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LONDON HEAT MAP STUDY
FOR LONDON BOROUGH OF LAMBETH

RAMBOLL

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Date	**2010/06/24**
Made by	**Katie Symonds / Olof Jangsten/ Pernille M. Overbye / Peter Mildenstein**
Checked by	**Pernille M. Overbye / Peter Mildenstein**
Approved by	**Pernille M. Overbye**
Description	**Heat map study gathering data for mapping, analysis of data and maps together with outlining a implementation plan**

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Ramboll
Teknikerbyen 31
DK-2830 Virum
Denmark
T +45 4598 6000
F +45 4598 8520
www.ramboll.com

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0. EXECUTIVE SUMMARY

In February 2010, Ramboll was appointed by the London Borough of Lambeth to carry a heat mapping study as part of the LDA's Decentralised Energy Masterplanning Programme (DEMaP).

The study has three main stages of work:

1. Assemble heat load data for priority buildings in the Borough, using as much actual energy consumption data as possible. Mapping of all priority buildings using Ordnance Survey coordinates. All data was recorded on an Excel spreadsheet template, with fixed fields for completion and issued to the LDA for conversion into a GIS heat map.
2. Upon receipt of the data and two maps identifying building types from the LDA, Ramboll produced heat maps for analysis. Clusters of buildings and development areas were identified as having the best potential for delivering future district heating networks.
3. A high-level implementation plan was then produced for the Borough, on a tabular format template, highlighting each individual district heating network opportunity, associated barriers, next steps, key dates and key personnel within the Council for moving it forward.

The methodology for collecting data for the heat map study was set out by Lambeth in collaboration with the LDA.

District heating is a method of delivering heat from a variety of heat production sources to a number of customers such as residential dwellings, commercial and public offices, schools, warehouses and factories, hospitals plus industrial process heating.

In this project we have collected actual annual heat data and where required, estimated annual heat demand (measured in MWh), for potential district heating networks in the London Borough of Lambeth. The heat demand is required to determine the heat load for future proposed network(s) (measured in MW), which is then used to establish the capacity required for the system as a whole.

The Borough covers an area of some 17km^2, 118,000 households and 10,000 businesses. The task of gathering data to cover heat demands for the building stock in the whole area, was very ambitious, hence prioritisation was required.

The data gathering methodology adopted was guided by a list of 'priority buildings' identified in the project scope and entered into an Excel spreadsheet template.

The heat demand of over 594 buildings, was included in the assessment. No major heat production facilities were identified but the Borough has a number of smaller CHP plants being developed or proposed, together with some smaller heat networks.

From the information gathered Ramboll determined that the buildings identified in the study have a collective heat demand of over 243,000 MWh.

With this information and that of the potential developments planned for the Borough, nine focus areas were identified as having potential to develop district heating networks and have been ranked below in order of priority;

High priority:

- SBEG/Waterloo (focus area 1)
- Future Brixton (focus area 3)

Medium / high priority:
- Myatt's Field (focus area 9)

Medium priority:
- Future Clapham (focus area 6)
- Ethelred (focus area 2)
- Hertford (focus area 4)

Low priority:
- Clapham Park (focus area 5)
- Norwood (focus area 7)
- Roupell Park (focus area 8)

The scope of these potential heat network focus areas was illustrated on localised maps and annotated for ease of interpretation. These specific heat network focus areas could collectively contribute to a heat demand of over 143,000 MWh or 59% of the heat load of the Borough identified in this study.

A tabulated Implementation Plan was created to help identify how these Focus Areas could be developed to the next stage of investigation and a series of recommendations summarised these actions.

1. INTRODUCTION

In February 2010, Ramboll was appointed by the London Borough of Lambeth to carry a heat mapping study as part of the LDA's Decentralised Energy Masterplanning Programme (DEMaP).

Our work was structured to meet the aims of the study as defined in the brief, which were as follows:

1. Produce a heat map of the Borough;
2. Provide advice and support to the Borough in interpreting and acting upon results of the heat mapping; and
3. Identify potential areas for the development of further district heating networks in the Borough;

The course of the study was broken down into 3 stages:

1. Assemble heat load data for priority buildings in the Borough, using as much actual energy consumption data as possible. Mapping of all priority buildings using Ordnance Survey coordinates. All data was recorded on an Excel spreadsheet template, with fixed fields for completion and issued to the LDA for conversion into a GIS heat map.
2. Upon receipt of the data and maps from the LDA, heat maps were produced and the maps was analysed and clusters of buildings and development areas were identified as having the best potential for delivering future district heating networks.
3. A high-level implementation plan was then produced for the Borough, on a tabular format template, highlighting each individual district heating network opportunity, associated barriers, next steps, key dates and key personnel within the Council for moving it forward.

The broader objective of this exercise was to enable the results to be fed directly into the emerging Local Development Framework documents. In particular, based on the findings of the current study, the Site Allocation Development Plan Documents (DPDs) can identify areas/sites with specific District Energy Network (DEN) opportunities in the Borough.

This will also be supplemented by the Infrastructure Programme Evidence Base document, which should help establish the delivery mechanisms (including ongoing funding/maintenance) for DEN

proposals within the Borough over the Local Development Framework (LDF) plan period (i.e. up to 2026).
Moreover, the Development Management DPD will establish policies for the assessment of DEN proposals, and set criteria to ensure that new development links into established networks. It is expected that clear guidance from the Council will provide the certainty needed to attract investment in DEN proposals within the Borough.

Decentralised energy is the co-generation of electricity and heat, but cooling is sometimes also associated and the term tri-generation is then used. To enable the successful implementation of a decentralised energy scheme a piped network for distributing heat is required; the terminology used is district heating. District heating may be defined as the distribution of heat through pipes to two or more buildings generally with different owners.

District heating is a method of delivering heat from a variety of heat producing sources to a number of different heat customers. Heat produced from fuel sources such as natural gas, oil or renewables burned directly in boilers or through combined heat and power (CHP), or a combination of both, can be delivered to residential dwellings, commercial & public offices, schools, warehouse and factory, hospitals plus industrial process heating such as air drying or pre-heating.

District heating is a precondition for:

- substantial energy savings and CO_2 emission reductions in towns and cities through more efficient utilisation of fuels;
- an efficient use of local surplus heat sources, e.g. from industrial processes;
- the use of low- grade heat sources, e.g. geothermal energy and solar hot water heating;
- an environmental safe use of low grade domestic fuels; and
- real competition between all types of heat sources and fuels and therefore an important element in a liberalised energy market, despite the fact that the network could be considered a monopoly.

District heating may, with the appropriate planning and management, provide the consumers with high quality heat supply at a low competitive price in the case of consumer or municipal ownership. Similarly, it may be a profitable business for a private investor with the license to supply district heating at a competitive price. Care has to be taken to ensure that the founding assumptions are sound and unchanged to avoid threatening either the competitive energy price or the viability of the project. District heating, therefore, has to be handled with care and attention by all parties from national politicians to investors.

It is essential that district heating is carefully planned and the mapping of heat demands is a first step. The heat map study is intended to support policy recommendations in new planning policy documents, specifically SPDs for Brixton Town Hall, Waterloo and Vauxhall, the Site Allocations DPD and Development Management DPD. Further work is being supported by the LDA to develop suitable policy for focus areas where an SPD is relevant. A policy recommendation report will be produced in parallel with the heat mapping report.

2. DATA COLLECTION

The main objective of the project was to collect actual heat demand data for a list of priority buildings for later illustration on the London heat map website.

2.1 Methodology

The methodology for collecting data for the heat map study was set out by Lambeth Council in collaboration with the LDA.

The Borough covers an area of some 17km^2, 118,000 households and 10,000 businesses. The task of gathering data to cover heat demands for the building stock in the whole area was very ambitious, hence prioritisation was required.

The data gathering methodology adopted was guided by the list of 'priority buildings' identified in the project scope and entered into the Excel spreadsheet template. Most of the data was collected by Ramboll and can be found, in spreadsheet format, in Appendix A.

During the data collection exercise, the LDA provided additional information on buildings in the Borough. This information was gathered in previous studies and did not necessarily include buildings classified in this study as being "priority buildings". Where appropriate the LDA consolidated the data provided to them by Ramboll, with data they already had. A spreadsheet of the LDA data is shown in Appendix B.

In practise the data gathering is a continual process, which Lambeth ideally would need to maintain to improve the accuracy of the heat map.

As well as gathering energy data for the various heat loads, heat supply and district heating network sites and converting them into the required LDA template format, the required location data also had to be sourced and formatted in the correct manner. This included name, address and postcode of each site, together with the Ordinance Survey X&Y coordinates. The Borough gave Ramboll access to the Borough's Local Land and Property Gazetteer (LLPG) database file, allowing us to match buildings for which we had already had heat data to their geographical location coordinates. Matching the numerous datasets could not be done automatically, when for example the names of sites differed slightly between datasets, individual properties had to be aggregated to produce an entry for a single domestic site. The discrepancies have been minimised and all coordinates should lie within the footprint of the building or site they refer to.

An entry for each building was recorded within the template provided. For each entry, all the mandatory fields were completed with the exception of some postcode entries for housing estates that covered too large an area for these to be relevant.

Appendix C lists the data sources for each type of priority building and includes some notes on sites identified. Additional entries were filled in from the LLPG database.

Supermarkets were identified via an internet search. Contact was made with the following company headquarters to determine a level of interest in connecting to a heat network; Sainsbury, TESCO, ASDA, Waitrose, Morrisons, Marks & Spencer and Iceland. Only Morrisons responded with data but unfortunately this arrived too late to be able to be included in the analysis. A spreadsheet listing contacts that were made, together with the template letter can be found in Appendices D & E.

Through discussion with Lambeth, the following proposed (or 'new') buildings or developments have been identified:

1. Future Lambeth. This is the council's long-term regeneration programme for Brixton, Clapham, Kennington, Norwood, and Streatham. The adopted Future Brixton masterplan contains proposals for a district heating network and three energy centre sites. The adopted Streatham masterplan proposes a CHP unit at Streatham Hub development.

2. Vauxhall Nine Elms Battersea (VNEB). Led by the Greater London Authority, the VNEB opportunity area framework is an energy masterplan for the area. It identifies specific district heating network opportunities and energy centre sites primarily within the Borough of Wandsworth but also within a small area of Lambeth.

3. South Bank Decentralised Energy scheme. The South Bank Employers Group (SBEG) has commissioned a feasibility study for decentralised energy published in February 2009. This report contained proposals for district heating networks around clusters across the Lambeth/Southwark border.

4. South East London Combined Heat and Power (SELCHP). A report by PB Energy Solutions (then PB Power) with the support of Ramboll in 2005 included a proposed district heating network route extending from the SELCHP plant in Lewisham across to the central area of Lambeth, serving the Myatt's Field North and South estates, and others nearby. The route outlined then was found to be a viable option supplying connections in Lewisham, Southwark and Lambeth. The project has since moved on and both the London Boroughs of Lewisham and Southwark are keen to establish a connection with SELCHP to utilise its heat. At present, it is uncertain which direction this project will take but in Ramboll's view, Lambeth should try and establish information sharing with SELCHP, Lewisham and Southwark to ensure an opportunity is not missed.

5. Stockwell Park. The development was granted outline planning permission in 2007 for 550 residential units and other mixed uses such as office, community centre and retail. Two separate communal heating systems supplied by gas-fired CHP are planned, one system supplying the north elements and the other, the south elements.

6. Lilian Baylis School. The site of the now disused school is included in the Future Lambeth programme but a use for it has yet to be identified. It is located within the Ethelred Estate focus area and should be considered in any heat network development.

7. Streatham Hub. As part of the Streatham masterplan, the Streatham Hub will consist of a new build leisure centre, ice rink, residential units and a retail store. As proposals are developed, the option of decentralised energy network should be investigated and appraised,

The development pipeline reports, provided by the Borough, highlight both residential and commercial proposed developments and redevelopments/refurbishments. The data, however, is not in such detail that heat demand estimates and/or co-ordinate entries could be included in the heat map data spreadsheet but it is included here for possible inclusion in future work.

The Lambeth Housing Development pipeline report, 2008/2009, major residential buildings/developments that appear to fall within the priority of this study are listed below.

2008/2009 GLA Housing Capacity Study - Identified Major Sites under Construction Site Schedule

- St George Tower Site;
- Kerrin Point, Black Prince Road;
- St George Wharf Site phase 2; and
- Clapham Park Estate Redevelopment.

2008/2009 GLA Housing Capacity Study - Identified Major Sites with Planning Permission

- Freemans Warehouse, Clapham Road;
- South Bank University, Thorparch Road;
- SW Services, Coldharbour Lane;
- Bradleys Plumbase, Stockwell Green;
- 63 Old Town;
- Ice Rink Streatham High Road; and
- Founders Place, Royal Street.

Please note that the ice rink site is part of the Streatham Hub development proposals currently under development.

From the Lambeth Commercial Development Pipeline Report, 2008/2009, the following could be identified:

- 131-143 Clapham Road SW9: Demolition of buildings around the Victorian print works, retention 135 Clapham Road and Victorian print works building and erection of new buildings containing 260 residential units, plus A1, A2, A3, A4 and B1 units.512 - 522 Streatham High Road, SW16 3QF: Demolition of existing buildings and the erection of a four storey building (plus basement) comprising 12,961m² of self storage floor space (Class B8) and 619m² of offices (Class B1).

Heat Demand

A building's heat demand depends on the heat loss of the building fabric, the ventilation rate, and domestic hot water usage. Typical existing houses and buildings in the UK are fairly inefficient in terms of heat usage when compared to similar European examples. New policies have considerably improved the new build stock in terms of energy demand and based on benchmark figures and Ramboll's experience, an average existing home requires at least four times more energy to heat as the average new home.

It can be seen, therefore, that it is existing homes and buildings that benefit most from being connected to an efficient district heating network.

In this project, we have collected actual heat data and in some instances estimated annual heat demand (measured in MWh) for potential district heating networks in the London Borough of Lambeth. The heat demand represents the sum of all the heat consumptions of consumers. The heat demand is used to determine the heat load to the proposed network(s) (measured in MW), which is then used to establish the capacity required of the system as a whole.

Where actual consumption data could not be obtained within the timescales available, estimated consumption data was calculated for existing buildings by using floor areas and benchmark figures taken from CIBSE Guide F (2004). Proposed developments can be benchmarked based on a 20%, 50% or 80% reduction of Part L value depending on the predicted construction date. Benchmarks that have been or can be used are as follows:

- Assuming 210 kWh/m^2/annum (CIBSE F table 20.1 Offices, Air conditioned, prestige)
- Assuming 67 kWh/m^2/annum (80% of 2006 Part L Benchmark for Office)
- Assuming 80 m^2/unit (80% of 2006 Part L Benchmark for Residential)
- Assuming 47 kWh/m^2/annum (80% of 2006 Part L Benchmark for Residential)
- Assuming 58 m^2/unit and 47 kWh/m^2/annum (80% of 2006 Part L Benchmark for Hotel)

The heat demand for six entries has been estimated:

Brixton Prison, The Leigham Court Hotel, Novotel Hotel, EuroTower Hotel, Comfort Inn Hotel and the Marriott Hotel.

Where floor area data was not available within the timescales available to produce estimated heat consumption figures for existing buildings that were expected to have a high heat load, the buildings were included in the heat map with a zero heat load, but with a view to adding heat load data should this information become available in the future.

Heat sources & networks

The LDA template also required the compilation of major heat supply plants and district heating networks in the Borough. Ramboll interpreted these two datasets in the following manner:

- District heating networks are those that are existing or proposed networks that will have an accompanying energy centre (that may be CHP enabled), but the energy centre is not repeated in the major heat supply plant section, as they are not likely to have excess capacity to feed a new network.
- A major heat supply plan is considered to be a larger power station, energy from waste (EfW) plant or similar that doesn't currently export heat, or a large industrial site where there are processes that produce waste heat.

As per the IEA (International Energy Agency) report comparing distributed CHP/DH with Large scale CHP/DA, small-scale CHP/DH schemes are typically in the range 300kW to 10MW, where large CHP stations are in excess of around 50MW and the in-between is classified a medium range.[1]

The DECC CHP database, the OFGEM CHP database and the Eionet Large Combustion Plant database and the industrial heat map website did not yield any major heat supply plants.

The following smaller purpose built/designed CHP plants have been identified and included in the heat map data spreadsheet; however, not all heat production capacities have been obtained:

Location	System / fuel type	Status
Roupell Park Estate	Gas fired CHP	Installed but not in operation
Ethelred Estate	Gas fired CHP	Proposed
Clapham Park Estate CHP	Gas fired CHP	Proposed
Stockwell Park Estate	Gas fired CHP	Proposed
South Bank Decentralised Energy Network	Gas fired CHP	First stage feasibility complete. Second stage feasibility commissioned
Myatt's Field North CHP	Gas fired CHP	Proposed and planning application submitted
Norwood Hall	Gas fired CHP	Proposed
Future Brixton	Gas fired CHP	Three proposed energy centres sites: Brixton Recreation Centre, Somerleyton Road, and Acre Lane.

No major heat supply plants were identified within the Borough by Ramboll, however the data already on the LHM website and include by the LDA lists a number of smaller CHP units within the Borough as 'Major Heat Supply Plants'. These include: Roupell Park (already noted above and has been deleted by Ramboll from the heat map); Dick Sheppard Secondary School; Clapham Manor Baths (this is the site for the new Clapham Leisure centre); Streatham Swimming Pool (swimming pool has however been closed and it is not clear what has happened with the CHP, if it has or will be considered for another scheme); Guys & St Thomas' Hospital NHS Trust, and BT plc.

In addition the following proposed new development is likely to have a CHP unit of some type and could be able to be included in future study work:

Streatham Hub	TBC	Proposed in the Streatham masterplan

[1] IEA DHC/CHP Annex VII Report 8DHC-05.01 – A Comparison of distributed CHP/DH with Large-Scale CHP/DH

Interaction with and/or utilisation of the CHP at the closed Streatham swimming pool could be considered.

The LEP database was pursued but no existing networks have been identified. The district heating networks identified were all new proposed smaller networks as part of the CHP developments listed above.

2.2 Methodology Considerations

With a limited time scale for data gathering, it was important to prioritise the buildings according to the potential heat load and connection opportunity. A priority list was provided to Ramboll in the project brief. Accordingly, a heavier focus was placed on gathering the data for hospitals, council-owned premises, proposed developments and hotels.

Remaining building types were also pursued by identifying the relevant premises in the LLPG database and sending standard letters to the concerned parties. Least focus was placed on the building types which were going to be investigated by the LDA, i.e. fire stations, police stations, TfL premises, commercial floor space listed in the Valuation Office (VOA) database.

The LLPG database was also used to obtain OS coordinate points for a specific address. Where data was not found in the database, internet searches and mapping websites were used to find and map additional premises.

Consideration was given to proposed developments, which were identified through planning applications and data sent to Ramboll by the Borough. Proposed developments were recorded by clustering all the buildings to a point in the centre of the development. Floor areas were split between residential and commercial typology and benchmarks based on Part L energy reduction were used accordingly.

There are a number of additional issues that should be considered when analysing the data:

- Double counting – future developments with estimated heat demand may overlap existing sites where heat demand has already been counted. Also, data collected from various sources may overlap data which information was already on the London heat map and added to this study by the LDA.

- Estimated data, as noted in the spreadsheet, may differ from actual consumption depending on, e.g. building fabric, occupancy patterns, and actual building performance.

- Major heat supply plants – existing networks that will have an existing energy centre that may be CHP, should not automatically be considered as a major heat supply plant, as they are not likely to have excess capacity to feed a new network. A major heat supply plant should be considered to be a power station that doesn't currently export heat, or a large industrial site where there are processes that produce waste heat. Many of the proposed developments plan to utilise CHP and communal heating systems. Minor amounts of excess heat from these CHP systems may be available for export to a future network.

- Heat consumption from existing retail and other commercial premises. The LDA was due to receive data from the Valuation Office (VOA) on commercial properties, to include location data and floor space figures, which would then be used with energy benchmarks to produce estimated heat demand figures. This data, however, was not available in the project timescales.

  A number of retail organisations were contacted by Ramboll to try and obtain actual consumption data for their properties within the Borough, however, no data was received within the timescale.

It should also be noted that many large supermarket premises may have more significant cooling loads than heating loads, which should be considered in further development of a project.

- Data provided by the LDA was from a previous study, so some of the buildings, by definition, would not be considered as 'priority buildings'.

- Heat consumption data from organisations involved in Lambeth's Cross River Partnership, mainly in the SBEG area, was not included due to confidentiality issues. What heat data that has later been made available has been collected by Ramboll and provide to Lambeth and the LDA separately.

3. HEAT MAP ANALYSIS

The next stage of the project was to analyse heat maps produced by the LDA based on the data collected.

The heat demand of over 594 buildings (including those buildings identified by the LDA) was included in the assessment. The majority of the buildings recorded are existing (only two new), any new developments (and the buildings associated) has been recorded as networks.

The original maps received from the LDA mapped types of buildings, but no heat data was illustrated. These maps can be seen in Appendices 1 and 2. Whilst these maps highlight clusters of buildings, they do not necessarily help exploit opportunities with respect to clusters of heat. Ramboll therefore produced the heat demand map which can be seen in Appendix 3.

Due to the relatively large number of priority buildings and building categories it was necessary to group the data differently to enable the illustration of the heat demand data.

Appendix 3 shows five building categories each illustrated by a different coloured dot. To further clarify, the size of the dot indicates the magnitude of energy consumption, i.e. the larger the dot the larger the heat demand.

The buildings categories are listed below with an indication of the enclosed buildings type:

- Private: Private residential, private commercial, hotels, education, museums, multi-address buildings (businesses)

- Local Government: Local Government Estate (including council owned housing), education, sports & leisure, museums

- Central Government: Central Government Estates

- Other public: NHS, Fire, Police, other public, multi address (public with central boilers)

- Unidentified: consists of data primarily received from the LDA

The heat demand maps also indicate the heat supply plants and a potential new network or development with CHP by a triangle.

It should be noted that the heat map appendices produced for this report is for support and overall illustration only. For any detailed assessment of building data and their location the London Heat Map website has to be explored.

3.1 Larger district heating regions

The Borough can be grouped into geographical regions as a more manageable breakdown of the Borough. This can be used as a method of targeting areas which requires more data collected and for future phasing the introduction of the district heating network and this can be seen in Appendix 4.

The regions have as far as possible been identified using an annotated area housing map given to Ramboll by Lambeth, which outlined housing estates and current CHP proposals in the borough. Please note that the regions are not geographically the same size and the number of buildings also varies within each of the outlined regions.

Consideration should, where at all possible, also be given to major road, rail and water courses. This is based upon practical reasons. Crossing major road infrastructure can be quite difficult especially when the road is a major artery for an area. Restrictions such as maintaining bus and ambulance movements can reduce the available working space and time. Rail and water present similar restrictions which tend to be overcome by either bridges or tunnels, but these can result in significant additional cost.

The quantitative heat demand assessment results are presented in Table 1.

Larger Regions	**Estimated heat consumption (MWh/yr)**
1. Brixton	76,520
2. North Lambeth	81,611
3. South Lambeth	27,452
4. Clapham	41,080
5. Streatham	7,384
6. Norwood	8,926
TOTAL HEAT DEMAND	**242,973**

Table 1: Regional heat demands for potential district heating network(s)

The numbers of buildings that have been identified as part of this study represent a small proportion of the total number of buildings located within Lambeth. As such, the above figures should be treated as an underestimation of the amount of heat available within the Borough. Furthermore, it has not been possible to obtain data for all the buildings identified. Appendix F includes a more detailed list of buildings within each region and their heat demand. Priority buildings with no heat data included in Appendix F should be targeted so that the heat map can be refined with actual data.

3.2 Criteria for creating clusters (Focus Areas)

Clusters can be developed around the existence of one or more of the following factors for the creation of focus areas;

Large heat user(s)

- Large heat users are the most crucial element of any cluster development. Ideally a number of large energy users or a number of energy users concentrated into a small area creates an ideal environment. Often (one or more) anchor loads are sought as these can provide either a secure and sizeable income stream or be seen as a landmark building that influences the thinking of others in the vicinity.

Large heat producer

- The provision of a primary energy source is also a requirement. Any successful network should seek out a local source of energy, preferably a source of waste heat. Waste heat would normally be assumed to come from a source which would otherwise have to "dump" this heat as part of its process. Waste heat can often be secured at a price less than conventional energy sources from fossil fuel, for example.

Existing networks and/or new development(s)

- In some instances small heat networks may already have been developed and could form part of a new wider network; they may also contain a heat source that can be used either directly as a primary energy source or as future back-up. In most instances, however, they will have been sized to accommodate the intended load and have little capacity for expansion, for example the new CHP plant that is being installed at Ward Point on the Ethelred Estate.

- Larger networks may also have been developed and the extent to which new networks and buildings can interlink would be subject to discussion with the operator of such a network.

- The installation of heat led CHP on various estates around Lambeth also offer opportunities for linking up and/or adding additional loads to potentially enable a more efficient operation of the already sized plant(s).

- New developments can provide an ideal platform for creating a new heat network that is able to connect to a wider area. The new development can act as the anchor load and as the site of any primary energy source which can be sized to provide a greater heat load than required by the immediate development. This often makes the development of a wider network more viable as the initial asset provisions can be accommodated by the new development. This option may sometimes require additional capital investment, but it may also be an opportunity to defer investments and/or optimise existing plant.

Public buildings(s)

- Connecting public buildings not only provides a series of potential anchor loads but also sends a very positive message to other building owners in the area. This action often provides assurance from prospective connectors who may harbour concerns over that suitability and connectivity to a heat network.

Building Diversity

- In an ideal scenario a heat network should strive to secure a variety of buildings with differing demand profiles and heat loads. This variation helps to optimise the sizing and selection of heat network equipment. It should be noted that whilst this is desirable, it is by no means essential that this should always apply.

Primarily technical viability has been used to define the focus areas, but other factors such as the status of a project and deliverability will impact on how the focus area is ranked in terms of priority.

3.3 Focus areas

Whilst the Borough has been divided into district heating regions to facilitate the management of future network development as described above, the immediate step is to identify a number of smaller areas that could be focused upon to provide potential for the development of larger district heating heat networks.

With the criterion listed above in mind, the process by which a Focus Area is determined is by grouping as many large heat users together as possible and at the same time corral as many of the smaller heat users as possible. The Focus Areas are also determined by areas where an energy strategy is already in process or where planning permission is being sought or given to a larger residential and/or mixed use development.

This process may result in a Focus Area intersecting two or more of the regional areas identified and it may cross larger roads, railways and rivers just as it could be excluding some buildings that appear to be within reach, but it would be expected that a detailed feasibility study would determine the scope for a heat network within the areas.

In total over 145 buildings/connections have been identified within nine Focus Areas.
District heating networks can potentially be developed within each Focus Area and there is also opportunity for the future connection of Focus Areas to form larger heat networks.

The Focus Areas shown in Appendix 5 are briefly described below and the buildings within each area are listed in Appendix G. Table 2 summarises the estimated heat loads for each of the Focus Areas.

1. **SBEG/Waterloo**: The South Bank Employer's Group (SEBG) are actively seeking to establish a decentralised energy network to serve 14 of their members. A feasibility study has been commissioned by SBEG to assess the viability of this proposed scheme.
   Allied to this, there are housing and retail premises in close proximity together with the large St Thomas' hospital which already has a CHP energy centre. It therefore makes sense to look at this area at a higher level.
   There is also a potential to link this area with the VNEB District Heating network as identified in the VNEB Energy Master Plan.

   Within this Focus Area 31 buildings/connections have been identified.

   Part of this Focus Area (SBEG) is at a more advanced stage and Ramboll understands that a second and more detailed feasibility study is being carried out. However, focus on this area should be maintained as from a technical perspective, there is opportunity for a larger network in this area.

2. **Ethelred**: Within this area ten housing estates have been identified as well as the Novotel Hotel which is a significant potential energy consumer – hence the potential for a network could be investigated for the area. A number of multi-address residential developments are identified by the current LDA Heat Map and should be investigated further for connection opportunities. Although not part of the VNEB Energy masterplan, there could be a potential to link the VNEB network to buildings in the Ethelred area.

   The Ethelred estate is mid-way through a phased major refurbishment programme which includes the installation of a CHP unit to serve the three tower blocks on the estate. The project is part-funded by the EU Concerto programme. The CHP unit has been sized to only accommodate demand from the three tower blocks; therefore in the short term the council believes future connections are unlikely. This should however, be verified with the technical design of the scheme and the demand profiles.

   A feasibility study should be considered to identify the potential for this area further, specifically where there is scope for any further heat sources that could be connected to the Ethelred CHP.

In total, 25 buildings/connections have been identified in this Focus Area.

There has, however, been some double counting due to the merging of new data collected by Ramboll and existing data provided later by the LDA:

- Vauxhall Garden Estate: the following entries have been removed from Appendix F: Coverley Point, Hayman's Point, Arne House, Arrowsmith House and Mountain House, because an entry for Burchell and Kennedy house (which house the communal boilers for this estate) with actual data is already included.

- There is an entry for Ward Point on Ethelred Estate with real data. The boiler house for the three tower blocks on Ethelred is in Ward Point, therefore entries for Brittany Point and Elkington Point have been removed from Appendix F. The entry for Ward Point notes that Brittany Point and Elkington Point are served by this central boiler.

These entries have not been deleted from the heat maps.

3. **Future Brixton**: This is a 53 hectare regeneration area identified in the Future Brixton masterplan document where district heating is proposed as the preferred strategy. In Brixton 16 hectares of land is under council ownership and should be prioritised for potential network connections.

   Within this Focus Area 32 buildings/connections have been identified and a feasibility study and/or option appraisal for the development of a network should be taken forward.

   There are a number of potential options to be investigated:

   I. The heat mapping study confirms Brixton recreation centre, Southwyck House and Canterbury Gardens estates as large heat consumers within this Focus Area. This matches the Future Britxon Masterplan which identified the following key regeneration sites:

      - Somerleyton Road - Southwyck House falls within the Somerleyton Road key regeneration area. A CHP unit is already proposed in this regeneration area and the masterplan identifies a site along Somerleyton Road. The development site along Somerleyton road currently houses the temporary Evelyn Grace Academy and there are proposals from the community group Brixton Green to develop new residential units and an anaerobic digestion plant.
      - Brixton Recreation Centre and Canterbury Gardens fall into the Brixton Central key regeneration area. Again a CHP energy centre is already proposed for the regeneration site and the masterplan suggests locating the energy centre to the rear of the Brixton Recreation centre.
      - Lambeth Town Hall falls into the Town Hall key regeneration area and an energy centre is proposed in the car park of the Tesco store along Acre Lane to serve the wider areas. Although the masterplan only suggests minor refurbishment to the Town Hall, the opportunity to link the Town Hall to a DE network should be assessed.

   II. Connection could be made to the communally heated Myatt's Field estates, the Cowley estate with a number of blocks, two of which are communal heated and also linking up to Paulet Road housing and Holland Grove housing estates (Focus area 9).
   The redevelopment of Myatt's Field estate is currently proposed to be supplied by a 1.8 MW electrical capacity CHP.

III. The delivery of heat from SELCHP has previously been identified as a viable option for this area. The London Boroughs of Lewisham and Southwark are also looking to establish a connection with SELCHP and utilising its heat. It is uncertain which direction this project is taking. In Ramboll's view Lambeth should try and establish information sharing with SELCHP, Lewisham and Southwark to ensure an opportunity is not missed.

Some double counting has occurred due to the merging of new data collected by Ramboll and existing data by the LDA, this data has not been deleted from the heat maps but in the table listing buildings for this focus area the following changes have been made:

There is an entry for the Loughborugh housing estate. The following blocks are part of the Loughborough Estate and have been removed from the table in Appendix F: Nevil House, Kettleby House, Secker House, Woolley House, Harper House, Leicester House, Kemble House, Harris House. Loughborough has been classified as having individual boilers.

4. **Hertford**: In this area the Hertford Estate is already served by a communal boiler. Nearby, King's College London (KCL) is developing a new research building on their Denmark Hill site which will include a CHP system to power the Denmark Hill campus. Planning approval has been sought for a CHP unit off Coldharbour Lane. Due to the very close proximity of the proposed CHP plant, there is potential to link to the Hertford Estate.

   Ramboll recommends that the various proposals for this area are looked at with a view of linking these smaller opportunities in to a larger more efficient scheme.

   This area could also potentially connect with Focus Area 3.

   A more thorough investigation of the heat loads in this area should be conducted and, at a later stage, a scoping study could be commissioned to assess the feasibility of increasing plant size and the potential of linking focus area 3 & 4 (and 9).

   A technical and financial feasibility study is proposed to assess the viability..

5. **Clapham Park**: In this area several housing estates have been identified as significant heat consumers, together with three primary schools they provide an opportunity for decentralised projects.

   The Clapham Park estate was transferred to Clapham Park Homes, part of the MHT RSL group. The estate is currently undergoing a wider redevelopment over a phased timescale. Two CHP plants will service the whole estate and these units have according to the council been sized for the base load of the development, which they believe will limit the expansion of the schemes.

   The schools in the local vicinity, which would have a different heat demand profile, could help improve the efficiency of the CHP units if connection at a future date is assessed as feasible. This would require discussion between Clapham Park Homes, schools and the council.

   Within this Focus Area 21 buildings/connections have been identified.

   The options available should be investigated i.e. one larger more efficient CHP, the linking of plant through a network and the connection of more buildings for increase operational efficiency.

6. **Future Clapham**: This area houses a collection of local government buildings, eleven housing estates, primary schools and also the Clapham Fire station which has a significant heat demand. A number of large housing estates along Clapham Park Road could potentially join this network, subject to crossing of the A3.

   The masterplan for future Clapham includes two development sites. The first is the redevelopment Mary Secole House, a former council office block. The site will be home to a new library, healthcare centre and new homes and is to include a CHP unit. The second development is for a new leisure centre. The existing leisure centre will be demolished and a new leisure centre built which will include a CHP unit. Both of these projects received planning approval in 2009 and are now according to the council "on site with fixed budgets". In the short term, the council judge it unlikely that future connections will be made. However, there is the potential for a larger network to be developed and the connection of the two sites should be (or should have been) combined to form a more efficient system.

   Within this Focus Area 20 buildings/connections have been identified.

7. **Norwood/Hainthorpe**: There is a proposal for a CHP scheme located in the Norwood Hall. In addition there is public housing in the area that could help in securing more heat loads and enable a more efficient scheme. Norwood Hall is a PFI project that involves the development of a new health and leisure centre on the old Norwood Hall site. The Hainthorpe Estate is adjacent to the development site and while connection may not be feasible at present, there is potential to assess connection at a later date. This will require a more thorough investigation.

   Within this Area 2 buildings/connections have been identified.

8. **Roupell Park**: Six estates along with a nursery school and Raleigh Hotel create a cluster of buildings which together could build a load for district heating within this area. A CHP unit has been installed at Roupell Park to provide heating and hot water to all units but has yet to be put into operation.

   Within this Area 12 buildings/connections have been identified.

9. **Myatt's Field**: The Myatts Field North estate is scheduled to undergo major re-development which includes the installation of a gas-fired CHP unit to provide communal heating to all units. The ESCO for this scheme is showing an interest in connection the CHP to the already communal heated South estate.
   Subject to further investigation, there is potential to connect other buildings in the area such as the Cowley estate, the Paulet Road and Holland Grove housing estates, which all have significant heat loads.
   An opportunity also exists to include a link with Future Brixton (Focus area 3). In addition, the Myatt's Field estates were originally considered for connection to a heat supply from SELCHP and this is a future opportunity that should be tracked.

Table 2 below summarises the estimated heat loads for each of the Focus Areas.

Focus Area	Estimated heat consumption (MWh/yr)
1. SBEG/Waterloo	63,730
2. Ethelred	9,330
3. Future Brixton	16,374
4. Hertford	42,530
5. Clapham Park	6,035
6. Future Clapham	1,295
7. Norwood**/Hainthorpe**	470
8. Roupell Park	3,669
9. Myatt's Field	13,744
TOTAL HEAT DEMAND	**157,176**

Table 2: Focus Area heat demands for potential district heating network(s)

The distances between the different focus areas are such that a future aspiration for Lambeth Borough should be to link up all or some through a large district heating network. The linking of Focus Areas with a wide area distribution network will allow the implementation of energy centres at strategic locations, away from densely populated areas if desired. This also allows the development of renewable/low carbon fuel sources in a progressive manner displacing any fossil fuel based generation.

4. IMPLEMENTATION PLAN

4.1 Focus Areas

Having identified Focus Areas where a heat network could be created, we have tried to ring fence heat loads within each Focus Area. We have then extracted the building data within each Focus Area and tabulated the summary data. The data tables for each Focus Area can be found in Appendix G.

The data in the Focus Area tables (Appendix G) are set out in order of greatest magnitude of annual energy consumption. It should be noted that we consider some of the information regarding the energy consumption not consistent with the type and use of the building, so it is possible that the original data provision may include errors. Some buildings have no heat data, but have been included for information as they may have the potential of contributing to the development of a heat network.

The buildings where the data needs to be validated include:

- Lambeth Fire Station
- Department of Health, 133 - 155 Waterloo Road
- Stockwell Gardens Housing Estate
- Clapham Library
- Alexandra Walk Housing Estate

The ranking of the Focus Areas has been generally set out on a High/Medium/Low basis. This ranking is to allow the Borough to concentrate their efforts in areas of greatest potential. A Low ranking does not mean to convey the impression that the area has no potential for a heat network; merely that it is comparably less likely than another.

Ranking also takes into consideration local impacts such as major road, rail and water courses that may impede the development and/or expansion of a heat network and these are set out in the 'Barriers' column of the Implementation Plan in Appendix H.

At this stage we have not determined the viability of each building connection as this is an activity that would occur during a more detailed feasibility study. Appendix H tabulates the Implementation Plan with respect to each Focus Area and the Focus Areas are illustrated in Appendix 5.

The implementation plan in Appendix H needs to be read and utilised in conjunction with the information conveyed in this report and in particular Section 6, 7 and 8 below.

The implementation plan has been populated with inputs from the council and reflex their view and priority.

4.2 Further Data Gathering

In order for the Borough to maximise the opportunity of each Focus Area, consideration should be given to gathering data on the buildings that this study was unable to retrieve due to time constraints. This work could be considered as part of the detailed study of individual Focus Areas or as a separate study.

4.3 Cross Borough Opportunities

1. Future Clapham and Ethelred Focus Areas (focus area 6 & 2) border the VNEB OAPF. This provides an opportunity to link to the Wandsworth part of the VNEB system.

2. Myatt's Fields (focus area 9) is located on a proposed route of the SELCHP district heating network as identified in SELCHP community heating scheme – options appraisal report. The Camberwell area in Southwark has been identified as a focus area (Southwark focus area 3) so there could be opportunities to link these two focus areas together along with the Hertford area (Focus area 4).

3. The Kings College Hospital in Hertford could link into developments in Southwark. The SELCHP system has been investigated and proposals include a network that comes through Peckham and Camberwell into Lambeth. As part of this or on its own merit, there may be synergy effects by linking the King's College Hospital with Camberwell and or the Myatt's Fields developments as above.
   The different proposed and installed CHP schemes opens up an opportunity for a larger network utilising and mixing different heat producers and optimising their operation.

4. Clapham Park Focus Area 5 could extend into Wandsworth on the other side of Balham Hill, as there is a highly developed mixed area on the Wandsworth side. There are several developments that would warrant an investigation located south-west of the South Clapham Underground station. e.g. St Francis Xavier College.

5. COMPLETE DISTRICT HEATING SYSTEM

District heating (DH) is a method of delivering heat from a variety of heat producing sources to a number of heat customers. Heat produced from fossil fuel sources such as natural gas, oil or renewables burned directly in boilers or through combined heat and power (CHP), or a combination of both, can be delivered to residential dwellings, commercial & public offices, schools, warehouse and factory, hospitals plus industrial process heating such as air drying or pre-heating.

Conventionally the heat demand in a DH system is met by waste heat from power stations and energy from waste plants, utilising heat generation which would otherwise be wasted and subsequently it comes at a very low cost. In smaller schemes it is common to have to install the heat production assets, which often unfortunately adds cost to the scheme.

The advantage of a district heating system is the flexibility and the ability to utilise a variety of heat sources, including what can be called low-grade heat. Low grade heat can be considered as heat delivered at a temperature that would not normally be usable in conventional heating systems.

While CHP and district heating enable the delivery of low-carbon energy on a large scale, it is the renewable fuel used in the process that makes all the difference. For this reason, the use of biomass, biogas, or bio-fuel is becoming more widespread though the sourcing of such fuels must be analysed with care.

A number of options are likely to emerge when the objectives of a district heating project are considered. Ramboll's experience shows that two key principles are useful to consider.

First we think it important to avoid advanced technologies, such as biomass fuelled CHP, at the early stage of a project. Simple or proven technologies are cheaper to install, they carry less risk in terms of operation and maintenance and once the project is running and creating revenue, there will be a more solid base for further investments.

The second principle is to avoid overspending on the network and therefore a phasing of the build-out would often be part of the suggested approach. District heating networks require considerable investment and it is necessary to optimise dimensions both in the initial situation and with a view to future proofing. The crucial part of establishing a district heating system is to ensure that enough customers connect at an early stage.

A complete district heating system includes everything between the heat exchanger at the heat production facility to the consumer's heat exchanger. A complete district heating system includes as main components:

- Heat Production.
- Pumps.
- Pressurisation system.
- Controls.
- Pipes.
- Heat exchangers and End-user installations.

In addition a thermal store could be part of a system as well.

Often a feasibility study is carried out to in broad terms assess the viability of a district heating scheme. A feasibility study can be carried out to different levels of detail and can look more closely at technical and/or financial issues. Planning and implementation is also often focused

upon early on. Not until a preliminary or detailed design would we generally look in detail at identifying all the equipment necessary for a specific district heating system.

The heat production facility is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP is, as a rule of thumb, only operated as a base load[2] plant as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well designed district heating network heat from CHP, this will provide between 60% and 80% of the annual heat requirement with heat-only boiler plants providing the peak load and back-up.

District heating opens up the opportunity for utilising low/no carbon fuels and can offer maximum energy utilisation from solar energy as a heat sink for the low temperature water. Larger solar thermal arrays are sometimes included in a district heating system. There are a number of examples in Europe where large-scale solar thermal arrays have been integrated with district heating networks, also in an urban and city environment. This is often seen as the next stage in decarbonising the heat supply.

There are technical and hydraulic components of a district heating scheme that are important to the design and operation of a system and there are considerations to be made in respect to temperatures, pressures, base and peak heat load and reserve or back-up requirements.

In general a district heating network can be divided into three main parts:

- The transmission network.
- The distribution network.
- The internal heating system at the consumer.

The transmission network operates at high temperatures and pressures and carries large amounts of heat from larger heat producing units such as central power plants, waste incineration plants, to strategically placed heat exchanger stations where the heat is transferred to the distribution network.

The distribution network, operating at lower temperatures and pressures than the transmission network, supplies heat to each individual consumer. Normally, the transmission and distribution network interact only through heat exchangers meaning that they are hydraulically separated. In many cases this also applies for the interface between the distribution network and the internal heating system at the consumers.

The cost of installing the heating network depends in summary on four factors:

- The design operating temperature and pressure.
- The complexity of existing services.
- The length of the network.
- The peak heat demand.

Although not considered for this study it might be an option to use the heat distribution network for district cooling purposes in the summer. For example, the network can be used to transmit hot water to decentralised absorption chillers producing chilled water for a group of consumers. In this way it is possible to utilise any surplus heat from the heat production plant e.g. the CHP plant in the summer.

From a design and operation point of view higher temperatures are desirable when considering the use of absorption chillers. A high temperature heat source will reduce the overall size of the chiller system. Therefore, from a district cooling point of view, the higher the operation flow temperature in the distribution network, the better.

[2] Here base load is considered to be more than just the demand for domestic hot water load (DHW)

5.1 District Heating Network Outline

As part of the heat map study work Ramboll has outlined an example of a heat network. Focus Area 3 covering part of the Future Brixton area was selected and a potential network is illustrated in Appendix 6 and a network outline with pipe dimensions can be seen in 5.3 below.

5.1.1 Pre-conditions

The outline of the district heating network considered in this assessment is based on the conditions described below.

The flow temperature has been chosen as 90ºC and the cooling of the district heating water, which could also be expressed as the delta (Δ) T through all consumer installations, chosen as 40ºC (meaning that the consumers return the district heating water at or below 50º C). A ΔT of 40 ºC at a flow temperature of 90ºC is normally a very cost effective option to minimise construction costs of district heating networks while still meeting the standard heating design temperatures within existing properties for connection.

The distribution network is recommended as being pressure rated at 16 bar. A maximum pressure of 16 bar and a static pressure of 1.5 bar, therefore, has been used for the hydraulic optimisation. A pressure difference of 1 bar at the end-user installations has also been assumed.

It is assumed that there are no significant changes in ground level throughout the study area.

The necessary pipe dimensions are estimated by using the software package "SYSTEM RORNET", which is a simulation programme for hydraulic and thermal analysis of district heating networks. SYSTEM RORNET (SR) calculates the optimum diameters of the pipes based on knowledge about temperature difference between flow and return, pressure levels, costs for piping and the maximum velocity in the pipes. SR is a Ramboll in-house software package specifically developed for district heating and cooling network optimisation.

5.1.2 Heat Loads and Diversity

Heat loads are used for network dimensioning and are calculated based on the annual heat demand.

In a district heating network the branch supplying a single consumer is designed for the consumers peak load demand. A distribution pipe supplying several consumers is not designed for supplying all the consumers with their peak load demand at the same time as individual peak load demands will not occur at the same time (referred to as diversity in heat loads). Therefore, the peak load demand of each consumer has to be multiplied by a diversity factor to find the heat load that the distribution pipe should be designed for.

The annual heat demands in Table 2 are turned into heat loads using a yearly utilisation time of 2,250 hrs per annum taking diversification in the system into account.

The rounded heat demands and network heat loads for the proposed scheme are shown in Table 3.

Area	**Estimated heat consumption (MWh/yr)**	**Max. Heat Load (MW)**
Focus area 3 Future Brixton	16,400	7.3
TOTAL HEAT DEMAND ON NETWORK:	**16,400**	**7.3**

Table 3: Rounded heat demands and loads estimated for the potential district heating network.

5.1.3 Network Layout

A network layout showing the proposed nominal diameters is seen below:

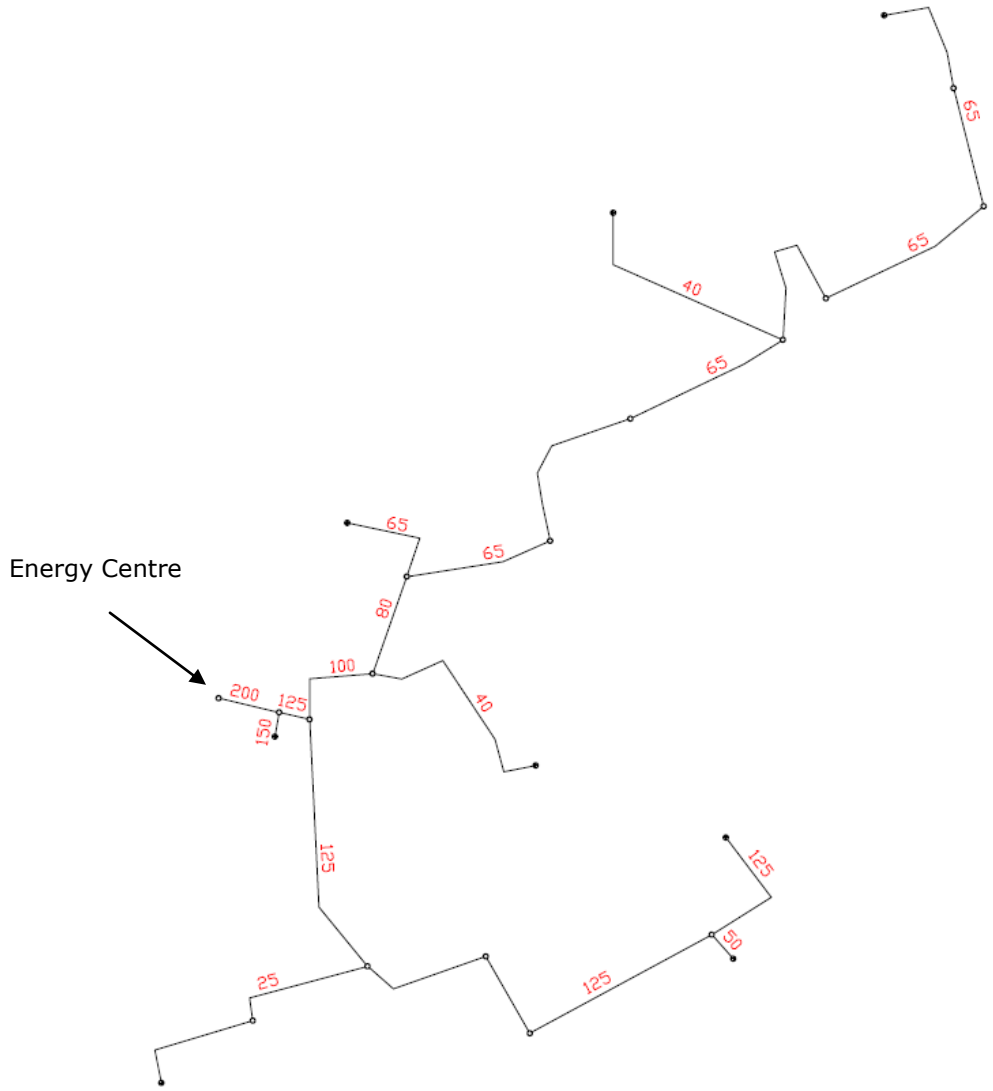

Figure 1: Example heat network layout.

The total length of this particular network is approximately 2.9 km. The largest pipe dimension is DN200.

The network outline above can also be seen in Appendix 6.1.

5.1.4 Heat Loss from the Network

The network heat loss has been estimated based on the proposed pipe dimensions, the flow and return temperatures and the assumption that the surrounding soil is at 8 °C. The heat loss in a full load situation is found to be around 100 kW which gives a heat loss of around 750 MWh per annum. I.e. on average less than 5%.

5.1.5 District Heating Main Network Cost Estimate

The network costs have been estimated to be around £2.9M. This cost is a basic and high level estimation based upon an average cost per linear metre of installing a flow and return pipe in a suitable trench. The cost includes for the mechanical and civil engineering works. The unit cost basis differs for each of the pipe sizes identified in the network and for the type of ground that the pipe is installed in, e.g. road, verge, grassland. This cost however, excludes the cost of the energy centre and any modifications and/or equipment required by buildings to connect to the heat network,

The cost and difficulty associated with crossing the A23 and rail links also needs to be investigated and priced in addition.

5.1.6 Comments on network

The network indicated has been enclosed as an example of connecting a number of buildings and across Focus Areas. The Focus Areas are to some extent indicative and a network does not necessarily have to consist of the precise number of buildings.

The outlined network is relatively large in UK terms, both in respect to the length and demand that is being met. Although as mentioned earlier, there is potential in the area for a much larger network.

The exact approach and connection of buildings should be investigated in more detail.

6. DISTRICT HEATING VIABILITY

District heating represents a significant capital investment. Often it requires long term investment to pay for the establishment of a district heating network.

This very high level assessment study does not include a detailed cost analysis which would be required to fully evaluate the viability of a complete district heating scheme. This study does not provide enough information to fully evaluate the viability of a complete district heating scheme with all its capital costs and operation and maintenance over a whole life cycle.

This assessment only looks at the outlined heat network as an example from when it leaves the energy centre and to a node or point of entry into a building or area of buildings. It does not include any heat production facility or energy centre, any heat exchangers and/or consumer interface units.

The network costs are generally by far the most significant investment which can account for as much as 70% of the total capital investment.

This is of course a very rough estimate based on a basic network outline which needs to be validated with a feasibility study.

When looking to establish the feasibility and/or options available with respect to implementing a district heating infrastructure there are a number of potential variations and/or level of detail that can be required. It is unlikely that there will be one model that fits all potential schemes and it will be important to look at the particular scheme to establish the best way forward.

In terms of viability there will be other measures than capital costs and short paybacks that should be contributed a value. Ramboll's experience from Denmark is that district heating offers many environmental, social and in a longer perspective also economic benefits to a community or country as a whole.

The history of both large and medium scale district heating systems bears evidence that the scale of the investment and the length of the payback period make both the funding and the

organisations implementing and operating the system very important when considering a scheme.

The delivery vehicle is frequently referred to as an Energy Services Company (ESCO) in the UK but a traditional ESCO is not necessarily always the answer. The scale of the technical installations, the complexity involved in the phasing of the scheme and the commercial arrangements could call for a different approach. Again the details of the specific scheme proposed will and should have an influence in the model chosen.

The requirements of those who finance schemes will have a strong influence over the chosen delivery vehicle, and the nature of energy supply agreements. They will lead to fundamental requirements that will include:

- Return on capital.
- Servicing of debts.
- Loan period.
- Supply agreements.

Looking at the history of district heating in the UK each of the models used in the past has been driven by Local Authority leadership, influenced by specific local priorities, and constrained by policies governing the apportionment of risk and public sector borrowing.

There is a variation on the ESCO model which has been termed a MUSCO (Multi Utility Services Company). This approach has not yet been implemented on any significant scale in the UK. The UK's largest MUSCO is currently being planned in London[3].

Setting up the delivery model for a potential district heating scheme is often a study in itself.

The demand for flexibility could be the most serious obstacle to a framework contract with a private enterprise, but also the financing, which is essential to the future heat price. This is very important because it will influence the heat price and thereby the competitiveness of the scheme compared with the alternatives.

An obvious conclusion, therefore, could be that the delivery vehicle will have to be based on a public framework agreement, possibly including private stakeholders but with strong influence from local government. The planning requirements and the fuel poverty issues also point in the direction of a public enterprise.

The investment in the pipe network is substantial and long-term and developers often find it difficult to identify any special conditions that would make the scheme more attractive to them.

If we look at the most successful schemes in the UK, like Sheffield and Nottingham, they were originally set up by the city councils as public enterprises driven by social and environmental goals.

We are not aware of any modern district heating scheme in any part of the world that successfully has been established without public investment or other public support mechanisms and it seems unlikely that significant scaled schemes can go ahead without local authority initiative and financial support from either local or central government.

[3] The London Borough of Southwark has determined that the regeneration of the Elephant & Castle district should be a model of sustainable development with particular focus on reducing the energy-related carbon footprint of the new developments. The regeneration is privately funded but facilitated by the public sector (LB Southwark), necessitating a private sector solution to the provision of low carbon energy services to the sited.

In Section 7 we look a little further at non technical issues to consider when venturing into a district heating project.

7. OTHER DISTRICT HEATING NETWORK ISSUES

There are a number of technical issues that have to be overcome to be able to establish a heat network but the development, installation and operation of a system has some very important aspects from the (relatively) short term engagement to the very long term operation and maintenance.

The following outlines some of the non-technical issues that need careful consideration and inclusion prior to the development of a heat network.

The issues listed broadly cover what Ramboll would expect at this early stage of the project process of establishing district heating networks. It is likely that there are areas that the council is already covering fully or partly and so the list of issues can be used as a check list and pointer as to establish if the Borough is moving in the right direction.

7.1 Local Authority and Stakeholder Engagement

Engaging the Local Authority (LA) and other stakeholders early in the development process can result in a simplified marketing requirement.

A continued engagement will allow aspects of the future system to be explained and accepted. Many of the benefits that can be deployed through a district heating (DH) system can be relayed through local meetings and positive press coverage. It is important that, at this stage, robust technical and commercial support and guidance is offered to ensure that the correct technical and economical message is conveyed.

7.2 Marketing

Marketing, particularly to third party potential business, is key in informing and reassuring. New developments that will have obligations under National Planning Policies may feel that their options are limited by the presence of a local heat network and will require gentle and informative guidance as to the benefits of a DH system. Typically discussions would concentrate on capital cost savings over a traditional solution, operational cost savings, reliability of operation, efficiency and controllability of the DH system and space saving. In many instances many aspects of building design can be simplified and enhanced by not having to design in space for boiler flues, for example.

A different approach can be taken with existing buildings whose heating plant has reached, or is about to reach, the end of its working life. In many cases a need is automatically created and can be met with a DH connection. Discussions at this stage can typically involve speed of solution and cost rather than the other benefits.

Maintaining a close awareness of existing buildings without an immediate need for a connection will be an ongoing activity until such time that their heating system comes to the end of its working life. Other factors like fuel price or modernisation may accelerate a change.

Clearly these activities will require resources – particularly at the outset – and maintained throughout the business via the use of a computerised customer database.

7.3 Local Authority Involvement

The LA involvement is essential in creating the correct environment for the success of a DH system. Much of the assistance that the LA can contribute is the coordinated view of new and existing development when considered from a Local Development Framework perspective.

Close cooperation with the Planning Department will help develop a coordinated approach to helping the LA adhere to National Planning Policies particularly with respect to Energy and Sustainability.

A continued dialogue and understanding with the 'Highways' department will ensure that the installation of the DH apparatus in LA possessed land can be identified to ease the financial and technical risks involved in the ongoing development.

Ideally a LA would want to have cross-party consensus on the development of a DH system but it is important that such a development should have, at least, a champion at Councillor level; if not at Officer level. Maintaining the political will for such a scheme in the early days of development can provide a powerful boost to the uptake of a DH system.

7.4 Operating Company/ESCo

The Borough has previously undertaken a study to determine what ESCo solution would be most appropriate.

Very early in the conceptual stage of business development, a decision has to be made regarding the future structure of the Operating Company. Typically, reference is made to an Energy Services Company (ESCo); this being a common offered solution. The size and structure of an operating company, be it a traditional ESCo or any other arrangement, will depend on the duties undertaken by that specific company and whether these duties include maintenance.

There are a number of models that can be identified which can be used to establish an 'ESCo'. Each of these models can be been driven by Local Authority leadership, influenced by specific local priorities, and constrained by policies governing the apportionment of risk and public sector borrowing and can be broadly characterised into five models:

- Private enterprise driven by public sector framework agreement.
- Private enterprise driven by public sector stakeholding.
- Social enterprise driven by public sector stakeholding.
- Social enterprise driven by consumer and public sector stakeholding.
- Public enterprise driven by social and environmental goals.

The variations between these models are largely the result of the following factors:

- Public sector borrowing: The need to minimise borrowing that would appear on a Local Authorities balance sheet, as required by Central Government.
- Exposure to risk: The need to minimise the potential exposure of a Local Authority to financial risk if an ESCo was to default on finance repayments.
- Expansion and replication: The ability of the ESCo and its partners to expand and replicate energy networks across towns and cities.
- Social and environmental goals: The ability of an ESCo to strategically deliver on social and environmental goals in the short, medium and long term.

The ESCo will need to ensure that key aspects of developing a heat network are accommodated. Notable is the need to ensure that detailed planning is maintained and updated to ensure that the developing network is designed sufficiently to be able to connect to all new build.

The Borough should consider the contractual implications of any arrangements with the ESCo as these are likely to be developed for the long term to allow the ESCo to secure the original funding. This important aspect can also set the tone for the ongoing relationship.

8. RECOMMENDATIONS & WAY FORWARD

Ramboll's experience is that district heating offers many environmental, social and in a longer perspective, economic benefits to a community and country as a whole. For example, around 60% of all households in Denmark are connected to a heat network with three-quarters of that heat supplied as waste heat from CHP plants, some of which are biomass fuelled. A further 12% comes from waste incineration, 6% is biomass burned in boilers and 3% is industrial waste heat. Only the remaining 4% is natural gas or oil used in back up boilers during peak demand or to provide spare capacity in case of emergency or maintenance.

Nine focus areas were identified as having potential to develop into heat networks and have been ranked in order of priority;

High priority:
- SBEG/Waterloo (focus area 1)
- Future Brixton (focus area 3)

Medium / high priority:
Myatt's Field (focus area 9)

Medium priority:
- Future Clapham (focus area 6)
- Ethelred (focus area 2)
- Hertford (focus area 4)

Low priority:
- Clapham Park (focus area 5)
- Norwood (focus area 7)
- Roupell Park (focus area 8)

The heat networks that can be developed within the proposed focus areas for the Borough of Lambeth and others like it are fundamental to the UK and its environmental targets.

The Mayor of London has a target of 25% of London's energy requirements to come from decentralised energy by 2025. This aspiration is further emphasised in the draft replacement London Plan and draft Climate Change Mitigation and Energy strategy, which both state that wherever possible, decentralised energy should be incorporated into new development, by either expanding existing heat networks or installing new. The draft replacement London Plan prioritises decentralised energy in all new development *and* major refurbishment, if viable.

Heat networks are proven to be an efficient method of meeting heat demands. Successive national policies have continually emphasised the deployment of decentralised energy as a key mechanism to reduce carbon dioxide emissions, contribute to a diverse and secure energy supply, and help tackle fuel poverty, heat networks are vital to the success of the policies.

The Low Carbon Transition Plan was published in 2009; it set out Government's plan on meeting the legally binding carbon dioxide reduction targets in the Climate Change Act 2008, which included setting up decentralised energy infrastructure.

In addition, Government is consulting on a new Planning Policy Statement (PPS) on Planning for a Low Carbon Future. This new PPS makes it unequivocally clear that councils "should assess their area for opportunities for decentralised energy"[4].

[4] www.communities.gov.uk/publications/planningandbuilding/ppsclimateconsultation (page 16)

The heat map study produced as part of this study is the start of developing a strategic approach to decentralised energy in Lambeth. It is a very early high level assessment of the potential network locations. The next phase should be to complete a more detailed feasibility study of the proposed preferred schemes as a whole.

- A detailed and more in-depth study would examine the heat demands and their connection to a district heating system in more detail.
- Due to the varying sizes of the potential district heating networks within the Focus Areas considered in this study and to fully consider the potential for a Borough-wide approach, a more detailed study needs to consider the transmission/distribution network approach as to what will be the best technical solution in combination with the viability of the scheme.
- The investment is significant and a more detailed study should look at phasing the implementation of the heat networks and look at reducing the investment risk.
- A detailed cost analysis and viability calculation based on whole life cost should be carried out on each potential network.

It is likely that even following a detailed feasibility study, a number of questions and uncertainties will remain, which should be thoroughly investigated to minimise risks. The investment in a heat network can be considerable and thus it is important that work is carefully planned to mitigate against potential risks. The detailed specification for the installation and maintenance of the district heating network is worth considering as early as possible in the project process to gain greater certainty for both the capital and operating costs.

Ramboll would recommend that;

- A feasibility study or number of feasibility studies be undertaken for each of the recommended Focus Areas potential heat networks.
- A study should be undertaken to determine what other buildings, not identified within the scope of this study, could form part of the core heat networks. For each heat network an additional investigation should be undertaken to consider the network and the heat production facility in more detail.
- A study should be undertaken to determine the heat data for buildings that this study was unable to retrieve.
- A study should be undertaken to determine how the heat energy demands for the Borough – as a whole - can be met, particularly from low carbon sources. This work should be considered in light of the development of heat networks.
- Consideration should be given to determining an overarching energy plan with all neighbouring Boroughs.

Once the decision has been taken to establish a district heating scheme it is Ramboll's experience that the next stage should be a preliminary design.

The project process can be listed as below, but what is included within the different stages will depend on time and budget available; however it is important to the success of the scheme that it is planned and investigated thoroughly.

- Feasibility study – can be carried out at different levels of detail and accuracy
- Preliminary design
- Detailed design
- Tendering / procurement
- Construction management
- Supervision
- Commissioning