District Heating Feasibility

Phase 1: Heat Mapping and Energy Masterplanning

Prepared for:

London Borough of Merton

Executive Summary

This study investigates the feasibility of implementing district heating and cooling in the London Borough of Merton, with the aim of providing low cost energy and increased energy security to residents and businesses in the area, whilst also delivering carbon emissions savings and environmental benefits.

Initially, the heating, cooling and electrical requirements of commercial, industrial and residential buildings in the Borough were assessed and illustrated graphically on maps of the area. Key opportunity areas (Colliers Wood and South Wimbledon; Morden Town Centre and Leisure Centre) for district heating were then explored in more detail, with particular attention paid to:

- Existing buildings and future developments, and which of these would be eligible for connection to a district heating network (DHN);
- Suitable heat generation technologies;
- Existing or planned heat sources and supplies in the vicinity;
- Viable energy centre locations; and
- Key infrastructure in the area such as road, railways, rivers and utilities (i.e. gas and electricity).

Transport for London (TfL) confirmed that there are ventilation shafts for the London Underground located in South Wimbledon/Colliers Wood on the Northern Line. However, in the interests of security, TfL did not confirm their exact location. High level calculations showed a potential heat source capacity of around 850kW might be recoverable from such a shaft. A new ultra-low temperature network could serve the High Path Estate, a large new development (see red shaded area in Figure 0-1) which is close to the indicative shaft location range (which runs between South Wimbledon and Colliers Wood in line with the A238). Utilising an ultra-low temperature network would enhance the efficiency of the heat recovery system on the ventilation shaft, whilst also reducing the heat losses experienced on the network.

Also in close proximity to the High Path Estate is the River Wandle, with a suggested heating capacity of 3.6MW, according to the Department for Business Energy and Industrial Strategy's (BEIS) map of water source potential in the UK. With the use of a heat pump, this energy could also be fed into an ultra-low temperature network in the development. This quoted heat capacity is subject to further scrutiny, since a visual survey of the 'river' showed it to be of very low flow rate.

Additional heat sources in the Borough that were assessed include the Beddington Energy Recovery Facility (ERF) in the neighbouring borough of Sutton; a large electrical substation on Plough Lane (from which heat could be recovered); and planned Combined Heat and Power (CHP) installations in the area. These technologies were analysed quantitatively and were not currently found to be either technically viable or economically attractive for incorporation into a DHN in Merton.

Other heat generation technologies were appraised in terms of their financial, environmental, deliverability and technical performance to establish which would be the most applicable for use in Merton. It was found that gas CHP was currently the best performing technology but that this should be reassessed against the prevailing regulatory, market and carbon emissions conditions when the first generation plant reaches the end of its useful life.

A range of gas CHP fed district heating network scenarios were proposed and modelled for each of the two areas, in order to assess their technical, financial and environmental performance.

Colliers Wood and South Wimbledon (CWSW) area

Figure 0-1 and Table 0-1 show the network scenarios for the CWSW area, where each scenario is made up of different network sections as denoted in the figure. Council owned areas were assessed for their viability as locations for the network Energy Centre (EC). The most preferable location was within the High Path Estate development (see red shaded area in Figure), but further engagement with the developers is necessary to determine whether this would be acceptable. Network routing is indicative at this stage.

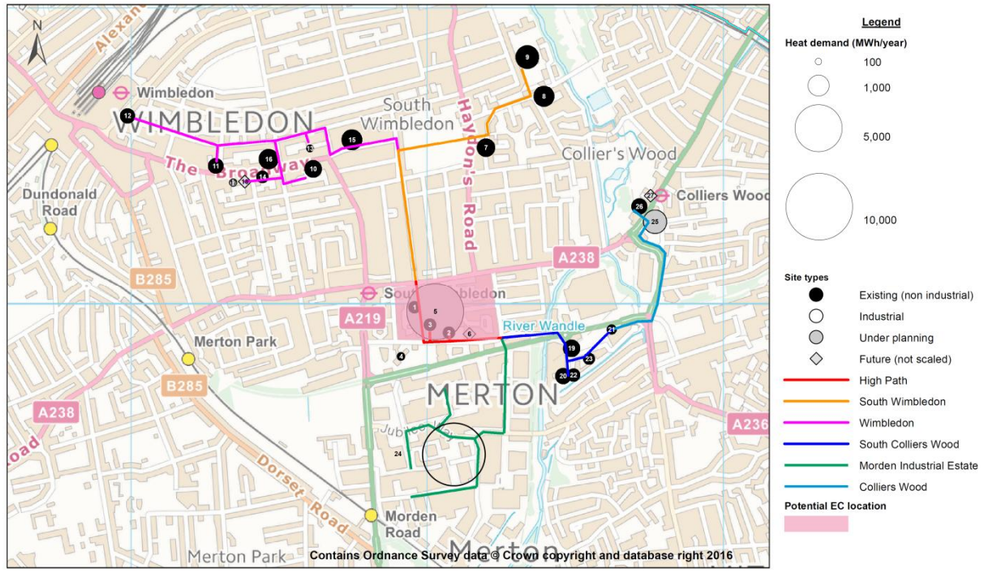

Figure 0-1: CWSW Network Options (building numbers provided in Table 7-1)

Table 0-1: Summary of CWSW network scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
CWSW	High Path and South Colliers Wood	High Path, South Colliers Wood and Central Colliers Wood	High Path, South Colliers Wood, South Wimbledon and Wimbledon	High Path, South Colliers Wood, Central Colliers Wood, South Wimbledon and Wimbledon	High Path, South Colliers Wood, Central Colliers Wood, South Wimbledon, Wimbledon and Morden Industrial Estate

A summary of the resultant technical and financial results for each network scenario in the CWSW area is provided in Table 0-2. Scenario 1 performs best financially, due to the heating loads being in close proximity to one another, hence reducing pipework requirements.

Table 0-2: Summary of CWSW network scenario results

CWSW key findings (40 year period)	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Total network thermal load (MWh_{th} p.a.)	11,300	13,600	18,900	21,200	31,800
Total EC Capacity (kWth)	2,700	3,500	7,300	8,100	22,400
New External Energy Centre size (m^2)	269	352	725	809	2,244
Total CAPEX (£'000s)	£4,320	£5,805	£9,312	£10,881	£21,365
IRR (%)	9.2%	8.0%	7.0%	6.5%	4.6%
NPV (£'000s)	£4,137	£4,330	£5,228	£5,235	£3,539
Av. annual CO_{2e} savings (tCO_{2e})	77	81	226	230	484
Average annual CO_{2e} reduction (% on counterfactual)	4.4%	3.7%	6.0%	5.5%	7.7%
Total customer savings	**8.9%**	**8.8%**	**13.3%**	**12.8%**	**18.4%**

The addition of the Morden Industrial estate in Scenario 5 has a negative impact on the network financial performance due to the large pipework requirements to serve the load. It is AECOM's view that the council pursues Scenario 1 in the CWSW area in the first instance, with a view to extending the network out towards Central Colliers Wood. Future phases of this study will seek to further assess the viability of an ultra-low temperature network specifically for the High Path Estate, using the River Wandle and London Underground vent shafts as low grade heat sources.

Morden Town Centre and Morden Leisure Centre (MTCML) area

Figure 0-2 and Table 0-3 show the network scenarios for the MTCML area. Morden Town Centre is undergoing significant refurbishment and includes a number of new developments such as the large Morden Station development and Abbotsbury Triangle development which are due to include hotels, residential, commercial and office buildings. Furthermore, road infrastructure improvements are being proposed in the area around Morden Station, which may help the installation of buried pipework.

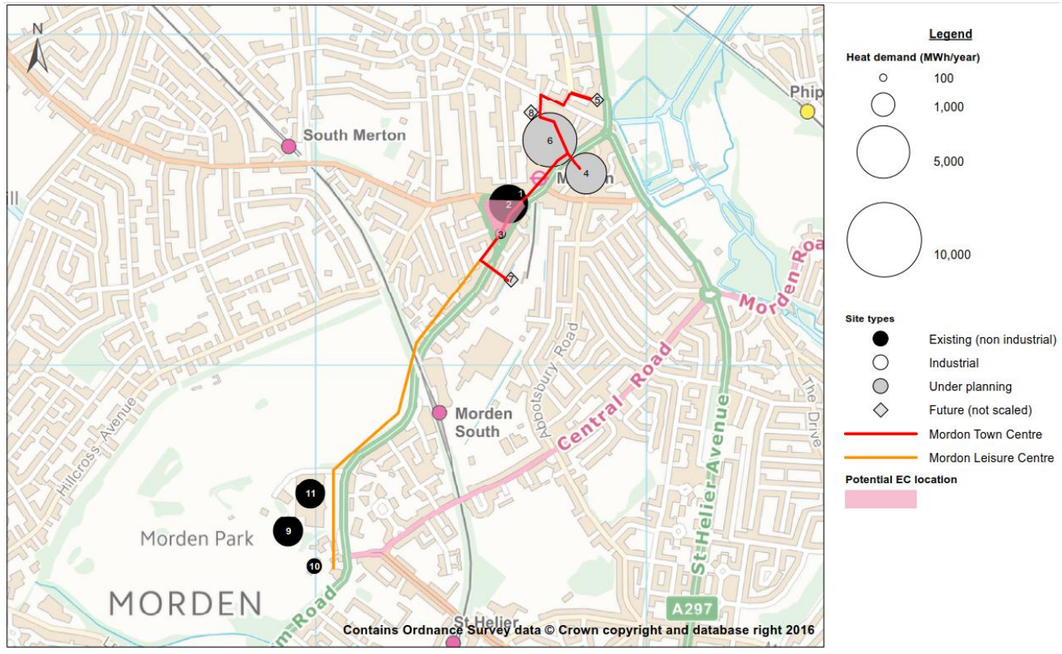

Figure 0-2: MTCML Network Options (building numbers provided in Table 7-2)

It is proposed that the energy centre for the MTCML network would be located next to, or inside the Merton Civic Centre (see Figure 0-2). This is particularly advantageous to the development of a network in the area as the council already has access to the land and the existing building on site is tall, aiding flue arrangements and helping ensure air quality regulations can be met, assuming planning consent is granted.

Table 0-3: Summary of CWSW network scenarios

	Scenario 1	Scenario 2	Scenario 3
MTCML	**Morden Town Centre**	**Morden Leisure Centre**	**Morden Town Centre and Morden Leisure Centre**

Table 0-4 provides an overview of results for the three modelled network scenarios in the MTCML area. Scenario 1, which includes the civic centre and the new developments around Morden Station, performs best over the 40 year assessment period. It offers higher customer savings than the CWSW network scenarios, suggesting that financial performance could be improved by increasing parameters such as the price of heat, connection costs and standing charges, whilst still offering benefits to customers.

Table 0-4: Summary of CWSW network scenarios

MTCML network key findings (40 year period)	Scenario 1	Scenario 2	Scenario 3
Total network thermal load (MWh_{th} p.a.)	13,100	4,300	17,400
Total EC Capacity (kWth)	7,400	4,000	11,300
New External Energy Centre size (m^2)	739	395	1,135
Total CAPEX (£'000s)	£6,512	£4,682	£10,500
IRR (%)	5.71%	0.38%	4.35%
NPV (£'000s)	£2,462	-£2,034	£1,474
Av. annual CO_{2e} savings (tCO_{2e})	43	85	127
Average annual CO_{2e} reduction (% on counterfactual)	0.3%	1.8%	0.7%
Total customer savings	18.0%	30.3%	21.4%

AECOM recommends that the Council takes forward Scenario 1 of the MTCML options, with a view to extending the network to the south in the future. The difficulties and costs associated with laying pipework along the London Road dual carriageway and under the railway in order to serve the Morden Leisure Centre and nearby buildings should be further investigated if this area is to be included.

Key findings and next steps

Due to the predicted future decarbonisation of the UK's electricity grid, gas CHP is only expected to provide carbon emissions savings up to c.2032. CHP is therefore considered a viable low-carbon technology for use at inception, and provides the Council with a proven and reliable source of heat that is able to generate significant revenue streams over the course of its operating life and thereby provide a return on the original investment. However, CHP engines are generally expected to have an operating life of 80,000 – 100,000 hours; thereafter, a replacement primary heat source will need to be found.

Based on future carbon emission factors published by the Government, CHP is predicted to become less carbon efficient than the equivalent 'do-nothing' base case (e.g. gas boiler) by 2032. As such, the network operator must keep abreast of developments in terms of carbon emissions associated with grid electricity consumption, and periodically assess the low-carbon performance of different heat generation technologies, especially when the first generation CHP engines reach the end of their useful life after 12-15 years of operation.

The findings of the financial and technical modelling are particularly sensitive to the amount of generated electricity which is sold to private customers in the area, as opposed to exported back into the grid. Maximising private sales is paramount, as revenues generated from private sales are much higher than those generated through export to the electricity grid. This is because sales to 3rd parties can be negotiated on the basis that they will be comparing any agreed electrical unit price (£/kWh) against the price they currently pay on the retail market (typically between 8-13p/kWh. Sales direct to the grid can only be done at wholesale prices (typically 4p/kWh). Whilst unit rates to 3rd parties are typically offered at a discount of 5-20% below their existing unit rates, this is still significantly greater than the prices that can be achieved by selling directly to the grid.

Finding relevant and willing private wire customers is therefore an essential part of district heating network development, and a key element of the next stages of work. Initial conversations with TfL suggested that in general they are open to opportunities for purchasing electricity from CHP schemes. This will be a key point to engage with in future phases of this study.

The Phase 2 aspects of this study will seek to refine the findings of Phase 1, initially concentrating on stakeholder engagement and site surveys, before moving into design development and detailed financial modelling.