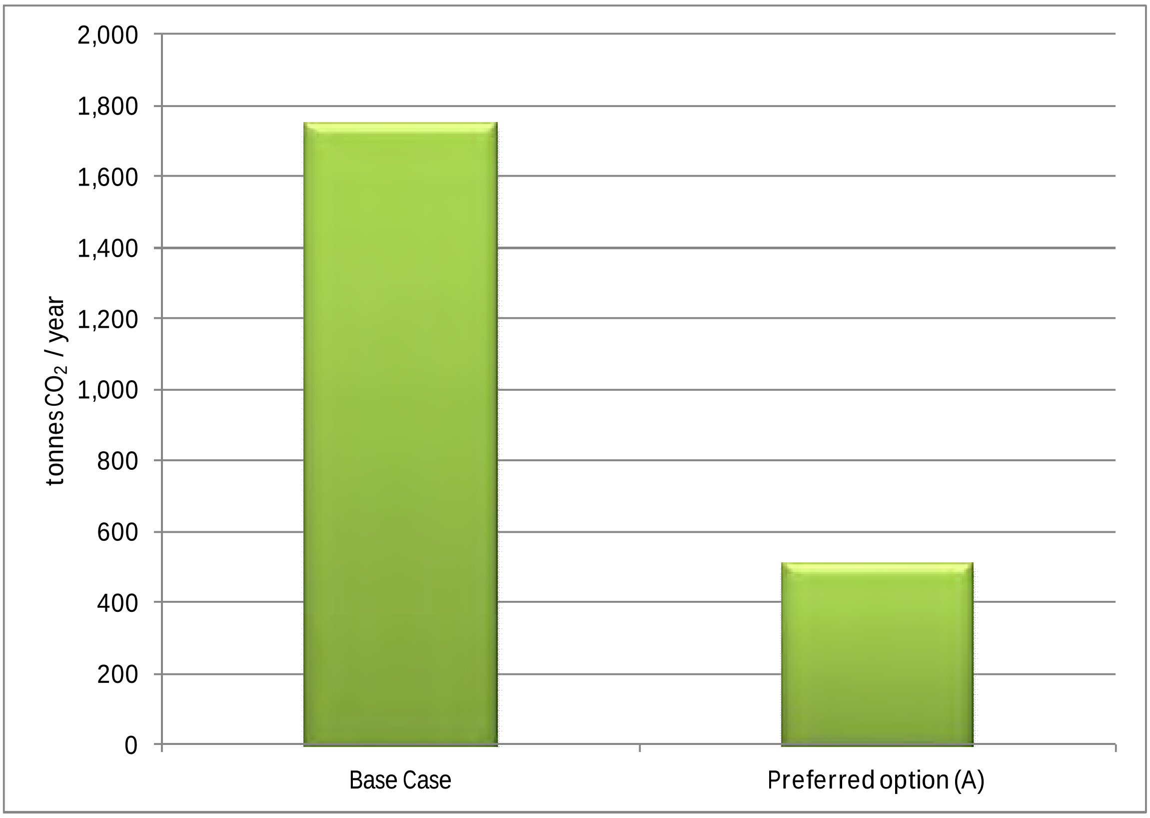
3.13 Projected emissions savings

3.13.1 Annual emissions from the preferred CHP option (800kWe unit) and the base case, along with the option percentage saving over the base case are presented in Table 3-6 and Figure 3-7. Note that these are the annual emissions at full build-out.

Table 3-6: BHL North annual emissions at full build-out

Option	CO_2 Emissions (t/yr)	Saving over base case
Base Case	1749	
Preferred option (A)	509	71%

Figure 3-7: BHL North base case and preferred options emissions comparison



3.14 Scheme Conclusions

3.14.1 This scheme, of the three assessed, is the one with the most imminent development and with the most certainty of size, type and programme of development.

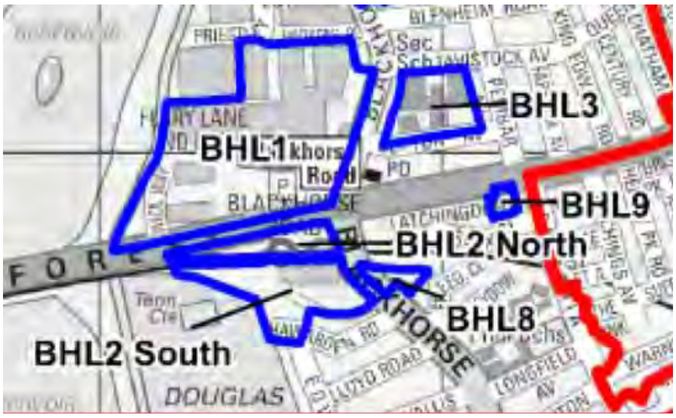
3.14.2 These results show how, based on the calculated heating demand and the options modelled, there appears to be a viable scheme at Blackhorse Lane North based on a low discount rate. Although a better return could be developed with the immediate connection of the new development at Papermill Place, connection of this site in fifteen years time (when existing boilers might reasonably be expected to need replacement) still provides a positive return, and hence a decentralised energy network is recommended for this area of development.

4 BLACKHORSE LANE SOUTH

4.1 Overview

4.1.1 Blackhorse Lane South (BHL South hereafter) is located in the industrial corridor to the north west of Walthamstow Town Centre and east of High Maynard Reservoir. The area action plan (AAP) for the area shows several key development sites, around which the load assessment for this area has been based. A map showing the location of these sites from the AAP is presented below.

Figure 4-1: BHL South development sites



4.1.2 As with BHL North, the majority of load at BHL South is planned development rather than existing buildings, which makes it attractive for the purposes of district heating connection. Development loads are also a mix of residential, business and community uses which would provide a complimentary overall mix of loads that could be met by a DH system – i.e. with an extended overall diurnal demand period from the residential / community elements. Also included are St Patrick's Primary and Stoneydown Park Junior schools, located off Blackhorse Road to the south of BHL 8.

4.1.3 As with BHL North, the majority of the loads considered for inclusion in the scheme at BHL South are planned new development. Details of the likely use type, scale and phasing of this development were provided by the Area Action Plan Manager.

4.1.4 The BHL 3 site comprises an existing educational facility (Willowfields School) the use of which may change dependent on other development. The treatment of this site is discussed below.

4.2 Excluded sites

4.2.1 Willowfields School was excluded as a future development site but included as an existing building on the basis that our assessment of the potential demand as a developed site was very close in size to the demand of the existing building.

4.2.2 Essex Close Estate (Ascham) was included in the pre-feasibility assessment but as part of this study has been identified as not being immediately compatible with a district heat network since it comprises dwellings heated by individual gas boilers. Although not immediately compatible this site is worth considering for future conversion to a community heat network that could be served by the district scheme.

4.2.3 Stoneydown House (Ascham) was identified as an additional site to those assessed in the pre-feasibility study. The Ascham asset database indicated that this comprises three blocks of six flats, all individually heated by gas boilers making it also not immediately compatible for a heat network connection but worth considering for future conversion.

4.2.4 Freedom Close, understood to be owned by Circle Housing Association, and located adjacent to Stoneydown House, and Latchingdon Court (identified by LBWF Officers as a private residential block built in the early ‘90’s) were both excluded on the basis that they are outside the Council’s control and offer less long term demand certainty, as discussed in 2.3.2.

4.3 Phasing

4.3.1 One key difference in the load assumptions for BHL South compared to BHL North is the timeframe for development. Whereas BHL North is planned for development over the next five to ten years, BHL South is anticipated to develop over a longer time period.

4.4 Overall demand projections for schemes considered potentially viable

4.4.1 From the information received and load assumptions listed above, PB calculated annual heating demand and developed appropriate demand profiles on an hourly basis that represent typical requirements for heat from the buildings selected for the scheme. Annual estimated demands for loads at BHL South are presented in Table 4-1 below.

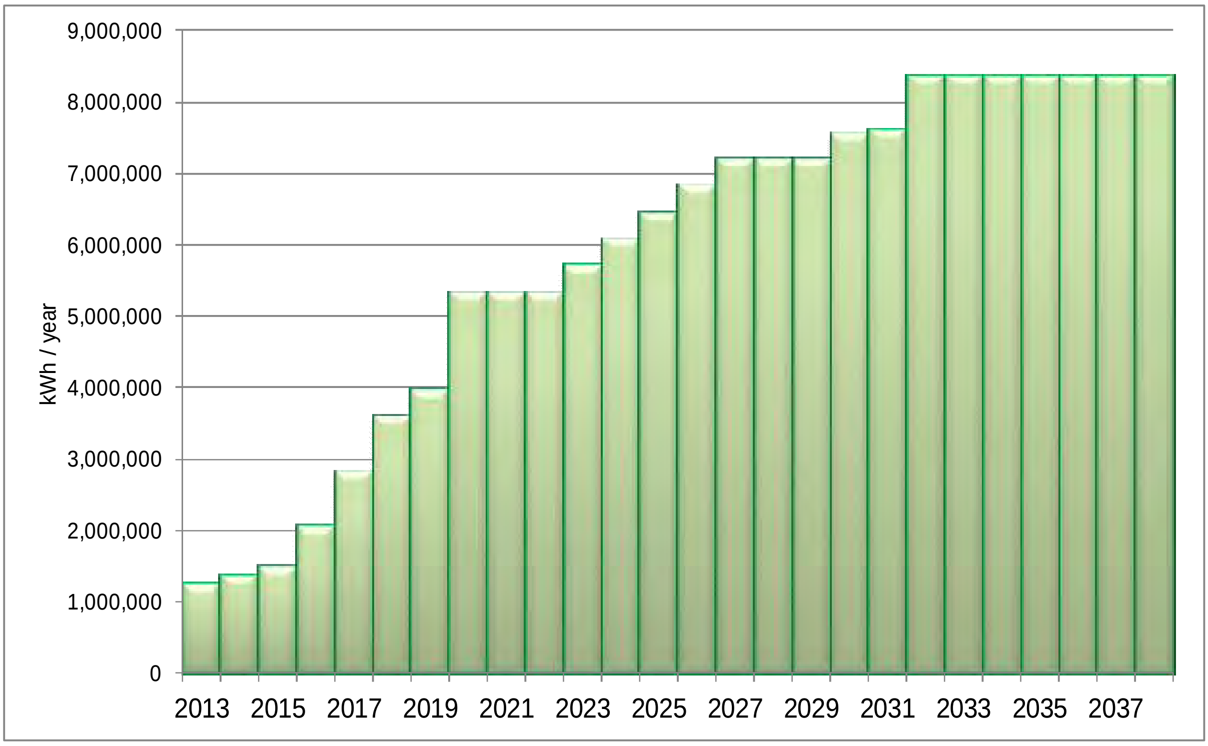
4.4.2 Note that the usage type presented for each development site is based on information provided to PB by LBWF. At this stage, these uses should be considered as indicative and, as such, the benchmarks used may be subject to change as the development schedule for each site progresses.

Table 4-1: BHL South heat demands

Corresponding AAP Area	Name	Type	Calculated heating demand (kWh)	Peak heating demand (kW)
N/A	St Patrick's Primary School	Education	311,604	581
N/A	Stoneydow n Park School	Education	228,998	427
BHL 1	Royal Standard	Pub	215,600	174
BHL 1	Royal Standard	Retail	40,656	46
BHL 1	TfL Car Park	Residential	695,509	466
BHL 1	TfL Car Park	Retail	43,761	50
BHL 1	Mandora	Residential	1,792,714	1,200
BHL 1	Mandora	Office	98,902	124
BHL 1	Mandora	Retail	54,396	62
BHL 1	Legal and General	Residential	1,107,296	741
BHL 1	Parkdale	Residential	765,205	512
BHL 2n	Car Wash Site	Residential	450,120	301
BHL 2n	Car Wash Site	Retail	84,491	96
BHL 2n	Car Wash Site	Restaurant	177,653	125
BHL 2n	Car Wash Site	Pub	55,978	45
BHL 2n	Car Wash Site	Health Centre	128,016	138
BHL 2n	Car Wash Site	Entertainment Halls	268,834	283
BHL 2s	Blackhorse Road / Haw arden Rd 69	Education	759,780	1,417
BHL 8	152 / 154 Blackhorse Road	Residential	225,060	151
BHL 8	152 / 154 Blackhorse Road	Office	86,016	108
BHL 8	152 / 154 Blackhorse Road	Retail	23,654	27
BHL 8	152 / 154 Blackhorse Road	Day Centre	53,760	91
BHL 3	Willow fields School / Tavistock Avenue	Education	711,728	1,327
		Total	**8,379,729**	

4.4.3 The build-up of load over time at BHL South is shown in Figure 4-2 and is based upon the likely timeframe for development provided by LBWF for each site.

Figure 4-2: BHL South – Load build-up over time



4.5 Scheme start date

4.5.1 As with BHL North, PB modelled several variations of the BHL South scheme to determine the optimum time to develop the DH network (see Section 2.8.6). The development schedule for BHL South is more long-term than that of BHL North.

4.5.2 The results represent the preferred scheme development schedule following these modelling iterations with a start date as stated in 4.12.1 below.

4.6 CHP energy centre location

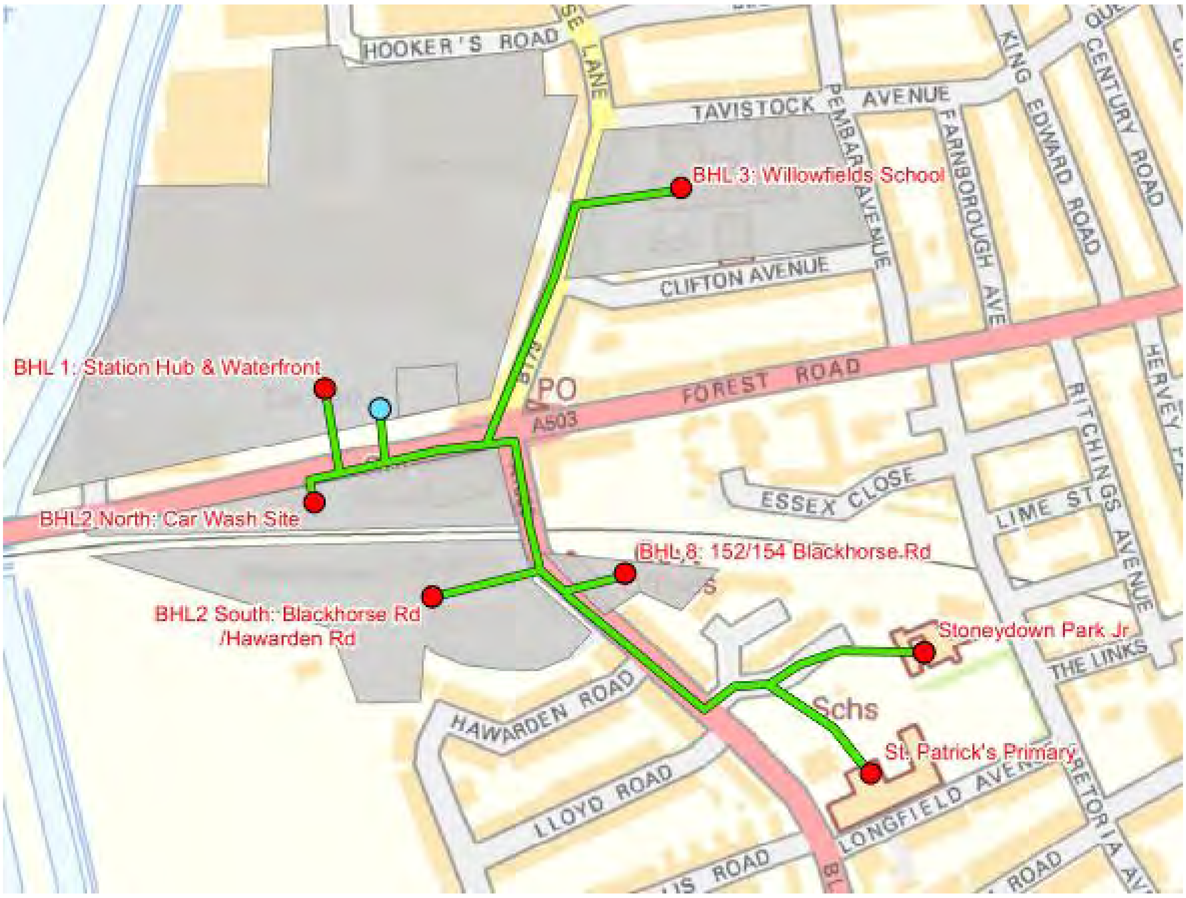
4.6.1 PB has modelled a location on the south east corner of the BHL 1 development site based on its proximity to Forest Road, which is the route planned for the wider DEN scheme's entry to Waltham Forest. As with the energy centre location for BHL North, by locating the energy centre close to Forest Road, it provides a strategic location for connection to the DEN as and when required. This location also offers good access for deliveries and maintenance via an existing car park access road, not direct from Forest Road.

4.6.2 As previously discussed (at section 2.5) the energy centre locations identified in this study are notional and only based on the technical and physical constraints. No commercial factors, in terms of the land use displaced, have been assessed.

4.7 District Heating Routing

4.7.1 PB has developed a preliminary network route for BHL South based on the spatial distribution of development areas as included in the AAP (see Figure 4-1). The network route modelled for BHL North is shown in Figure 4-3. Development areas are shown in grey and labelled. The proposed notional energy centre location is shown as the blue point on the plan below.

Figure 4-3: BHL South preliminary network route



4.8 Options modelled

4.8.1 PB has modelled three heat supply options for BHL South. The basis of these options is discussed at 2.8.6. The key plant items included in each option are detailed in Table 4-2.

Table 4-2: BHL South option plant modelled

	Base Case	Option A	Option B
CHP (kWe)	-	800	600
Boilers (kWth)	7,000	7,000	7,000
Thermal Store (m^3)	-	90	90

4.9 Capital cost estimates

4.9.1 A summary of the capital cost of each modelled option is presented in Table 4-3. A full breakdown of cost items for each option is presented in Appendix B.

Table 4-3: BHL South option total capital costs

Base Case (£k)	£187
Option A (£k)	£2,292.8
Option B (£k)	£2,262.8

4.10 Maintenance cost estimates

4.10.1 Maintenance costs were included for gas boilers and CHP annual maintenance in all options. A summary of those costs is presented in Table 4-4.

Table 4-4: BHL South annual maintenance costs

	CHP Maintenance	Gas Boiler Maintenance
Base Case (£k)	-	£20
Option A (£k)	£70.1	£15
Option B (£k)	£58.8	£15

4.11 Replacement cost estimates

4.11.1 Replacements costs were included for gas boilers and CHP engines in all options. A summary of those costs is presented in Table 4-5.

Table 4-5: BHL South replacement costs

	CHP Replacement	Gas Boiler Replacement
Base Case (£k)	-	£175
Option A (£k)	£298	£175
Option B (£k)	£279	£175

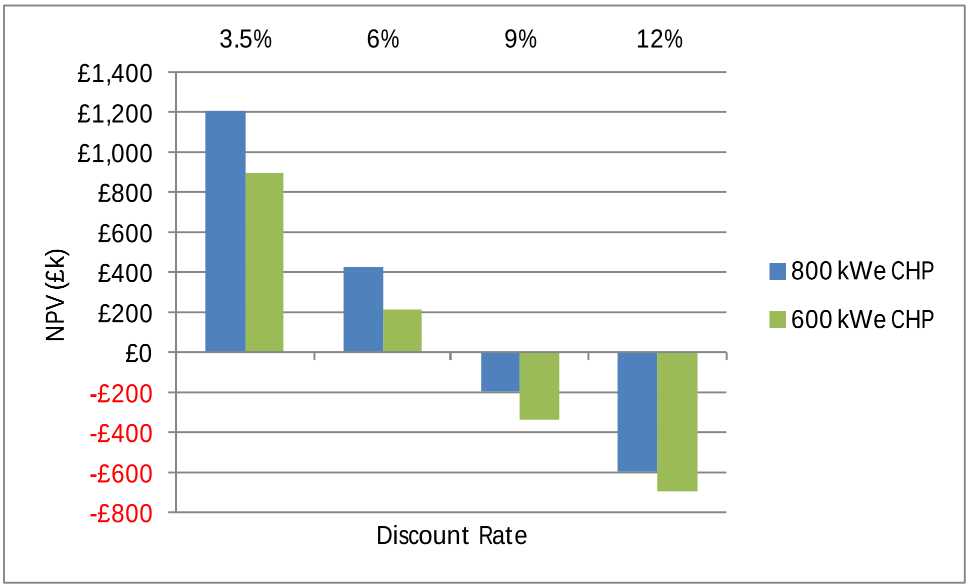
4.12 Results

4.12.1 PB modelled the performance of the two CHP options against the base case. Results are presented for a range of discount rates. In all cases, the DECC central utility price scenario was used (see Section 2.7). Based on the current assumptions on development phasing, the preferred project start date is 2018, with construction of an energy centre assumed in 2017. As the certainty and details of each development become further defined, further assessment should be performed to establish the most viable start date for the scheme.

4.12.2 Results are presented for both the cost of heat generation, i.e. without the inclusion of heat sales in the district heating options, and for commercial performance, i.e. including heat sales in the district heating options.

4.12.3 Figure 4-4 shows the difference between the cost of heat generation for CHP options compared to the base case at a range of discount rates.

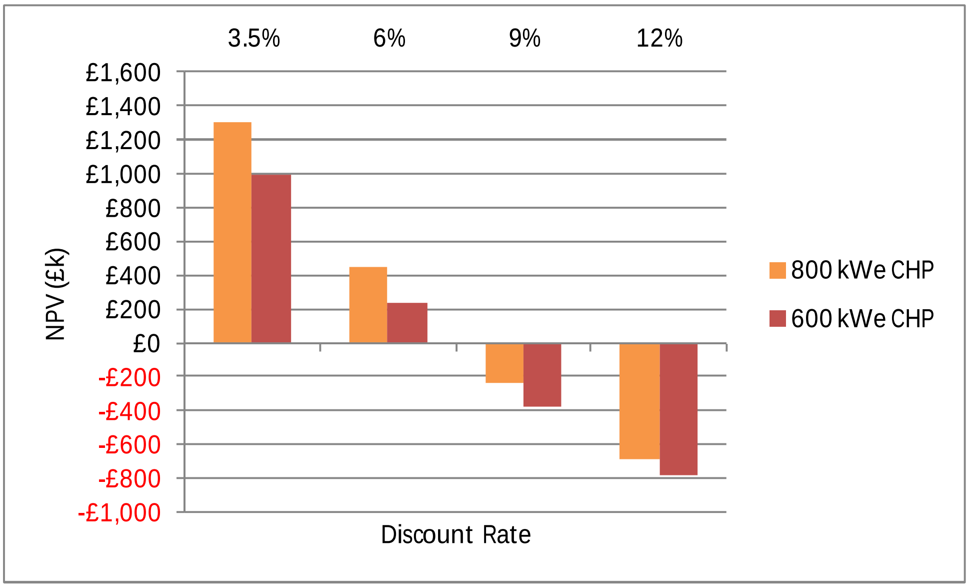
Figure 4-4: BHL South – comparison of option heat generation cost against the base case



4.12.4 Section 3.11.4 explains this chart. It shows how both the 800kWe and the 600kWe CHP options generate heat more cheaply than the base case at a discount rate of 3.5 percent and at 6 percent over the 25 year project lifetime. This equates to 'passing' the recommended Treasury Green Book test of viability for infrastructure projects (which demands evaluation at this discount rate). As the discount rate increases, the performance against the base case worsens as a result of the decreasing value of future annual operating cost reductions, such that it cannot offset the capital cost of the DH network.

4.12.5 Figure 4-5 shows the commercial performance of the two district heating options over the 25 year project lifetime, i.e. including heat sales.

Figure 4-5: BHL South – NPV performance of CHP options



4.12.6 This graph shows how a district heating network with an 800kWe CHP delivers a positive NPV of c. £1.3m at a discount rate of 3.5 percent and c. £400k at a 6 percent discount rate. The 600kWe engine also delivers a positive NPV at both a 3.5 percent and 6 percent discount rates, but does not perform as well as the larger engine.

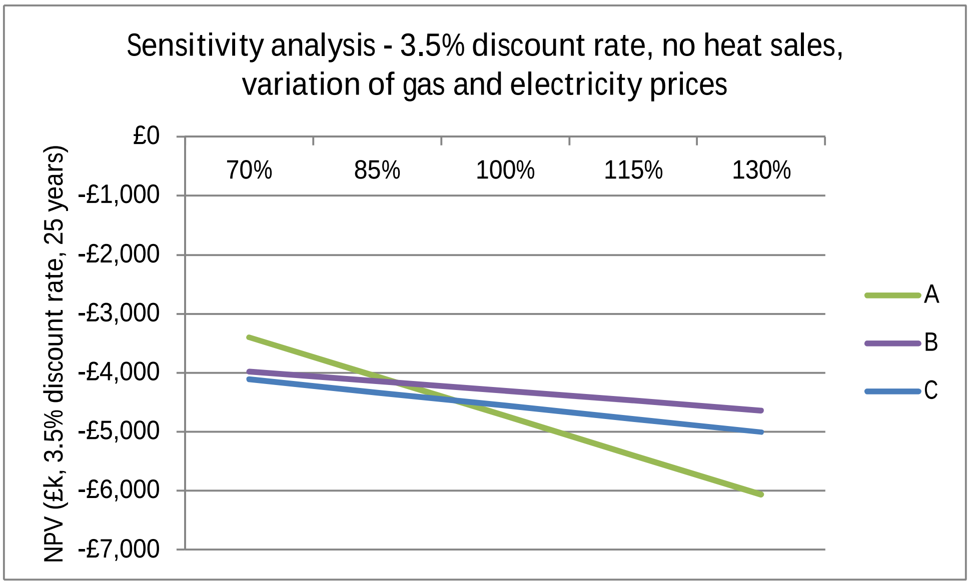
4.13 Sensitivity Analysis on energy prices

4.13.1 This chart shows the impact of higher and lower energy prices on the whole life assessments presented above. With higher energy prices, the relative performance of the district energy options (B and C) improves compared with the base case (A) of current gas heating.

4.13.2 The graph illustrates how, as energy prices rise or fall by a given percentage level (as shown on the x-axis) the net present values of the different schemes are impacted. This shows that as energy prices rise, all of the options need to spend more money on energy provision, hence all of the NPVs fall. However, within this trend, the comparative cost of the provision of energy is different for the different options. The CHP options become comparatively less costly than the 'base case' with any increase in prices and down to a 90% reduction , for example.

4.13.3

Figure 4-6: BHL South – NPV sensitivity to energy price variation



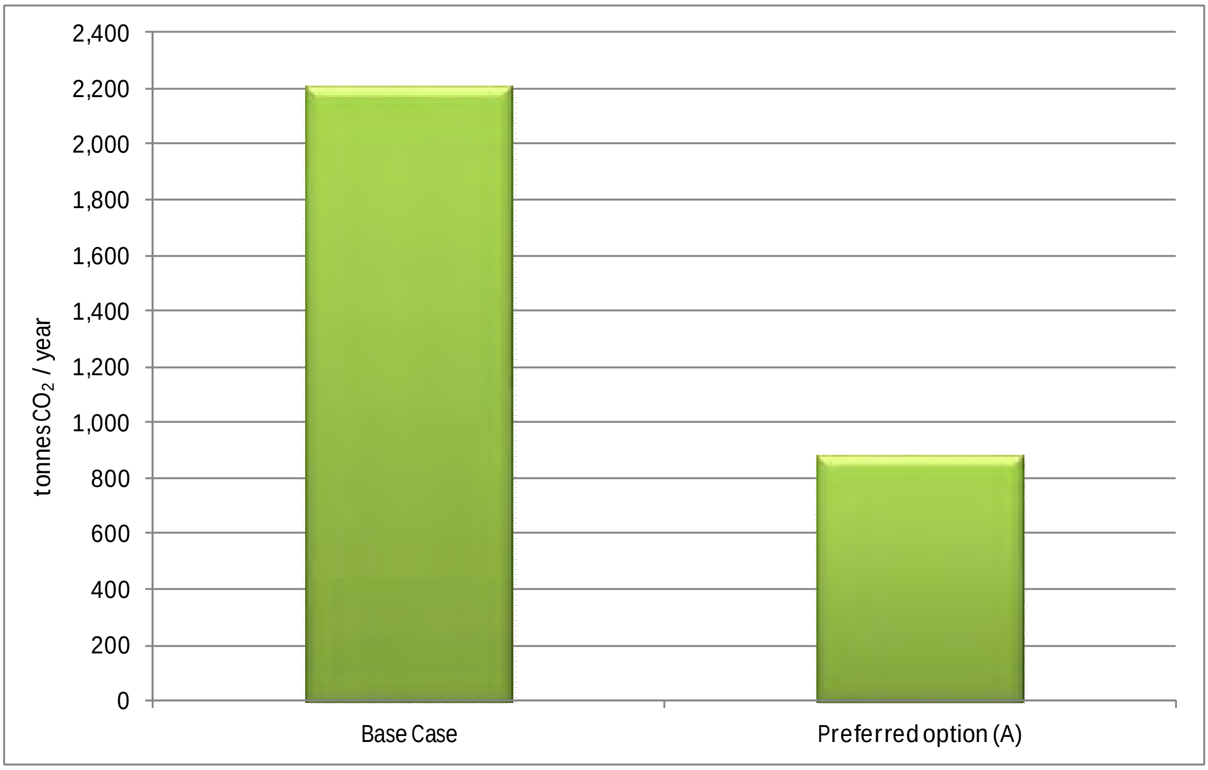
4.14 Projected emissions savings

4.14.1 The emissions from the preferred CHP option and the base case, along with the option's percentage saving over the base case are shown in Table 4-6.

Table 4-6: BHL South emissions

Scenario	Emissions (t CO2/yr)	% saving over base case
Base Case	2212	
Preferred CHP option (800kWe)	882	60%

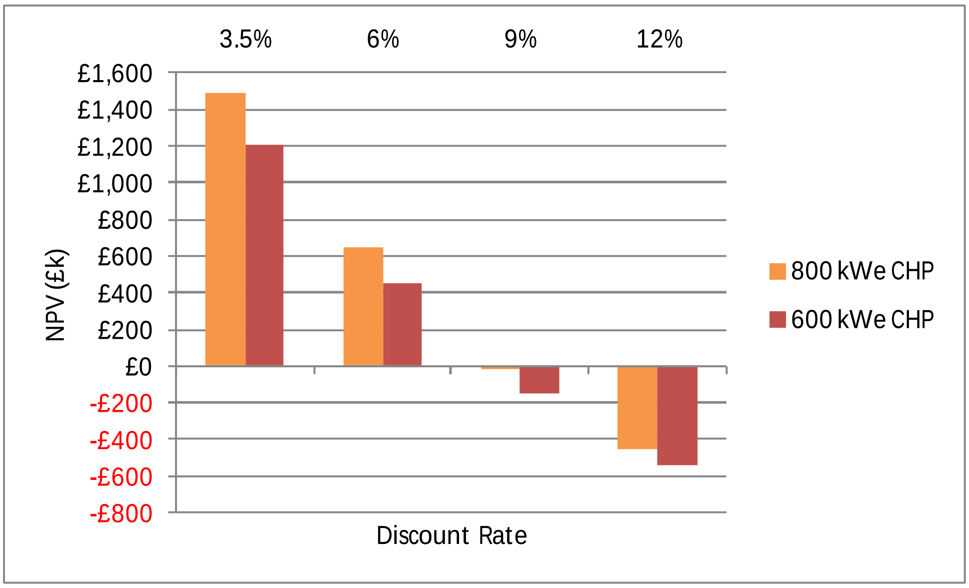
Figure 4-7: BHL South base and case and preferred option emissions comparison



4.15 Exclusion of St Patrick's and Stoneydown Park schools

4.15.1 The network modelled and described above includes St. Patrick's Primary and Stoneydown Park Junior schools. The inclusion of these schools requires additional network of around 370 metres to serve a combined annual load of around 541 MWh. PB modelled a version of the network in which the schools were excluded to determine whether their inclusion offers a net benefit to the scheme. The commercial performance of this model run is shown below.

Figure 4-8: NPV performance of CHP options – St Patrick's and Stoneydown Park schools excluded



4.15.2 These results show how, by excluding the two schools, the commercial performance of the BHL South cluster improves by c. £200k over a 25 year project lifetime. The choice of inclusion or exclusion of these schools from this scheme resides with LBWF. As noted, exclusion improves the financial performance of the scheme, whilst inclusion increases carbons savings and the geographic coverage – increasing the potential for further growth in the future.

4.16 Scheme Conclusions

4.16.1 This scheme is anticipated to develop over a longer time period than the BHL North scheme. The Carwash site's development in particular is uncertain, accounting for 20% of the total scheme's heat demand. There is uncertainty around the Blackhorse Road/Hawden Road site and proposed development at Willowfield School is potentially dependent on this,,although funding for the new school has now been secured.

4.16.2 The Station Hub and Waterfront site accounts for just over half of the total heat demand of the scheme and is therefore the core of the scheme.

4.16.3 These results show how, based on the calculated heating demand and the options modelled, there appears to be a viable scheme at Blackhorse Lane South at a low discount rate.

4.16.4 The delayed start date of providing heat from the scheme is critical to the positive economic case presented. Although some recent, renewed activity and interest in some of these development sites could bring these dates forward.

5 WALTHAMSTOW TOWN CENTRE

5.1 Overview

5.1.1 Walthamstow Town Centre (WTC hereafter) is located to the south east of Blackhorse Lane. The area action plan (AAP) for the area shows several key development sites. A map showing the location of these sites from the AAP is presented below.

Figure 5-1: WTC development sites

5.1.2 As with the Blackhorse Lane clusters, development loads at WTC comprise a mix of residential, business and community uses. However, unlike BHL, and as you would expect with a town centre, there are many existing buildings in the area that should also be considered for connection to the scheme. PB used a mix of information provided by LBWF and site surveys to determine the size, nature and compatibility of the existing buildings in WTC with a DH network. The DH schemes considered have been based only on the existing buildings under LBWF control and new development.

5.2 Excluded sites

5.2.1 Although existing buildings outside Council control have been excluded (as discussed in 2.3.2 above), Selborne Walk shopping Mall is a large building, centrally located in the area assessed and warranted further investigation. PB contacted the shopping centre to determine the size and nature of its current heat load. In discussion with the Operations Manager, it was determined that the heating system is not communal, with each retail outlet having their own gas boiler. As such, Selborne Walk does not represent a site that could easily be connected to a district heating scheme without significant and costly alterations to the secondary heating system. It has therefore been excluded on this basis.

5.2.2 Of the AAP sites, three were excluded. WTCP1-3, the Snooker Hall, Former Factory on Tower Hamlets Road and the Former Petrol Station on Hoe Street. The projected loads of these developments were deemed too small for their distance from the centre of the AAP.

5.2.3 The WFD Service Centre building was identified whilst walking the proposed route. The flats above it were referred to in the Ascham database which indicated that they are all heated by their own, individual gas boilers making them incompatible with a heat network connection. As the result of a site visit, it was identified that the WFD Service Centre itself is electrically heated. This site was therefore excluded from our assessment. It does, however, represent an opportunity to convert the building to communal heating in the future and connect to a heat network.

5.2.4 1-8 Tower Mews was excluded since the site has now been completed without communal heating.

5.2.5 Mission Grove Primary School - LBWF provided information that a biomass boiler has recently been installed. This reduces the incentive for the school to connect to a heat network. In addition, this site was identified, along with others, as being part of a potential network loop that reduces the financial performance of the overall scheme due to their distance from the main route relative to the heat demand they added. It was therefore excluded.

5.2.6 Progress House – this was a load identified in the pre-feasibility desktop work. However, neither LBWF nor PB has been able to confirm what this load represents, and on this basis it has been excluded from this study.

5.2.7 Edison Close / Exeter Road E17, a new housing association development adjacent to the Station Car Park site highlighted by LBWF Officers, was excluded on the basis that it is outside the Council's control and offers less long term demand certainty, as discussed in 2.3.2.

5.3 Phasing

5.3.1 It is assumed that existing loads under LBWF control (Central Library, and Goddart's House directly and Longfield House via Ascham Homes) are available for connection to the scheme as soon as the network is available. Planned development in WTC is scheduled for development over the next five years.

5.4 Overall demand projections for schemes considered potentially viable

5.4.1 From the information received and load assumptions listed above, PB calculated annual heating demand and developed appropriate demand profiles on an hourly basis that represent typical requirements for heat from the buildings selected for the scheme. Annual demands for loads of WTC are presented in Table 5-1.

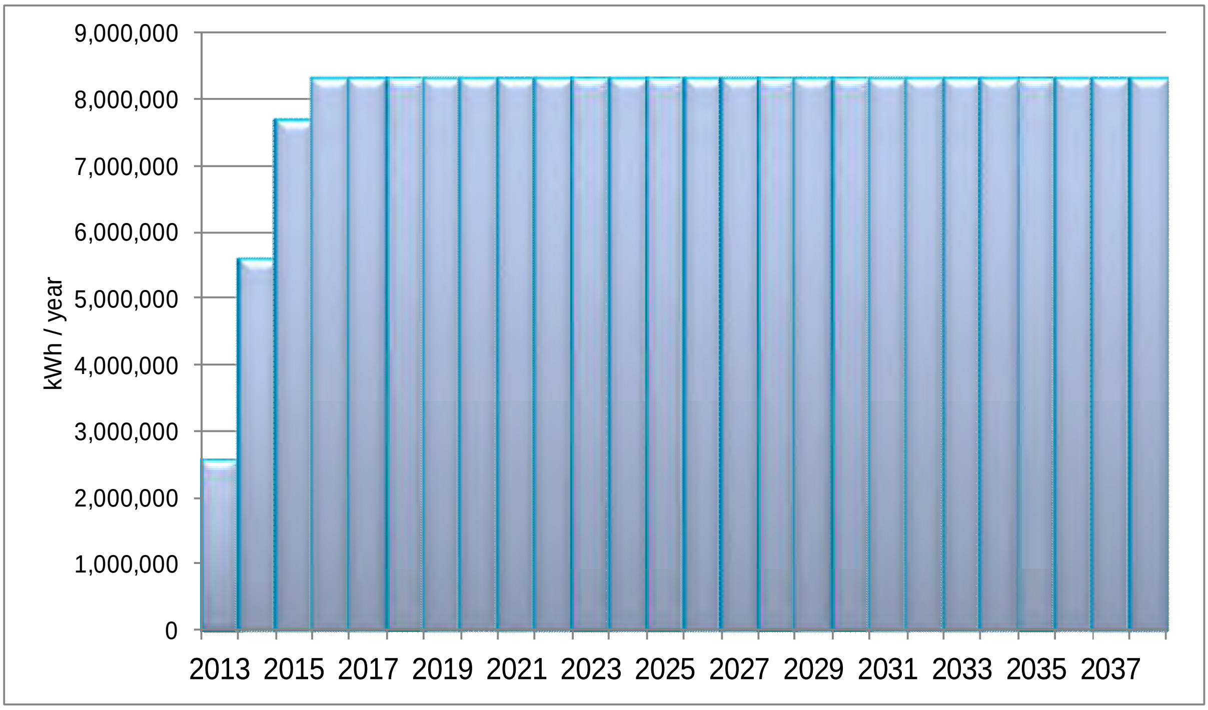
5.4.2 Note that the usage type presented for each development site is based on information provided to PB by LBWF. At this stage, these uses should be considered as indicative and, as such, the benchmarks used may be subject to change as the development schedule for each site progresses.

Table 5-1: WTC heat demands

Corresponding AAP Area	Name	Type	Calculated heating demand (kWh)	Peak heating demand (kW)
N/A	St Patrick's Primary School	Education	311,604	581
N/A	Stoneydow n Park School	Education	228,998	427
BHL 1	Royal Standard	Pub	215,600	174
BHL 1	Royal Standard	Retail	40,656	46
BHL 1	TfL Car Park	Residential	695,509	466
BHL 1	TfL Car Park	Retail	43,761	50
BHL 1	Mandora	Residential	1,792,714	1,200
BHL 1	Mandora	Office	98,902	124
BHL 1	Mandora	Retail	54,396	62
BHL 1	Legal and General	Residential	1,107,296	741
BHL 1	Parkdale	Residential	765,205	512
BHL 2n	Car Wash Site	Residential	450,120	301
BHL 2n	Car Wash Site	Retail	84,491	96
BHL 2n	Car Wash Site	Restaurant	177,653	125
BHL 2n	Car Wash Site	Pub	55,978	45
BHL 2n	Car Wash Site	Health Centre	128,016	138
BHL 2n	Car Wash Site	Entertainment Halls	268,834	283
BHL 2s	Blackhorse Road / Haw arden Rd 69	Education	759,780	1,417
BHL 8	152 / 154 Blackhorse Road	Residential	225,060	151
BHL 8	152 / 154 Blackhorse Road	Office	86,016	108
BHL 8	152 / 154 Blackhorse Road	Retail	23,654	27
BHL 8	152 / 154 Blackhorse Road	Day Centre	53,760	91
BHL 3	Willow fields School / Tavistock Avenue	Education	711,728	1,327
		Total	**8,379,729**	

5.4.3 The build-up of load over time at WTC is shown in Figure 5-2 and is based upon the likely timeframe for development provided by LBWF for each site.

Figure 5-2: WTC – Load build-up over time



5.5 Scheme start date

5.5.1 As with the Blackhorse Lane clusters, PB modelled several variations of the WTC scheme to determine the optimum time to develop the DH network (see Section 2.9).

5.5.2 The results represent the preferred scheme development schedule following these modelling iterations with a start date as stated in 5.12.1 below.

5.6 CHP energy centre location

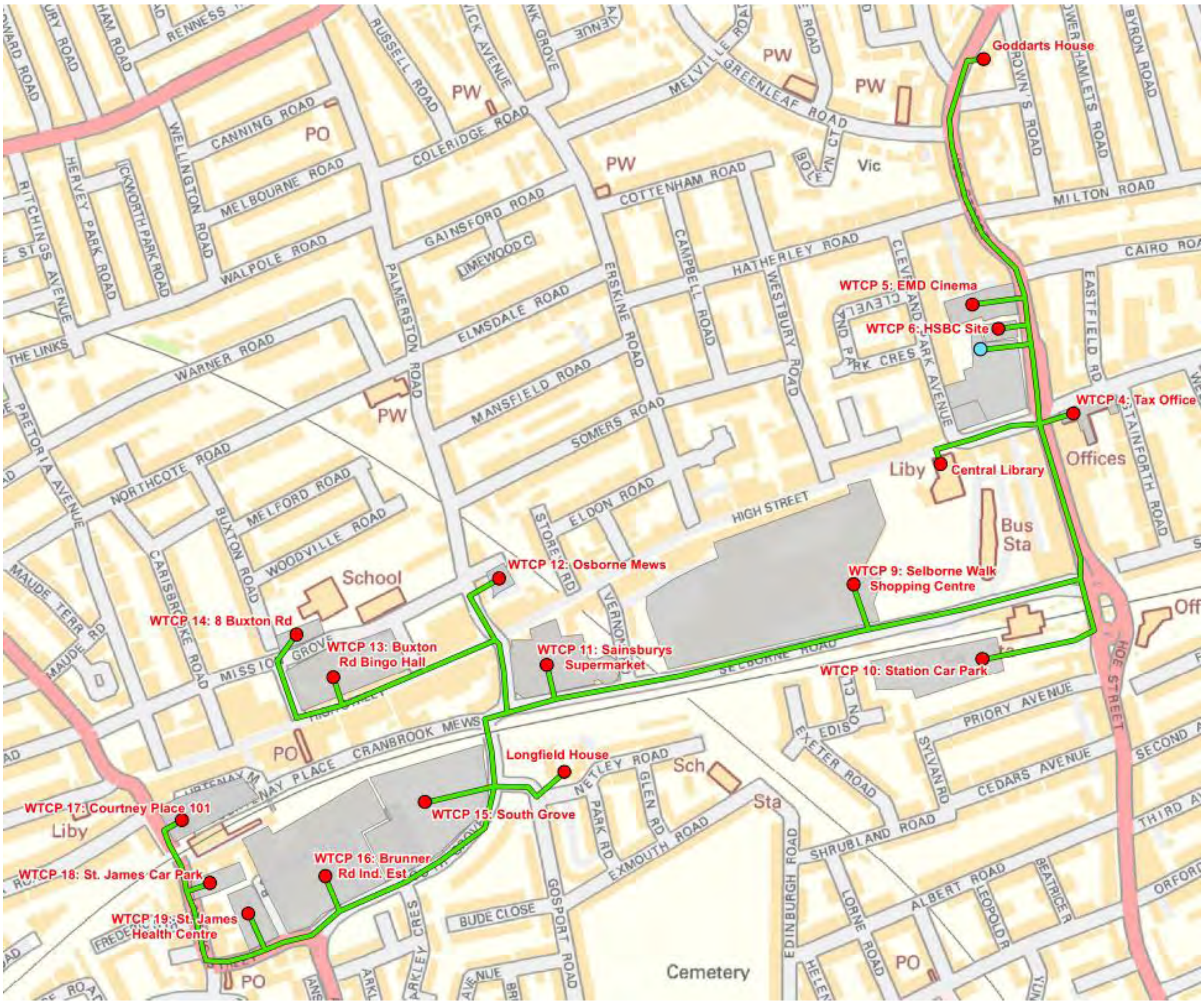
5.6.1 The latest draft proposals for the Arcade Site show a CHP plant room located to the north of the site, behind the bank. As such, PB has modelled an energy centre in the Arcade Site as shown in Figure 5-3.

5.6.2 As previously discussed (at section 2.5) the energy centre locations identified in this study are notional and only based on the technical and physical constraints. No commercial factors, in terms of the land use displaced, have been assessed.

5.7 District Heating Routing

5.7.1 PB has developed a preliminary network route based on the spatial distribution of existing loads and development areas included in the AAP (see Figure 5-1). The network route modelled for WTC is shown in Figure 5-3. Development areas are shown in grey and labelled. The notional energy centre is shown as a blue dot.

Figure 5-3: WTC preliminary network route



5.8 Options modelled

5.8.1 PB has modelled three heat supply options for WTC. The basis of these options is discussed at 2.8.6. The key plant items included in each option are detailed in Table 5-2.

Table 5-2: WTC option plant modelled

	Base Case	Option A	Option B
CHP (kWe)	-	1,200	889
Boilers (kWth)	7,000	7,000	7,000
Thermal Store (m^3)	-	120	120

5.9 Capital cost estimates

5.9.1 A summary of the capital cost of each modelled option is presented in Table 5-3. A full breakdown of cost items for each option is presented in Appendix B.

Table 5-3: WTC option total capital costs

Base Case (£k)	£189
Option A (£k)	£4,480.2
Option B (£k)	£4,318.5

5.10 Maintenance cost estimates

5.10.1 Maintenance costs were included for gas boilers and CHP annual maintenance in all options. A summary of those costs is presented in Table 5-4.

Table 5-4: WTC annual maintenance costs

	CHP Maintenance	Gas Boiler Maintenance
Base Case (£k)	-	£20
Option A (£k)	£92.3	£15
Option B (£k)	£79.4	£15

5.11 Replacement cost estimates

5.11.1 Replacements costs were included for gas boilers and CHP engines in all options. A summary of those costs is presented in Table 5-5.

Table 5-5: WTC replacement costs

	CHP Replacement	Gas Boiler Replacement
Base Case (£k)	-	£175
Option A (£k)	£396	£175
Option B (£k)	£298	£175

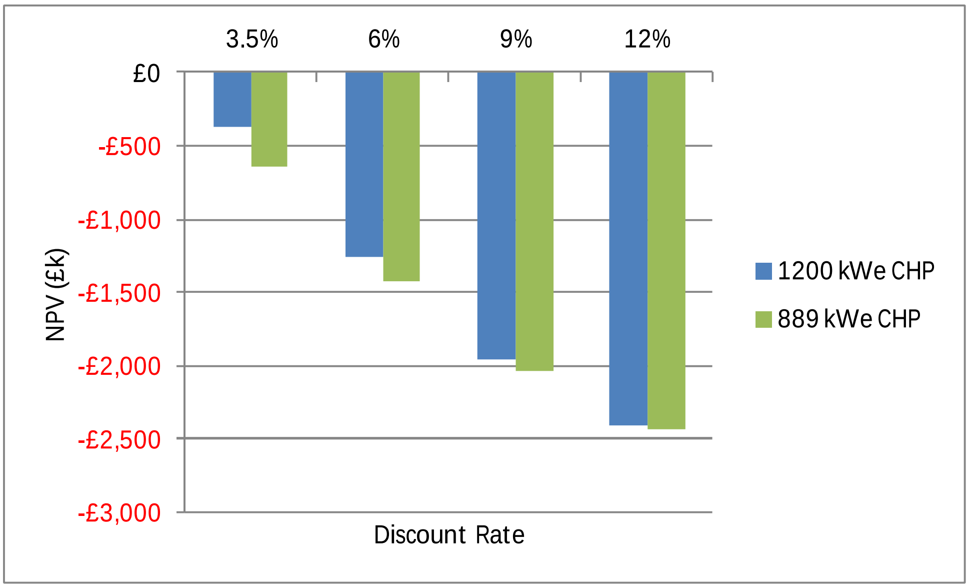
5.12 Results

5.12.1 PB modelled the performance of the two CHP options against the base case. Results are presented for a range of discount rates. In all cases, the DECC central utility price scenario was used (see Section 2.7). The preferred project start date is 2015, with construction in 2014.

5.12.2 Results are presented for both the cost of heat generation, i.e. without the inclusion of heat sales in the district heating options, and for commercial performance, i.e. including heat sales in the district heating options.

5.12.3 Figure 5-4 shows the difference between the cost of heat generation for CHP options compared to the base case at a range of discount rates.

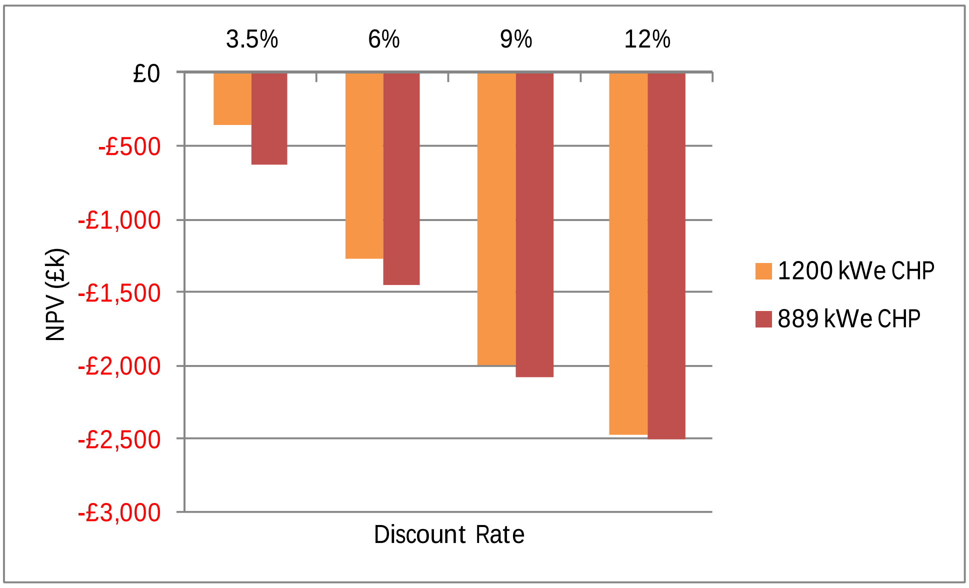
Figure 5-4: WTC – comparison of option heat generation cost against the base case



5.12.4 Section 3.11.4 explains this chart. It shows how both the 1,200kWe and the 889kWe CHP options generate heat that is more costly than the base case over the 25 year project lifetime.

5.12.5 Figure 5-5 shows the commercial performance of the two district heating options over the 25 year project lifetime, i.e. including heat sales.

Figure 5-5: WTC – NPV performance of CHP options



5.12.6 These results show how, based on the calculated heating demand and the options modelled, a district heating scheme serving all of the loads in Walthamstow Town

Centre is not viable. This is due to the extent of the network, which is considerably larger than the Blackhorse Lane clusters, in relation to the heat demand. This can be shown using a simple metric showing the ratio of heat load to the network cost, which is a product of the length and width of the pipeline.

Table 5-6: Ratio of heat load to network cost

Cluster	Total annual heat load (kWh)	Network cost	Heat load per £ (kWh)
BHL North	6,575,156	£657,727	10.00
BHL South (excluding schools)	7,839,128	£542,190	14.46
Walthamstow TC	8,379,729	£2,457,022	3.41

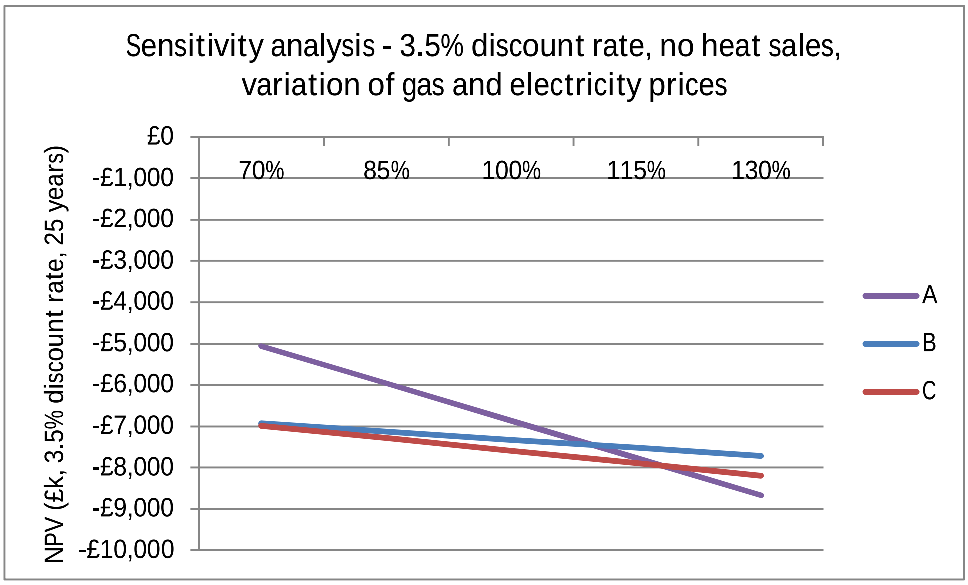
5.12.7 Table 5-6 shows how WTC is significantly less cost efficient than BHL clusters. Blackhorse Lane North and South deliver three and four times the amount of heat respectively for every pound spent on the network, compared to WTC.

5.13 Sensitivity Analysis on energy prices

5.13.1 This chart shows the impact of higher and lower energy prices on the whole life assessments presented above. With higher energy prices, the relative performance of the district energy options (B and C) improves compared with the base case (A) of current gas heating.

5.13.2 The graph illustrates how, as energy prices rise or fall by a given percentage level (as shown on the x-axis) the net present values of the different schemes are impacted. This shows that as energy prices rise, all of the options need to spend more money on energy provision, hence all of the NPVs fall. However, within this trend, the comparative cost of the provision of energy is different for the different options. The CHP options become comparatively less costly than the ‘base case’ as energy prices are increased by 30%, for example.

Figure 5-6: WTC– NPV sensitivity to energy price variation



5.14 Projected emissions savings

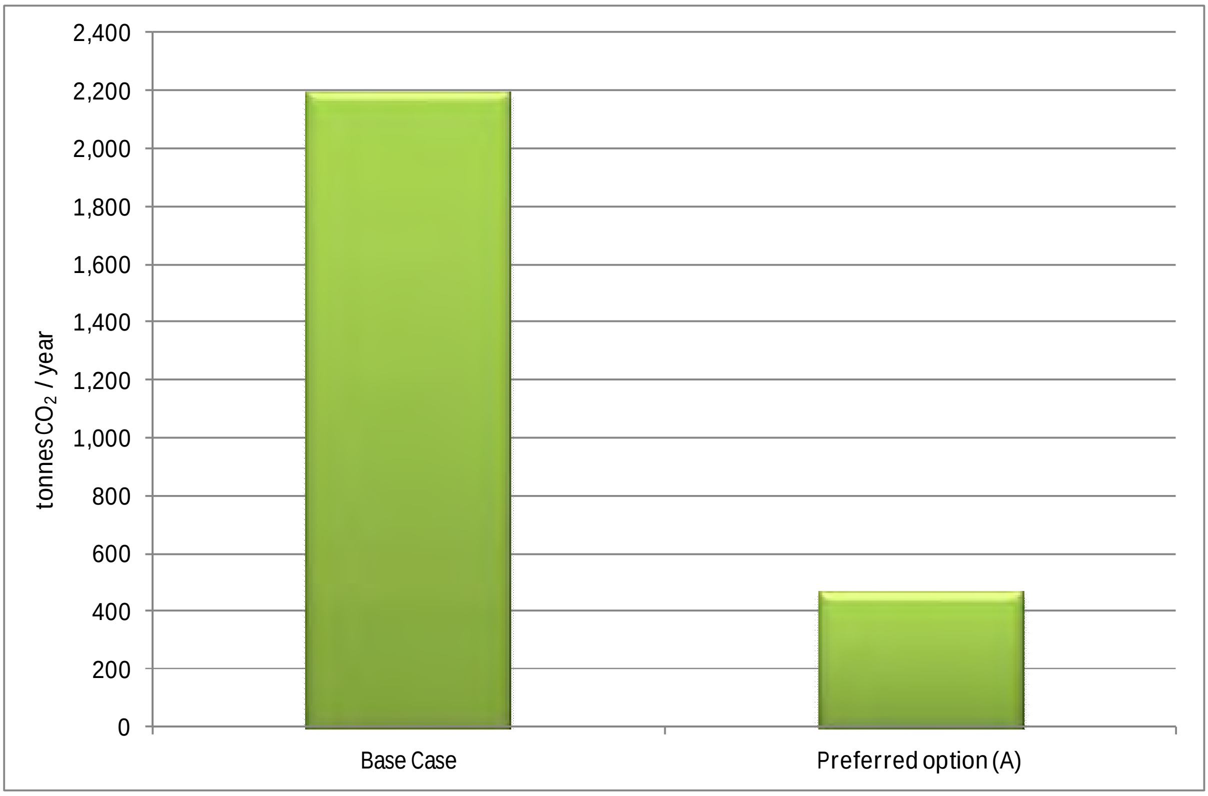
The emissions from the WTC preferred CHP option and the base case, along with the option percentage option percentage saving over the base case, are presented in

5.14.1 Figure 5-7 and Table 5-7.

Table 5-7: WTC emissions

Scenario	Emissions (t CO2/yr)	% saving over base case
Base Case	**2195**	
Preferred CHP option (1,200kWe)	**470**	**79%**

Figure 5-7: WTC base case and preferred option emissions comparison



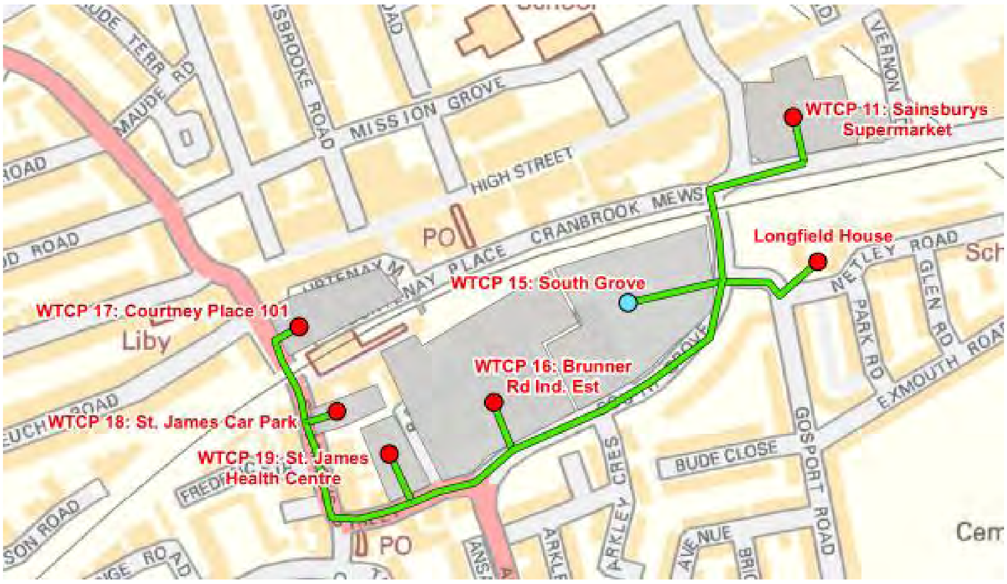
5.15 Walthamstow Town Centre reduced network to west

5.15.1 As can be seen from Figure 5-3, the outline network design for the Walthamstow Town Centre is spread out over a wider area than the Blackhorse Lane schemes. There is also a clear concentration of two groups of loads to the west and east with the Selborne Walk shopping centre currently the only load connecting the two areas.

5.15.2 There is a long run of network route along Selborne Road with only one connection on it which is the potential extension to the shopping mall. As discussed at 5.2.1 the Selborne Walk centre heating systems are not currently compatible with a heat network connection. Should this site come forward for redevelopment, and a centralised heating system implemented then the viability of the Selborne Raod network route link would be much improved.

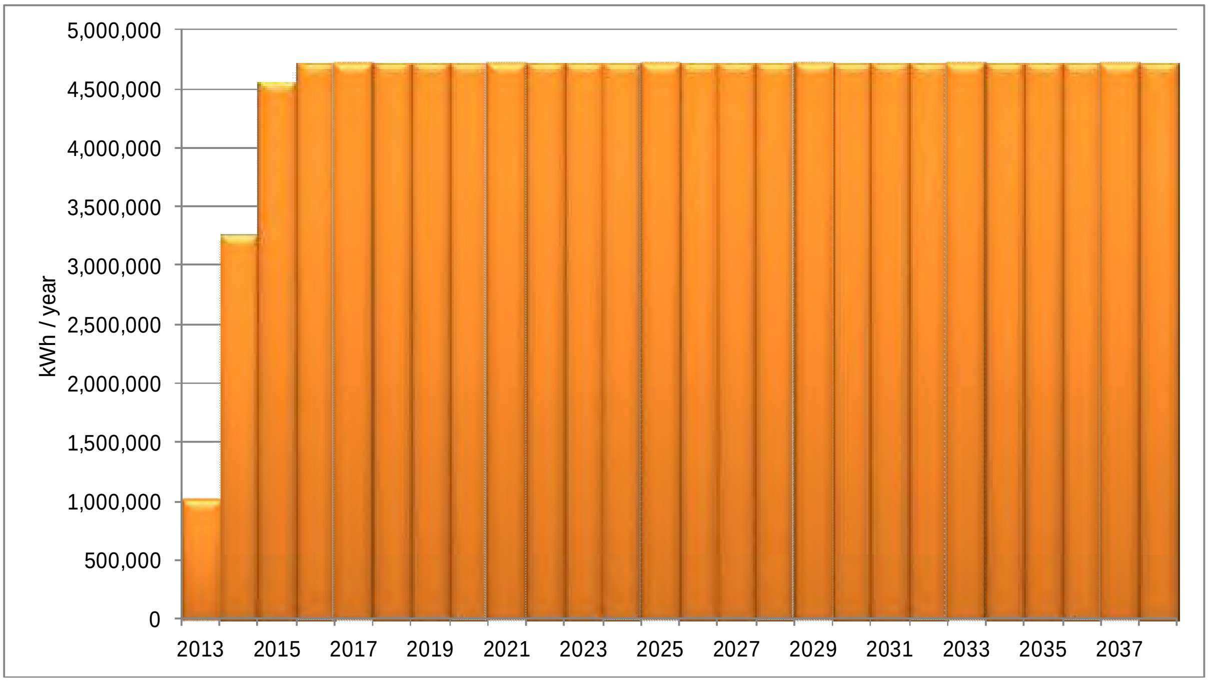
5.15.3 It therefore makes sense to model variations on the wider WTC network to determine whether a smaller cluster would be viable. The most effective of these variations is a smaller network to the west of the railway line running north-south through Walthamstow Town Centre (Liverpool St to Chingford), as shown in Figure 5-8. The notional energy centre is shown as a blue dot.

Figure 5-8: WTC – Smaller network route west of railway line



5.15.4 The build-up of load over time for the reduced network is presented in Figure 5-9.

Figure 5-9: WTC smaller network – Load build-up over time



5.16 Results

5.16.1 These results show that a smaller network to the west of the Liverpool St to Chingford linein Walthamstow Town Centre does perform better than the main WTC scheme, returning a positive NPV at a 3.5 percent discount rate. This is a product of the higher load density to the west of the Liverpool St to Chingford line compared to the eastern part of the main WTC network. The heat load per pound spent on DH network (i.e. the metric presented in Table 5-6) for the smaller network to the west of the railway line is 6.21kWh – almost double the figure for the wider WTC network.

5.16.2 It can therefore be concluded that there appears to be a viable DH scheme to the west of the railway line in Walthamstow Town Centre.

Figure 5-10: WTC smaller network west of Liverpool St to Chingford rail line – NPV performance of CHP options

5.17 Options to connect the Station Car Park development to a reduced network

5.17.1 This reduced scheme excludes a key site for LBWF, the Station Car Park site (WTCP 10). PB therefore investigated two options to link this site into the reduced scheme.

5.17.2 The first option challenged the assumption that the existing Mall offered no opportunity to connect to a network. The Mall is the only significant potential demand located between the Station Car Park and this reduced scheme. Identifying a larger viable demand at the Mall could have made this long link more viable. Direct contact was made with the Mall operations manager and it was confirmed that there is no central plant serving the retail premises making a network connection unviable.

5.17.3 For the second option, PB also assessed a route using a different, more direct route to connect the Station Car Park into the smaller, west of railway network. This had been discussed with LBWF, where the possibility of crossing the railway line using the footbridge at the end of Exmouth Road was raised. Visual appraisal of the bridge using Google Earth concluded that the footbridge is not suitable for running a district heating pipe over as it forms the main platform access route for Walthamstow Queen's Road train station and it is appears to be structurally unsuitable, to route this way. Figure 5-11 shows the footbridge.

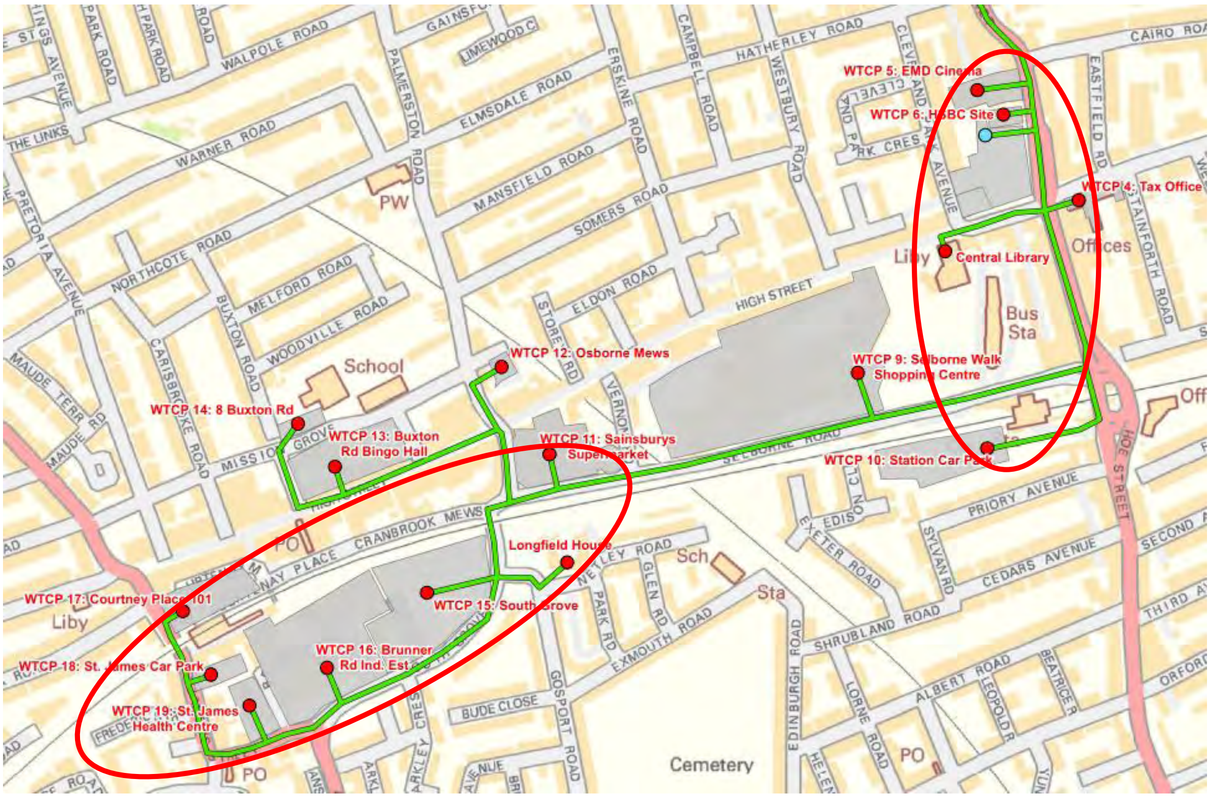
Figure 5-11: Footbridge at end of Exmouth Road – Walthamstow

5.17.4 The alternative would be to use the road bridge crossing the (Liverpool St to Chingford) railway line at Shrubland Road. However, analysis of this route shows that this would entail more than 800 metres of additional network to serve a load of 769.5 MWh, which would certainly have a negative impact on the scheme.

5.18 Option to develop a smaller scheme around the Arcade and Station Car Park

5.18.1 As well as the smaller scheme to the west of the WTC site, there is a possible scheme to the east that is worth considering.

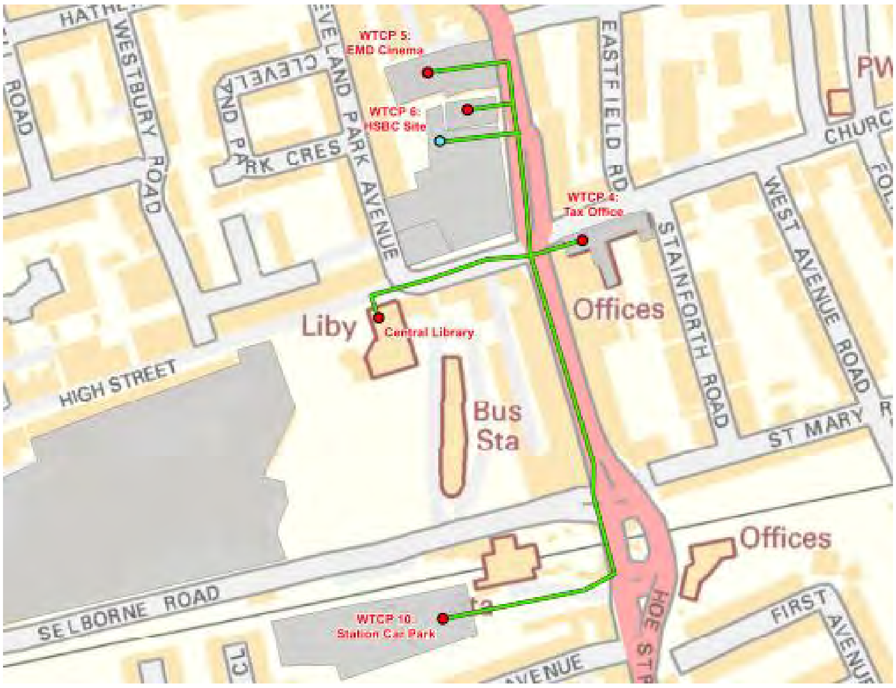
Figure 5-12: comparison of length of east and west reduced network options



5.18.2 The network to the west of the (Liverpool St to Chingford) railway line (assessed above in section 5.15) has an annual heating demand of 4.7GWh The loads to the east of the railway line in Walthamstow Town Centre have a combined annual heating demand of 2.74 GWh (excluding the Selborne Walk Shopping Centre load). Figure 5-12 shows how a network serving only loads to the east of the Liverpool St to Chingford line would be comparable in size to the network tested to the west. As such, it is worthy of further investigation as there may be a viable scheme here also.

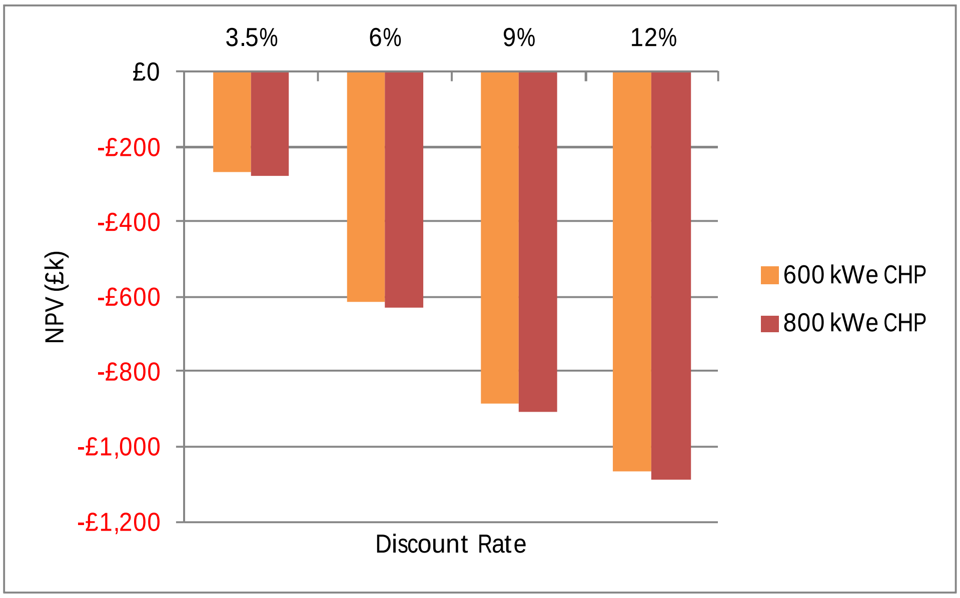
5.18.3 The scheme that is tested hereafter excludes both Selborne Walk Shopping Centre and Goddarts House due to the extent of network required to serve these (relatively small) loads. It is presented in Figure 5-13.

Figure 5-13: Network tested to the east of the Liverpool St to Chingford railway line in WTC



5.18.4 Figure 5-14 shows the commercial performance of a smaller scheme to the east of the Liverpool St to Chingford line in Walthamstow Town Centre. It shows how, although there is an improvement over the wider WTC scheme, it returns a negative NPV at all discount rates. As such, it can be concluded that this scheme is not commercially viable.

Figure 5-14: WTC smaller network east of Liverpool St to Chingford rail line – NPV performance of CHP options



5.18.5

5.19 Increasing connection charges to achieve a viable scheme

5.19.1 As discussed in 2.9 this assessment includes an allowance for connection charges levied on new developments that want to connect to the scheme. For the reduced network to the east of the Liverpool St to Chingford railway line assessed above these total a contribution of £355,707 to the capital costs of the scheme.

5.19.2 The performance of this scheme could be improved by increasing the level at which these charges are levied as set out in the tables below.

Table 5-8: WTC reduced network to east of Liverpool St to Chingford rail line connection charge increases required to achieve viable rates of return

IRR	combined connection charges	connection charge rate
negative	£355,707	£100.00
3.5%	£642,933	£181
6%	£1,038,666	£292

Table 5-9: WTC whole networkconnection charge increases required to achieve viable rates of return

IRR	combined connection charges	connection charge rate
negative	£927,944	£100
3.5%	£1,606,524	£142.38
6%	£3,423,387	£369

5.19.3 These tables show that a cost neutral life time cost could be achieved at a 3.5% rate of return by increasing the connection charge for the wider WTC scheme by 50%, or an almost doubling of the charge as applied to the reduced scheme to the east of the Liverpool St to Chingford railway line. Reference is made, in section 2.9 above, to a reasonable level of £200/kW$_{th}$.

5.20 Scheme Conclusions

5.20.1 This is the largest scheme assessed both in terms of the potential heat demand served and the distance over which the network would need to be laid. It therefore represents the greatest opportunity to reduce carbon dioxide emissions. However, the economic assessment has shown that, of the options assessed, only a smaller scheme to the west of the Liverpool St to Chingford railway line generates a positive NPV. This is mainly due to the wider area over which the potential loads are spread and the associated costs, in terms of installing pipes, required to serve them, as shown in Table 5-6.

5.20.2 The existing Selborne Walk Mall is centrally located but not easily compatible with a decentralised energy network since heat is currently provided by individual systems serving each unit. The entire approach to heating this centre would need to be adapted in order to convert it to a system compatible with a decentralised energy supply. This assessment has not retained the assumption (used in the pre-feasibility study) that all retail outlets along the high street would connect to the scheme.

5.20.3 A reduced scheme was also modelled which only marginally improved the economic performance but not enough to generate positive returns even though the network is more compact.

5.20.4 Increases in the connection charges required to achieve viable returns have been modelled showing that a 50% increase in the charge on the reduced scheme would make it viable, whilst a doubling of the charge for the wider, full Town centre scheme would bring that into viability. These levels of charge are below the £200/kW_{th} discussed at section 2.9 as being a reasonable level, justifiable on the basis of the avoided cost of compliance with building regulations.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

6.1.1 All three schemes were assessed on the basis of optimal delays prior to scheme start date to improve the returns forecast. Both Blackhorse Lane schemes show positive potential returns with the North scheme being most imminent and the South likely to develop more slowly.

6.1.2 The level of return presented for the Blackhorse Lane North scheme, as assessed, is dependent on a significant connection to an existing, recently completed development (Papermill Place). Although, the scheme has been shown to still provide a viable level of return if connection of this development was delayed until the boilers serving it required replacement (forecast at fifteen years time).

6.1.3 Although not assessed, an option to combine the Blackhorse Lane schemes into one was considered in the event that Papermill Place took a decision not ever to connect to a heat network. The phasing of development forecast at the Papermill Place schemes is such that, in terms of new development, BHL North is likely to come forward in advance of BHL South . An energy centre located to the north of the BHL South scheme (i.e. to the south of the BHL north scheme) could deliver a viable scheme. One option could be the Willowfields School site if space was available within the works proposed there.

6.1.4 The Walthamstow Town Centre scheme, although the largest in terms of potential heat demand served and therefore carbon emissions reduced, is also the largest in terms of the area over which it is spread. This wide geographic spread of demand results in the highest costs to connect the demand which in turn means that the scheme shows negative whole life costs at 3.5% discount rates. This higher cost could, however, be offset by a higher level of developer contributions (connection charges) to achieve a viable scheme. Reducing the scheme to a more compact area did not significantly improve the scheme's economic case.

Scheme name	CHP engine size [kWe]	carbon savings [tonnes CO_2 p.a.]	capital cost [£m]	start date	25 year NPV, 3.5% discount rate [£k]
Walthamstow Town Centre	1,200	1,700	4.4	2014	-448
Walthamstow Town Centre - reduced	600	747	2.1	2014	-230
Blackhorse Lane North	800	1,200	2.1	2013	633
Blackhorse Lane South	800	1,252	2.3	2017	1,034

6.1.5 Increasing the connection charge for new developments to connect to the scheme (recognising the costs of development which would be offset by connecting to the network) is a route to achieving viability. On the wider network covering the whole of the Town Centre, this charge would need to increase to almost £200/kW_{th} to achieve viability. A rate of almost £150/kW_{th} would achieve viability for the reduced network. Justification has been presented at 2.9 to show that a level of £200/kWth is reasonable where low carbon plant would be required to meet Building Regulations standards. There is also the option to increase the rate at which heat use is charged.

6.1.6 None of the schemes provide the opportunity, in our assessment, for a privately financed operation. These schemes will therefore likely require public investment. Both Blackhorse Lane schemes show global whole-life cost efficiency improvements as required by Treasury Green Book assessment criteria.

6.2 Inputs to strategic decentralised energy network growth

6.2.1 There are potentially viable schemes available here providing significant carbon dioxide emissions savings. These loads would be valuable to a wider decentralised energy network if it can be demonstrated that it is viable to connect. These schemes are heavily reliant on future development and the best returns are generated where the capital investment in the scheme is timed closely with the realisation of these developments.

6.2.2 Funding of these schemes would need public sector support for implementation since returns of a level to interest private sector involvement are considered unlikely to be achieved.

6.3 Recommendations and Evidence Base Implications

6.3.1 Since the Blackhorse Lane North scheme is the most advanced in terms of new development, there needs to be an assertive effort to catch these developments in terms of planning policy and individual applications. This study provides an evidence base that there is a viable scheme on which such policy and application discussions could be based. There is also a need to engage with the management company, owners and /or residents and occupants of Papermill Place, since there is no planning condition, to consider connection.

6.3.2 The case to progress these schemes should be based on the initial technical viability assessed in this report alongside the significant potential carbon dioxide emissions savings. Although not at levels to interest the private sector, there are viable schemes worth pursuing at public sector investment rates of return.

6.3.3 Where rates of return assessed do not present an immediate opportunity to attract private sector investment, we have suggested public sector assistance is required, and that further funding routes need to be identified. There are a number of potential routes to funding the infrastructure costs which include, Community Infrastructure Levy, Allowable Solutions (as discussed under the proposed move to zero carbon under building regulations) and other forms of developer contributions such as the connection charges we have already accounted for at a notional level.

6.3.4 Our assessment has included an estimated level of connection charges for new development which recognise the savings a developer can make on meeting planning and building regulations obligations on carbon emissions targets, by connecting to a low carbon heat supply from a decentralised energy network. Further work needs to be conducted to understand what level of charge is viable and whether increases (such as those assessed for the Walthamstow Town Centre Scheme) are viable.

6.3.5 In the event that the Papermill Place scheme takes a decision not to connect to a heat network, further assessment should be conducted on the viability of a scheme which combines Blackhorse Lane North and South schemes, potentially served from one energy centre.

6.3.6 There are a number of Ascham Housing sites that may warrant conversion to communal heating systems in time, should a network come forward (see list below). Recent announcements regarding the eligibility for ECO funds (under the Green Deal) indicate that funding may be available for District Heat networks via this route, in combination with insulation measures applied to hard to treat properties. It may be that the same, Ascham site are hard to treat properties. This should be looked into further as the Green Deal and ECO schemes start operating.

6.3.7 Ascham Housing sites to the east of Blackhorse Lane North include: Blackhorse Lane Estate 224-234, Priory Court Estate, St Andrews Road Estate. Further expansion could then be considered to: Lowton Lodge Estate, Priory Court, Vermont House, Washington House.

6.3.8 In the south Blackhorse Lane area, Ascham Properties include: Essex Close Estate, Stoneydown House Estate. In the Walthamstow Town Centre area, Ascham properties include: Westbury Road, Westbury Hse Estate, Hatherley House Estate, Woodville Road 41-43, Central Parade Estate, Palmerston Court Estate, Gosport Road Estate, Exmouth Glen Estate.

6.4 Recommendations from Strategic Scheme common to all local DENs

6.4.1 Ensure developments connect to the local satellite networks. Where a development is completed before the network is in place, the energy supply system should be designed to be compatible with technical standards established for the operation of the network. These technical standards should be developed as part of the design development of the satellite network, and where this has not taken place, generic standards such as those anticipated in the 'Decentralised Energy Manual' (GLA publication anticipated in 2013) should be adopted. Planning obligations could be used to ensure subsequent connection.

6.4.2 Contact the GLA in order to access technical guidance documents for DH connection requirements.

6.4.3 Ensure that Council-controlled buildings, where relevant, connect and benefit from connection to the network.

6.4.4 Ensure that strategic growth and future connections are considered in detailed design. This would include the wider Upper Lee Valley DEN, and also potentially other development that has not yet been scoped.

6.4.5 Ensure that areas of dense commercial / retail properties are also converted to DH compatible systems at points of planning intervention, in order to facilitate future expansion of networks (i.e. Walthamstow Town Centre in particular)

6.4.6 Ensure that locations for energy centres are safeguarded for each scheme

6.4.7 Consider the ways in which a common delivery vehicle might influence technical design – areas here might include a single type of metering interface for facilitating energy metering and billing operations, a single buried pipework supplier for reduced maintenance contract costs, etc.

6.4.8 The value of electricity generation has been based in our analysis on export to the grid, valued at wholesale electricity prices. The economic performance of all the schemes would be significantly improved if the value of generation could be increased via the implementation of alternative power sales routes, such as the 'licence lite', ‘netting off’ or private wire sale to a single large demand site. This should be considered a potential upside risk, as the ‘licence lite’ is understood to be in development, and the GLA is understood to be moving towards making the first application to implement this power sales route.

6.5 Next Steps

6.5.1 Common to all three clusters

- identify funding routes for capital investment
- decide on preferred route to implementation, operation and ownership of network
- develop detailed business case
- develop policy and planning conditions on new development to encourage connection

6.5.2 Initial focus on Blackhorse Lane North

- engage with developers or management company at Papermill Place to negotiate connection
- with policy in place and more certainty on loads willing to connect, conduct further more detailed outline design and business case

6.5.3 Prepare the ground for Walthamstow Town Centre and Blackhorse Lane South

- identify and engage with existing buildings in close proximity to the proposed routes to build potential demand
- prepare more detailed business case including realistic assessment of existing building loads that would be willing to connect within the first 5 years

APPENDICES

APPENDIX A – DECC price projections

- Central Scenario

Real Energy Prices[3]: 2000-2030 **DECC Updated Energy & Emissions Projections - October 2011**

2010 prices

SCENARIO ASSUMPTIONS	
PRICES	Central
POLICY	Currrent
GROWTH	Central

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WHOLESALE PRICES	Electricity[1]	p/KWh	4.81	7.03	7.32	7.82	7.64	7.64	7.68	7.67	7.39	7.41	7.59	7.99	8.17	8.22	8.73	9.01	9.06	9.37	9.50	9.59	9.86
	Gas	p/therm	42.7	61.2	67.0	71.8	77.7	78.6	78.6	73.8	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0	68.0
	Crude Oil ($/bbl)	$/bbl	81.0	108.6	109.6	110.6	111.5	112.5	113.5	114.5	115.5	116.6	117.6	118.6	119.7	120.7	121.8	122.9	124.0	125.1	126.2	127.3	128.4
	Coal	£/tonne	59.4	83.1	83.1	83.1	81.1	79.2	77.3	76.0	74.1	72.2	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3	70.3
RETAIL PRICES[2]																							
Electricity	Residential	p/KWh	12.9	14.4	15.4	16.2	16.7	16.9	17.5	17.8	17.5	18.0	18.7	19.3	19.6	19.6	20.1	20.6	20.8	21.2	21.3	21.2	21.5
	Services	p/KWh	7.7	12.1	12.7	13.6	13.7	13.7	13.9	14.1	14.0	14.3	14.8	15.4	15.6	15.7	16.2	16.6	16.7	17.1	17.1	17.1	17.3
	Industrial	p/KWh	6.8	11.5	12.1	13.0	13.2	13.1	13.4	13.5	13.4	13.7	14.2	14.8	15.0	15.1	15.7	16.1	16.2	16.6	16.6	16.6	16.9
Gas	Residential	p/KWh	4.2	4.3	4.6	4.8	5.2	5.3	5.4	5.3	5.0	5.0	5.1	5.1	5.1	5.1	5.2	5.2	5.2	5.2	5.2	5.3	5.3
	Services	p/KWh	2.3	3.2	3.4	3.6	3.9	3.9	4.0	3.8	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.8	3.8	3.8	3.8	3.9	3.9
	Industrial	p/KWh	1.9	2.7	2.9	3.1	3.4	3.4	3.4	3.3	3.1	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.3	3.3	3.4
Petroleum	Premium unleaded	p/litre	116.9	132.3	132.8	134.9	135.9	136.3	136.8	137.3	137.8	138.3	138.8	139.3	139.9	140.4	140.9	141.4	142.0	142.5	143.1	143.6	144.2
	Super unleaded	p/litre	123.8	139.7	138.9	140.8	143.2	143.7	144.2	144.7	145.2	145.7	146.2	146.8	147.3	147.8	148.3	148.9	149.4	149.9	150.5	151.0	151.6
	DERV	p/litre	119.3	140.2	140.8	142.9	143.9	144.5	145.0	145.6	146.2	146.7	147.3	147.9	148.5	149.1	149.7	150.3	150.9	151.5	152.2	152.8	153.4
	Average[4]	**p/KWh**	**8.1**	**9.3**	**9.3**	**9.5**	**9.6**	**9.6**	**9.6**	**9.6**	**9.7**	**9.7**	**9.7**	**9.8**	**9.8**	**9.9**	**9.9**	**9.9**	**10.0**	**10.0**	**10.0**	**10.1**	**10.1**

1 Electricity prices based on stated wholesale fossil fuel prices and central growth projection. Projected carbon price is fossil fuel price consistent.
2 Retail price projections are based on projected taxes, duties and policy cost recovery and averaged historical non-fuel markups.
3 Historical data are adjusted to 2010 prices using the the GDP Deflator series (YBGB)
4 Weighted average for private vehicles, weights reflect the fuel use mix in each year.

- Low Scenario

Real Energy Prices[3]: 2000-2030 **DECC Updated Energy & Emissions Projections - October 2011**

2010 prices

SCENARIO ASSUMPTIONS	
PRICES	Low
POLICY	Currrent
GROWTH	Central

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WHOLESALE PRICES	Electricity[1]	p/KWh	4.81	6.37	5.46	5.23	5.35	5.28	5.02	5.15	5.00	5.27	5.75	6.03	6.34	6.11	6.74	7.10	7.31	7.37	7.53	7.55	7.78
	Gas	p/therm	42.7	61.2	46.6	31.1	32.0	32.0	32.0	33.0	33.0	34.0	35.0	35.9	36.9	37.9	38.8	39.8	40.8	41.7	42.7	42.7	43.7
	Crude Oil ($/bbl)	$/bbl	81.0	108.6	106.5	104.4	102.3	100.2	98.2	96.3	94.3	92.5	90.6	88.8	87.0	85.3	83.6	81.9	80.3	78.7	77.1	75.6	74.1
	Coal	£/tonne	59.4	83.1	79.2	74.7	71.6	67.7	64.5	61.3	58.1	54.3	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1	51.1
RETAIL PRICES[2]																							
Electricity	Residential	p/KWh	12.9	13.7	13.1	12.8	13.5	13.4	13.5	14.0	13.7	14.3	15.1	15.5	16.0	15.7	16.5	17.0	17.4	17.5	17.8	17.6	17.7
	Services	p/KWh	7.7	11.4	10.7	10.8	11.1	10.8	10.6	10.9	10.8	11.1	11.7	12.0	12.4	12.2	12.9	13.3	13.6	13.6	13.7	13.7	13.8
	Industrial	p/KWh	6.8	10.9	10.3	10.4	10.9	10.8	10.7	11.0	11.1	11.6	12.4	12.9	13.2	13.0	13.7	14.2	14.4	14.6	14.6	14.6	14.8
Gas	Residential	p/KWh	4.2	4.3	3.7	3.0	3.1	3.2	3.3	3.4	3.4	3.5	3.6	3.6	3.7	3.8	3.8	3.9	3.9	4.0	4.1	4.1	4.2
	Services	p/KWh	2.3	3.2	2.6	2.1	2.1	2.2	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0
	Industrial	p/KWh	1.9	2.7	2.2	1.7	1.8	1.8	1.8	1.9	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3	2.3	2.4	2.4	2.5	2.5
Petroleum	Premium unleaded	p/litre	116.9	132.3	131.3	131.8	131.3	130.3	129.3	128.3	127.4	126.4	125.5	124.6	123.7	122.9	122.0	121.2	120.4	119.6	118.8	118.1	117.3
	Super unleaded	p/litre	123.8	139.7	137.3	137.7	138.6	137.6	136.6	135.7	134.7	133.8	132.9	132.0	131.1	130.2	129.4	128.6	127.7	127.0	126.2	125.4	124.7
	DERV	p/litre	119.3	140.2	139.0	139.4	138.7	137.5	136.4	135.3	134.2	133.2	132.1	131.1	130.1	129.1	128.2	127.2	126.3	125.4	124.5	123.6	122.8
	Average[4]	**p/KWh**	**8.1**	**9.3**	**9.2**	**9.3**	**9.2**	**9.1**	**9.1**	**9.0**	**8.9**	**8.8**	**8.8**	**8.7**	**8.6**	**8.6**	**8.5**	**8.5**	**8.4**	**8.3**	**8.3**	**8.2**	**8.2**

1 Electricity prices based on stated wholesale fossil fuel prices and central growth projection. Projected carbon price is fossil fuel price consistent.
2 Retail price projections are based on projected taxes, duties and policy cost recovery and averaged historical non-fuel markups.
3 Historical data are adjusted to 2010 prices using the the GDP Deflator series (YBGB)
4 Weighted average for private vehicles, weights reflect the fuel use mix in each year.

- High Scenario

Real Energy Prices[3]: 2000-2030 **DECC Updated Energy & Emissions Projections - October 2011**

2010 prices

SCENARIO ASSUMPTIONS	
PRICES	High
POLICY	Currrent
GROWTH	Central

			2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
WHOLESALE PRICES	Electricity[1]	p/KWh	4.81	7.05	7.91	8.40	8.18	7.99	7.97	8.38	8.38	8.76	8.90	9.19	9.34	9.46	9.95	10.20	10.19	10.42	10.52	10.63	10.88
	Gas	p/therm	42.7	61.2	76.7	78.6	80.6	82.5	84.5	86.4	88.3	90.3	92.2	94.2	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1
	Crude Oil ($/bbl)	$/bbl	81.0	108.6	111.2	113.7	116.4	119.1	121.8	124.7	127.5	130.5	133.5	136.6	139.8	143.0	146.3	149.7	153.2	156.8	160.4	164.1	167.9
	Coal	£/tonne	59.4	83.1	87.5	91.4	92.0	93.3	93.9	94.6	95.2	96.5	97.1	97.7	97.7	98.4	98.4	99.0	99.0	99.0	99.0	99.0	99.0
RETAIL PRICES[2]																							
Electricity	Residential	p/KWh	12.9	14.4	16.0	16.8	17.3	17.3	17.8	18.5	18.5	19.5	20.1	20.6	20.8	20.9	21.4	21.8	22.0	22.3	22.4	22.3	22.6
	Services	p/KWh	7.7	12.1	13.3	14.1	14.3	14.0	14.2	14.8	15.0	15.6	16.1	16.6	16.8	16.9	17.5	17.8	17.8	18.1	18.1	18.1	18.3
	Industrial	p/KWh	6.8	11.6	12.7	13.6	13.7	13.5	13.7	14.2	14.4	15.1	15.5	16.0	16.2	16.4	16.9	17.3	17.3	17.6	17.6	17.7	17.9
Gas	Residential	p/KWh	4.2	4.3	5.1	5.1	5.3	5.5	5.7	5.8	5.9	6.1	6.2	6.3	6.5	6.5	6.5	6.5	6.5	6.5	6.6	6.6	6.6
	Services	p/KWh	2.3	3.2	3.8	3.9	4.0	4.1	4.2	4.3	4.4	4.5	4.6	4.7	4.8	4.8	4.9	4.9	4.9	4.9	5.0	5.0	5.0
	Industrial	p/KWh	1.9	2.7	3.2	3.3	3.5	3.6	3.6	3.7	3.8	3.9	4.0	4.0	4.2	4.2	4.2	4.2	4.3	4.3	4.3	4.3	4.4
Petroleum	Premium unleaded	p/litre	116.9	132.3	133.6	136.5	138.2	139.6	140.9	142.3	143.8	145.2	146.7	148.2	149.8	151.4	153.0	154.7	156.4	158.2	160.0	161.8	163.7
	Super unleaded	p/litre	123.8	139.7	139.6	142.4	145.6	147.0	148.3	149.7	151.2	152.6	154.1	155.7	157.2	158.8	160.5	162.2	163.9	165.7	167.5	169.3	171.2
	DERV	p/litre	119.3	140.2	141.7	144.7	146.6	148.2	149.7	151.3	152.9	154.6	156.3	158.1	159.8	161.7	163.5	165.5	167.4	169.4	171.5	173.6	175.7
	Average[4]	**p/KWh**	**8.1**	**9.3**	**9.4**	**9.6**	**9.7**	**9.8**	**9.9**	**10.0**	**10.1**	**10.2**	**10.3**	**10.4**	**10.5**	**10.7**	**10.8**	**10.9**	**11.0**	**11.1**	**11.3**	**11.4**	**11.5**

1 Electricity prices based on stated wholesale fossil fuel prices and central growth projection. Projected carbon price is fossil fuel price consistent.
2 Retail price projections are based on projected taxes, duties and policy cost recovery and averaged historical non-fuel markups.
3 Historical data are adjusted to 2010 prices using the the GDP Deflator series (YBGB)
4 Weighted average for private vehicles, weights reflect the fuel use mix in each year.

APPENDIX B – Capex Summaries

BHL North

Item	Base Case	Option A	Option B
CHP		£425,000	£689,000
boilers	£135,000	£135,000	£135,000
Startup network		£657,727	£657,727
flues		£64,000	£64,000
thermal store		£60,000	£60,000
Metering		£7,890	£7,890
Controls and instrumentation		£120,000	£120,000
Pumps and VSDs (including flex connections, anti vibration mounting, plant room piepwork, valves, insulation and acccessories)		£11,984	£11,984
Alarm System		£10,000	£10,000
Security system		£5,000	£5,000
Dosing, sidestream filtration, expansion, make-up water, pressurisation		£8,245	£8,245
Connecting Pipework and Valves		£30,275	£30,275
Electrical cabling and switchgear		£15,138	£15,138
Testing and cleaning, commissioning		£25,132	£25,132
Mech Buildng Services		£12,952	£12,952
Ventilation		£8,650	£8,650
EC Design Fees		£46,963	£60,163
Energy Centre construction		£101,166	£101,166
EC architects fees		£12,140	£12,140
Utilities diversions & on-site works		£176,765	£176,765
CONTINGENCY	£13,500	£193,403	£221,123
	£148,500	**£2,127,430**	**£2,432,350**

BHL South

Item	Base Case	Option A	Option B
CHP		£425,000	£399,000
boilers	£155,000	£155,000	£155,000
network		£794,476	£794,476
flues		£64,000	£64,000
thermal store		£63,000	£63,000
Metering		£7,890	£7,890
Controls and instrumentation		£120,000	£120,000
Pumps and VSDs (including flex connections, anti vibration mounting, plant room piepwork, valves, insulation and acccessories)		£11,984	£11,984
Alarm System		£10,000	£10,000
Secuirity system		£5,000	£5,000
Dosing, sidestream filtration, expansion, make-up water, pressurisation		£8,245	£8,245
Connecting Pipework and Valves		£30,275	£30,275
Electrical cabling and switchgear		£15,138	£15,138
Testing and cleaning, commissioning		£25,132	£25,132
Mech Buildng Services		£12,952	£12,952
Ventilation		£8,650	£8,650
EC Design Fees		£46,363	£45,063
Energy Centre construction		£101,166	£101,166
EC architects fees		£12,140	£12,140
Utilities diversions & on-site works		£176,765	£176,765
Rest of main spine Connected			£34,132
CONTINGENCY	£12,000	£179,661	£176,931
	£167,000	**£2,272,837**	**£2,276,939**

Walthamstow Town Centre

Item	Base Case	Option A	Option B
CHP		£565,000	£425,000
boilers	£130,000	£130,000	£130,000
startup spine network		£2,457,022	£2,457,022
flues		£64,000	£64,000
thermal store		£84,000	£84,000
Metering		£12,660	£12,660
Controls and instrumentation		£120,000	£120,000
Pumps and VSDs (including flex connections, anti vibration mounting, plant room piepwork, valves, insulation and acccessories)		£58,604	£58,604
Alarm System		£10,000	£10,000
Security system		£5,000	£5,000
Dosing, sidestream filtration, expansion, make-up water, pressurisation		£10,276	£10,276
Connecting Pipework and Valves		£37,731	£37,731
Electrical cabling and switchgear		£18,865	£18,865
Testing and cleaning, commissioning		£31,321	£31,321
Mech Buildng Services		£16,142	£16,142
Ventilation		£10,780	£10,780
EC Design Fees		£59,344	£52,344
Energy Centre construction		£111,303	£111,303
EC architects fees		£13,356	£13,356
Utilities diversions & on-site works		£215,451	£215,451
CONTINGENCY	£14,250	£404,336	£389,636
	£144,250	**£4,435,191**	**£4,273,491**

Walthamstow Town Centre – West of Liverpool St to Chingford Railway

Item	Base Case	Option A	Option B
CHP		£399,000	£425,000
boilers	£100,000	£100,000	£100,000
startup spine network		£760,467	£760,467
flues		£60,000	£60,000
thermal store		£52,500	£52,500
Metering		£7,500	£7,500
Controls and instrumentation		£120,000	£120,000
Pumps and VSDs (including flex connections, anti vibration mounting, plant room piepwork, valves, insulation and acccessories)		£25,592	£25,592
Alarm System		£10,000	£10,000
Security system		£5,000	£5,000
Dosing, sidestream filtration, expansion, make-up water, pressurisation		£6,370	£6,370
Connecting Pipework and Valves		£23,390	£23,390
Electrical cabling and switchgear		£11,695	£11,695
Testing and cleaning, commissioning		£19,416	£19,416
Mech Buildng Services		£10,007	£10,007
Ventilation		£6,683	£6,683
EC Design Fees		£42,858	£44,158
Energy Centre construction		£91,804	£91,804
EC architects fees		£11,016	£11,016
Utilities diversions & on-site works		£169,743	£169,743
Later spine		£120,745	£120,745
2013 Connections		£80,815	£80,815
2014 Connections		£122,924	£122,924
2015 Connections		£85,270	£85,270
CONTINGENCY	£10,000	£193,304	£196,034
	£110,000	**£2,536,099**	**£2,566,129**

APPENDIX C - Summary results from Pre-feasibility Study

Scheme name	Location designation on ULV area map (e.g. covering whole ULV)	Proposed technology for individual scheme	Anticipated level of carbon savings (tonnes CO2 p.a.)	Estimated capital cost (£m)	Assumed date by which complete	25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)
LBWF Town Hall	26	Gas-fired CHP, approx 1.1MWe	1,700	2.8	2015	332
LBWF Blackhorse Lane North	1	526kWe gas-fired engine CHP	773	1.9	2016 (build out from 2013)	-340
LBWF Blackhorse Lane South	2	635kWe gas-fired engine CHP	903	2.1	2018 (build out from 2013)	428
LBWF Wood Street North	32	Approx 300kWe gas-fired reciprocating engine CHP	498	1.5	2020 (first units completed 2013)	- 1,012
LBWF Wood Street South	33	Approx 1.1MWe gas-fired reciprocating engine CHP	2,100	2.8	2010, some major loads existing. AAP build-out to 2020, starting 2013.	2,756
Leyton Orient	11	Gas-fired CHP – approximately 185kWe	248	1.1	2015 (existing loads, but see notes below)	-1,512
LBWF Walthamstow Town Centre	25	Approx 1.2MWe CHP (gas fired)	1,545	3.6	2020	948
Innova Park	10	526kWe CHP	797	3.3		-2,236
Southbury	21	526kWe CHP	771	2.3		-1,475

Scheme name	Location designation on ULV area map (e.g. covering whole ULV)	Proposed technology for individual scheme	Anticipated level of carbon savings (tonnes CO2 p.a.)	Estimated capital cost (£m)	Assumed date by which complete	25 year NPV, 3.5% discount rate (no sales price reduction on existing estimated heat prices) (£k)
Ponders End / Southern Brimsdown	20	2679kWe CHP	3,448	9.8		-2,090
Enfield Town	8	2002kWe CHP	2,788	7.2		-1,160
Edmonton	6	1487kWe CHP	1,970	6.6		-3,387
Palmers Green	18	307kWe CHP	243	2.7		-1,291
New Southgate	13	844kWe CHP	1,028	4.2		-2,567
Cockfosters	5	888kWe CHP	1,424	4.9		-2,427
Wood Green North	30	500kWe CHP	438	2.5		-1,455
Tottenham Town Hall	23	526kWe gas-fired CHP	846	1.6		331
Hornsey High Street	9	635kWe CHP	896	3.3		-£914
Wood Green East	29	500kWe CHP	433	2.1		-£1,505
Haringey Heartlands	31	307kWe CHP	296	1.3		891