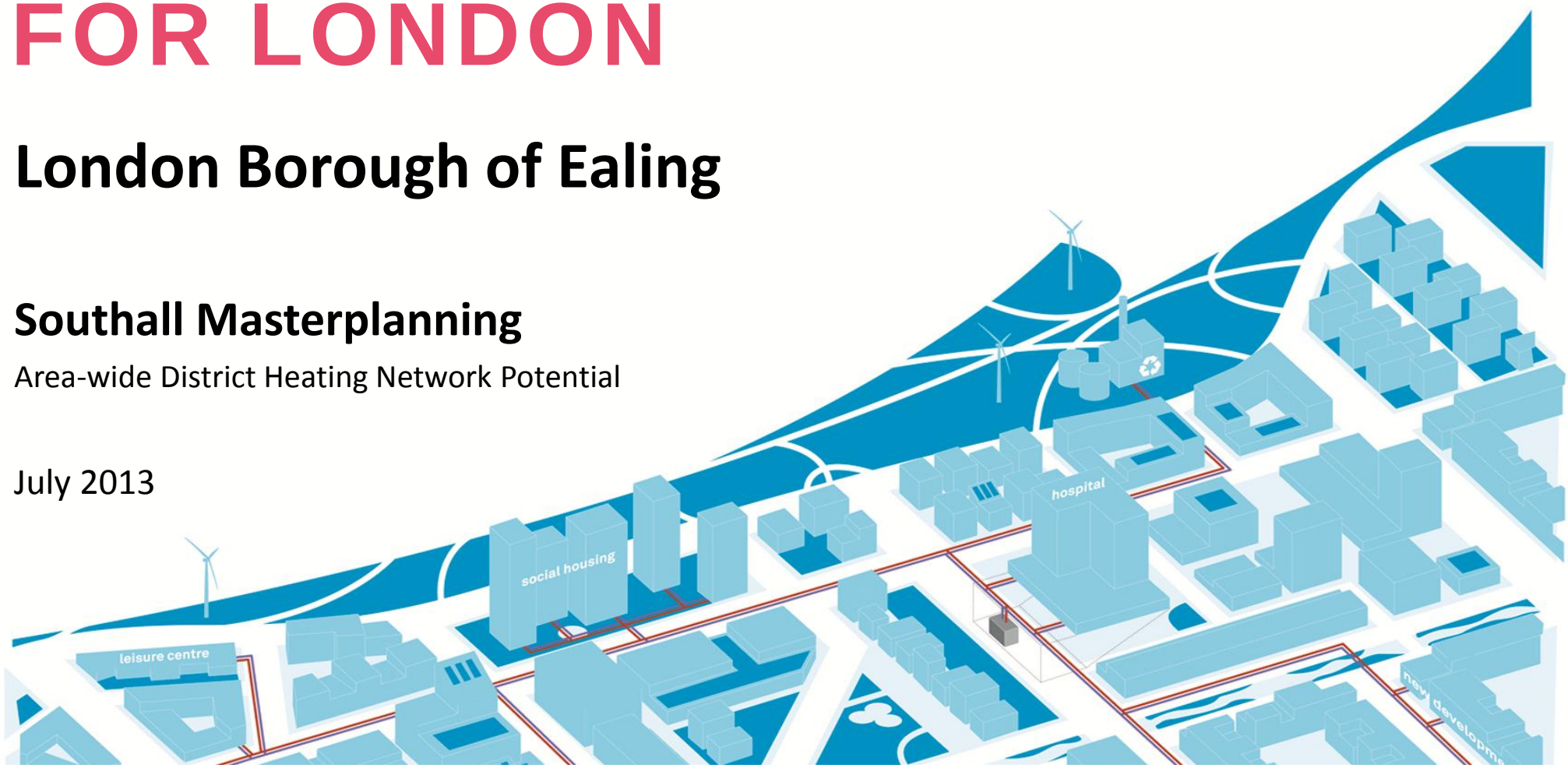
DECENTRALISED ENERGY FOR LONDON

London Borough of Ealing

Southall Masterplanning

Area-wide District Heating Network Potential

July 2013



Document Verification

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Executive Summary

This report presents the findings of energy masterplanning investigation carried out by Decentralised Energy for London for the London Borough of Ealing.

This study investigates the potential for delivery of a Decentralised Energy (DE) scheme focussed around the Southall Town Centre area in the London Borough of Ealing. It identifies a plan for a District Heating (DH) network that would serve a number of new residential and commercial developments in the area, as well as some existing buildings, with low-cost, low-carbon heat and hot water. Key findings and next steps are highlighted below.

Key Findings

- A DE scheme has been identified in the area. Costing £5.7M between 2017 and 2032, it is achievable at public sector discount rates (of 6% over 25 years) with relatively low new-build connection charges of £1,626/residential unit and £1000/kW of non-domestic load.
- The scheme is based around a combined heat and power (CHP) engine of capacity 1.1MWe. This would not be installed until 2021, with traditional boilers providing heat in the interim period. Annual carbon emissions savings by 2032 as a result of the low-carbon technology would be 3,300 tCO_2e.
- Calculations indicate that domestic heat could be delivered at 10% below current average prices paid by domestic gas consumers, aiding in efforts to combat fuel poverty.
- Key risks to the project's future delivery are the availability of land for the energy centre; the ability and willingness of relevant parties to create the necessary commercial structures for a network to be delivered and operated; the need to cross the railway; and the scheme's reliance on the delivery of a number of future developments that are at best in the very early stages of planning. Measures have been identified to clarify uncertainties and/or mitigate risks.

Next Steps

1. LB Ealing to review findings and discuss their implications in the context of planning policy and wider economic and environmental goals.
2. LB Ealing to engage with existing developers regarding the opportunity and connection to the scheme. In particular, contact should be made with the Southall West developer where the scheme energy centre is proposed to be located.
3. Pending decision to take the project further, a responsible party within the council is tasked with progressing the opportunity.
4. Potential network layouts and scheme characteristics entered into planning documents such as AAPs, as well as the London Heat Map.
5. Planning policy to require further developments in the area to consider connection to the scheme.

Aims of the Study

The main purpose of the study was to update existing demand mapping and carry out techno-economic modelling of a potential district heating network to serve the Southall area of Ealing, centred on the Southall Gas Works site.

The key intended information outputs of the study are:

- A map showing suitable heat loads and the potential layout of a district heating network to serve those buildings.
- Technical information on the components of the network and their scale (in physical and energy terms)
- Economic information on the scheme, including capital expenditure (CAPEX), net present value (NPV) and internal rate of return (IRR)

DEfL & LB Ealing Engagement to Date

Arup (acting for DEfL) has been in engagement with LB Ealing since autumn 2012. A summary of activities is provided below for information.

- Initial kick-off discussions
- Initial priority loads in the opportunity area identified via the London Heat Map
- Likely new developments in the area taken from *planning documents*, benchmarked according to standard assumptions
- Initial identified loads and indicative network routing returned to LB Ealing for review
- Data request for potential loads identified in area with no existing data
- No significant issues identified with indicative network routing, majority of fuel consumption data sourced by LB Ealing directly from owners.
- Remainder of data points benchmarked based on typologies and estimated floor areas (less than five buildings from over 50)

- Further expected engagement:
  - Review of DEfL findings & discussion with LB Ealing
  - Additional clarifications and investigation as necessary, subject to GLA approval
  - Discussion of next steps

Details of Modelling Approach

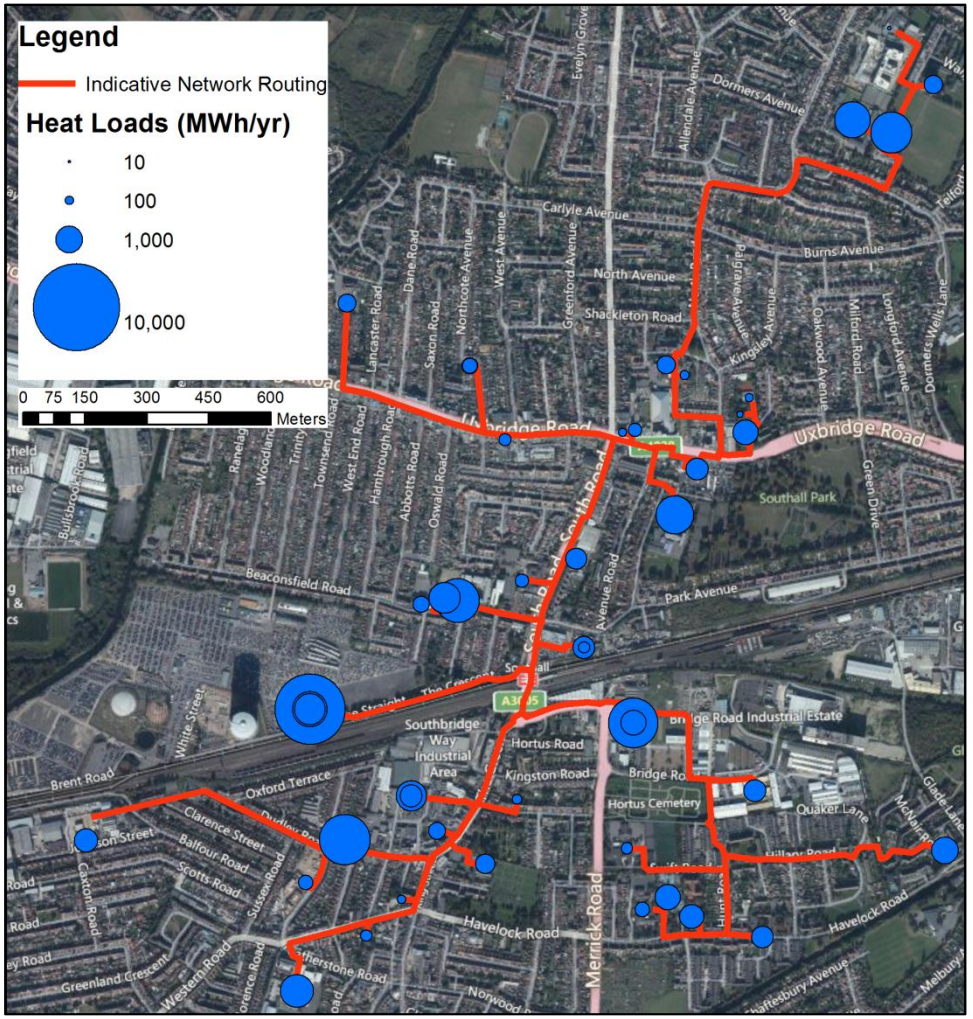
The primary aim of energy masterplanning is to identify the greatest appropriate extent of a future district heating network. This section outlines the scope and method of the techno-economic modelling.

The study sought to identify a District Heating Network that could supply low cost, low carbon heat to customers in the Southall area. The techno-economic modelling exercise looked to answer several key questions:

- What are the high level technical figures for a DHN scheme in the area, such as system capacity, thermal and electrical outputs?
- Could heat be provided to customers at prices lower than currently available through conventional gas supply and heating means?
- What are the principle financial indicators and results of a representative scheme in the area, including NPV, IRR, CAPEX?
- What is the likely carbon abatement potential of the network?
- What are the next steps required to move the project forward?

To determine the extent of any economically viable network in the area, the below key steps were followed:

- Start with all identified potential heat loads in the area; develop indicative network routing and identify an appropriate energy centre (EC) location. Further information about loads considered is given in Appendix 1.
- Identify what, if any, load configuration leads to the most favourable NPV; investigate loads (dis)connecting individually or in clusters.
- Investigate the effects of phasing on project returns. Connect all loads as soon as possible? Does a later build-out enable different configurations?
- Investigate the effects of receiving developer contributions and connection charges for new developments.



Above: Maximum indicative extent of network and all loads identified

Details of Modelling Approach: Core Assumptions

The significant modelling assumptions made for this particular study are outlined below. Arup use a standard set of techno-economic assumptions when analysing DE schemes of this nature; these technical and financial variables are listed on the next page.

Technical Assumptions

- The earliest practical start year for any scheme operation is 2015
- Energy Centre (EC) is located in the Southall West development
  - Scenarios that start operation before the development on this site comes forward are assumed still to be able to use this location for the EC
- Single gas CHP engine sized for maximum scheme demand (following thermal baseload) installed once total scheme loads are such that it can operate above 50% turndown; prior to this event the scheme is supplied by heat-only boilers (HOBs)
- There are no significant difficulties (and therefore no abnormal installation costs) in the network crossing the bridge at Southall Station
- There is one round of major plant replacement over the lifetime of the project, with the CHP and boilers being replaced 20 years after initial installation
- DH pipes are sized according to peak thermal demand they serve. No future proofing capacity is assumed as standard.

Economic Assumptions

- 25 year economic analysis period
- Energy unit prices and equipment costs as given in table on next page
- Infrastructure construction costs occur one year before loads are live
- Construction of the Energy Centre has been fully costed; whilst it appears likely that the developer of the Southall West site might be expected to front some of the costs, this full costing ensures viable schemes are identified and are already based on a worst-case scenario where the network developer must pay for all infrastructure.
- Network costs include infrastructure from energy centre up to and including heating substations. Building internal piping and customer interface units are not included
- The CHP is able to sell some generated electricity to on-site consumers at near-retail rates, with the balance being exported to the grid at wholesale prices
- Where collected, developer contributions or building connection charges are credited to the project in the year that the loads come live.
- No financial contributions assumed to come from existing developments

Details Of Modelling Approach: Modelling Assumptions

Equipment CAPEX Assumptions	*Value*	*Units*	*Notes*
Gas Boilers	**35**	£ / kW_{th}	Costs include installation and commissioning
Gas-fired CHP	**825**	£ / kWe	Costs include installation and commissioning. Cost only applies to the range of capacities considered here.
Pipe Network: 100mm – 250mm	**£1,302 - £1,841**	£ / m	Costs for pairs of simple transmission flow & return pipework, including trenching, installation and burial. Costs vary according to pipe diameter and nature of dig (brown field, hard suburban etc.)

Equipment performance Assumptions	*Value*	*Units*	*Notes*
Domestic gas boiler operational efficiency	**90**	% efficiency	New boiler (condensing) - Assumed to be constant over boiler lifetime
	85		Existing boiler (less than years old) - Assumed to be constant over boiler lifetime
	80		Existing boiler (10 years or older) - Assumed to be constant over boiler lifetime
Non-Domestic gas boiler operational efficiency	**90**	% efficiency	New boiler (condensing) - Assumed to be constant over boiler lifetime
	80		Existing boiler (10 - 20 years old) - Assumed to be constant over boiler lifetime
	75		Existing boiler (20 years or older) - Assumed to be constant over boiler lifetime
CHP Operational thermal efficiency	**42**	% efficiency	For CHP's over 900kWe. Assumed to be constant over CHP lifetime
CHP Operational electrical efficiency	**43**	% efficiency	For CHP's over 900kWe. Assumed to be constant over CHP lifetime
Plant and Equipment lifetime	**20**	Years	This is included within the 25 years period of the assessed studies.

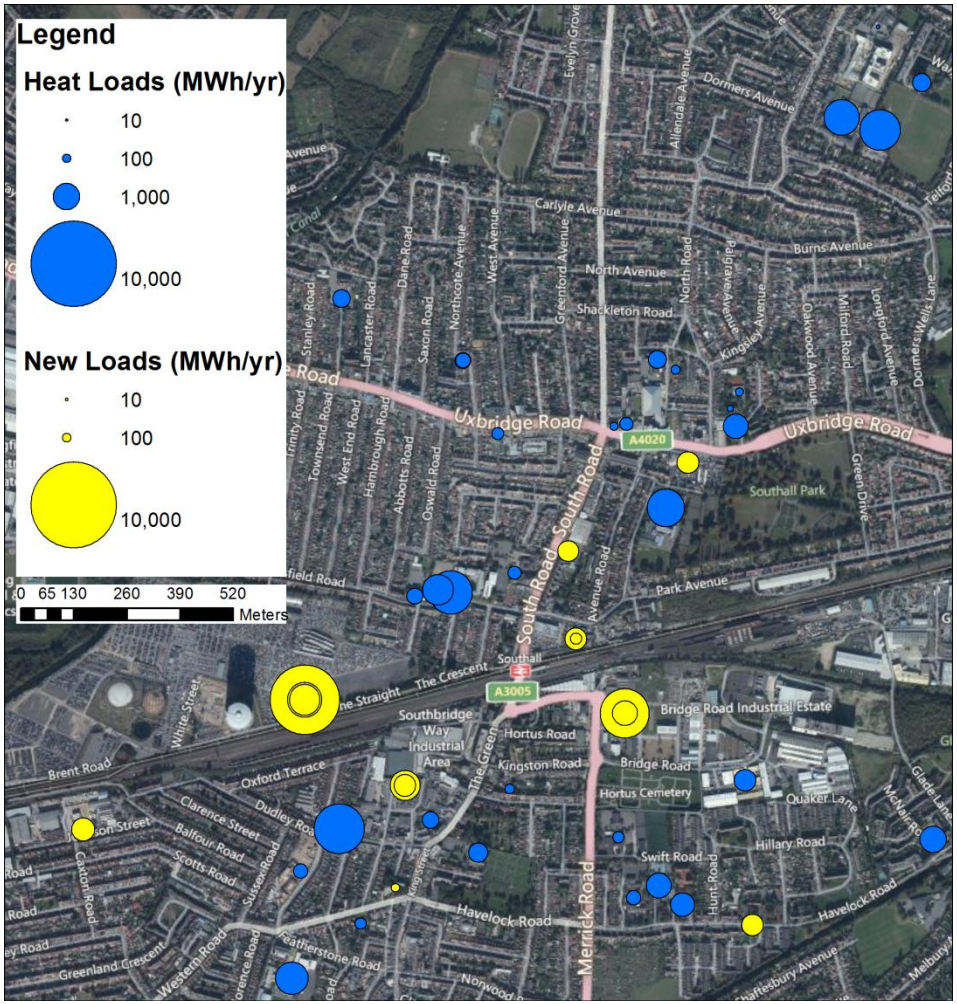
DH Revenue Assumptions	*Value*	*Units*	*Notes*
DH Network domestic Heat Sell Price	**4.6**	p/kWh	Based on current average kWh gas cost paid by London customers, with a 10% discount applied. Source: DECC Quarterly Energy Statistics Q1 2013
DH Network non-domestic Heat Sell Price	**3.9**	p/kWh	Average Heat price calculated from on DECC Quarterly Energy price range, taking into account a 85% boiler efficiency. This applies to the all non-domestic heat loads of the DH Scheme
CHP On-site domestic Electricity Sell Price	**11**	p/kWh	This applies only to the building where the Energy Centre is located, if relevant (Southall West)
CHP On-site non-domestic Electricity Sell Price	**8**	p/kWh	This applies only to the building where the Energy Centre is located, if relevant (Southall West)
CHP Export to Grid Electricity Sell Price	**4.5**	p/kWh	Indicative price as per DECC guidance on Feed in Tariffs export price

Other Economic Assumptions	*Value*	*Units*	*Notes*
Discount Rate (all figures discounted to 2013)	**6**	%	Rate is based on the Treasury discount rate (3.5%) plus a risk premium 2.5%
	12		Typical commercial return threshold used to assess interest from private sector entities
Natural Gas Cost for Energy Centre	**2.26**	p/kWh	Based on DECC Quarterly Energy Statistics Q1 2013 for Large Consumers (27,778 – 227,777 MWh/yr), excluding VAT (20%) and CCL
Main Gas Supply CO_2 Emission factor	**0.206**	$kgCO_2$ / kWh	Source: SAP 2009a
Grid Electricity Supply CO_2 Emission factor	**0.517**	$kgCO_2$ / kWh	Source: SAP 2009a

All modelling inputs are assumed to constant over the 25 year period assessed. Sensitivity analysis to assess the impact of price volatility and variability should be undertaken at full feasibility stage.

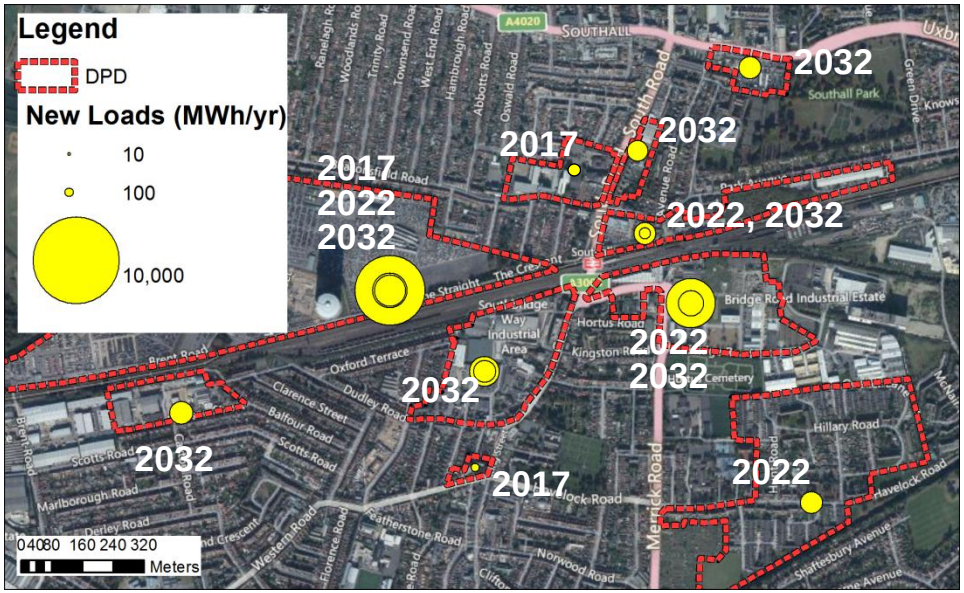
All Buildings Included In Analysis

A total of 40 new and existing buildings were identified by this study for analysis and inclusion in investigating a masterplan for a District Heating (DH) network in the area. Appendix 1 holds further information on all loads considered.



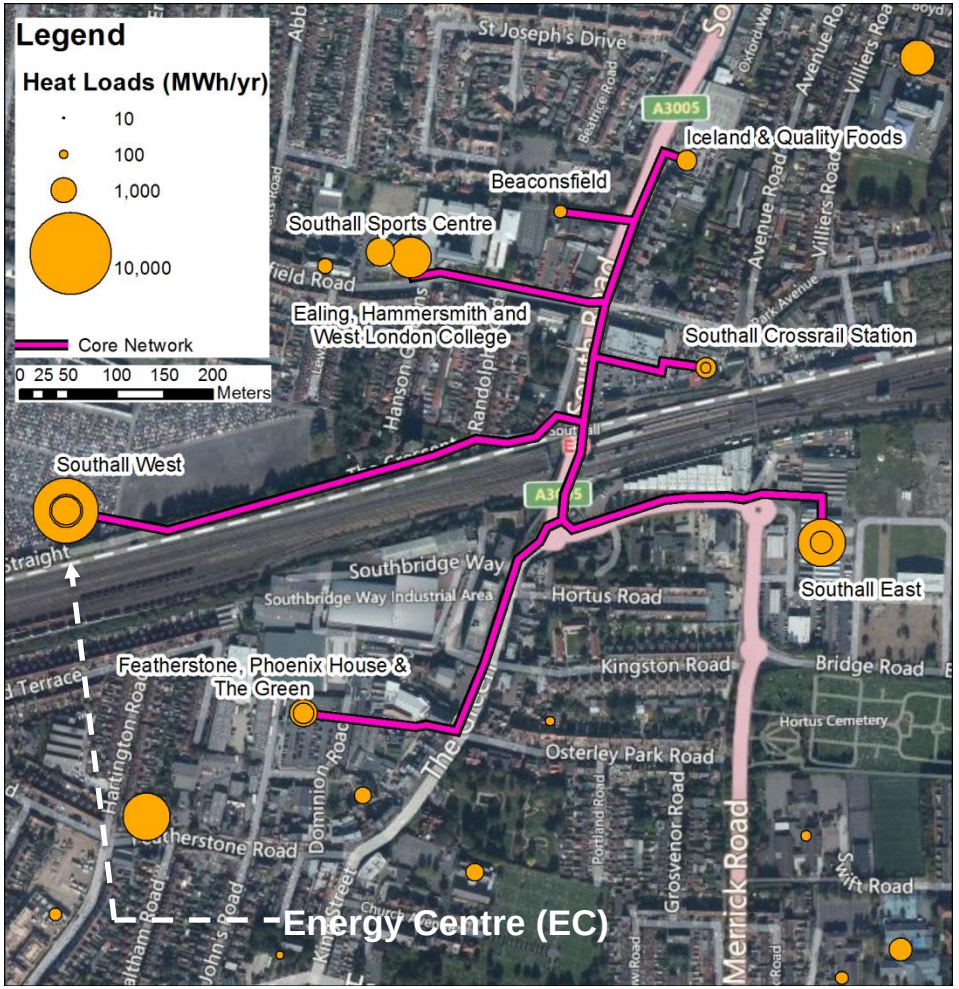
A list of the buildings included and their key characteristics is provided in Appendix 1

- Total annual heat demand of these buildings is estimated to be approximately 34,400MWh/yr.
- Priority buildings are primarily residential new developments. Retail and education typologies make up the majority of the remaining heat loads.
- Almost 5,000 residential units and over 32,000 m^2 of commercial floor space are expected to be developed in the area by 2032, based on DPD documentation and discussions with LB Ealing. Phasing assumed is as indicated below.



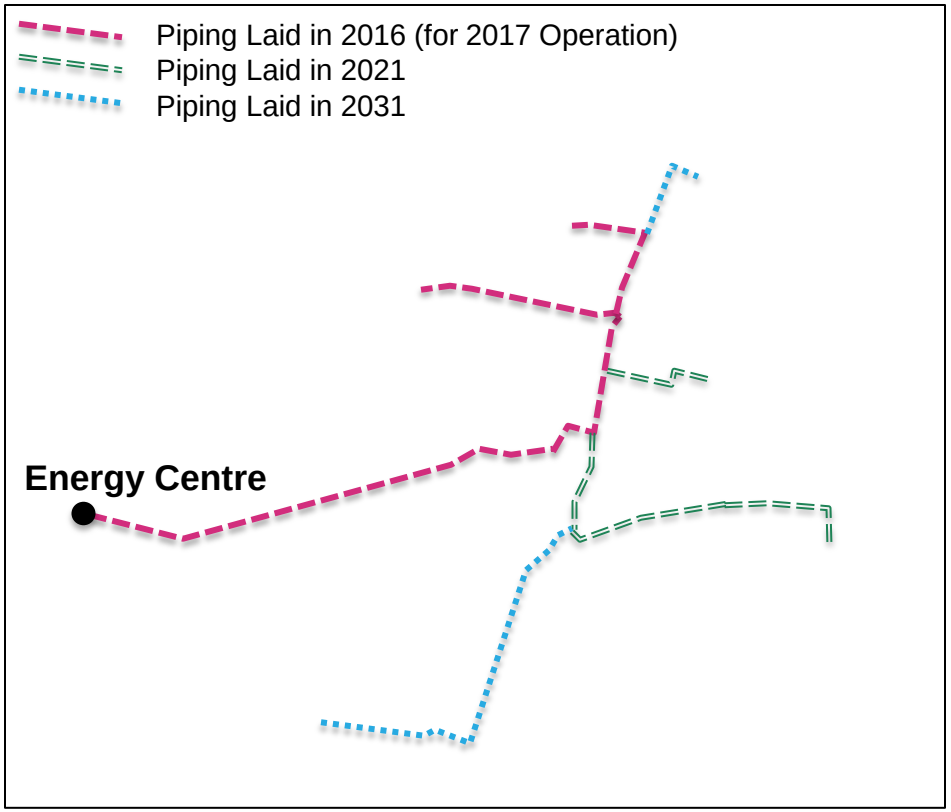
Findings: Core Scheme

A potential DE masterplan has been identified for the Southall Area. Based on an energy centre located at the "Southall West" development site, this scheme would start generating heat in 2017, gradually expanding up to 2032 as new residential developments come on line.



Network Phasing

- The below schematic indicates the timetable for the phased build-out of the heat network



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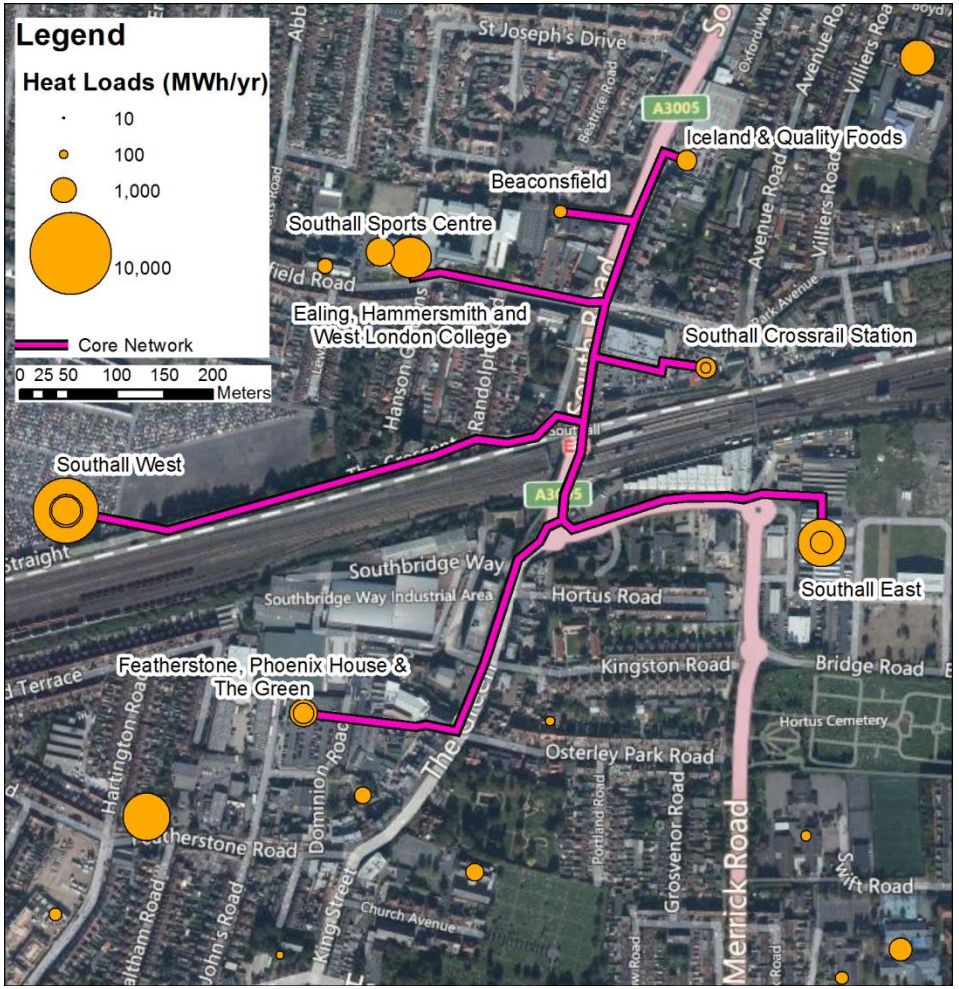


Technical Characteristics

- Annual heat demand (including losses): 17,300MWh/yr
- Network length: 2,280m
- CHP size (electrical): 1.1 MWe
  - Installed and operational in 2022 — 1.1 MWth
- Installed boiler capacity: 6.5 MWth
  - First phase operational in 2017
- Annual CO_2 savings* on full build-out (2032): 3,300 tCO_2e
  - *Based on today's electrical grid carbon intensity

Financial Characteristics

- CAPEX in 2016: £4.1M
- CAPEX on full build-out (excludes plant replacement): £5.7M
- OPEX on full build-out (per annum): £960k
- Revenues on full build-out (per annum): £1.2M

Funding Considerations:

- Gap funding required* for 6% return over 25 years: £3.8M
  - *This is if assuming no developer contributions or connection charges

Funding Scenarios: Prices and Costs

To ensure a reasonable rate of return for the project, connection charges would be need to be levied or alternative gap funding found. This section investigates the impacts on scheme returns of various funding options, and indicates the scheme can be delivered under conditions that would likely prove acceptable to public or private sector entities.

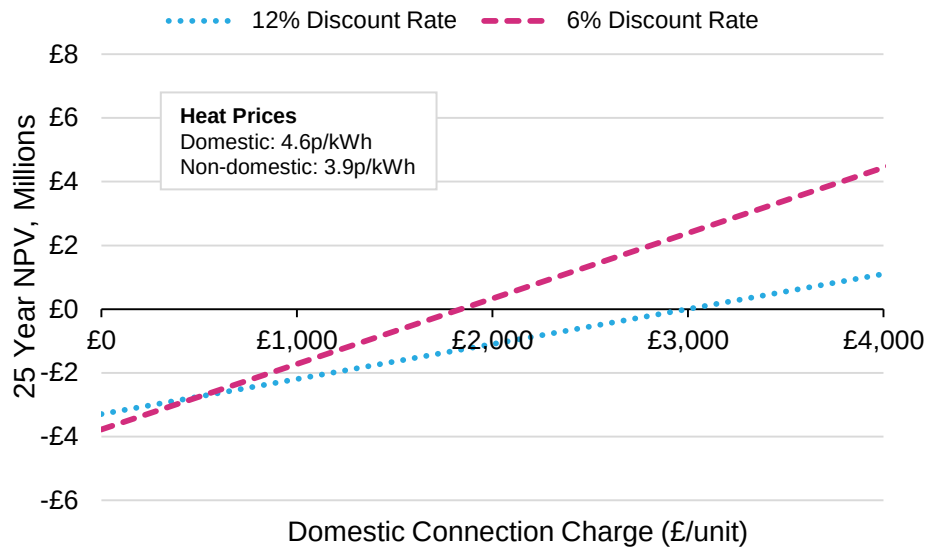
Funding scenario 1. Domestic Connection Charges *Only*

Since the development is primarily comprised of domestic developments *(95% domestic)*, charging a fee for each unit connected to the network provides the most significant gap funding.

A 25 Year NPV of £0 can be achieved with a domestic connection charge of:

- £1,838/dwelling with a 6% (public sector) discount rate and no connection charge for non-domestic customers
- £2,996/dwelling with a 12% (commercial) discount rate and no connection charge for non-domestic customers
- Connection charges can be levied on the basis of the avoided costs to the customer for the provision of on-site boilers and lifetime maintenance in the properties.
- Avoided costs for the carbon savings needed to achieve a reduction equivalent to the difference between CSH Level 3 and CSH Level 4 has been estimated to be over £4,000/dwelling for similar sized developments in London.
- Should £4,000/dwelling be achieved, analysis indicates an NPV of £4.4m at 6% discount rate for the core scheme. At a commercial, 12% discount rate, the NPV drops to £1.1m. The IRR stands at 18%, indicating the project could be very commercially attractive. The second table on the next page highlights the variations in NPV for the various funding scenarios should £4,000/dwelling be achievable.

Impact on Scheme NPV of Domestic Connection Charge



Funding Scenarios: Prices and Costs *Continued*

To ensure a reasonable rate of return for the project, connection charges would be need to be levied or alternative gap funding found. This section investigates the impacts on scheme returns of various funding options, and indicates the scheme can be delivered under conditions that would likely prove acceptable to public or private sector entities.

Funding scenario 2. Domestic *and* Non-domestic connection charges

- In addition to the domestic connection charges, non-domestic connection charges could be utilised to raise additional capital.
- Costs for a non-domestic connection to another DH network in London are in the region of £1,000/kW.
- Due to the small portion of the site dedicated to non-domestic development, variations in the non-domestic connection charge yield small differences in the necessary domestic connection charge.
- Nevertheless, a £1000/kW non-domestic connection charge enables the residential developer contribution to reduce to £1,626 when using a public sector discount rate
- The table to the right indicates the effect of various non-domestic connection charges on required developer contributions. It indicates that a commercially acceptable discount rate of 12% could be achieved with a £1000/kW non-domestic connection charge and £2,777 per residential unit developer contribution. This is still somewhat below the avoided costs mentioned on the previous page.

The effects of discount rate and non-domestic connection charges on required developer contributions:

Discount Rate (25 years)	Non-domestic connection charge [£/kW]	Developer contribution required for zero NPV [£/unit]
6%	**£1,000**	**£1,626**
6%	£500	£1,732
6%	£0	£1,838
12%	£1,000	£2,777
12%	£500	£2,887
12%	£0	£2,996

The effects of £4,000/unit developer contributions on NPV:

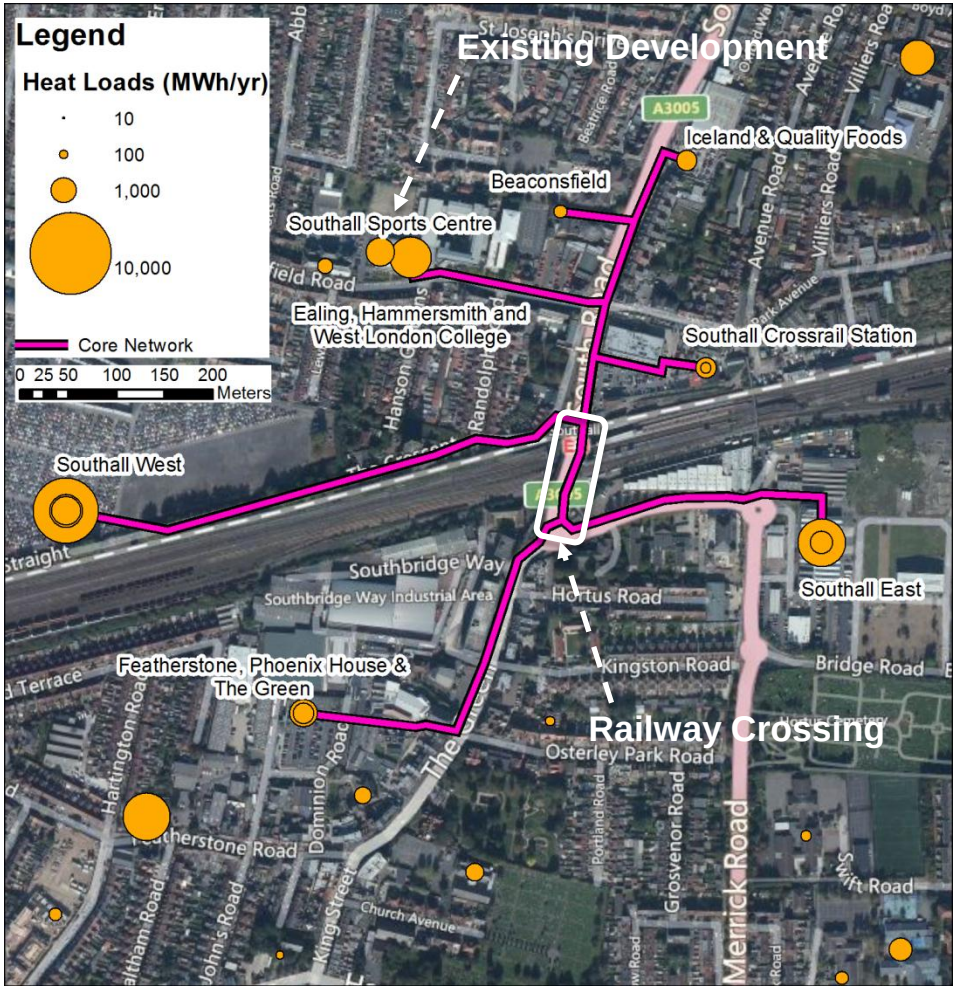
Discount Rate (25 years)	Non-domestic connection charge [£/kW]	NPV when developer contribution is £4,000/unit
6%	£1,000	£4.9M
6%	£0	£4.4M
12%	£1,000	£1.3M
12%	£0	£1.1M

On-Site Electricity Use

- All figures reported above assume electricity generated by the CHP engine is exported to the grid at the rate indicated on Page 9 (4.5 p/kWh)
- Depending on commercial arrangements, it might prove possible to utilise electricity generated on-site, so receiving revenues at close to retail rates (11 p/kWh for domestic, 8 p/kWh for non-domestic, as per assumptions on Page 9).
  - Should on-site use of electricity be possible, the required developer contribution to achieve a 6% IRR over 25 years would reduces to £1,132 per residential unit (£1000/kW is still assumed for the non-domestic connection charge).

Benefits, Risks and Uncertainties

The Core DE Scheme was developed as an optimal balance between technical, commercial and planning drivers and risks, taking into account the wider opportunities associated with delivering a low-carbon heat network in the area. This section highlights the main identified benefits of the suggested scheme, and its associated risks and uncertainties.



Benefits

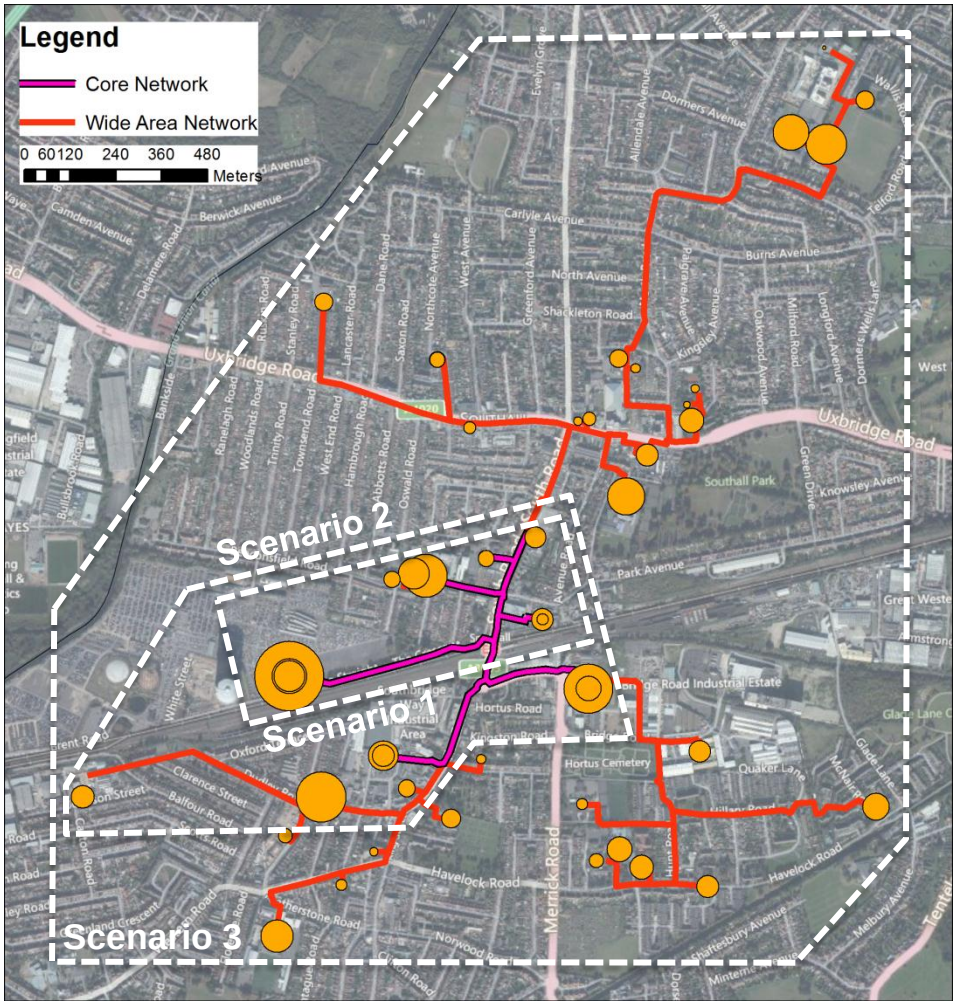
- The Core DE scheme establishes a DH spine along the north-south axis of Southall – this is excellent for future development potential and enables the possibility of connection to large scale heat networks developing in the south
- The Core development is not overly dependent on existing loads, reducing some of the risks typical for DH network development

Risks and Uncertainties

- The scheme is dependent on phasing of new developments and scale of new developments
  - Mitigate by early engagement with developers and clear planning policy
- The scheme is dependent on financial contributions from developers and connection charges
  - Given the magnitude of avoided costs for developers, and the minimum charges required for viability, it is likely that negotiations would secure a price that is acceptable both for building developers and DE scheme developers
- Crossing the railway might prove costly (at least in the range of £100k-£250k), long-winded due to the consents process, or impossible
  - Gain clarity through early engagement with Network Rail, Crossrail, Crossrail site developers. The crossing is not required until 2017, so it is likely sufficient time exists.
  - Note that the modelling has assumed elevated costs associated with this crossing, but true costs would require more detailed investigation

Alternative Options Analysed

Different network configurations and phasing timetables were investigated in developing the Core scheme. This section presents the findings of some key additional studies that test the assumptions discussed previously.



Option Descriptions and Analysis Results

In the three scenarios analysed below, the energy centre is located at Southall West, schemes do not come on line until 2017, heat prices are the same as for the Core analysis, the non-domestic connection charge has been fixed at £1,000/kW, and the discount rate assumed is 6%.

1. Network for only the core loads north of the railway
   - This scenario investigates the effect on the viability of the Core scheme if it should prove impractical to cross the railway.

2. With developer contributions increased to £2,000/unit, how large can the network be?
   - Increasing developer contributions to £2,000/unit gives the scheme an additional £768k to use towards network expansion (i.e. an NPV of £768k at 6%)

3. Viability of a Wide Area Network (WAN)
   - This scenario investigates the developer contributions required to connect all loads in the area. All existing loads are assumed to connect in 2017.

Variable	Scenario 1	Scenario 2	Scenario 3
Annual Heat Demand (MWh/yr)	12,100	25,000	34,400
CAPEX (£M)	3.9	10.8	21.6
CHP Size (MWe)	0.8	1.7	2.4
Developer Contributions (£/unit)	2,055	2,000	5,913

Commercialisation and Planning Considerations

Whilst the identified Core scheme appears viable from technical and financial perspectives, its dependence on a significant number of developments in the area coming forward as expected presents considerable commercial issues. Similarly, the availability of the Southall West development site as a location for an energy centre is a potential commercial challenge.

Commercialisation Issues

- How can an energy centre, and subsequently a DH network be established on the Southall West or, indeed, any development site?
  - There is no guarantee that loads scheduled for delivery in 2022 or 2032 will come on line
- What incentives or commercial arrangements could be used to encourage a developer of the Southall West site to act as the location for the EC?

Potential Resolutions

- Initial development of the network only needs to take in the initial development phase; as long as space is reserved for future expansion of plant
- Developer contributions for a viable scheme are currently estimated to be relatively low given the avoided costs

Planning Context

The proposed site for the energy centre benefits from an existing outline planning permission for major mixed use development. The energy strategy for the development comprised two options:

- Primary Strategy 1: on-site heat network powered by a combination of CHP engines, gas-fired boilers and biomass boilers.
- Primary Strategy 2: on-site heat network with heat and power generated as part of an expanded gas pressure reduction facility. This strategy was dependent on a separate planning permission, but this was refused.

The facilities associated with Primary Strategy 1 are:

- 770kWe CHP (installed in modules as development is built)
- 2,200kWth Heat-only biomass boilers (also phased build-out)

The development is committed to having a single energy centre on the site.

These commitments provide a positive indication that a wider heat network could be compatible with the existing outline planning scheme, albeit with the energy centre having to be enlarged to accommodate the larger overall energy load. Depending on the exact parameters of the outline permission, it may be possible to incorporate the larger energy centre design as part of the detailed “reserved matters” application process at the site. If not, then a variation application (a “Section 73 application”) may be required. Refusal or delay risk associated with such an application is considered at this stage to be relatively low.

Key Findings:

Core Scheme

- A “Core” district heating scheme has been identified that would be able to supply low-carbon heat to homes and businesses in the Southall area, with the below key technical and financial characteristics. These findings are subject to the assumptions highlighted on Page 9.

Technical Highlights

Annual Heat Demand	17,300MWh/yr
Network Length	2,280m
CHP capacity	1.1MWe
Boiler capacity	6.5MWth
Carbon savings*	3,300 tCO_2e/yr

*Based on current carbon intensity of electricity grid

Economic Highlights

Initial CAPEX	£4.1M
CAPEX on full build-out*	£5.7M
Maximum OPEX	£960k
Maximum Revenues	£1.2M
Gap Funding Required at 6%, 25 years**	£3.8M
New-build domestic connection charge	£1,626/unit
Non-domestic connection charge	£1000/kW

*Excluding plant replacement
**If no developer contributions or connection charges

- Network build-out is completed between 2017 and 2032, according to expected development timetables for new-builds.
- This scheme requires a crossing of the railway, which might prove costly and time consuming.
- In establishing this network, many future possibilities open up for future connection and expansion within the borough, delivering on low-carbon and fuel poverty agendas.
  - The residential heat prices assumed in this analysis are equivalent to a 10% discount on average domestic heat.
- The scheme is most sensitive to residential connection charges, and can be delivered for a relatively low charge, given likely avoided costs to developers.

Key Findings Continued:

- The core network can be delivered at a commercial discount rate (12%) if a residential connection charge of £2,777/unit can be levied as well as the same non-domestic charge. This is still lower than typical estimated avoided costs to developers.
- If on-site use of electricity generated by the CHP engine is possible, the required developer contribution to deliver the core scheme at a public sector discount rate reduces to £1,132, as a result of higher revenues. This would be dependent on commercial arrangements.

Risks and Sensitivities

- The network is reliant on a number of expected new developments in the area coming to market. This reliance represents a risk to the project's overall viability and could inhibit market appetite for the network unless there is a party (e.g. LB Ealing) willing to provide some mitigation of deployment risk.
- The energy centre location is not on land owned by LB Ealing but instead is part of a site with planning permission for new development. The availability of land for an energy centre which could be sized to serve the network should be established at the next stage of project development.
- There may be an opportunity to start the network based solely on supplying heat to the Southall West development where the energy centre would be located. However, there is no information at this stage of the ability or willingness of the relevant parties – the developer, LB Ealing or a third party – to establish the necessary commercial and contractual structures for this to happen in a way which enabled future expansion of the network.
- There is a risk that the railway will not be suitable for a crossing. With this in mind, a reduced-scale network taking in only core loads north of the railway has been identified as viable with slightly increased developer contributions. These contributions are still somewhat below the avoided costs to developers identified in other DH projects.

Potential Next Steps:

1. LB Ealing to review findings and discuss their implications in the context of planning policy and wider economic and environmental goals.
2. LB Ealing to engage with existing developers regarding the opportunity and connection to the scheme. In particular, contact should be made to the Ealing E[illegible] developer where the scheme energy centre is proposed to be located.
3. Pending decision to take the project further, a responsible party within the council is tasked with progressing the opportunity.
4. Potential network layouts and scheme characteristics entered into planning documents such as AAPs, as well as the London Heat Map.
5. Planning policy to require further developments in the area to consider connection to the scheme.

- Depending on commitments from the borough, and further discussions with the GLA, further technical, commercial and financial assistance would be available from Decentralised Energy for London.

Appendix 1: Schedule Of Buildings Used In Analysis

Building Name	Type	Predicted Heat and DHW Fuel Consumption [MWh/yr]	Residential_Units (New Developments)	Non-Residential GFA [m2] (New Developments)	Earliest Possible Connection Date Assumed	Actual / Benchmark Data
Beaconsfield Primary School	Education facilities	355.5	64	1117	2017	Benchmark
Southall West 2017	Mixed-use	1288	400	0	2017	Benchmark
Southall Crossrail Station 2022	Mixed-use	659.9	147	2568	2022	Benchmark
Southall West 2022	Residential	1610	500	0	2022	Benchmark
Southall Market	Mixed-use	634.7	141	2470	2032	Benchmark
Iceland & Quality Foods	Mixed-use	619.6	138	2411	2032	Benchmark
Southall Crossrail Station 2032	Mixed-use	165	37	642	2032	Benchmark
Southall West 2032	Residential	6440	2000	0	2032	Benchmark
Villiers High School	Education facilities	1863			2017	Actual
Southall Sports Centre	Sport & Leisure facilities	1240			2017	Actual
Charter Court	Multi-address buildings	844.4			2017	Actual
North Primary School	Education facilities	423.2			2017	Actual
Grove House [Nursery School] Children's Centre	Sport & Leisure facilities	127.4			2017	Actual
Southall Young Adults Centre	Sport & Leisure facilities	104			2017	Actual
Phoenix Social Club for Young People	Sport & Leisure facilities	65.64			2017	Actual
Southall Fire Station	Fire stations	254.9			2017	Actual
Phoenix House	Residential	667.5	149	0	2010	Benchmark
Featherstone	Residential	640.6	143	0	2010	Benchmark
Southall East 2022	Mixed-use	3314	737	12897	2022	Benchmark
Havelock Estate	Residential	644	200	0	2022	Benchmark
Southall East 2032	Mixed-use	828.6	184	3224	2032	Benchmark
The Green	Mixed-use	1199	267	4665	2032	Benchmark
Johnson St	Mixed-use	700.2	156	2724	2032	Benchmark

Appendix 1: Schedule Of Buildings Used In Analysis

Building Name	Type	Predicted Heat and DHW Fuel Consumption [MWh/yr]	Residential_Units (New Developments)	Non-Residential GFA [m2] (New Developments)	Earliest Possible Connection Date Assumed	Actual / Benchmark Data
Harmony Lodge	Multi-address buildings	745			2017	Actual
St Anselms Catholic Primary School	Education facilities	484.1			2017	Actual
Dominion Arts Education Centre	Museums & Art Galleries	405.4			2017	Actual
Southall Library	Other public buildings	119.1			2017	Actual
Windmill Lane	Local government estate	634.5			2017	Actual
Albert Dane Centre	Sport & Leisure facilities	174.1			2017	Actual
Waterside Health Centre	NHS	973.7			2017	Actual
Broadway Health Centre, Southall	NHS	218.7			2017	Actual
Southall North Community Offices (HVs and DNs)	NHS	671.3			2017	Actual
Rutherford Tower	Multi-address buildings	447.6			2017	Actual
Dormers Wells Leisure Centre	Sport & Leisure facilities	2230			2017	Actual
Tudor Primary School	Education facilities	426.8			2017	Actual
St John's Church Hall and Bus Depot	Mixed-use	91.38	20	353	2017	Benchmark
Sybil Elgar School	Education facilities	178			2017	Benchmark
Havelock Primary School	Education facilities	271.9			2017	Actual
Dairymead Meadow Primary School	Education facilities	183.8			2017	Actual
Feathersone Junior Mixed School	Education facilities	260.8			2017	Actual
Featherstone High School	Education facilities	1435			2017	Actual
Hambrough First School	Education facilities	242.7			2017	Actual
Southall Town Hall	Education facilities	103.9			2017	Actual
Allenby Primary School	Education facilities	21.96			2017	Actual
Dormers Wells High School Re-development	Education facilities	1691			2017	Benchmark
Ealing, Hammersmith & West London College	Education facilities	2938			2017	Benchmark