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LONDON HEAT MAP STUDY
FOR LONDON BOROUGH OF LEWISHAM

RAMBOLL

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1. INTRODUCTION

In February 2010, Ramboll were appointed by the London Borough of Lewisham to perform 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 the results of the heat mapping.
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 to a GIS heat map.
2. Upon receipt of the heat map from the LDA, the map 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 DH network opportunity and 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 development of District Energy networks in the Borough to help strengthen and consolidate current plans for such networks. In particular, based on the findings of the current study, the Strategy and Sites Development Plan Documents can identify areas/sites with specific District Energy Network (DEN) opportunities in the borough. It is expected that clear guidance from the Council will provide the certainty needed to attract investment in DEN proposals within the Borough.

2. DATA COLLECTION

The main objective of the project is 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 Lewisham Borough in collaboration with the LDA.

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 what they already had. A spreadsheet of the LDA data is shown in Appendix B.

Each building row entry was populated in as many columns as possible in the spreadsheet. All the mandatory columns were completed with the exception of some postcode entries for housing estates that covered too large an area for these to be relevant.

The methodology for data gathering was to target heat demand by building type.

- Multi-address buildings
  - Gas consumption data for council-owned premises was provided to us by Peter Gibbs of Lewisham Council (NI 185 database).
  - The GLA SELCHP Report[1] which Ramboll co-authored includes five entries which were added to the spreadsheet.
  - Five housing associations were contacted.
    - Lewisham Homes (Martin Hayes): buildings with communal heating systems were obtained but no heat data is available.
    - Metropolitan Housing Trust (Roger Tullet): confirmed that no large schemes are present in Lewisham.
    - Affinity Sutton (Susie Ward): we are still waiting on data.
    - L&Q Group (Robin Feeley): we received no response.
    - Hyde Housing (Richard Payze); no response was received from Hyde Housing.

- Sport & leisure facilities
  - Heat consumption data was extracted from the NI 185 database
  - Additional entries were filled in from the borough's Local Land and Property Gazeteer (LLPG) database.

- Prisons: There are no prisons in the Borough.

- Hotels
  - Large hotels (> 149 bedrooms) were identified using an internet search. Gas consumption was approximated using CIBSE Guide F benchmarks.

- Education facilities
  - Gas consumption for schools and nurseries was extracted from the NI 185 database.
  - Goldsmiths University premises gas consumption was supplied to us by Peter Gibbs of Lewisham. The data is confidential.
  - Additional entries were identified in the LLPG database.

- Police stations
  - Police stations were copied from the LLPG database. LDA to provide consumption data.

- Fire stations
  - Fire stations were copied from the LLPG database. LDA to provide consumption data.

- Hospitals
  - Gas consumption data for Lewisham Hospital was obtained via the NHS website.
  - One private hospital site was identified in the LLPG database. Number of beds was recorded.
  - Gas data for Lewisham PCT sites was obtained and included in the spreadsheet.

- Museums & art galleries
  - Gas consumption data for the Horniman museum was obtained and recorded.

[1] *SELCHP Community Heating Scheme - Options Appraisal. Rev 3.,* Greater London Authority, February 2005.

- Central government estate
    - We have contacted JobCentre Plus but were told that JobCentre Plus do not own or manage their premises and that no data is available

- Local government estate
    - Data was extracted from the NI 185 database. Energy for premises with no consumption data was approximated with CIBSE Guide F benchmarks.

- Religious institutions
    - Premises were identified through the LLPG database but due to the low heat demand, no attempt to gather actual consumption figures was made.

- Private residential units (>149 units or 9,999m^2)
    - Planning application data and area development plans were sent to us by the Borough. Proposed developments were benchmarked based on a 20% or 50% reduction of Part L value depending on the predicted construction date.

- Private commercial units (>9,999m^2)
    - Private commercial units were identified based on the planning application data and area development plans sent to us by the Council and identified on the Council's website. Where possible, data for mixed use developments was split into multiple entries according to the typology. Proposed developments were benchmarked based on a 20% or 50% reduction of Part L value depending on the predicted construction date.
    - 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 (for their London sites in Acton, Camberwell, Peckham, Queensbury, Southwark, and Streatham) but unfortunately this arrived too late to be able to be included in the analysis, however the loads that were indicated would appear to offer potential to a network. Lidl and Aldi were not contacted due to time constraints.

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 affected and considerably improved the new building stock in terms of energy demand; an average existing home requires 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 and estimated the annual heat demand (measured in MWh) for potential district heating networks in the London Borough of Lewisham. The heat demand represents the sum of all the estimated 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 were benchmarked based on a 20%, 50% or 80% reduction of Part L value depending on the predicted construction date. Benchmarks 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/m2/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)

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 in a heat load should the data become available in the future.

Heat Sources

- Industrial Heat Map website: No records of heat source
- LEP database: 2 entries - SELCHP and Phase III Former Bell Green Works. These were added into the spreadsheet.
- Eionet Large Combustion Plant Database: No records in Lewisham.
- DECC CHP Database: No records in Lewisham.
- OFGEM CHP Database: No records in Lewisham.

District Heating Networks

The LEP database lists four community heating schemes:

- 1-41 Leander Court, Ship Street: No further detail
- Lewisham Gateway: Listed as "Constructed"
- Phase III Former Bell Green Works: Listed as "Proposed" for 2008
- SELCHP: Listed as "Constructed"

The information from the LEP database would appear to be unreliable since no network currently exists for SELCHP and Lewisham Gateway has planning permission but nothing has as yet been built. Ramboll are not aware of any national database that records specific information on the existence and extent of heat networks.

The Borough kindly informed Ramboll that planning permission has been granted for a mini-network serving a new leisure centre, housing and the adjoining existing/future school at Loampit Vale in Lewisham Town Centre. The scheme, we understand, is currently being built.

The raw data gathered by Ramboll for the heat map study is included in Appendix A. The existing LDA data included in the heat map is included in Appendix B.

2.2 Methodology considerations

With the relatively limited time scale of data gathering, it was important to prioritise the buildings and effort in line with 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 Borough's LLPG database was extensively used to identify potential buildings and consumers to be pursued. The LLPG database was then interrogated to obtain OS coordinate points for a specific address.

Where data was not found in the database, internet searches and mapping websites (Google, Streetmap, NHS, Expedia) were used to find and map additional premises.

Special consideration was given to proposed developments, which were identified through planning applications and data sent to us 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. Updated planning policies now provide greater incentive for new developments to become good candidates to start a district energy network.

Additional issues should be considered when analysing the data.

- 'Double counting' – future developments with estimated heat demand may overlap existing sites where heat demand is already counted. Data collected from various sources may overlap data which was already on the London heat map database but which was not made available to Ramboll.

- Estimated data, as noted in the spreadsheet, may differ from actual consumption depending on, e.g. building fabric, occupancy patterns, 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. SELCHP Power station was identified as the major heat source in the borough. Many of the proposed developments plan to utilise CHP and communal heating systems. Excess heat from these CHP systems may be available for export to a future network.

- There was an expectation the LDA would provide information from the VOA covering commercial buildings, but at the time of completing the report this data had not been made available to Ramboll. Consequently a number of buildings have not been identified or included in the heat analysis and will need to be added in later.

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

- Police stations and TfL data to be collected by the LDA was not available in the timescales of the project.

- A proportion of the information gathered was partially incomplete, as information could not be returned within the timescale of the study.

3. HEAT MAP ANALYSIS

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

599 buildings (including those buildings identified by the LDA) were included in the assessment.

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 found 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, multi-address buildings (businesses)
- Local Government: Local Government Estate, education, sports & leisure, museums
- Central Government: Central Government Estates
- Other public: NHS, Fire, Police, other public, multi address (public with central boilers)
- Unidentified: This consists of data primarily received from the LDA

The heat demand maps also shows the major supply plants and/or a potential new network or development with CHP will be by a triangle (△), and/or by the outline of a proposed network.

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 that can later be used as a method of phasing the introduction of the district heating network and this can be seen in Appendix 4. The breakdown of the heat demand data for each region is given in Appendix C.

As much as possible the grouping has been based on dividing the Borough by major road, rail and water course. This decision 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 offer similar restrictions which tend to be overcome by either bridges or tunnels but these come at a significant additional cost.

The regions, therefore, are not geographically the same size and the number of buildings also varies within each of the outlined regions. The quantitative heat demand assessment results are presented in Table 1.

Larger Regions	Estimated heat consumption (MWh/yr) [based on available data only]
1. Deptford	75,350
2. Lewisham	19,011
3. Honor Oak Park	45,521
4. Hither Green	3,444
5. Catford	20,911
6. Bell Green	17,776
TOTAL HEAT DEMAND	**182,012**

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

The table summarises all the existing and proposed buildings identified from this work and from the current LDA database. There are many more buildings that fall outside the priority list but are worthy of inclusion in any future heat network viability and design. The above figures, therefore, are a significant underestimation of the total amount of heat available within the Borough. It must be noted, however, that not all of this potential load will ever be a viable opportunity.

Appendix C has the more detailed list of the buildings, identified in this work and from the LDA database, within each region and their heat demand. From this, priority buildings with no heat data can be seen. Theses should be a future target for obtaining heat demand data.

3.2 Criteria for creating clusters (Focus Areas)

Clusters need to be developed based on the following factors;

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. Where no such waste heat can be found, conventional sources of fossil or biomass should be sought.

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 have little capacity for expansion.
- 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.
- 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. This often makes the development of a wider network more viable as the initial asset provisions can be accommodated by the new development.

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.

3.3 Focus areas

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

With the criterion listed above in mind, the process by which a focus area is determined is by trying to group as many large heat users together as possible and at the same time corral the smaller heat users. 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 crossing across 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.

These Focus Areas are shown in Appendix 5 and described below, Table 2 below summarises their estimated heat demands for each focus area:

1. **Deptford/New Cross**: This is a high priority area. First, the area is in proximity of SELCHP, which could supply waste heat into the network. Secondly, there is a large number of existing and proposed development sites which, if connected, will largely increase the viability of the network:

   - Convoys Wharf (3,500 new homes)
   - Oxestalls Road/Deptford Wharfes (1,100 – 1,200 new homes)
   - Cannon Wharf (665 new homes)
   - Marine Wharf (527 new homes)
   - Surrey Canal Road (2,700 new homes)
   - Grinstead Road (160 new homes)
   - Arklow Road (200 new homes)
   - Kent and Sun Wharves (300 new homes)
   - Deptford Town Centre

- Sainsbury's Site (200 new homes)
- NDC Centre (173 new homes)
- Pepys Estate
- Silwood Estate (146 new homes)
- Neptune Wharf

Moreover, the New Cross Gate Area is home to Goldsmiths College which has, in its 2010 Masterplan, plans to provide a sustainable estate. This could provide a large and ideal start up load for a potential network and is illustrated thus in Section 5. Finally, a number of high-rise housing estates south of the A2 road can also provide a steady heat load for this network. This Focus Area should be looked at as a cross-borough opportunity with Southwark and Greenwich.

Within this Focus Area 178 buildings/connections have been identified. Each of the housing developments above is considered as one heat load or one connection.

2. **Central Lewisham**: The Lewisham Town Centre is earmarked as a major regeneration area in the borough. The two main development areas are Lewisham Gateway, a mixed-use project providing up to 800 new homes and Loampit Vale, a scheme of eight buildings ranging in height from 5 to 24 storeys incorporating a new leisure centre with an 8-lane swimming pool, 788 new homes, commercial units, and various community facilities. Both developments list CHP and community heating as the preferred servicing strategy. Other developments that can benefit from a potential network are Cornington Road (462 apartments), Lee High Road, as well as existing Lewisham Bridge Primary School.

   Within this Focus Area 11 buildings/connections have been identified.

3. **Hither Green**: This is an area with a concentration of residential blocks along with Hither Green Primary School, which may warrant the establishment of a small community heating network. In general, the heat load density would appear to be relatively low though.

   Within this Focus Area 13 buildings/connections have been identified.

4. **Catford/Lewisham Hospital**: This area could benefit from a network built around Lewisham Hospital and Lewisham Town Hall as the anchor loads. Other major consumers in this Focus Area are the Catford Greyhound Stadium development, Broadway Theatre, Ladywell Leisure Centre, Lewisham Shopping Centre, as well as Malling, Bredgar and Kemsley Residential Towers.

   Within this Focus Area 46 buildings/connections have been identified.

5. **Sydenham**: This is a relatively low heat density area, however there are a number of larger heat consumers which could be linked together. A network could serve the Hive Hotel as the anchor load and link Sydenham School with residential estates along Dartmouth Road, Wells Park Road and up to estates around Shackleton Close to the north. The network could perhaps extend westward as far as Sydenham Hill.

   Within this Focus Area 24 buildings/connections have been identified.

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

Focus Area	Estimated heat consumption (MWh/yr)
1. Deptford/New Cross	65,283
2. Central Lewisham	9,874
3. Hither Green	1,523
4. Catford/Lewisham Hospital	38,222
5. Sydenham	4,382
TOTAL HEAT DEMAND	**119,284**

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

The buildings for each focus area are listed in Appendix D. This list also identifies existing and new homes.

4. IMPLEMENTATION PLAN

4.1 Focus areas

Having identified Focus Areas where a heat network may be able to be created, we have extracted the building heat demand data within each Focus Area and tabulated the information in Appendix D.

The data in the Focus Area tables (Appendix D) is 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 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 course 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 E.

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 E tabulates the Implementation Plan with respect to each Focus Area.

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

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

The Deptford / New Cross Focus Area extend westward into Southwark where there is a high concentration of existing and planned developments. The concurrent Southwark Heat Mapping Study has identified this area as the "Canada Water" Focus Area. There are also a number of large properties in Greenwich along the A2 road, which could be connected to the Deptford / New Cross network. This cross-borough opportunity has been studied in more detail in the GLA SELCHP Report[2]. This report explores the various options of utilising waste heat from SELCHP. Ultimately, three branches are proposed to serve clusters in the London Boroughs of Southwark, Lewisham, and Lambeth. Although many of the report's finding still hold, several new developments have come into plans since its issue in early 2005. Moreover, the likely introduction of a Renewable Heat Incentive may improve the economics of the system, as it will depend on the detailed outline of the incentive.

5. COMPLETE DISTRICT HEATING SYSTEM

District heating (DH) is a method of delivering heat from a variation of heat producing sources to a variation 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, or industrial process heating.

Conventionally the heat demand in a DH system is met by waste heat from power stations and Energy from Waste plants utilising a heat generation which would otherwise be wasted and subsequently it comes at a very low cost. In smaller schemes it is common to look at installing heat production plant, 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.

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 biofuel 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. We will briefly outline a couple of the principles that we would suggest to be followed in a project.

First we think it is important to avoid advanced technologies 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 be part of the suggested approach. District heating networks require considerable investments and it is necessary to optimise dimensions both in the initial situation and with a view to future proofing. The crucial part of the establishing of a district heating system is to ensure that enough customers connect at an early stage.

[2] *SELCHP Community Heating Scheme - Options Appraisal. Rev 3.,* Greater London Authority, February 2005.

The 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.

The network links up the heat production and the end users.

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 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 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 will provide between 60% and 80% of the annual heat requirement with heat-only boiler plants providing the peak load and back-up.

Larger solar thermal arrays are also 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. District heating schemes offer maximum energy utilisation from solar energy as a heat sink for the low temperature water.

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, pressure, 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 the 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 chilled system. Therefore, from a district cooling point of view, the higher the operation flow temperature in the distribution network the better.

5.1 Sample district heating network outline

As part of the heat map study work, Ramboll has outlined an example of a heat network in New Cross, a sub-area of the "Deptford / New Cross" Focus Area. This sample network is outlined in Appendix 6 and shown schematically in section 5.3 below (including preliminary pipe dimensions). This network was chosen as a manageable sized network which could be developed for the potential for later receiving heat from SELCHP.

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 40ºC 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 but no information is available in this respect.

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: the individual peak load demands will not occur at the same time due to diversity. 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.

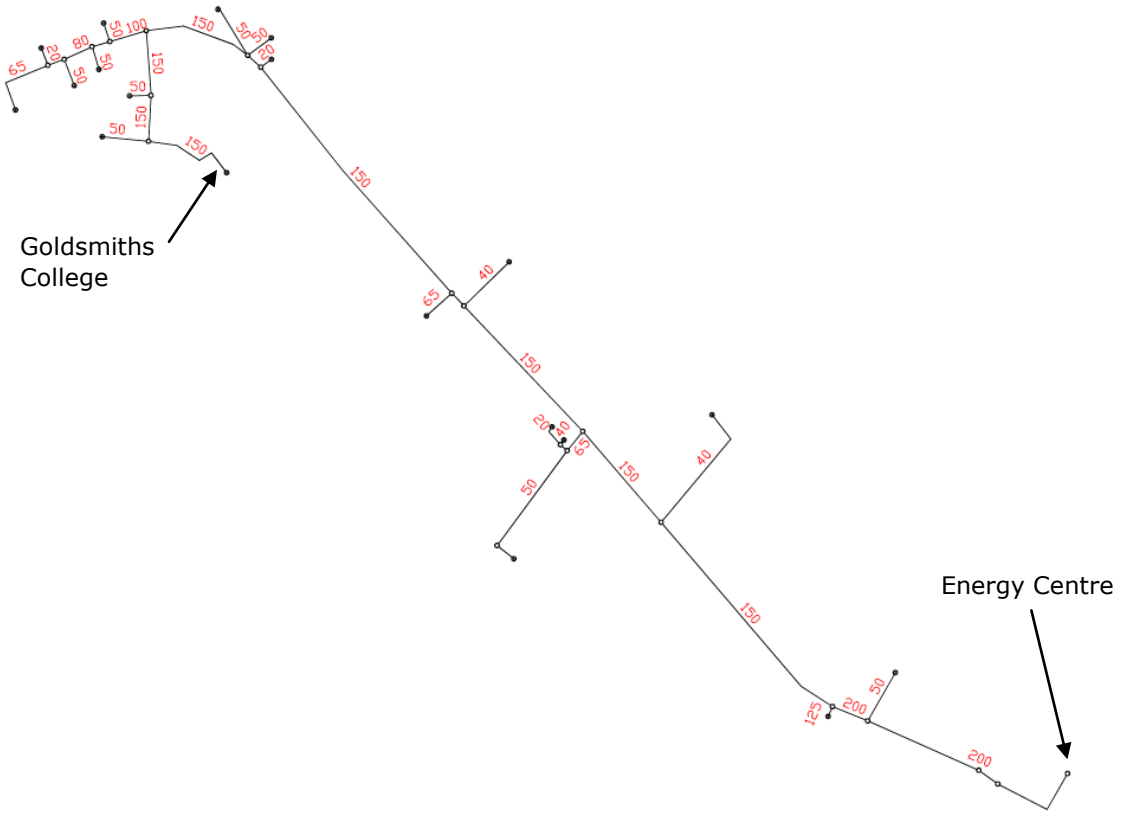
The rounded heat demands and network heat loads for the scheme are shown in Table 3.

Modelled Area	Estimated heat consumption (MWh/yr)	Max. Heat Load (MW)
Part of focus area 1, New Cross 19 consumers	18,800 MWh	8.4 MW

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 shown below and in Appendix 6.1:



The total length of the network is approximately 2.65 km. The largest pipe dimension is DN200. In this example the Energy Centre has been located in the south-east corner of the network. If Goldsmith's College was to be a significant player and the Energy Centre located at the college, the cost of the network could reduce.

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 130 kW which gives a heat loss of about 950 MWh per annum.

5.1.5 District heating main network cost estimate

The New Cross network costs have been estimated at £3.2 million. This cost is an 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.

5.1.6 Comments on the network

The network indicated has been enclosed as an example of connecting a number of buildings within a Focus Area. 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 heat demand being met. Although as mentioned earlier, there is potential for a much larger network in this area.

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 estimates 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 in 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 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 issue 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 has been established without public investment or other public support mechanisms and it seems unlikely that significant scaled scheme can go ahead without local authority initiative and financial support from either local or central government.

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

[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 site.

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 LDF perspective. This critical element will provide an, as yet, developing DH system useful foresight of potential future business. 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

7.4.1 Structure

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. In reality the formation of an operating company can be borne out of the inclusion of a number of sources and be quite fluid in its structure.

If the LA is driving the initial agenda, it is they who can provide the initial staff to operate the Company. LAs have a broad skills base from which they can second specific requirements until such time as the company can recruit. Typically resources from housing, engineering, highways and finance departments would have the skills base to provide assistance and may be able to be seconded on an extended or permanent basis.

More specialist skills that are unique to DH systems, e.g. pre-insulated pipe laying, will have to be contracted in. It is unlikely the Company would become sufficiently large enough to directly employ such specialism but it could share this with neighbouring developments as the demand increases.

The size of the initial business may preclude a formal structure but the diagram below indicates a typical organisation.

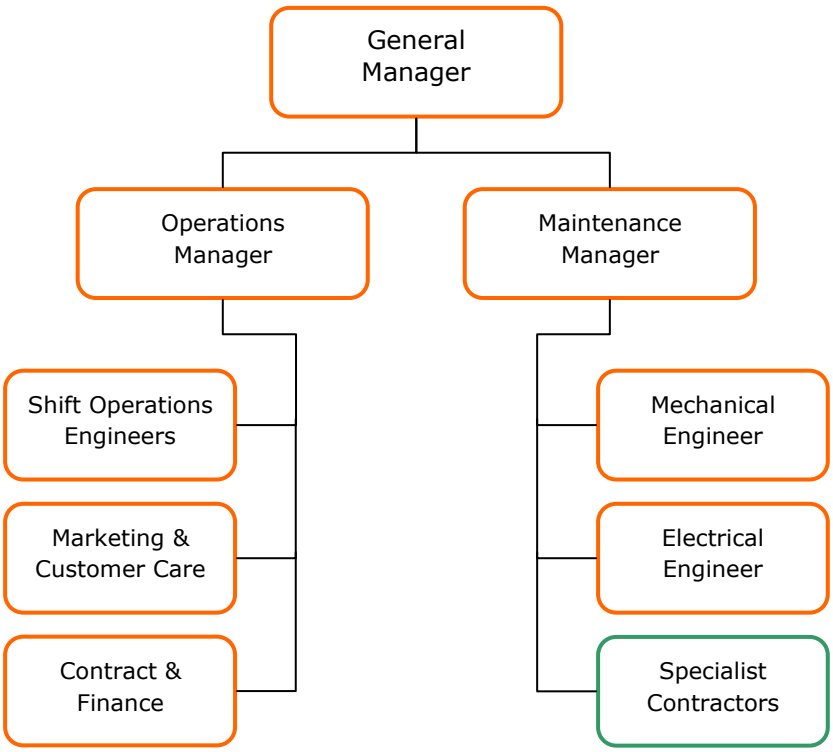


Figure 2: Typical organisational structure.

A General Manager will be required to provide the company figurehead and take responsibility for business development and interaction with shareholders and key stakeholders. The General Manager will be instrumental in driving expansion and growth.

The identification of a separate Operation and Maintenance work streams is to ensure that sufficient importance is allocated to each. The asset base will grow to a multi-million pound responsibility and the Company should ensure that sufficient resources are allocated to its long term care.

The Maintenance team may need to grow over the early years, depending upon the intended size of the DH system. It is prudent to identify this team early on to allow familiarisation by the team of the technology. This is critical in engendering confidence in the new customers of the system, particularly in the very early months of operation.

Specialist services should be handled by contractors and this can often lead to a long term partnership through which benefits and security can be developed.

The Operational work stream is no less important but has a different kind of imperative. It can also be seen to compose of a technical and a non-technical requirement.

The technical operation of the system ideally requires constant monitoring and control to take place. A control facility will have to be established for both the energy production and the DH network. This can act independently of labour but it is not possible to make all decisions and manual intervention is ultimately required. Decision making for the operational strategy – which can change periodically – has to be carried out. Finally the whole DH system has to be monitored for correct operation and for information feedback to the Maintenance work stream.

The non-technical element of the work requires marketing, contract and financing skills and again these can be seconded in. Marketing skills should be seen as an early requirement to assist in the development and acceptance of the concept of the DH system. Finance and contract issues will require sufficient resources to ensure revenues are secured. This will require suitable operational assistance from accurate metering and data collection.

It is possible, of course, to outsource some or all of these work streams but whatever the set-up of the operating company might be, it is necessary to have a core staff dedicated to the operation of the system. It is important to ensure a high degree of stability in staff so that the lessons learned during the operation of the system can be more effectively adopted in the operation strategy. It is for this reason, though, that it should be carefully considered whether the operation should be outsourced.

7.4.2 Delivery vehicle

The size and structure of an operating company, being 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.

7.4.3 Financing

Clearly the ongoing access to finance to further develop the DH system is an essential element of the success of the system.

Whether through public borrowing, privately provided debt or equity finance, or European infrastructure investment funds, the cash flow for repayment will need to generate sufficient surplus to cover the lenders required rate of return.

The lender will need to be provided with sufficient security in the event that the ESCo is unable to service its debts. This could take the form of equity geared finance but can also be in the form of energy supply contracts particularly if sufficient number of contracted anchor loads can be secured – often this can come from the LA controlled buildings.

The period of the loan repayment could vary from 5-20 years for Bank debt finance or private equity, to 10-15 years or more for public sector borrowing or European investment funds or a combination of a number of sources. Clearly care has to be taken to ensure the financing matches the long term business plan.

Debt risk has to be sufficiently factored into any financing arrangements with individual housing typically carrying the highest debt risk. This can be mitigated through contracting with the housing provider who will have already factored this into their business models.

7.4.4 Contract arrangements

The type and duration of the energy supply contracts will be intrinsically linked to the financing options open to the ESCo.

Energy supply contracts can be made up of a number of items ranging from a balance of capital and revenue, including operational incentives and penalties.

It may be possible to require consumers to pay the full cost of heating connections, thereby reducing the risk associated with recovery of capital costs through an availability charge. This, though, can often make connections to smaller buildings unviable. Larger ESCos may have the financial strength to offset some of the capital cost through an availability charge, making connection more attractive financially to building developers and managers. The balance of the capital cost recovered from the long term revenue of the energy charge.

District heating, by its very nature, represents a monopoly supply but this is necessary to securitize the high capital costs. This, however, can raise concerns for customers – particularly commercial building managers who may have the ability to negotiate wholesale energy tariffs. It is therefore important that supply agreements are transparent and linked to retail and/or fuel price indices to ensure they remain competitive throughout the life of the contract.

Variable and optional contract elements can include time weighted tariffs to reward the avoidance of demanding heat at peak times. Operational 'cooling' tariffs ensure that the building connected to the DH system consumes energy correctly (kWh/m^3 DH water delivered).

7.5 Building surveying/optimisation

Identifying existing buildings capable of being connected to a DH system will initially involve ascertaining whether they have a 'wet' heating system, typically those using radiators.

Clearly buildings that have electric based heating systems will not be suitable without significant modification. This work is still possible and has been typified, for example, in the refurbishment of tower blocks originally built with electric underfloor heating.

Buildings that are notionally able to connect to a DH system may still need to be determined for suitability. Many heating system are designed using old design techniques applicable to coal fired heat generation and are not suitable for DH without some modification.

Whilst the process of surveying a single building is not time consuming, the process of surveying all buildings initially highlighted for connection will require a carefully structured programme of work. The interpretation and determination of any solution required will then have to be disseminated to the building owner to start the process of optimisation.

Optimisation of building heating systems requires careful adaptation and negotiation with the building owner. This activity can be time consuming and must be considered at the earliest opportunity as the process may take several months and require investment to undertake. It is possible that evidence of the operating parameters has to be gained prior to an assessment being complete and this could require a winter period being monitored further adding time to the process. It is possible that this process can create an unpopular environment between building owner and DH operator so it is critical that the impact and potential disruption are communicated as soon as possible. It is often the maintenance staff of the building that can provide the most insight into a building heating system and building a close working relationship with these people can simplify the optimisation process.

7.6 Planning

An important and inherent part of the implementation plan is the need to assess the potential of connecting heat loads beyond the original scope. This may include areas beyond which any control can be employed.

It is quite possible that in situations where heat loads surround a boundary between LAs, for example, it should be considered that these heat loads can form part of the scope of the system. Careful coordination with neighbouring LAs should take place to ensure the optimum solution for cross-border heat supply is arranged.

The identification of buildings currently in the planning process should be considered carefully as to whether they can form part of a future system. The development of a DH system may take several years by which time any building having previously identified through the planning process, is likely to have been completed with a conventional energy source. Whilst the building may still be able to be connected, the building owner is likely to be left with a stranded asset.

7.7 Licensing and legislation

Any new Energy Centres will require planning consent under the standard procedure required of by the Town and Country Planning Act 1990.

Emissions from installations with a gross energy input of more than 50MW will be legislated under the auspices of the IPPC Directive. The Directive has a number of requirements that the ESCo will have to adhere to. The ESCo shall need to demonstrate that BAT techniques have been employed, that a suitable Environmental Management System is in place with robust control systems and procedures and that a full understanding of the releases to atmosphere can be shown.

Emissions from installations with a gross energy input below 20MW will require approval to be granted by the Local Planning Authority.

The installation of pipework into the ground will require to be carried out under the provisions of the Roads and Street Works Act 1991 and the Traffic Management Act 2004. This provision is applicable in the case of land under the control of the Local Highway Authority, TfL or other statutory body (Authority). The Authority can grant licenses to install and maintain apparatus but also can constrain when and for how long the highway can be opened for. Considerations such as traffic sensitivity, bus and ambulance routes will determine the working window for pipe installations and maintenance. Knowledge of these potential restrictions must be part of the detailed planning to ensure that the capital (and subsequent maintenance) costs are not adversely affected.

When pipework and equipment is installed in land not controlled by the Authority, the ESCo will have to enter into negotiation with the land owner(s) for this right. This can be a lengthy and costly process as legal agreements will have to be drawn up in advance of any work being carried out. The cost of this work plus the ongoing (annual) charges, likely to be levied by the land owner, should be weighed up against the additional capital cost of a less direct pipe route.

Generally District Heating undertakings are classified as a Specialist Rating Unit (SRU) class and the responsibility of the rating lies with one of the regional SRUs. Valuation of the equipment has been a matter of discussion for some years but the VOA adopts a policy that such undertakings should be valued under the Contractor's Basis. There generally is a potential for reasoned discussion with the regional SRU regarding the final valuation.

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 or 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 fueled. 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.

Five Focus Areas were identified in this study and ranked in the flowing order;

1. Deptford / New Cross – High
2. Central Lewisham - High

3. Hither Green – Medium
4. Catford / Lewisham Hospital – Medium

5. Sydenham - Low

The heat network proposals for the Borough of Lewisham and others like it are fundamental to the UK and its environmental targets. Hitherto, there has been insufficient importance placed on the role heat networks can play in the future energy demands of the country.

Recently though the UK has finally seen heat moving up the political agenda. Heat and its production and utilisation are being discussed through various consultations. This heat map study and future potential implementation of schemes is timely and can show the way forward.

The investment in a heat network and can be considerable and it is important that the work is planned to reduce risks.

When implementing district heating there are a number of good practices and recommendations in relation to the design and installation that have been developed over the years.

This study 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 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 network.

It is likely that even following a detailed feasibility study that a number of questions and uncertainties will remain. These should be thoroughly investigated and/or determined directly. The detailed specification for the installation and maintenance of the district heating network is something worth considering as early as possible in the project process. This helps 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 developing 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, what is included within the different stages will depend on time and budget available but 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
- Preliminary design
- Detailed design
- Tendering / procurement
- Construction management
- Supervision
- Commissioning