Greater London Authority, LB of Hammersmith and Fulham and RB of Kensington and Chelsea

Earl's Court & West Kensington Opportunity Area Energy Strategy

Decentralised Energy Feasibility Study

213679-20

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Contents

1 Introduction

This report provides the strategic framework for the development of a site-wide, low carbon, decentralised energy (DE) scheme in the Earls Court Opportunity Area (hereafter 'the OA'), to deliver environmental benefits above what might otherwise be achieved by individual developments on a plot-by-plot basis, and more cost effectively. The timeframe for the study is a 20 year period to 2031.

Decentralised energy schemes have a critical role to play in reducing London's carbon dioxide emissions. Decentralised energy means the generation of electricity close to the point of use, enabling heat released during the power generation process to be captured, distributed and used locally, often via a district heating network.

This approach enables higher fuel conversion efficiencies and lower electricity distribution losses. Implementation of DE schemes can contribute to London's carbon dioxide reduction target of 60% by 2025 as well as delivering on the target set out in the 2007 Climate Change Action Plan for 25% of London's electricity to be met be decentralised generation by 2025.

District heating networks can be fundamental to such schemes. In order to have the significant impact that is required, extensive heat networks will need to be installed in the right places, on a scale which has not been seen before in the UK. Such schemes will enable low-carbon heat captured from power stations, waste to energy facilities and dedicated CHP plants to be distributed and used for space heating and hot water production in buildings & industry across the city.

District heating networks (DHNs) need planning, co-ordination and specific policy and the supplementary planning guidance for the Opportunity Area is a sensible place to set out the overall ambition and a route map for developing such a scheme.

For a particular site, the viability of a district energy scheme commonly depends on a number of factors. This study will seek to identify if and where these conditions are satisfied within the OA, thereby signalling potential for DE. They include:

- **High energy demand density –** typically the case where there are high building densities. Low densities incur prohibitively high distribution costs.
- **Suitable demand volume and diversity** – to ensure year round base heat load and sufficient revenue from energy sales, to justify the cost of generation plant and infrastructure.
- **Confidence in customer base –** 'bankable' long term revenue streams (energy supply contracts) and confidence in the future potential customer base provides a degree of security, which will enable investors to provide capital finance
- **Stakeholder appetite –** potential customers must be willing to purchase energy from the scheme.

- **Convenient phasing** – it will be necessary to sell energy and generate revenue as soon as plant is operational to cover the costs of capital and other fixed costs. This may not be possible if connections are phased over a long period.
- **Suitable infrastructure connections** – connection to existing electrical and gas networks is generally required. This can be prohibitively expensive if significant distances are involved or where offsite reinforcement works are required.
- **Physical space for generation and distribution systems –** space will be required for one or more central energy generation plants within the area. The foot print required for plant supplying an area-wide scheme would be greater than for the plant space required for an individual development site, but collectively, a site wide plant would be more space efficient.

The London Plan already expects all major new developments to either connect into CCHP/CHP distribution networks where these exist, or provide site-wide CCHP/CHP schemes with communal heating to enable future connection into larger, low carbon district heating networks, if such an approach is suitable for the development. This approach is supported by the borough cores strategies. This energy master plan is intended to build on these principles, helping developers to comply with these requirements by identifying opportunities for schemes which incorporate multiple developments and which could potentially connect to existing buildings, delivering benefits of scale and diversity which may not otherwise be realised.

The study will focus on area wide district energy schemes rather than building integrated renewable energy options which are necessarily considered on a site by site basis, as required by the London Plan. It will, however, consider the scope for renewable energy sources to supply an energy network in the area and also comment in broad terms on the suitability and compatibility of current renewable technologies with such a network.

This report was edited at the request of the GLA one year after writing to update the policy section (see section 9) however these policy updates and other regulatory changes such as building regulations have not been included within the calculations.

2 Consultation strategy

This study has been undertaken in consultation with a number of key stakeholders listed below who have provided much of the data and information which is contained in this report.

- London Borough of Hammersmith and Fulham
- Royal Borough of Kensington and Chelsea
- Transport for London
- Greater London Authority
- London Development Agency Decentralised Energy Masterplanning (DEMaP) team
- Capital & Counties Plc (hereafter 'Capco')
- Hoare Lea

3 Opportunity area characteristics

The OA crosses the boundaries of the London Borough of Hammersmith and Fulham (LBHF) and the Royal Borough of Kensington and Chelsea (RBKC). The OA includes several distinctive buildings, including the Earls Court Exhibition Centre and the Empress State Building. The District and Piccadilly lines of the London Underground and the London Overground pass through the middle of the OA.

Capco,one of the principal land owners, is advancing proposals for the comprehensive redevelopment of the OA.

3.1 Land ownership

The OA has three principal land owners, Capco, LBHF and London Underground Ltd (hereafter 'LUL'), by far the lowest number of any Opportunity Area considered to date. Delivering decentralised energy requires a high level of coordination and co-operation between stakeholders. The small number land owners has the benefit of simplifying this process.

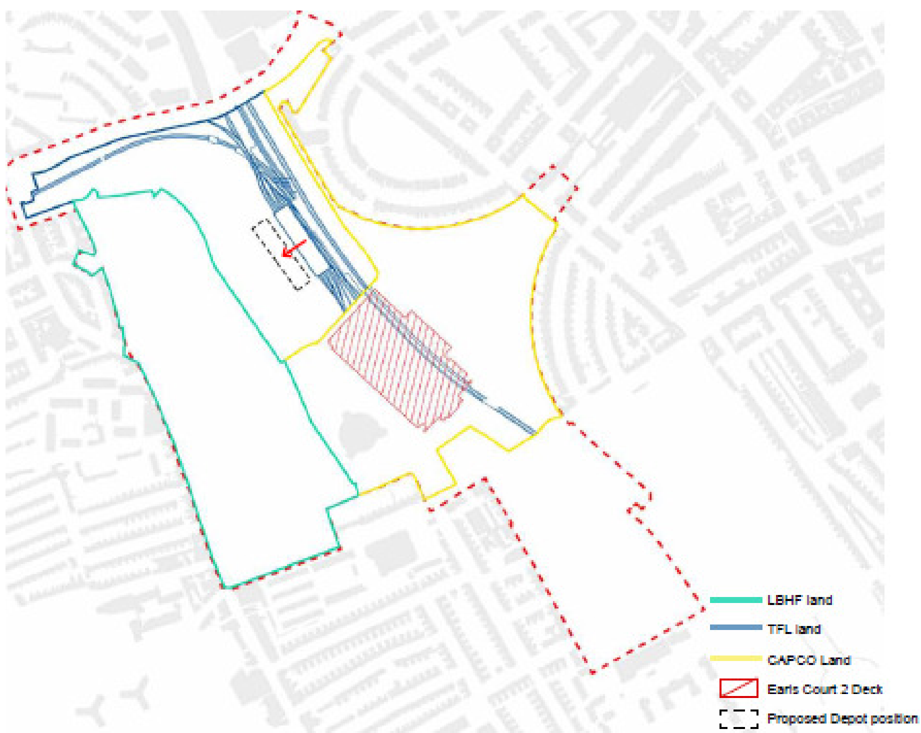

Figure 3.1 – Land ownership within the Earls Court Opportunity Area

3.2 Existing buildings

3.2.1 Capco land

The Earl's Court Exhibition Centre, both Earls Court 1 and 2 (EC1 and EC2), dominate a large part of the opportunity area. EC2 sits on a raised deck above the London Overground. Both EC1 and EC2 are on raised land relative to that to the west of the ECOA. There is a large void underneath EC2 which could potentially house energy generation plant.

3.2.2 London Underground Ltd (LUL) Land

LUL, a subsidiary of TfL, owns land comprising the Lillie Bridge Road depot, the operation track in the area and some of the land surrounding this. This depot includes stabling for tube trains, a workshop and Ashfield House, an office building used for training. LUL is in ongoing discussions with Capco regarding the future of the site and it is currently expected that it will be included in the plans for the redevelopment of the area. It is likely that the stabling function will be retained in a new underground depot and the other uses be moved off site. There is no fixed timeframe for these changes to take place but they are currently anticipated to come forward in the next 5 – 10 years .

3.2.3 LBHF Land

The LBHF land currently comprises the West Kensington and Gibbs Green estates, which are largely social housing built in the 1950's and 1960's. The buildings are predominately apartment blocks, of mixed type and tenure. LBHF is currently considering the future of these estates as part of its wider regeneration plans. The estates may be fully rebuilt over the next 15 years or they may be retained and refurbished as necessary over time.

Which of these options is progressed will have an impact on the potential for decentralised energy in the OA. This is due to the fact that the cost from the district heating system side is less for a new building than if modifications within the building are also included. See Section 7.1 for discussion of the potential implications of refurbishing rather than rebuilding these buildings.

3.3 New buildings

Three development capacity scenarios have been considered for the redevelopment of the OA. Scenario 1 is the least densely developed and would retain the existing estates, Scenario 3 the most so. This study has used the development quantities for the different building types in each scenario to generate energy demand estimates for the OA as described below.

Option	Housing capacity *	Residential floorspace **	Resident population ***	New Jobs ****	Total commercial / non-residential floorspace *****	Office floorspace	Retail floorspace	Hotel	Leisure (includes cultural) floorspace	Other non-residential floor	Total floorspace ******
Option 1	4000	364,000 sq.m.	9,600	7000	129,500 sq.m. (1,393,420 sq.ft.)	90,650 sq.m.	12,950 sq.m.	12,950 sq.m.	10,360 sq.m.	2,590 sq.m.	493,500 sq.m. (5,310,060 sq.ft.)
Option 2	6000	546,000 sq.m.	14,400	11,000	203,500 sq.m. (2,189,660 sq.ft.)	142,450 sq.m.	20,350 sq.m.	20,350 sq.m.	16,280 sq.m.	4,070 sq.m.	749,500 sq.m. (8,064,620 sq.ft.)
Option 3	8000	728,000 sq.m.	19,200	15,000	277,500 sq.m. (2,985,900 sq.ft.)	194,250 sq.m.	27,750 sq.m.	27,750 sq.m.	22,200 sq.m.	5,550 sq.m.	1,005,500 sq.m. (10,819,180 sq.ft.)

Table 3.1 – Development capacity scenarios for the OA

As indicated in Table 3.1 the density of development increases from Scenario 1 to 3, with building land use in Scenario 3 being more than twice that in 1. The proportional land use profile is consistent throughout all three scenarios. That is, the proportion of residential building floor space, compared to commerical, hotel etc, is the same throughout. The scenarios only differ in the net floor area for each building type.

Figure 3.2 below shows the illustrative masterplan for the OA under Scenario 1 and Figure 3.2 shows the illustrative masterplan under scenarios 2 and 3. These illustrative masterplans indicate how new development might be arranged in the area.

It is anticipated that each scenario development would be phased over a 20 year period, with the whole development completed around 2031. For the purposes of this study there are anticipated to be four broad phases, each five years in duration. Figure 3.4 illustrates the disposition of these phases. Seagrave Road Car Park and the land occupied by the Earl's Court Exhibition Centres are expected to be early phases with any redevelopment of land to the west and north coming forward later in the period.

Figure 3.2 – Illustrative masterplan – development capacity scenario 1

Figure 3.3 – Illustrative masterplan – development capacity scenarios 2 and 3

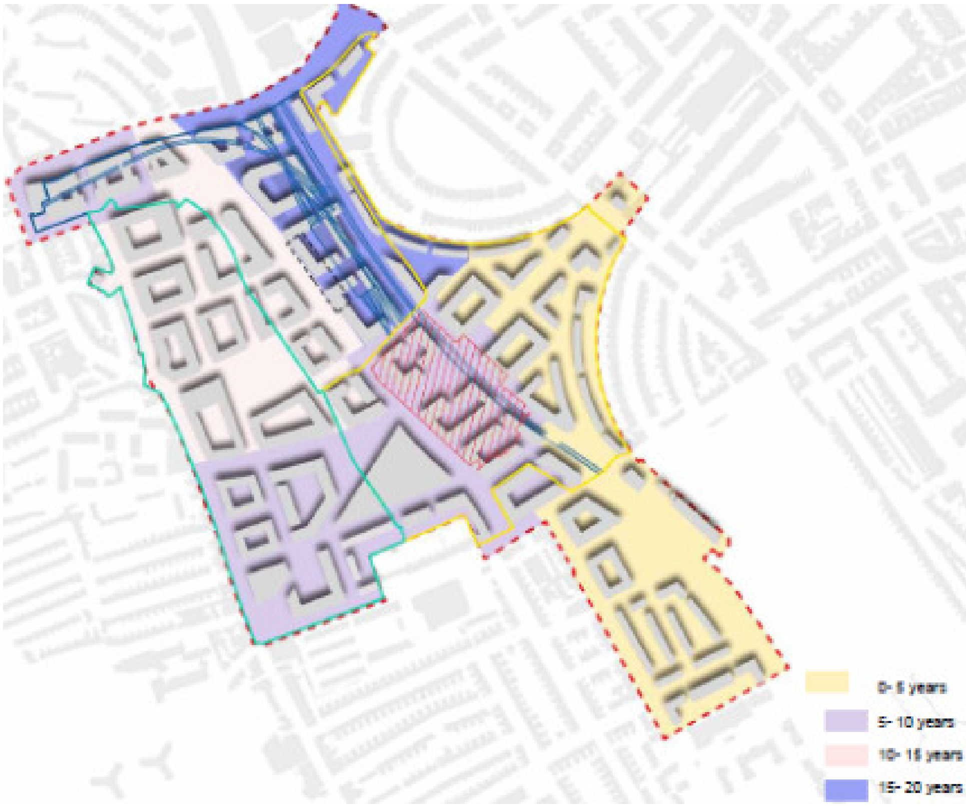

Figure 3.4 – Indicative phasing under development capacity scenarios 2 & 3

3.4 Energy demand overview

The vast majority of buildings in the OA, to which any proposed decentralised energy scheme might connect, are expected to be new buildings. This is with the exception of the Empress State Building, which is likely to remain in office use for the time being, and the LBHF housing estates were these to be retained.

Energy consumption has been estimated based on the development capacity scenarios and associated land use schedules. Energy benchmarks have been developed for each building type in dependence on planned evolution of Building Regulations throughout the development period. It is required for instance that all new homes reach are zero carbon from 2016.

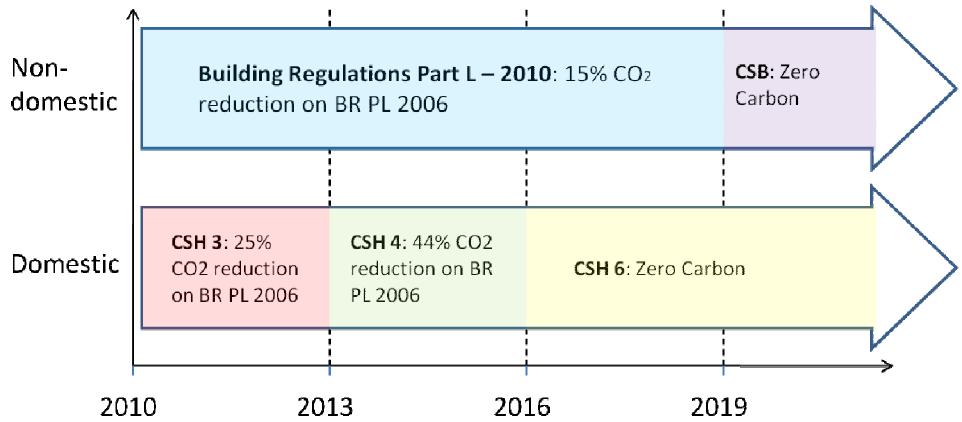

Figure 3.5 – Policy trajectory for new buildings

These benchmarks have been applied to the land use options for each scenario and phase under consideration, allowing annual heat and electricity consumption to be estimated. Monthly and daily energy use profiles, adjusted for 10 year average degree days, have been used to generate hourly demand profiles, for each building type, for each hour of the year.

These profiles can then be used to support the modelling of different energy supply options considered in framing energy strategy recommendations for the OA.

3.4.1 LUL land

The LUL owned land is expected to be reduced to working track and a train stabling depot. Both of these would have near zero electricity demands and zero heat demands. Therefore they have been discounted from the point of view of being potential energy customers and suppliers in the OA.

It is also noted that there are several London Underground stations in close proximity to the OA (West Brompton, West Kensington and Earls Court). However such stations typically have a low electricity demand (for lighting and escalators only) and zero heat consumption. Therefore at this stage they have not been regarded as likely energy customers or suppliers for any area wide decentralised energy scheme.

3.4.1 Housing on LBHF land

As noted above, there is the possibility that some of the existing homes on land owned by the LBHF may be refurbished rather than rebuilt completely. Given the requirements of Building Regulations and associated legislation (such as Building Regulations requiring refurbished buildings to meet the same standards as new buildings “where reasonably achievable”), it has been assumed that the refurbished buildings represent the same energy demand as new buildings.

This is considered sensible because, from the point of view of assessing potential for decentralised energy in the OA, it is a conservative assumption. Higher energy demands, particularly heat, typically raise the heat density of a development meaning greater returns and hence viability for decentralised energy. Thus, to err on the side of caution the assumption is that it will be possible to refurbish the existing homes to the standard of new ones, and therefore ensure the case for decentralised energy is not overstated.

Therefore, in relation to heat demand, this does not affect any of the demand scenarios. The implications of fully rebuilding versus refurbishment will impact on potential energy supply solutions, particularly in relation to costs. This will be addressed in Section 7.1 below.

3.4.2 Phasing

The indicative phasing of development in the OA four broad phases. The land use schedule has been provided for all phases. Given that the land use mix is the same across all scenarios, demand generation has only been undertaken for Scenario 2, although examples from other scenarios are used in this report. This is because the conclusions regarding the technical viability of each phase, will be the same for each scenario, given that their energy demand profiles and the constraints to district heating infrastructure are the same, noting that under scenario 1 there may also be potential to connect to the retained housing estates.

As indicated in Figure 3.6, phases 1, 2 and 4 are roughly equivalent in terms of annual heat consumption, being around 12 – 14GWh/yr. Phase 3 is smaller representing around 10GWh/yr. All phases have broadly similar land use mixes, resulting in roughly equal viability for deployment of CHP. This is confirmed by the fact that the proposed CHP system for each delivers roughly 50% of the site heat demand.

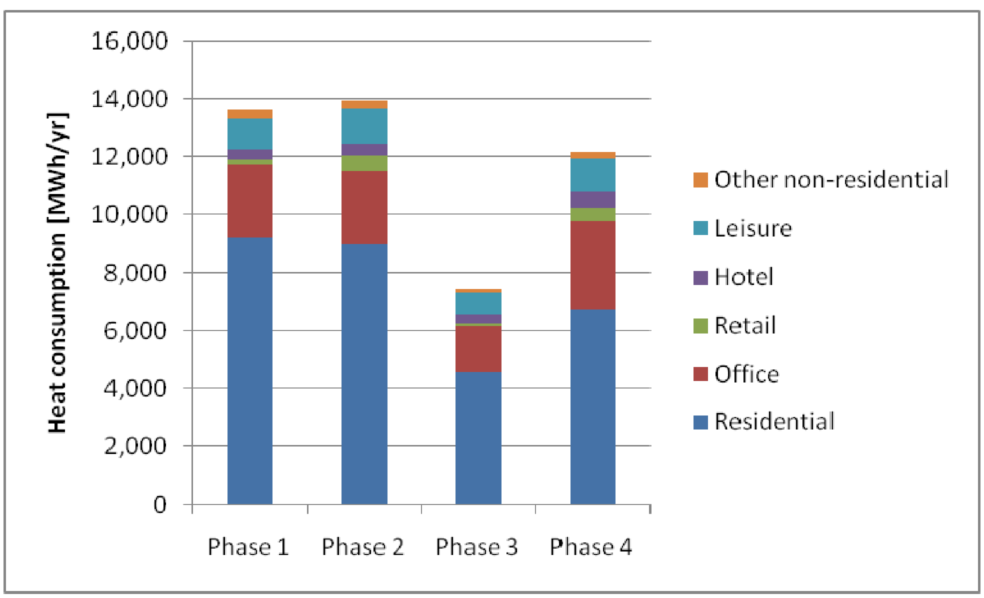

Figure 3.6 – Contribution per building type to heat consumption for each individual phase in Scenario 2

3.4.3 Complete scenarios

Building type	Floor area [m^2]	Annual heat demand [MWh]	Peak heat demand [kW]	Annual electricity demand [MWh]	Peak electricity demand [kW]
Residential	364,000	19,425	21,749	13,471	10,875
Office	90,650	6,395	12,209	11,197	4,029
Retail	12,950	795	1,654	1,375	1,880
Hotel	12,950	1,072	1,179	3,452	911
Leisure	10,360	2,787	965	858	429
Other non-resi	2,590	608	261	204	93
Total	493,500	31,083	38,017	30,556	18,217

Table 3.2 – Energy demand summary for full build out of Scenario 1

Building type	Floor area [m^2]	Annual heat demand [MWh]	Peak heat demand [kW]	Annual electricity demand [MWh]	Peak electricity demand [kW]
Residential	546,000	29,501	33,032	20,459	16,516
Office	142,450	9,713	18,542	17,005	6,119
Retail	20,350	1,208	2,513	2,089	2,855
Hotel	20,350	1,628	1,791	5,243	1,384
Leisure	16,280	4,233	1,465	1,302	651
Other non-resi	4,070	924	396	310	142
Total	749,500	47,206	57,738	46,407	27,666

Table 3.3 – Energy demand summary for full build out of Scenario 2

Building type	Floor area [m^2]	Annual heat demand [MWh]	Peak heat demand [kW]	Annual electricity demand [MWh]	Peak electricity demand [kW]
Residential	728,000	39,578	44,314	27,447	22,157
Office	194,250	13,030	24,875	22,813	8,209
Retail	27,750	1,620	3,371	2,802	3,830
Hotel	27,750	2,184	2,402	7,033	1,856
Leisure	22,200	5,679	1,966	1,747	874
Other non-	5,550	1,239	532	415	190

resi					
Total	1,005,500	63,330	28,338	22,776	13,579

Table 3.4 – Energy demand summary for full build out of Scenario 3

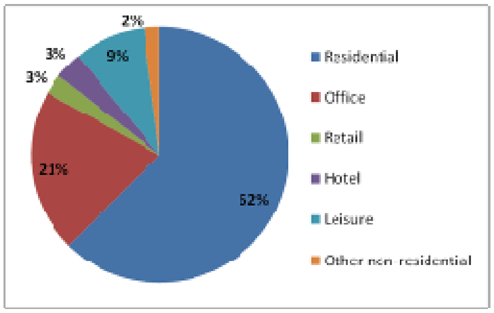

Figure 3.7 – Proportional contribution to annual heat consumption

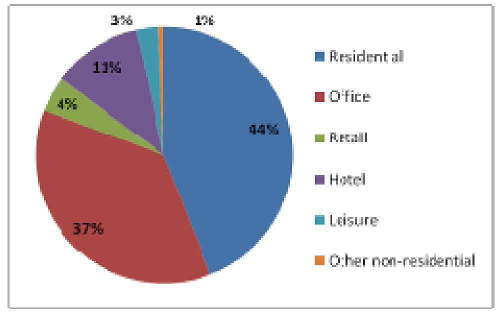

Figure 3.8 – Proportional contribution to annual electricity consumption

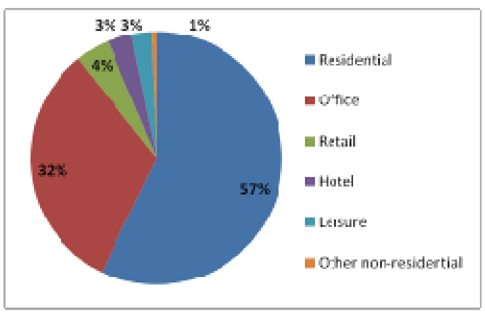

Figure 3.9 – Proportional contribution to peak heat consumption

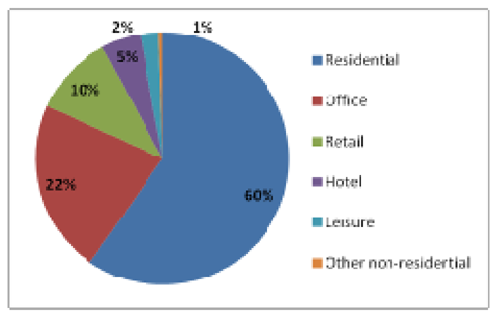

Figure 3.10 – Proportional contribution to peak electricity consumption

Due to the fact that all scenarios demonstrate the same proportional land use in all phases, Figures 3.7 to 3.10 are the same for all scenarios.

As is apparent in Figure 3.11, heat consumption is dominated by domestic buildings. A more balanced mix of buildings types would be preferable, as this would result in a more level demand profile. The more 'peaky' the profile, the more difficult it can be to strike a balance between sizing low carbon generation plant to meet as much demand as possible, and ensuring that the plant operates as often as possible.

As Figure 3.11 confirms, the heat demand profile is similar to that of a domestic development, with peaks in the morning and evening.

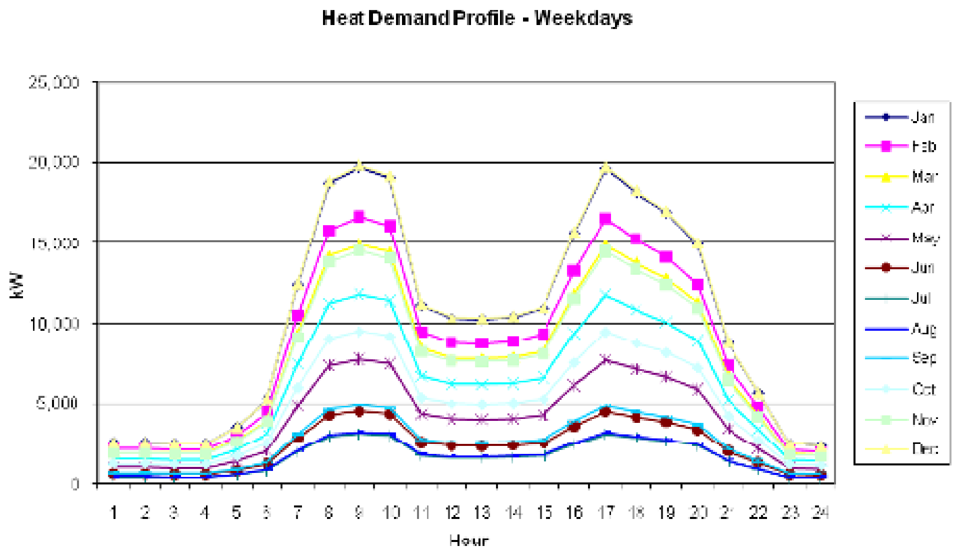

Figure 3.11 – Heat demand profile for full build out of the OA, Scenario 2

All three proposed land use scenarios have an almost identical land use mix. There are two key factors in relation to land use that have a bearing on the viability of decentralised energy, particularly district heat networks: energy demand profile (which is dependent on land use mix), and demand density (which is dependent on building density).

Note that the peak demand in Figure 3.11 is significantly less than in Table 3.3. This is because in Figure 3.11 this is the diversified peak, that is it takes into account the fact that peaks in different building types tend to happen at different times. Whereas in Table 3.3, the total peak is just the sum of individual building peaks, no matter whether they are likely to occur in parallel. It is the former that is relevant from the point of view of specifying energy supply systems.

Based on this demand profile it is anticipated that thermal storage, to allow heat to be stored in the early morning hours for use later in the day, will be key to developing feasible proposals for district heating in the OA.

4 Existing gas and electricity infrastructure

The presence of electrical distribution infrastructure is crucial for the installation of electricity generation plant. If proposals include large gas fired plant then sufficient gas supply is also required. If either require substantial increases in capacity this can have a negative impact on the commercial viability of any proposals.

Discussions with Hoare Lea indicate that there is ample mains gas supply to the site to support any scale of gas fired plant that could be required.

Electricity distribution infrastructure, in particular transformer capacity, is more limited. Initial investigations imply that there is sufficient existing capacity to accommodate roughly half of the development proposals for the OA.

5 Emissions reduction targets

A carbon emissions baseline for the development has been calculated assuming buildings specified according to Building Regulations 2006, Part L requirements (assuming distributed gas boilers for heat provision and no on-site electricity generation). This is because national and GLA carbon reduction targets used this as their baseline at the time the modelling was completed. Building regulations 2010 Part L has since been published which represents the current baseline for assessing applications and it is anticipated that this will be further updated over the course of the redevelopment of the OA.

The emissions requirements stipulated in legislation depend on the building type and time of construction. Buildings in the OA will therefore have very different emissions reduction targets, depending on whether they are domestic, non-domestic, and on when they obtain build regulations approval. Figure 3.5 indicates which targets apply and when. Based on this, and the specified phasing schedule, carbon emissions targets are illustrated in Figure 5.2 for build out of the four phases.

A key policy uncertainty at the time of writing is around the definition of zero carbon. It is widely accepted that supplying 100% of a building's energy demand through on site renewable energy is in most cases technically infeasible. Therefore provisions are being made, through a vehicle called Allowable Solutions, to allow a proportion of the required emissions reductions to be made in another way. These may include, for example, investment in off-site renewables, retail of spare low carbon heat to local customers or contribution to local green energy investment funds.

The key uncertainly is around what proportion of the required total can be accounted for through allowable solutions. Originally it was understood that a range of figures are being considered, from 30%, or even around 50%, however there have been a number of proposed changes to the definition of zero carbon since the first draft which have not been reflected in the calculations. This has significant impacts on the requirements for on-site energy provision, and so this study will seek to explore the implications of different definitions of zero carbon.

Discussion and information have been included in detail for Scenario 2. Then towards the end of the chapter, high level data in included for all scenarios. Due to the similarity in land use mix, these analyses and conclusions drawn for Scenario 2 are equally applicable for the other phases.

Figure 5.1 demonstrates the carbon emissions baseline for each phase, which are the emissions that would be produced were all buildings built to 2006 Building Regulations.

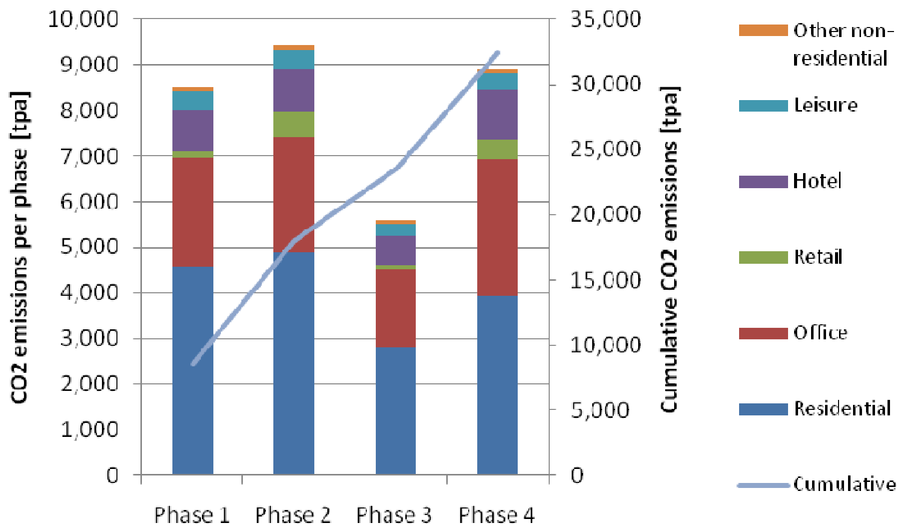

Figure 5.1 – Baseline carbon dioxide emissions values for Scenario 2

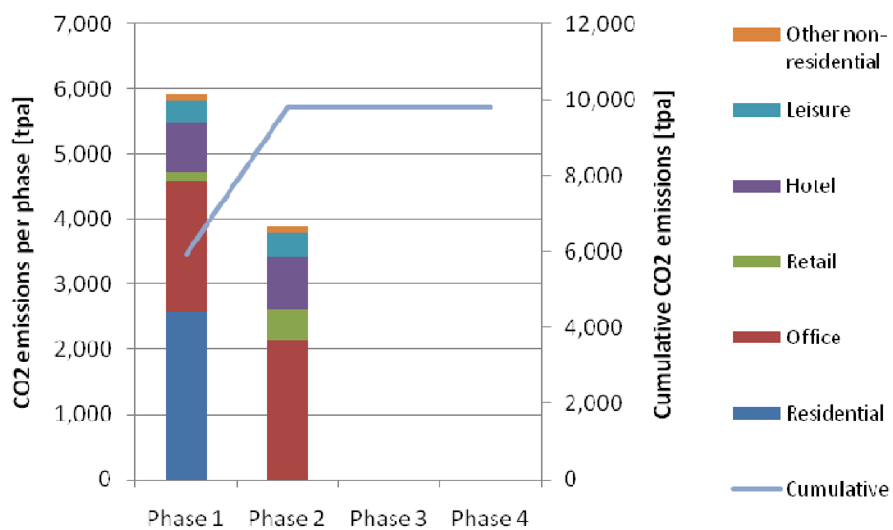

Figure 5.2 – Carbon dioxide emissions targets required by policy, for Scenario 2

From Phase 3 onwards all new buildings are required to be zero carbon, and so at this point emissions levels for the OA will plateau. Phase 1, despite having a very similar energy demand profile as Phase 2, has significantly higher carbon emissions due to the fact that all domestic properties from Phase 2 onwards are required to be zero carbon.

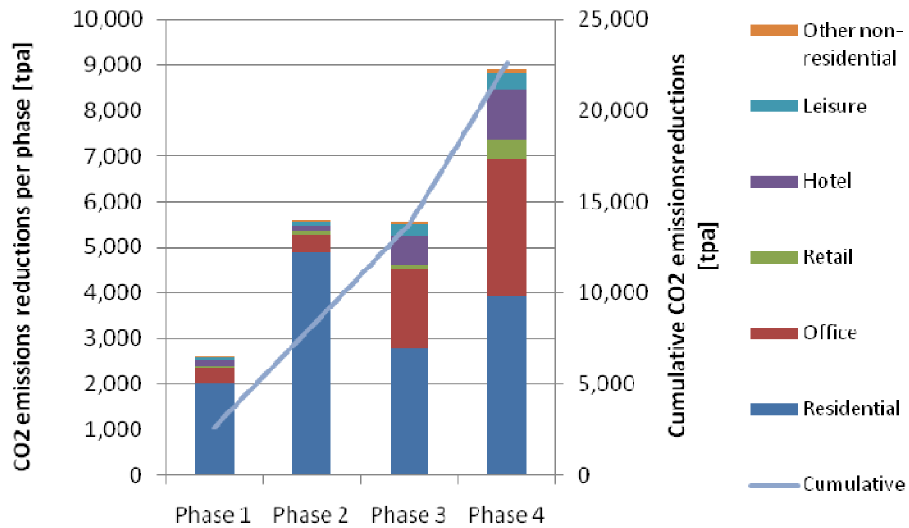

Figure 5.3 – Carbon dioxide emissions reductions to be achieved by energy efficiency and low carbon energy supply, for Scenario 2

The emissions savings that are required for each individual phase increase as legislation becomes more stringent and more building types are included within targets. This results in an exponential increase in required emissions savings, meaning that an escalation of effective energy efficiency measures and green energy supply solutions are required for each stage.

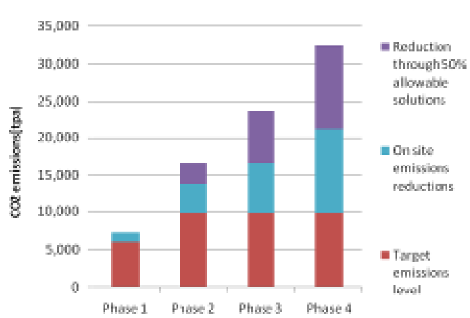

Figure 5.4 – Cumulative emissions (assuming 50% allowable solutions)

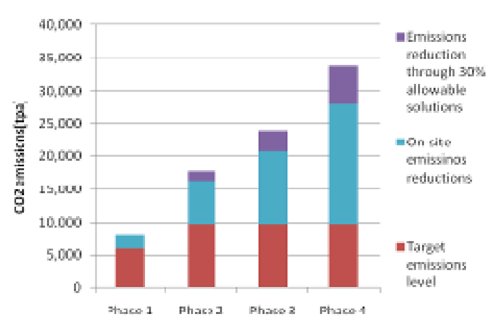

Figure 5.5 – Cumulative emissions (assuming 30% allowable solutions)

The contribution required from on-site energy supply solutions is indicated in Figure 5.4 and 5.5 in blue (for Scenario 2).

In calculating the data in Figures 5.1 to 5.5, the following assumptions have been made:

- Phase 1 emissions are those for 2015 assuming a national grid electrical carbon intensity of 0.475 kg/kWh
- Phase 2 emissions are those for 2020 assuming a national grid electrical carbon intensity of 0.423 kg/kWh

- Phase 3 emissions are those for 2025 assuming a national grid electrical carbon intensity of 0.376 kg/kWh
- Phase 4 emissions are those for 2030 assuming a national grid electrical carbon intensity of 0.335 kg/kWh
- Grid carbon. See Figure 5.6. Note if government targets meet a steeper trajectory, the use of gas fired CHP to generate both electricity means its relative carbon dioxide reduction reduces (because the grid becomes more carbon dioxide efficient).

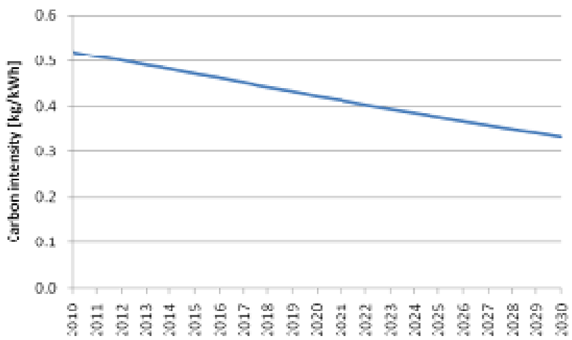

Figure 5.6 – Assumed grid carbon trajectory

The carbon intensity factors in Figure 5.6, for 2010 to 2020 were produced for DEFRA by the Market Transformation Programme[1]. To provide factors beyond 2020, it has been assumed that the downward trend continues steadily until 2030.

The above information is for Scenario 2, and illustrates the detail of emissions requirements, depending on phasing. The following tables summarise the baseline emissions, target emissions levels and associated reductions required for all three Scenarios.

	Phase 1	Phase 2	Phase 3	Phase 4
Baseline emissions	6,602	13,926	18,246	25,137
Target emissions	4,583	7,593	7,593	7,593
Emissions reductions required	2,018	6,333	10,653	17,544

Table 5.1 – Cumulative CO_2 emissions (tonnes/yr) for Scenario 1

	Phase 1	Phase 2	Phase 3	Phase 4
Baseline emissions	10,026	21,150	27,711	38,176
Target emissions	6,961	11,532	11,532	11,532
Emissions reductions required	3,065	9,619	16,179	26,644

Table 5.2 – Cumulative CO_2 emissions (tonnes/yr) for Scenario 2

	Phase 1	Phase 2	Phase 3	Phase 4

[1] BNXS01: Carbon Dioxide Emission Factors for UK Energy Use – Version 4.2 – reviewed 16-03-2010. http://efficient-products.defra.gov.uk/cms/market-transformation-programme/

Baseline emissions	13,451	28,374	37,176	51,215
Target emissions	9,339	15,470	15,470	15,470
Emissions reductions required	4,112	12,904	21,706	35,745

Table 5.3 – Cumulative CO2 emissions (tonnes/yr) for Scenario 3

As can be seen from the above tables, scenario 1 has a far reduced baseline emissions, and thus reduction requirement, due to the reduced scale of the development.

This will impact the size of the low and zero carbon technology required to meet the reduction targets, but as mentioned previously, the fact that the building mix remains in the same proportion, the technology required is unlikely to change.

6 Energy supply options

6.1 Energy supply technologies

The following technologies have been considered in this study as potential sources of heat or power for a site wide energy solution for the OA.

6.1.1 Gas fired boilers

Conventional gas fired boilers either centrally within each building, or even within each property. These represent the business as usual heat supply solution, and are also typically present in any energy supply strategy as back-up/peaking plant.

6.1.2 Gas fired CHP

Gas fired combined heat and power units collect the waste heat generated when producing electrical power. This can then be used to heat local buildings. This results in carbon savings over the conventional solution of a gas boiler and electricity from the national grid. However as the national grid decarbonises the savings decrease. Such units can vary in capacity from around 50kW to hundreds of megawatts requiring only a few meters squared of plant space to hundreds of meters squared respectively.

6.1.3 Biomass boilers

Biomass is often one of the cheapest renewable energy technologies in capital terms. It can be a convenient way, especially where a district heating system is already installed, to increase the contribution of renewable energy to the overall energy mix and can help to meet planning policy requirements for on-site renewable energy generation.

The technology consists of the combustion of woody biomass to generate heat. Typically systems incorporate centralised boiler plant, supplying several properties. This is due to the logistical complexity of having several deliveries, storage sites and fuel handling mechanisms in close proximity, when it is much easier to have one. Biomass is regarded as a low carbon fuel, depending on the distance over which it has travelled from source.

6.1.4 Biomass CHP

This technology is one of the few deliverable ways of consistently providing low carbon electricity and heat. It is both low carbon and can operate on demand, unlike many other renewable technologies.

Typically wood, either clean or waste material, from construction & demolition work, is the fuel source. There are a wide range of biomass CHP technologies available. Some more reliable and proven technologies (steam boilers and turbines), require significant space, are less efficient and usually generate much greater quantities of heat than electricity. This can be inconvenient when operating in summer periods. More advanced conversion technologies such as gasification and pyrolysis are potentially more suitable in urban context, but the technologies are still in their infancy, are more expensive and present a higher commercial risk.

A number of factors can present major barriers in planning terms for biomass systems (CHP or boilers):

- Impact on air quality
- Logistics of fuel deliveries
- Wood dust from storage (only a problem in case of poor design)
- Space required for storage

Biomass CHP is eligible for financial support under the Renewables Obligation and is awarded double ROC's. Plant below 5 MWe capacity will instead be eligible for the Renewable Heat Incentive (RHI) rates from 2010.

This study will consider only steam turbine based systems, as the others are not considered to be fully mature technologies at this stage, although some, in particular gasification, show great promise for the future. The main constraints for this technology are around operational flexibility (with systems performing poorly when operating at part load) and the high heat to power ratio, resulting in much greater volumes of heat generated than electricity.

6.1.5 Energy from waste

The main technology options for generating energy from waste are:

- Incineration/mass burn – As set out in the Mayor of London's Waste Strategy, London has a target of not installing any new waste mass burn capacity. The technology is particularly unsuitable for the OA because mass burn requires comprehensive flue gas cleaning technology, which is both very costly and physically large, meaning that commercially viable mass burn plants tend to be in the order of at least 50MW electrical generating capacity. Such a plant would be much larger than could be accommodated on or anywhere near the OA. Also it is considered very unlikely that there would be sufficient heat demand nearby, meaning the plant would have to be power generation only, an inefficient use of a valuable fuel resource.

- Advanced thermal technologies such as gasification and pyrolysis – Such technologies are more efficient and cleaner than mass burn, and can be delivered at much lower scales. They are however a much less mature technology, and as such it is considered unlikely that they would be considered suitable for use in the OA.

- Anaerobic digestion (AD) – The use of microbes to digest wet biological waste (such as kitchen and garden waste) in an oxygen deprived environment results in the emission of biogas, which contains mainly methane and carbon monoxide. Methane, or natural gas, is combustible and can be used to generate electricity and heat.

6.1.6 Existing Sources of Waste heat

In conventional power generation, whether using coal, gas, oil or nuclear material as a fuel source, large volumes of waste heat are generated. Where such power stations exist within a given distance of a heat demand, this waste heat, which is normally vented to atmosphere, can be captured and used.

This is the case around the Barking Power station in east London. The London Thames Gateway Heat Network (LTGHN) scheme is currently being delivered to allow the waste heat from this power station to supply up to 40,000 homes in London.

There are other potential sources of heat, for instance industrial operations, which can be harnessed in this manner. In such situations the case for investing in district heating infrastructure is very strong.

At present no known significant potential sources of waste heat have been identified in or around the OA.

6.2 District heating

This strategy explores the possibility for multi-site and area wide district heat networks. (see Powering Ahead report for further discussion of significance of district heating network scale[2], which outlines how scale can greatly improve financial viability).

The supplementary planning guidance and associated illustrative masterplan for the OA are still draft and therefore subject to change at the time of writing. This uncertainty, together with the illustrative nature of the masterplans for each sceanrio, limits the specificity with which recommendations and potential energy supply proposals can be developed. For these reasons all proposals, including network layouts, energy centre locations and plant sizings, are provisional (see below for more detail on potential district heating network layouts). There is, however, sufficient information available to comment on the feasibility of decentralised energy networks in the OA.

From the point of view of developing a district heating network, the OA has the following advantages:

- Most of the new roads are being re-built at a level significantly higher than existing. This means pipes can be laid in the space that will be filled to support the higher roads. Thus trenching costs, which often form a significant part of the cost of installing district heating network piping, will be very low or zero.
- The network would be servicing primarily new buildings, which can be designed specifically for integration with the network

The key constraints for the site are expected to be:

- Crossing the over-ground railway – although this should be mitigated in most places as a deck of two metres depth currently crosses sections of the

[2] Powering Ahead: Delivering Low Carbon Energy for London, London Development Agency, October 2009

railway, and this deck will be extended north and south with redevelopment

- Phasing – There are some sites which due to the current proposed phasing plan are not ideally placed for connection to a site wide scheme. This is because the cost to connect them across long pipe runs during early stages would not be offset by the heat sales. This means they may need to be connected at later stages, subject to changes in the phasing plan.

6.3 Energy plant sizing strategy

A notional energy supply concept incorporating gas fired CHP using internal combustion technology, top up biomass boilers and backup gas boilers and thermal storage has been used to define the energy supply requirements for the under Scenario 1.

The CHP has been sized to achieve a full load equivalent running hours of around 6,000 hours per year, in accordance with standard industry guidance [CIBSE]. The remainder of the heat in normal operation has been assumed to be supplied from biomass boilers in conjunction with high efficiency gas boilers that provide standby and top up capacity beyond the contribution provided by the biomass boilers. A thermal store is assumed to be incorporated within the scheme in order to provide operational flexibility and increase the potential CHP capacity. However, the model does not include for the any time lag between demand and generation.

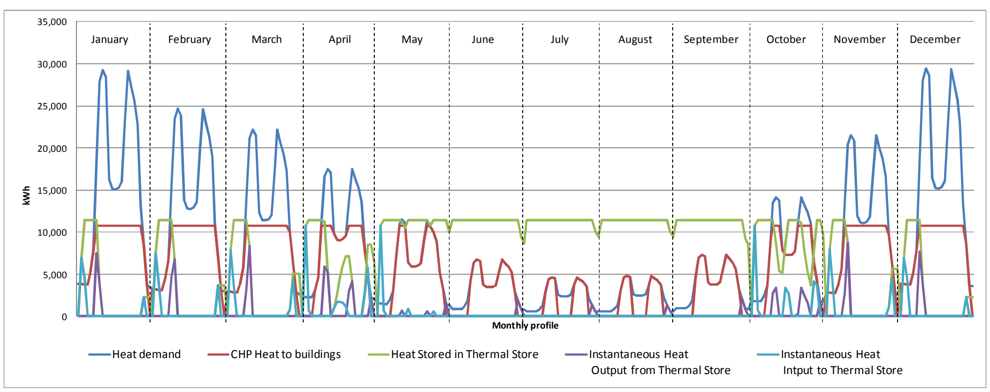

Figure 6.1 – Heat generation data for Scenario 3 as an example

The above graph shows 'system in operation' profiles and describes how the CHP strategy works for one day each month.

The blue profile represents the heat demand, the red one indicates the CHP heat supplied to buildings and the green is the heat stored profile.

CHP works in co-operation with a thermal storage system to optimises the operating time of the CHP throughout the year. Thermal storage works to collect CHP spare capacity when low building demand occurs, especially early in the morning and late in the night.

The reason for using a thermal store system is that of increasing the CHP efficiency both in terms of operational time and percentage of heat supplied into the buildings. This will occur when thermally stored heat is dispatched before there is a need to utilise the biomass boiler.

CHP should be employed to maximise energy efficiency. There is not the opportunity to export excess heat, whereas excess electricity can be exported to the grid. Thus any excess heat must be dumped, a waste of fuel and carbon emissions. Therefore the system has been modelled to ensure no excess heat is generated. This has been achieved by ensuring the CHP is operated according to heat demand.

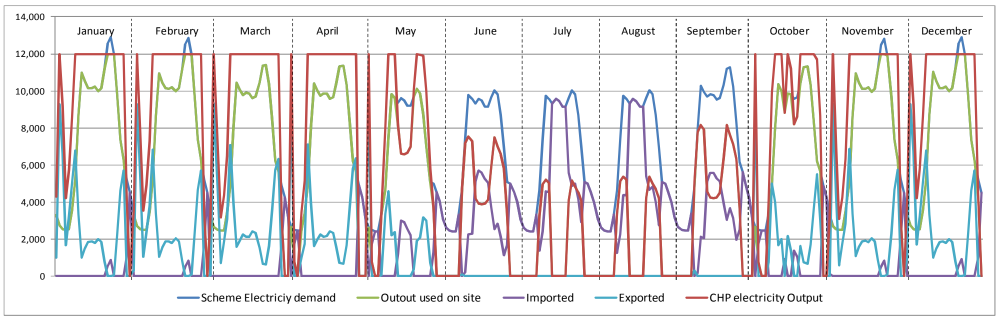

Figure 6.2 – Electricity generation data for Scenario 3 as an example

The following sections include the results of the modelling, and indicate the optimum amount of gas fired CHP capacity required to service the full development for each scenario.

Each scenario also includes a compliment of biomass boilers to introduce an element of renewable energy that can be cost effectively integrated with CHP. The inclusion of biomass boilers is an option, and their presence does not have any significant effect on the operation, size or viability of the CHP. Therefore in the case that biomass boilers were not considered suitable, for instance for air quality reasons, they could be replaced with gas boilers, and the CO2 savings associated with them removed. Section 6.6 below considers alternative forms of distributed renewable energy.

6.3.1 Phased energy supply options

Table 6.1 includes information on how gas CHP generation plant would be sized ideally for each phase of the roll out.

	Phase 1	Phase 2	Phase 3	Phase 4	Whole system
Thermal demand [kW]	13,618			12,151	
Thermal capacity [kW]	1,233	1,233	629	1,028	3,000
Electrical capacity [kW]	1,200	1,200	500	1,000	2,900
Annual heat generation [MWh/yr]	7,441	7,531	3,895	6,276	21,445
Useful electricity generation [MWh/yr]	7,240	7,327	3,098	6,107	20,865
Electrical used on site [MWh/yr]	6,575	6,683	2,977	5,878	14,779
Electricity exported [MWh/yr]	666	645	121	229	6,086
Gas consumption [MWh/yr]	20,112	20,354	8,851	16,963	57,959
Annual full load running hours	6,034	6,106	6,196	6,107	7,195
Thermal store volume [m3]	200	200	100	100	500
Biomass boiler					
Capacity [kW]	1300	1500	600	1000	3400
Annual heat output [MWh/yr]	4,019	4,353	2,036	3,460	13,593
Fuel consumption [tonnes/yr]	1,148	1,244	582	989	3,884
Fuel consumption [m3/yr]	4,593	4,975	2,327	3,955	15,535
Full load running hours	3,092	2,902	3,394	3,460	3,998
Gas boiler					
Size [kW]	3,188	3,136	1,912	3,076	8200
Annual heat output [kWh/yr]	2,838	2,780	1,916	3,021	14,528
Full load running hours [hr/yr]	890	886	1,002	982	1,080
Energy centre space take [m2]	960	960	400	800	2320

Table 6.1 – Generation plant operation for commercially sized gas CHP and biomass boiler, Scenario 2

Carbon emissions savings	Phase 1	Phase 2	Phase 3	Phase 4
Savings from energy efficiency design	13%	19%	22%	30%
Savings from energy supply	21%	15%	13%	1%
Total	34%	34%	34%	31%
Target	31%	45%	58%	70%

Table 6.2 – Cumulative emissions savings for commerically sized gas CHP and biomass boiler, Scenario 2

Table 6.2 indicates how the carbon emissions savings for the various phases are compiled as a combination of energy reduction through energy efficiency and decarbonisation through providing an alternative low carbon energy supply.

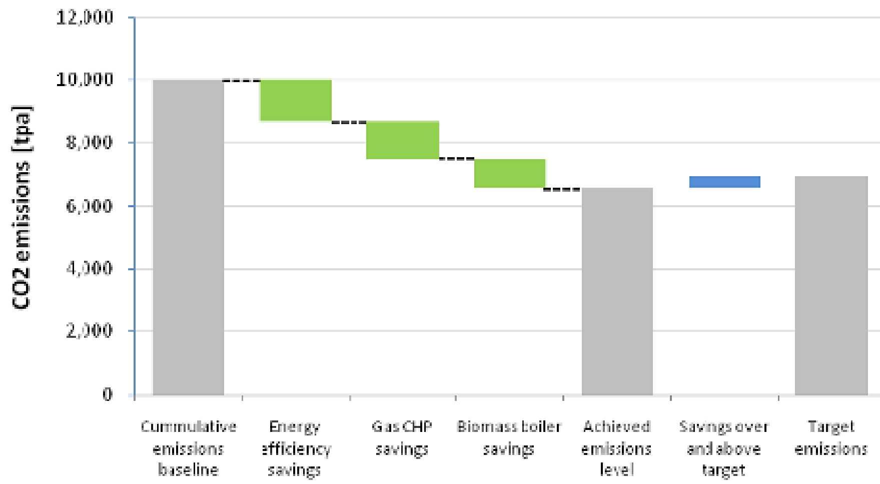

Figure 6.1 – Emissions contributions for Phase 1 (2015), Scenario 2

As is clear from the above graph, gas fired CHP with some compliment of biomass boiler will be sufficient to deliver the emissions reductions required by legislation at the time of construction.

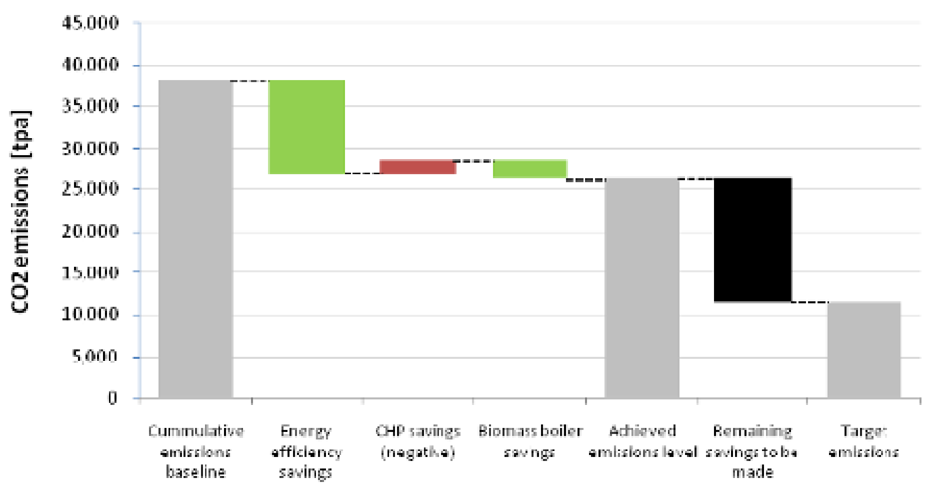

Figure 6.2 – Emissions contributions for full OA development (2031), Scenario 2

Figure 6.2 indicates the emissions profile for the full development of the OA if gas fired CHP is deployed for each phase. As is clear, the gas CHP actually has a slightly negative effect, due to the fact that the business as usual case (gas fired boilers and electricity from the national grid) is less carbon intensive than gas CHP once the grid has decarbonised along the trajectory set out in figure 5.6. There are significant savings still required for the development to reach the emissions targets as required by Building Regulations - approximately 11,500 extra tonnes per year.

The comparison of the 2015 scenario and the 2031 scenario indicates that a switch to a low carbon fuel to run the district heating scheme is likely to be required in 10 or 15 years, the point first point at which significant plant would be renewed.

As discussed above, a proportion of these savings can be accounted for through Allowable Solutions. Given the uncertainty around the proportion to which an Allowable Solution will apply, there may still be an extra 5,750 to 8,050 tCO2/ydr savings required through on-site solutions.

It is clear therefore that gas CHP is an interim solution that builds the capacity to for a low carbon district heating system that could eventually be powered by a low carbon fuel source, but cannot, on its own, make the required carbon emissions savings and other, zero carbon options must be considered. From the point of view of area wide, strategic energy opportunities – that is, those that are deployed on a site wide basis – these options are primarily CHP fired by either biomass or waste.

6.3.2 Scenario totals

In terms of the proportional contributions of gas CHP to energy supply, and the proportional carbon savings, all scenarios will be the same for all phases. On this basis the following assumptions can be made regarding CHP plant size and contribution to energy consumption for the complete development in each scenario:

	Scenario 1	Scenario 2	Scenario 3
CHP capacity [kWe]	1,909	2,900	3,891
Annual heat generation [MWh/yr]	14,120	21,445	28,770
Contribution to site heat demand [%]	43%	43%	43%
Thermal store volume [m3]	329	500	671
Capacity [kW]	2,239	3,400	4,561
Annual heat output [MWh/yr]	8,950	13,593	18,236
Fuel consumption (gas) [m3/yr]	10,229	15,535	20,842
Annual CO_2 emissions savings	6,408	9,732	13,057

Table 6.3 – Gas CHP supported by biomass boilers for each scenario

6.4 Energy from waste

Waste from homes, business and other sources can be used as a fuel source for the production of heat and electricity. Energy from waste (EfW) can be considered renewable, particularly in the case of options like anaerobic digestion (AD) technology, where only biological waste is used.

There are several key constraints to the use of waste as an energy source in urban contexts, namely the volume of waste resource available for energy conversion and technology constraints around perception, health and space. The following section explores these constraints in the context of the OA.

A number of relevant London targets for waste management include:

- To achieve zero municipal waste direct to landfill by 2025.

- To reduce the amount of household waste by 20 percent by 2031;
- To recycle or compost at least 45 per cent of municipal waste by 2015, 50 per cent by 2020 and 60 per cent by 2031; and
- To reuse and recycle 95 per cent of construction, excavation and demolition waste by 2020

Currently around 86,000 tonnes of waste per annum are collected in LBHF. Based on modelling roughly 16% of this is organic waste. Assuming that this waste could be used in an AD plant for the OA this would equate to around 13,760 tonnes per year.

6.4.1 Waste resources in and around the OA

Organic waste within the OA

Table 6.4 indicates the volume of organic waste that will be available for the full development of Scenarios 1, 2 and 3. This is then compared to the demand of the whole site to identify the potential contribution that waste from the OA can make to its own energy requirements. As implied in Table 6.4, this is less than 1%. Therefore if AD is to be a credible option for the site, waste will have to be collected from the wider area.

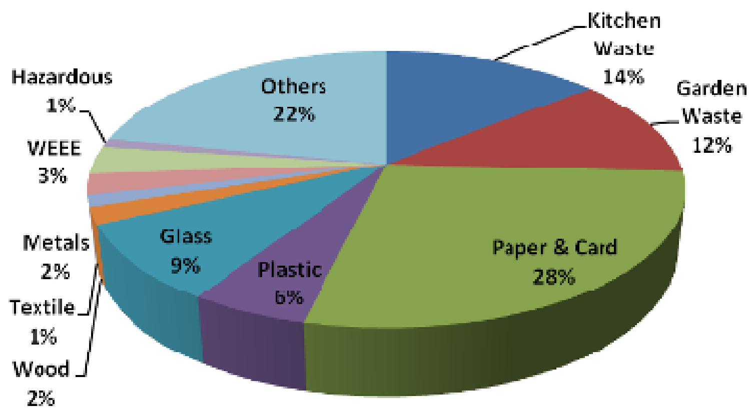

Figure 6.3 – Estimated waste composition for Earls Court Opportunity Area, implying 26% of waste is viable for AD

Scenario	Waste estimated Production (tonnes)	Organic to AD (tonnes)	Organic to meet 100% energy demand (tonnes)	Percentage of Energy demand from AD
1	7,349	1,829	377,000	0.5%
2	11,199	2,757	576,000	0.5%
3	15,048	3,686	776,000	0.5%

Table 6.4 – Organic waste volumes in the wider area

The existing arrangements for waste transfer, disposal, recycling and processing will continue in the short term as a result of LBHF's and RBKC's contractual obligations with WRWA until 2025.

Waste generated within the OA is currently transported via the Thames by barge from two Western Riverside Waste Authority (WRWA) transfer stations in Wandsworth to landfill in Essex. Dry recyclables are collected and sent to a Waste Management material reclamation facility (MRF) in Kent to be sorted.

Residual municipal solid waste from all borough's within WRWA's jurisdiction is soon to be diverted from landfill to a river fed energy-to-waste incinerator at Belvedere, Bexley. Dry recycled material will also be sent to a facility at Smugglers Way in Wandsworth and will therefore be processed within the WRWA area. Thus there will not be any municipal solid waste to support mass burn or gasification in the OA until 2025 at the earliest.

There are no dedicated waste processing facilities within the OA. All commercial waste generated by The Earls Court Exhibition Centres is currently collected by a private contractor and disposed of under separate arrangements.

6.4.2 Potential contribution towards OA energy consumption

Based on the above discussion of potential energy from waste technologies only AD is considered a viable option for the OA. Figure 6.4 indicates the amount of organic waste required to contribute towards the total ECOA energy demand. For instance to supply 75% of all energy consumption for Scenario 3 would require roughly 600,000 tonnes per annum.

As implied in Figure 6.4, the 13,760 tonnes of organic waste available in the surrounding area would only meet a very small proportion of the OA energy demand for each scenario (around 2% for Scenario 3, 4% for Scenario 1). To be able to offer any significant contribution to plugging the emissions gap identified in Figure 6.2, waste would be needed from much further afield. Building scale waste to energy systems, although potentially cleaver solutions, are therefore unlikely to have any material impact on carbon dioxide emissions for the OA.

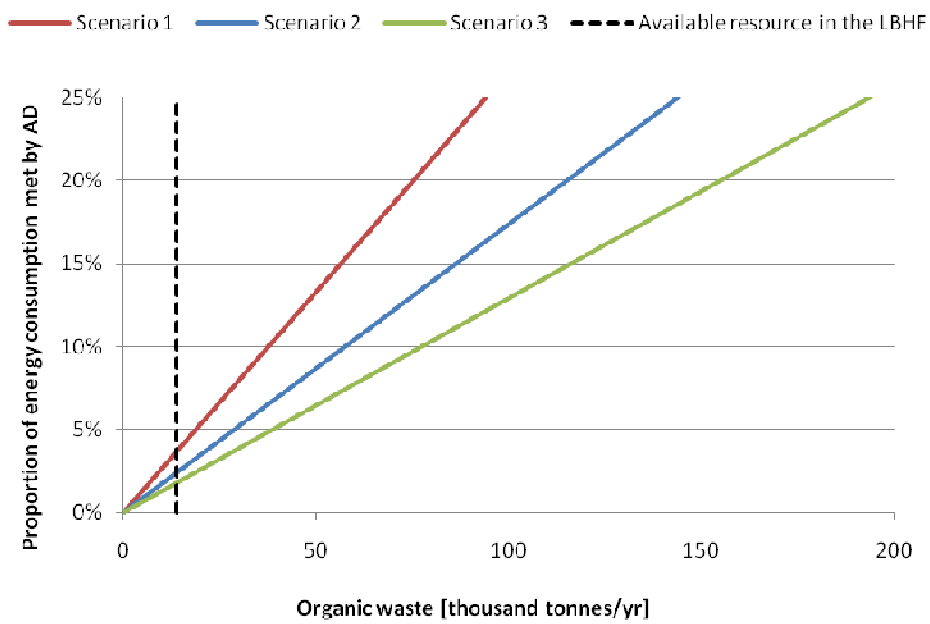

Figure 6.4 – Organic waste volume required to contribute towards the total OA energy demand for each scenario

AD plants are typically larger than other generating technologies in terms of land take. Table 6.5 below provides a high level indication of how the physical space take for an AD plant depends on its contribution to over all site demand. For instance to provide 75% of all energy consumed in Scenario 3 would require a plant of roughly ten hectares (1,000,000m2). It is anticipated that the absolute maximum that could possibly be accommodated on the OA is in the region of 0.5 – 1.0 Hectares. This would imply a contribution of little more than around 5% of total energy demand.

Scenario	**1**		**2**		**3**	
% of energy supplied by AD for full development of OA (2031)	25%	5%	25%	5%	25%	5%
AD energy centre space take [Hectares]	1.57	0.31	2.40	0.48	3.23	0.65

Table 6.5 – The space take of AD required to contribute towards the total OA energy demand for each scenario

Based on the above analysis, AD is not considered a viable solution for delivering all of the on-site emissions reductions that will be required for the OA. It may, however, be able to make some contribution given the high building density and availability of suitable waste.

6.5 Biomass energy

Policy requires that biomass energy installations minimise their negative impact on local air quality. In some cases this may require the installation of flue gas cleaning equipment to remove particles and other pollutants from exhaust gases.

Such equipment increases the capital cost of biomass schemes, a capital cost more easily borne by larger installations.

As indicated above, biomass boilers have been considered as part of the potential proposals for the scheme. It would also be possible to install a biomass fired CHP, rather than gas as specified here. This would deliver much greater carbon dioxide emissions savings. However air quality issues associated with large quantities of biomass combustion may preclude it from being a viable option.

Table 6.6 indicates the optimum sizing and energy contribution for a biomass CHP plant for each scenario. One of the implications of biomass technology is the need to source and deliver enough biomass. The logistical implications of such plant for the site are moderate, with no more than one articulated lorry delivery required per day on average. However, care would need to be taken to ensure that deliveries could take place without causing disruption and impacts such as noise from transferring the fuel from vehicle to storage area.

Scenario	Biomass CHP size [MWe]	Biomass consumption [tonnes/yr]	Average daily lorry deliveries	Carbon savings [tpa]	Operational hours per year	Proportion of demand met by CHP [%]
1	1.2	12,759	0.46	5,880	5,050	51%
2	1.7	17,971	0.65	8,235	5,021	47%
3	2.1	22,452	0.82	10,321	5,079	43%

Table 6.6 – Impact of biomass CHP

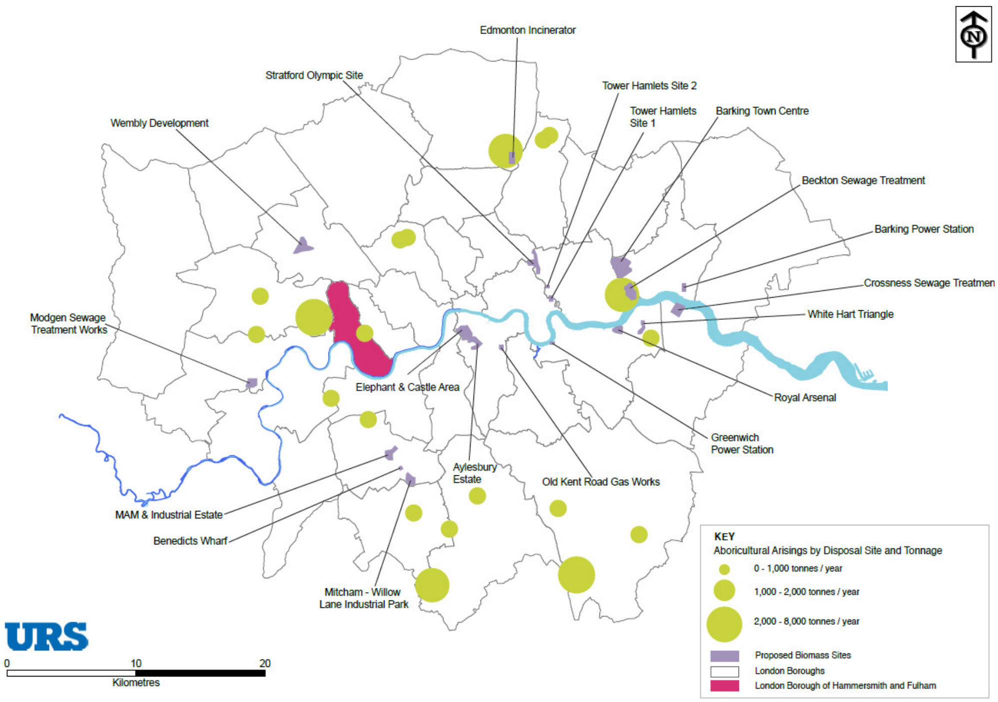

Figure 6.5 – Assessment of London biomass resources and potential other consumers

Comparison of Figure 6.5 with the biomass consumption values in Table 6.6 indicates that there is a limited biomass resource within London, while there is a growing number of potential competition for biomass fuel. The availability of a reliable, long term biomass supply is something that any proposals for biomass CHP will have to consider carefully.

6.6 Distributed renewable energy

Technology	Description	Integration with DH	Recommendations for ECOA
Solar PV	Generation of electricity directly from sunlight. Under current Feed in Tariff scheme, PV is technically viable. Future tariff levels are likely to change, impacting viability. Best placed on building roofs away from shading.	Electricity generation is always technically compatible with DH. However given that both may be competing to supply electricity on site (which offers the largest returns), deployment together may marginally damage their respective	PV panels should be installed to the maximum extent that is commercially feasible

		business cases	
Solar hot water	Conversion of solar energy directly into heat typically to supplement domestic hot water supply	Solar hot water is most productive in summer day times, and so would displace key base load demand for the CHP, potentially requiring CHP to be taken offline in summer.	Solar thermal systems should only be installed in later phases, should DH be shown to be an unsuitable option
Ground source and air source heat pumps	Electrically powered heat pumps using either solid earth or air as a heat source	Not suitable as central heating source to support DHN (on account of requiring distributed heat sink) and so would compete directly for heat demand.	Should only be considered in later phases should DH be shown to be an unsuitable option
Wind power	Generation of electricity from kinetic energy of wind, through either large stand-alone turbines or small building mounted systems (not recommended for urban areas due to low output)	Electricity generation is always technically compatible with DH. However given than both may be competing to supply electricity on site (which offers the largest returns), deployment together may marginally damage their respective business cases	Wind power generation should be installed to the maximum extent that is commercially and technically viable and compatible with the design policies for the area, especially in terms of visual impact.
Water source heat pumps	Electrically powered heat pumps using water (either from aquifer or river) as heat source	Could potentially form basis for heat supply to DHN	Should hydro-geological conditions prove suitable. Should be considered in any proposals for development in the OA.

Table 6.7 – Compatibility of distributed renewable energy with district heating

As implied in Table 6.7, some distributed technologies are compatible with district heating, and some are not. Heat generating systems, such as ground source and air source heat pumps, and in particular solar thermal hot water systems, tend not to be very compatible. However, electricity generating renewables, such as PV panels and wind power, are fully compatible with CHP fired district heating schemes. Therefore these systems should be included to the maximum extent that is commercially and technically viable, subject to them being consistent with other policies for the area.

7 District heating network

Given that the entire OA is to be developed, and much of it at a raised level relative to today, this offers an unusually convenient situation for developing a district heating network. Thus there is not anticipated to be any significant constraints to the potential network lay out. Crossing the London Overground rail track is also expected to be technically feasible due to the two metre thick deck which will traverse it across most of the OA.

Figure 7.1 includes a potential network lay out, including a schedule for how the system might be installed in line with phasing of the development.

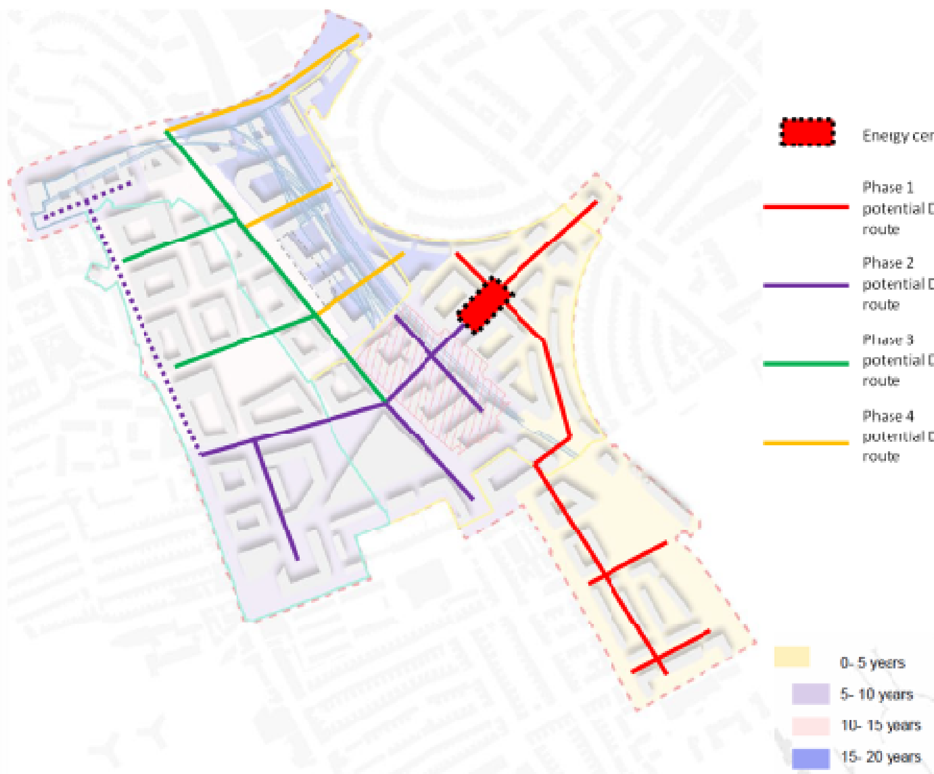

Figure 7.1 – Potential district heat network build out based on single energy centre

Figure 7.1 illustrates a network based around a single energy centre located in the void below EC1. In this situation, space would be left to allow plant to be included in a modular fashion to accommodate increases in heat demand as new phases are connected to the network. This is because it would be uneconomic to install energy generation plant sufficient to meet the whole development demand in the first phase.

One other possibility would be to set aside only that space required to install the plant required for Phase 1. Then as later phases are developed, new energy centres are identified in each phase to accommodate the extra plant required. Figure 7.2 includes a potential layout for doing so (although the actual layout would depend on the finalised masterplan layout). This option would require more space overall in the development to be dedicated to energy supply, yet it would avoid the problem of redundant space in the larger single energy centre option as the later phases are under development.

Which of the two options is selected depends on the actual delivered phasing schedule for development. If there is uncertainty regarding the date of a future phase, it may be more cost effective to include multiple energy centres. However if there is known to be a set period between phases, and the commercial impact of relying on one centralised energy centre can be established, there may be significant benefit from the reduced land take associated with one rather than several energy centres, as well as high efficiency plant associated with the increased generation plant size.

Figure 7.2 – Potential district heat network build out based on build up of several energy centres in line with phasing

7.1 LBHF land

Costing analysis has been undertaken to understand the impact on overall costs from the point of view of installing a DHN of:

1. Redevelopment - rebuilding the social housing on LBHF land, designed to be connected to a DHN, meaning that in-building costs such as internal piping and radiators, are already paid for as part of the building development costs.
2. Refurbishing – connecting the DHN to the buildings that currently exist once they have been refurbished to modern standards. This would be more

costly from the point of view of the DHN, as in-building costs, as far as they are over and above those of standard refurbishment, would have to be borne by the DHN developer.

Analysis implies that for a typical apartment block on the LBHF land the cost of connecting to a heat network are £83,000 in the case of retrofitting to an existing building, compared to £77,000 in the case of installing as part of constructing a new building.

The costing analysis of different options should inform the commercial analysis undertaken to support development proposals coming forward.

8 Local strategic opportunities

This section presents the local strategic opportunities for connection of buildings outside the OA to the OA district heating scheme. Data available on the London Heat Map[3] was used to identify heat customers and heat supply plant in the local area which have potential for connection to the scheme.

8.1 Local heat customers

Buildings with high heating demands are more likely to be viable for connection to the OA district heating scheme than those with low heating demands since the greater revenues from the heat sales would justify the cost of installation of the pipework. Clusters of buildings with high heating demand in area around the OA have been identified and are illustrated in figure 8.1.

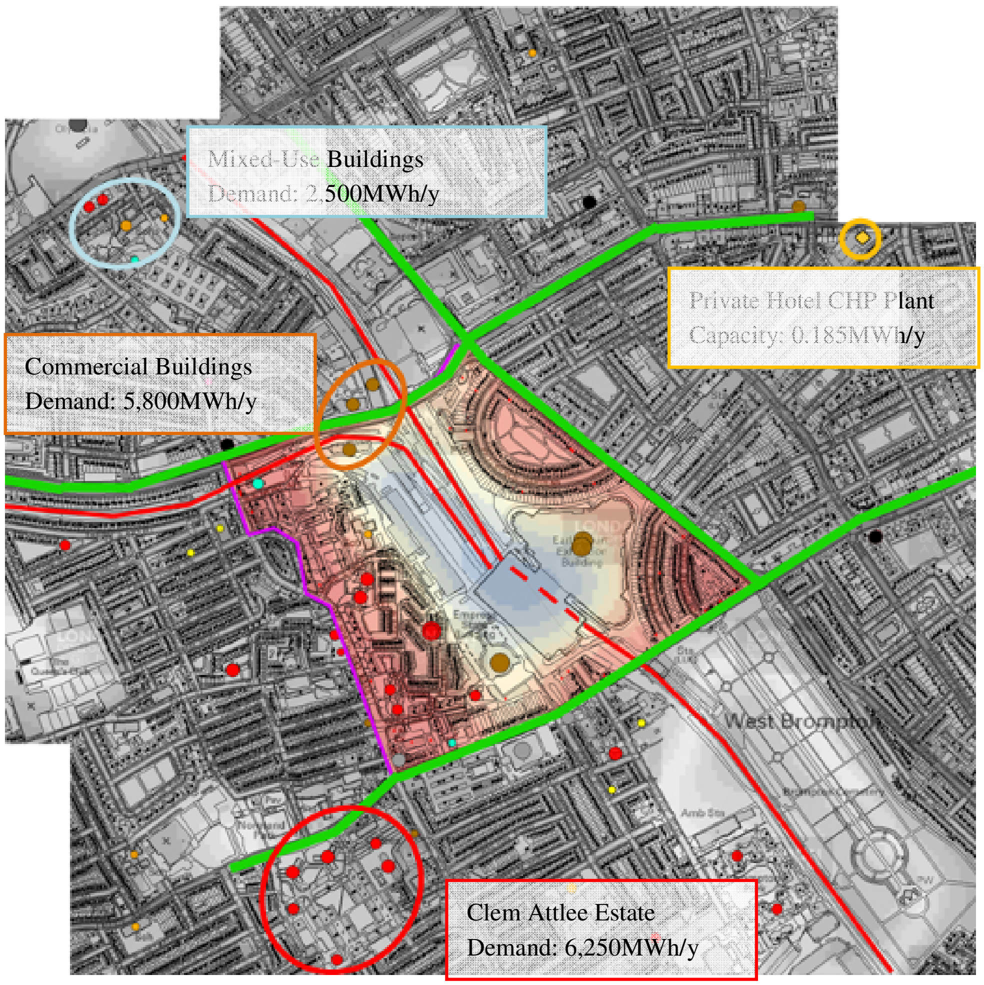

Figure 8.1 – Earls Court District Heating Network nearby sources demands.

Based on the London Heat Map data three clusters of buildings with high heat demand have been identified near to the OA as listed below:

[3] www.londonheatmap.org.uk

- The Clem Attlee Estate (484 flats identified on the heat map across six blocks) total energy demand of 6,250MWh/y in the South-West corner.
- Commercial Buildings with total energy demand of 5,800MWh/y on the northern border of the site.
- Mixed-used buildings (residential, leisure and educational facilities) with total energy demand of 2,500MWh/y north of the site.

Further investigation is necessary to assess whether retrofit of a district heating system connection would be a viable option for the buildings within the clusters identified. Key factors to consider will be whether they have central boiler systems, the condition of the existing heating plant in the buildings and the timeline for their replacement and whether they are listed. It is noted that recent schemes on Warwick Road identified below will also result in further demand.

8.2 Heat sources

Heat Map studies undertaken for RBKC and LBHF identified a number of potential opportunities for DE schemes in close proximity to the OA. If connected to the OA DH scheme these schemes could contribute a heat supply to the OA DH scheme. The schemes identified in the Heat Map Study are illustrated in figure 8.2 and those identified as having potential for connection to the OA (5) are Olympia (8), Cromwell Road (9) and South Chelsea (6). There have also been schemes subsequently identified on Warwick Road, immediately to the north of the site. These sites are at various stages of development, though all have submitted planning applications with associated energy strategies. Details of these developments are summarised in the table below.

Warwick Road Developments	Residential dwellings	Commercial floorspace	Distance to Earls Court [m]
Charles House	543	925 m^2	900
Former TA Site	255	481 m^2	900
Homebase	342	400 m^2	600
100 West Cromwell Road	293	3,570 m^2	550
Telephone Exchange	190	520 m^2	750

Two key factors which will affect the viability of connection of these schemes to the OA DH scheme are distance from the site and size of heat load.

Table 8.1 shows a matrix of the distances between the sites identified in the RBKC heat mapping study and Earls Court. It shows that Olympia is the closest scheme to OA.

Distances Matrix	Earls Court	Olympia	Cromwell Rd	South Chelsea
Olympia	~1,500m	-	~2,500m	~3,300m
Cromwell Rd	~ 2,300m	~2,500m	-	~1,500m
South Chelsea	~2,000m	~3,300m	~1,500m	-

Table 8.1 – Distances Matrix

The total scheme heat demand and construction commencement dates for Earls Court, Olympia, Cromwell Rd and South Chelsea district heating schemes are shown in table 8.2. It shows that Cromwell Rd has the highest total heat demand.

	Earls Court	Olympia	Cromwell Rd	South Chelsea
Scheme Heat Demand (MWh/y)		~10,000	~50,000	~30,000
Construction commencement date	2010 – 2030	No Data	No Data	No Data

Table 8.2 – Energy demand and construction dates

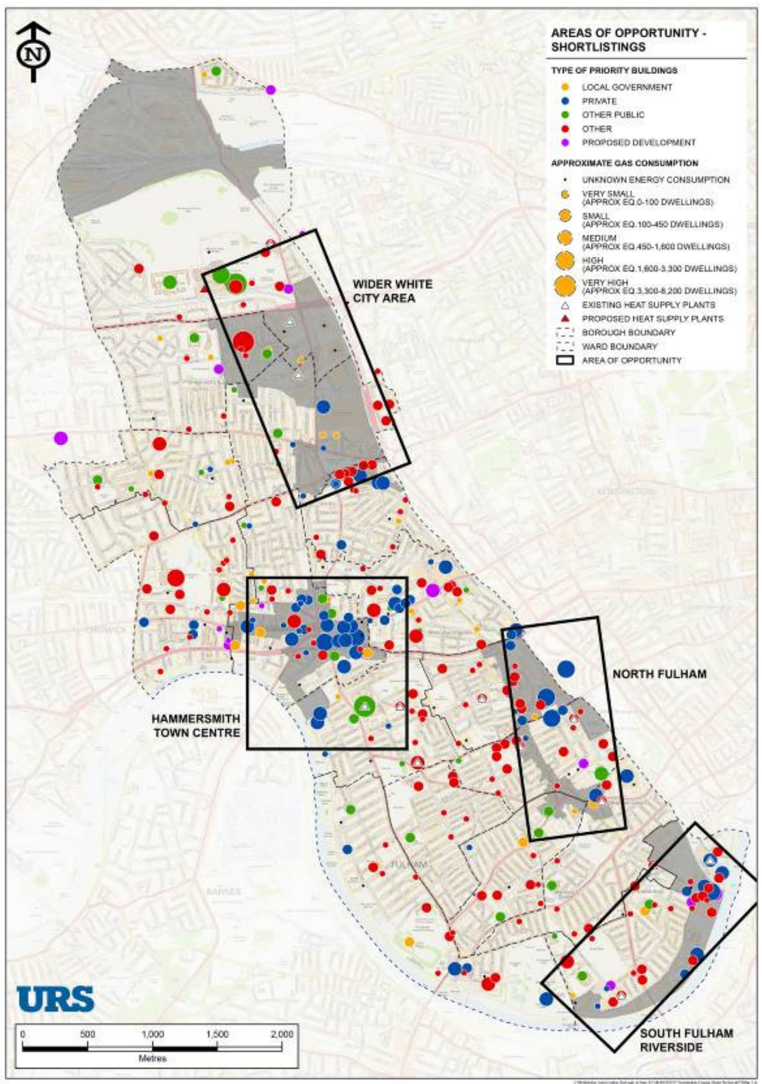

Figure 8.2 A - Fuel Consumption and Site Ownership in the London Borough of Hammersmith and Fulham including identified Heating Zones. Source: London Borough of Hammersmith & Fulham Sustainable Energy Study, Volume 1: Heat Mapping Study, January 2011.

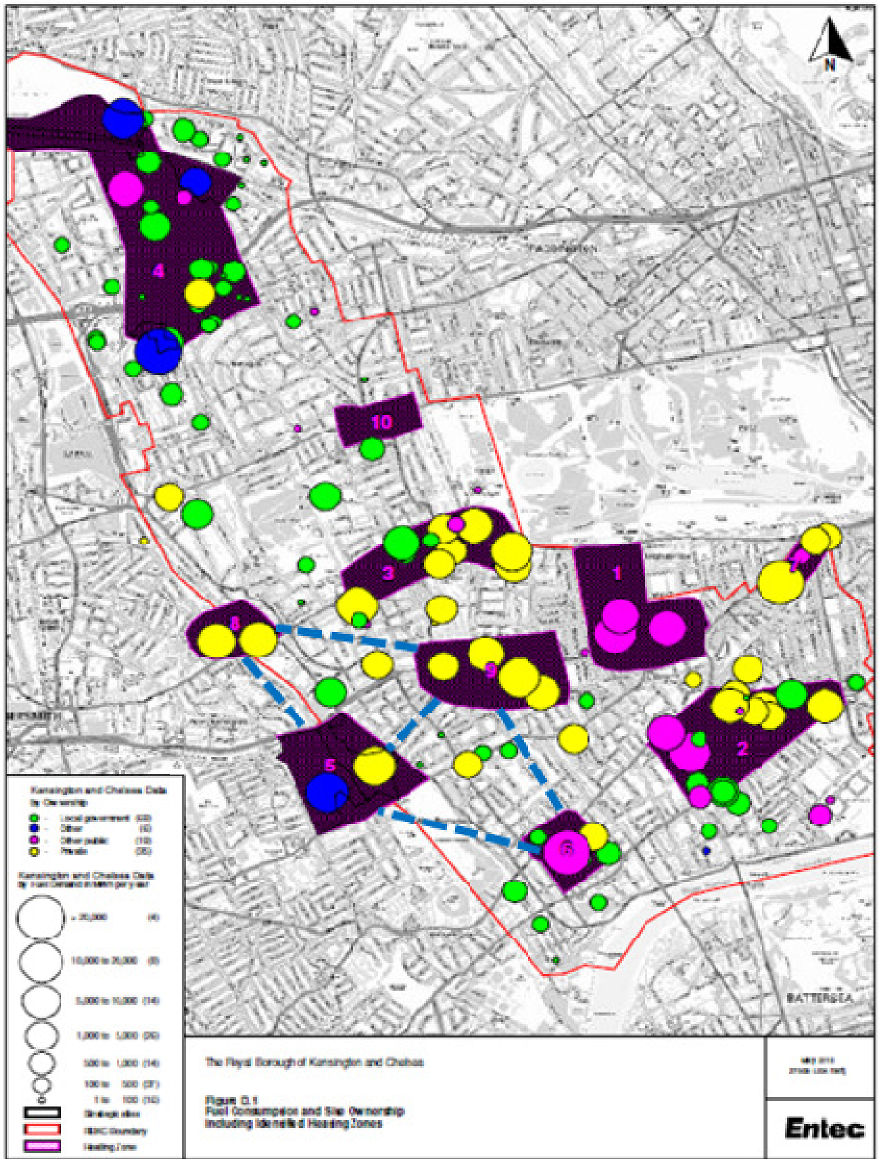

Figure 8.2 B – Fuel Consumption and Site Ownership in the Royal borough of Kensington and Chelsea including identified Heating Zones. Source: RBKC Heat Mapping Study Final Report, May 2010.

8.2.1 Possible area wide district heating scenarios

Given the proximity and heat demands of the district heating schemes opportunities identified in the RBKC Heat Map Study, three scenarios for the connection of the OA DH scheme to off-site opportunities have been compared as follows:

1. Earls Court connection to Cromwell Road
2. Earls Court connection to Olympia
3. Earls Court connection to South Chelsea.

As a general rule of thumb, a heat demand of 5,000MWh/yr will justify 1km of distribution pipe for district heating schemes. The presence of physical obstacles such as major roads and railways will add significantly to the cost of distribution, therefore increasing the minimum heat demand threshold that will justify distribution of heat over 1km. There are some physical obstacles such as railways and major roads between the opportunities identified however these are not necessarily insurmountable constraints to connection of the schemes. Further investigation would be required to assess whether the cost of crossing such barriers would compromise the viability of these connections.

Table 8.3 shows the total heat demand per kilometre of district heating pipe connection between OA and the off-site opportunities.

	Olympia	Cromwell Rd	South Chelsea
Total heat demand per unit length of DH pipe (MWh/km)	6,667	21,739	15,000

Table 8.3 – Heat demand per unit length of DH pipe

Cromwell Rd has the highest heat demand per unit length of DH pipe and is therefore the most likely to be viable for connection to the OA. This is therefore recommended as the highest priority opportunity for further investigation for connection to OA. However, both South Chelsea and Olympia have a heat demand per unit length of DH pipe above the minimum threshold previously mentioned and are also worthy of further consideration. In the case of the latter the emerging schemes identified on Warwick Road, immediately to the north of the site, may enhance the viability of this connection and given this the viability of this connection should be kept under review.

9 Policy Context

There are a number of policies and strategies impacting on the development of the sites in the OA in terms of energy. A brief review of the relevant policies and regulations is set out below.

9.1 National

At a national level, the Government passed the Climate Change Act in December 2008, setting a legally binding target of at least an 80% cut in greenhouse gas emissions by 2050, to be achieved through action in the UK and abroad.

The Government has also introduced the Planning Act 2008 which is of considerable importance for energy infrastructure projects, as well as the Energy Act and Climate Change Act 2008 which ensure that legislation underpins the long term delivery of the UK's energy and climate change strategy. More details can be found at www.berr.gov.uk/energy/sources/renewables/policy/index.html

The Renewable Heat Incentive is currently in development which would establish a financial support mechanism for renewable heat, for example from an anaerobic digestion plant or biomass combustion. Current proposals are for the introduction of a 'banded' system, similar to that of the Renewables Obligation, whereby suppliers can trade ROCs, potentially creating an additional revenue stream.

The Renewable Energy Strategy, which maps out how we will deliver the UK's renewable energy target by 2020, was published in July 2009 after widespread public consultation. The Strategy addresses the need to radically reduce greenhouse gas emissions, as well as to diversify the UK's energy sources. As part of this move to a low-carbon economy, a step change is required in renewable energy use in heat, electricity and transport over the next 12 years.

9.1.1 PPS 1 Supplement on Climate Change and the revised draft replacement PPS

PPS1 Supplement gives strong support to the implementation of decentralised energy systems. It encourages a commitment to decentralised and renewable or low carbon energy to be embedded in policy at a regional and local level. In making decisions about their spatial strategies a key principle for all planning bodies and authorities is that new development should be planned to make use of opportunities for decentralised and renewable or low carbon energy.

The PPS1 Supplement advises that local planning authorities, in their consideration of proposed development, should expect new development to "*comply with adopted DPD policies on decentralised energy supply and for sustainable buildings*" (para. 42).

It also expects developments to take account of "landform, layout, building orientation, massing and landscaping to minimise energy consumption, including maximising cooling and avoiding solar gain in the summer; and, overall, be planned so as to minimise carbon dioxide emissions" (para. 42).

In March 2010, the Department of Communities and Local Government (CLG) issued for consultation a revised version of its guidance on planning and climate change (*Consultation on a Planning Policy Statement: Planning for a Low Carbon Future in a Changing Climate*). The consultation document brought together the Planning and Climate Change supplement to PPS 1 with the 2004 PPS 22 on Renewable Energy into a new draft PPS on Planning for a Low Carbon Future in a Changing Climate. This document has not been taken forward to publication given the subsequent emergence of the National Planning Policy Framework. The latter is emerging at the time of writing. The draft currently states that local authorities should identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers. This study would support this emerging policy requirement.

9.1.2 Building Regulation and the Code for Sustainable Homes (CSH)

On October 1st 2010 Building Regulations Part L: "Conservation of fuel and power" was revised to increase energy performance standard requirements for new buildings. The main requirement being that all new buildings must achieve a minimum of 25% reduction in carbon dioixde emissions compared to the 2006 baseline through energy efficient design and low carbon or renewable energy supply.

The Government has set out a trajectory for the progressive tightening of energy efficiency and carbon emissions standards for new domestic and non-domestic buildings through the structure of the Code for Sustainable Homes. At the time of publication of this study, the provisions for allowable solutions to meet the Zero Carbon standard which will apply to all homes from 2016 and all other buildings from 2019 are still to be confirmed. Those solutions that received broad support during the consultation on the definition of Zero Carbon (as announced in July 2009) include:

- Further carbon reductions on-site beyond the regulatory standard;
- Energy efficient appliances meeting a high standard which are installed as fittings within the home;
- Advanced forms of building control systems which reduce the level of energy use in the home;
- Exports of low carbon or renewable heat from the development to other developments;
- Investments in low and zero carbon community heat infrastructure;
- Other allowable solutions remain under consideration.

The allowable solutions are highly relevant to the development of the ECOA decentralized energy networks, as it may be possible to use investment in the network and connection between developments as a way of achieving zero carbon schemes.

9.2 Regional

9.2.1 The London Plan

The London Plan, July 2011 forms the Spatial Development Strategy for Greater London. The London Plan identifies climate change as one of the city's cross cutting policy areas, the focus of which is the achievement of a reduction in carbon dioxide emissions. The Mayor's overall targets for reducing carbon dioxide emissions are set out in Policy 5.1, with an overall target of reducing emissions by 60% by 2025, based on 1990 baseline figures.

Policy 5.2 requires that the following hierarchy is used to assess planning applications in line with the Mayor's Energy Strategy:

- Be lean: use less energy
- Be clean: supply energy efficiently
- Be green: use renewable energy

Other relevant policies in the London Plan (2011) are 5.3 – 5.12. These cover the following areas:

- 5.3 Sustainable design and construction
- 5.4 Retrofitting
- 5.5 Decentralised energy networks
- 5.6 Decentralised energy in development proposals
- 5.7 Renewable energy
- 5.8 Innovative energy technologies
- 5.9 Overheating and cooling
- 5.10 Urban greening
- 5.11 Green roofs and development site environs
- 5.12 Flood risk management
- 5.13 Sustainable drainage
- 5.14 Water quality and waste water infrastructure
- 5.15 Water use and supplies

Policies 5.4 to 5.7 are of particular relevance to the OA as they require consideration of site-wide energy supply and demand, CHP and low carbon energy supply options and the environmental impact of existing buildings.

5.4 Retrofitting

Strategic

A. The environmental impact of existing urban areas should be reduced through policies and programmes that bring existing buildings up to the Mayor's standards on sustainable design and construction. In particular, programmes should reduce carbon dioxide emissions, improve the efficiency of resource use (such as water) and minimise the generation of pollution and waste from existing building stock.

LDF preparation

B. Within LDFs boroughs should develop policies and proposals regarding the sustainable retrofitting of existing buildings. In particular they should identify opportunities for reducing carbon dioxide emissions from the existing building stock by identifying potential synergies between new developments and existing buildings through the retrofitting of energy efficiency measures, decentralised energy and renewable energy opportunities (see Policies 5.5 and 5.7).

5.5 Decentralised energy networks

Strategic

A. The Mayor expects 25 per cent of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. In order toachieve this target the Mayor prioritises the development of decentralised heating and cooling networks at the development and area wide levels, including larger scale heat transmission networks.

LDF preparation

B. Within LDFs boroughs should develop policies and proposals to identify and establish decentralised energy network opportunities. Boroughs may choose to develop this as a supplementary planning document and work jointly with neighbouring boroughs to realise wider decentralised energy network opportunities.

As a minimum boroughs should:

a. identify and safeguard existing heating and cooling networks

b. identify opportunities for expanding existing networks and establishing new networks. Boroughs should use the London Heat Map tool and consider any new developments, planned major infrastructure works and energy supply opportunities which may arise

c. develop energy master plans for specific decentralised energy opportunities which identify:

- major heat loads (including anchor heat loads, with particular reference to sites such as universities, hospitals and social housing)
- major heat supply plant
- possible opportunities to utilise energy from waste

- possible heating and cooling network routes
- implementation options for delivering feasible projects, considering issues of procurement, funding and risk and the role of the public sector

d. require developers to prioritise connection to existing or planned decentralised energy networks where feasible.

5.6 Decentralised energy in development proposals

Planning decisions

A. Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

B. Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks
2. Site wide CHP network
3. Communal heating and cooling

C. Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

5.7 Renewable Energy

Strategic

A. The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Planning decisions

B. Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

LDF preparation

C. Within LDFs boroughs should, and other agencies may wish to, develop more detailed policies and proposals to support the development of renewable energy in London – in particular, to identify broad areas where specific renewable energy technologies, including large scale systems and the large scale deployment of small scale systems, are appropriate. The identification of areas should be consistent with any guidelines and criteria outlined by the Mayor.

D. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

9.2.2 Air Quality

In December 2010, the Mayor of London published his Air Quality Strategy. This document includes some provisions relating to the use of biomass energy technology in London (see Policy 8).

Policy 8 – Maximising the air quality benefits of low to zero carbon energy supply

Vision

A low to zero carbon energy supply for London that does not worsen local air quality and creates opportunities to improve local air quality.

Policy

The Mayor will ensure that low to zero carbon energy sources in London do not contribute to the deterioration of local air quality through the adoption of best practice in the management and mitigation of emissions.

Proposals

The Mayor will use his planning powers to:

Apply emissions limits for both PM and NOx for new biomass boilers (including use of biofuels) and NOx emission limits for Combined Heating and Power Plant (CHP) across London. These emission limits will be regularly reviewed as new evidence becomes available and abatement technology improves. This will be applicable at a strategic and local level.

Require an emissions assessment to be included as part of the standard air quality assessment that is submitted at the planning application stage for new developments that include biomass boilers or CHP.

Require biomass and CHP operators to monitor and provide evidence on a yearly basis in the form of an annual maintenance report to show continued compliance with emission limits.

Outputs

Ensure that the Mayor’s commitment to supporting the installation of low to zero carbon technologies, including decentralised energy production, does not lead to the deterioration of local air quality in London.

The London Plan (July 2011) policy on air quality (7.14) also relates to the use of biomass energy generators in London:

7.14 Improving air quality

Strategic

A. The Mayor recognises the importance of tackling air pollution and improving air quality to London's development and the health and well-being of its people. He will work with strategic partners to ensure that the spatial, climate change, transport and design policies of this plan support implementation of his Air Quality and Transport strategies to achieve reductions in pollutant emissions and minimise public exposure to pollution.

Planning decisions

B. Development proposals should:

   a. minimise increased exposure to existing poor air quality and make provision to address local problems of air quality (particularly within Air Quality Management Areas (AQMAs) and where development is likely to be used by large numbers of those particularly vulnerable to poor air quality, such as children or older people) such as by design solutions, buffer zones or steps to promote greater use of sustainable transport modes through travel plans (see Policy 6.3)

   b. promote sustainable design and construction to reduce emissions from the demolition and construction of buildings following the best practice guidance in the GLA and London Councils' 'The control of dust and emissions from construction and demolition'

   c. be at least 'air quality neutral' and not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs).

   d. ensure that where provision needs to be made to reduce emissions from a development, this is usually made on-site. Where it can be demonstrated that on-site provision is impractical or inappropriate, and that it is possible to put in place measures having clearly demonstrated equivalent air quality benefits, planning obligations or planning conditions should be used as appropriate to ensure this, whether on a scheme by scheme basis or through joint area-based approaches

   e. where the development requires a detailed air quality assessment and biomass boilers are included, the assessment should forecast pollutant concentrations. Permission should only be granted if no adverse air quality impacts from the biomass boiler are identified

LDF preparation

C. Boroughs should have policies that:

   a. seek reductions in levels of pollutants referred to in the Government's National Air Quality Strategy having regard to the

Mayor's Air Quality Strategy

b. take account of the findings of their Air Quality Review and Assessments and Action Plans, in particular where Air Quality Management Areas have been designated.

9.3 Local

9.3.1 Hammersmith and Fulham

The LBHF Core Strategy was adopted on 19 October 2011. The mitigation of climate change is identified as one of the Borough's strategic objectives, and is addressed though Policy CC1.

The following policies are of particular relevance to a potential decentralised energy scheme in the OA:

Tackling and Adapting to Climate Change

Borough Wide Strategic Policy – CC1

Reduce Carbon Emissions and Resource Use and Adapt to Climate Change Impacts

Require developments to make the fullest possible contribution to the mitigation of and adaptation to climate change.

The council will reduce carbon emissions and tackle climate change by:

- reducing carbon emissions from the redevelopment or reuse of buildings, by ensuring developments minimise their energy use, make use of energy from efficient sources and use renewable energy where feasible;
- maximising the provision of decentralised energy networks and integrating the use of renewable energy in the proposed regeneration areas;
- meeting London Plan targets for reducing carbon emissions from new development;
- promoting the efficient use of land and buildings and patterns of land use that reduce the need to travel by car;
- safeguarding existing heating and cooling networks in the borough; and
- requiring developments to be designed and constructed to take account of the increasing risks of flooding, drought and heatwaves.

The following policies are included in direct reference to the OA:

Strategic Site and Housing Estate Regeneration Area – FRA 1

The vision for the Earl's Court and West Kensington Opportunity Area includes the following statement:

"All development must incorporate high levels of environmental performance by the use of low and zero carbon technologies, including combined heat and power, the establishment of a decentralised energy network and the installation of renewable energy systems."

9.3.2 Kensington and Chelsea

The RBKC Core Strategy was adopted by the Council at its meeting on 8th December 2010. The policies contained that have a bearing on the deployment of distributed energy in the borough are:

Policy CE 1 Climate Change

The Council recognises the Government's targets to reduce national carbon dioxide emissions by 26% against 1990 levels by 2020 in order to meet a 60% reduction by 2050 and will require development to make a significant contribution towards this target.

To deliver this the Council will:

a) require an assessment to demonstrate that all new buildings and extensions of 800m² or more residential development or 1,000m² or more non-residential achieve the following Code for Sustainable Homes / BREEAM standards:

   i. **Residential Development**: Code for Sustainable Homes:
      - Up to 2012: Level Four; and seek to achieve:
      - 2013 to 2015: Level Five;
      - 2016 onwards: Level Six.

   ii. **Non Residential Development**: Relevant BREEAM Assessment
      - Up to 2015: Excellent; and seek to achieve:
      - 2016 onwards: Outstanding;

b) require an assessment to demonstrate that conversions and refurbishments of 800m² or more residential development or 1,000m² or more non-residential achieve the following relevant BREEAM standards:

   i. **Residential Development**: EcoHomes Very Good (at design and post construction) with 40% of credits achieved under the Energy, Water and Materials sections, or comparable when BREEAM for refurbishment is published;

   ii. **Non Residential Development**:
      - Up to 2015: Very Good (with 40% of credits achieved under

the Energy, Water and Materials sections); and seek to achieve:

- 2016 onwards: Excellent (with 40% of credits achieved under the Energy, Water and Materials sections);

c) require an assessment to demonstrate that the entire dwelling where subterranean extensions are proposed meets EcoHomes Very Good (at design and post construction) with 40% of the credits achieved under the Energy, Water and Materials sections, or comparable when BREEAM for refurbishment is published;

d) require that carbon dioxide and other greenhouse gas emissions are reduced to meet the Code for Sustainable Homes, EcoHomes and BREEAM standards in accordance with the following hierarchy:

i. energy efficient building design, construction and materials, including the use of passive design, natural heating and natural ventilation;

ii. decentralised heating, cooling and energy supply, through Combined Cooling Heat and Power (CCHP) or similar, whilst ensuring that heat and energy production does not result in unacceptable levels of air pollution;

iii. on-site renewable and low-carbon energy sources;

e) require the provision of a Combined Cooling, Heat and Power plant, or similar, which is of a suitable size to service the planned development and contribute as part of a district heat and energy network for:

i. strategic site allocations at Kensal, Wornington Green, Kensington Leisure Centre and Earl's Court; and

ii. significant redevelopment and regeneration proposals at Notting Hill Gate and Latimer as set out in the places section of this document;

f) require all CCHP plant or similar to connect to, or be able to connect to, other existing or planned CCHP plant or similar to form a district heat and energy network;

g) require development to connect into any existing district heat and energy network, where the necessary service or utility infrastructure is accessible to that development;

h) require development to incorporate measures that will contribute to on-site sustainable food production commensurate with the scale of development;

i) require, in due course, development to further reduce carbon dioxide emissions and mitigate or adapt to climate change, especially from the existing building stock, through financial contributions, planning conditions and extending or raising the Code for Sustainable Homes and BREEAM standards for other types of development.

The RBKC air quality policy is included below:

Policy CE 5 - Air Quality

Air Quality

The Council will carefully control the impact of development on air quality, including the consideration of pollution from vehicles, construction and the heating and cooling of buildings. The Council will require development to be carried out in a way that minimises the impact on air quality and mitigate exceedences of air pollutants. To deliver this the Council will:

a) require an air quality assessment for all major development;

b) resist development proposals which would materially increase exceedences of local air pollutants and have an unacceptable impact on amenity, unless the development mitigates this impact through physical measures or financial contributions to implement proposals in the Council's Local Air Quality Management Plan;

c) require that the Code for Sustainable Homes and BREEAM assessments obtains all credits available for reducing pollution and emissions, and improving air quality;

d) resist biomass combustion unless its use will not have a detrimental impact on air quality.

10 District Heating Network Technical Standards

10.1 Design parameters and operating principle

The OA DHN should be designed in accordance with the widely used European practice for large scale CHP/DH systems with design conditions of 16 bar, 120 °C. This will facilitate compatibility with other large scale renewable energy or CHP schemes that arise in the future, meaning the OA Main Scheme could be connected directly (without interposing heat exchanger station or modifications) to a possible future wide area network, enabling greater load diversity and economy of scale benefits in operation.

The OA primary network should be designed with a maximum operating temperature of 110 °C flow and a design return temperature of 55 °C at peak demand. The operation is based on variable flow and variable temperature design, where the actual momentary heat consumption level determines the actual water flow and flow temperature applied, i.e. the higher the consumption the higher the applied flow and temperature is.

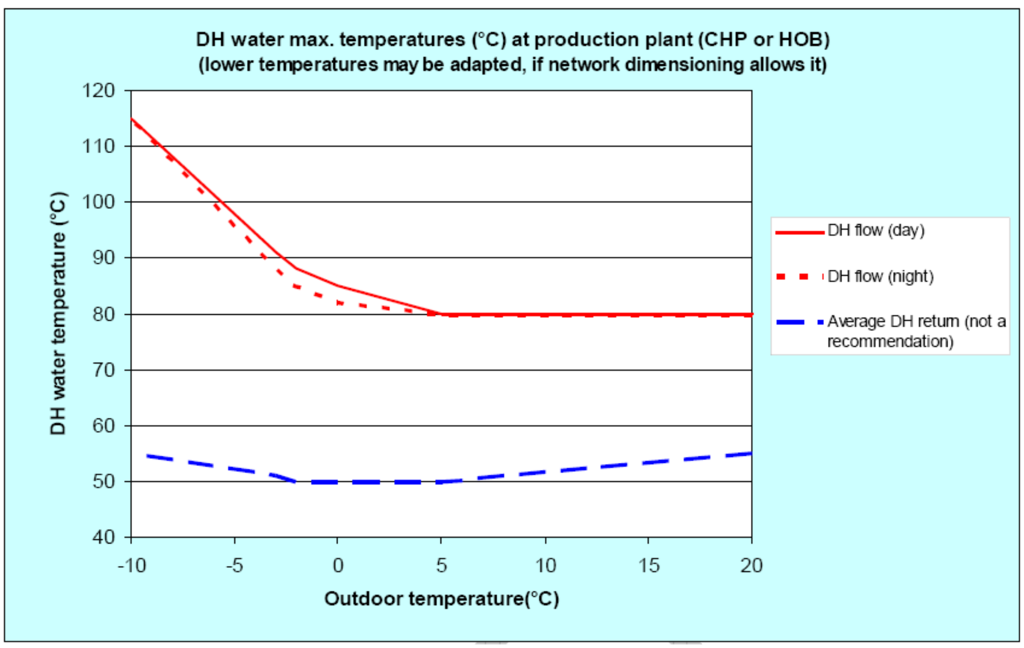

Figure 9.1 - Typical DH temperature at production plant (CHP or Heat Only Boilers) as a function of outdoor temperature (corresponding to -10 °C outdoor design temperature. Note: The outdoor design temperature in South England is -5 °C)

The heat capacity to be distributed is regulated by varying the supply (flow) temperature and water flow (controlled by the consumer substations). The flow temperature would typically be 80-85 °C when the outdoor temperature is greater than 5 °C. With colder weather, the temperature is gradually increased from 80 °C to the maximum level. The max. operating temperature of 115 °C would be applied at the local design outdoor temperature, which is -5 °C in South England.

The return temperature is fully dependent on correct/optimum design and operation of consumer substations and building heating systems, varying normally between 45-55°C.

The DH circulation pumping is designed to provide all consumer substations at all times with a sufficient pressure difference, normally about 1 bar minimum. Speed regulated DH circulation pumps with frequency converter and pressure difference control are used to optimise the pump operation in different consumption and flow situations. The pumps are regulated by pressure difference, which is measured in the most distant points of the network (critical consumers).

10.2 Space requirements within developments

The largest district heating pipes will require a trench approximately 2m wide with an overall working width of 5 m during installation.

Indicative pipe depth and trench dimensions are shown below for distribution pipes with internal diameter 400 mm and external diameter of 560 mm, including lagging.

A total trench depth of 1.2 m would need to be dug to accommodate the pipes, allowing for a minimum depth of cover of around 600 mm.

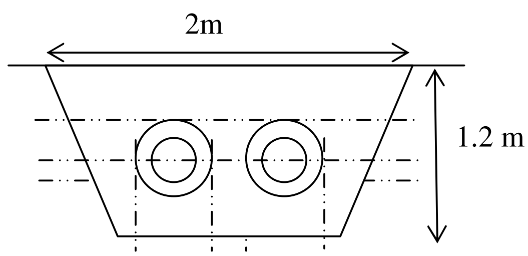

Figure 9.2 DHN pipe trench schematic

10.3 Typical consumer connections

10.3.1 *Substations*

Each of the new residential and commercial buildings would be connected to the DH network by means of a consumer substation unit. Consumer substations typically comprise two heat exchangers - one for heating and the other for centralised, instantaneous DHW production - complete with all necessary pumps, controls and valves.

The use of direct, instantaneous DHW production is recommended over the DHW storage applications, for the following reasons:

- no risk of legionella
- lower heat losses at building
- savings in investment and space

- better cooling of the DH primary circulation water resulting in higher transmission capacity/lower pipe line investments, lower pumping costs and lower heat losses

A substation unit comprises all the necessary equipment for heating connection and for domestic hot water preparation, complete with circulation pumps and an expansion tank for radiator system if necessary. Substation units are pre-assembled on a solid frame for floor mounting. A typical substation unit would comprise:

- Plate type heat exchangers for heating and domestic hot water
- Primary side equipment includes:

[1] filter/strainer
[2] control valves, isolation valves
[3] pressure and temperature gauges
[4] heat metering

- Secondary side equipment includes (if necessary):

[5] circulation pumps (normally speed controlled)
[6] isolation valves, filling valve, safety valves
[7] drains and air vents
[8] strainers
[9] expansion system

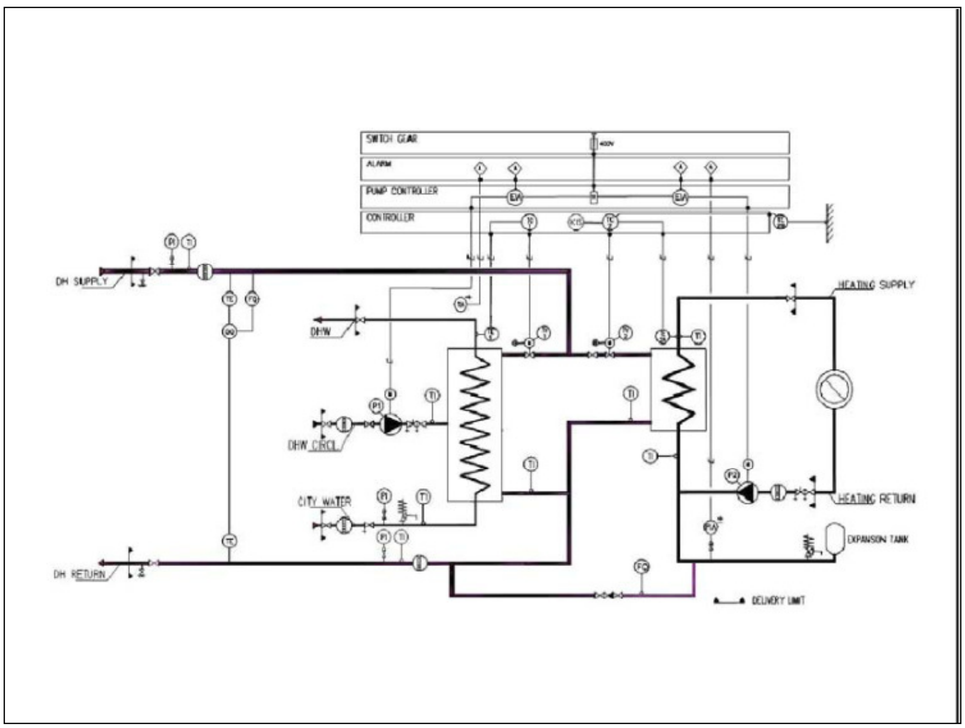

Figure 9.3 - Schematic for typical prefabricated substation unit

The following design parameters should be followed for the primary (DHN) and secondary (consumer building) systems, to facilitate a technically and economically efficient system.

Design Temperatures, °C	Primary side		Secondary side	
	Flow	Return	Flow	Return
Space heating new existing	115-110	55	70-80 80	40-50 60
DHW	70	max. 25	55	10

Table 9.1 - Recommended Design Temperatures, °C (Wet radiator systems and DHW)

The space heating secondary side temperatures depend on the internal heat distribution system being used. For example air heating and under floor heating use lower temperatures than conventional radiators. Generally, the lower the secondary side temperatures are the better for the DH system.

11 Conclusions and recommendations

11.1 Conclusions

A site wide district heating scheme is recommended for the OA. For the period covered by Phase 1 this would be supplied by gas fired CHP supported by biomass boilers, which would meet national, London and borough policy requirements.

The OA is broadly well suited for a larger district heat network extending across the whole OA, on account of its high building density, mixed use tenure and because the extent of redevelopment under all options means that the costs of laying pipes are much reduced. With increased building density, the viability of the scheme increases, with Scenario 3 being the most suitable for a CHP fed district heating network.

The viability of district heating in the later phases depends on there being suitable renewable energy technologies that can be deployed alongside the district heating scheme or an alternative “allowable solution” route to reducing carbon emissions beyond those reductions that the district heating system can achieve. This is because on its own, gas CHP will not deliver the emissions savings required by Building Regulations in phases 2 – 4 as a result of the decarbonisation of the national grid the carbon savings achieved by gas CHP fired district heating reduce over time.

On the basis of current modelling in later phases the impact of gas CHP decreases, with it actually emitting more carbon than the business as usual solutions in last phase. From phase 2 onwards gas CHP delivers increasingly high costs of carbon, due to its reduced savings. Therefore alternative sources of heat and electricity, that are compatible with district heating, will need to be identified.

The analysis in this report has considered the following energy sources:

- Anaerobic digestion, even when drawing on all the organic waste from a wider area, would only contribute to a small proportion of the required reductions.
- Biomass CHP may be a technically deliverable means of meeting targets. However there are constraints around commercial viability, fuel supply and air quality that would need to be overcome before this could be accepted as a viable solution.
- It may be possible to use biomass boilers in the interim for phases 2-4 as a way to deliver the required carbon emissions. However, the commercial viability of this will need to be consider along with the flue gas treatment and availability of biomass fuel.
- Given the grid decarbonisation trajectory, the long term ability of district heating to the OA to deliver the required carbon dioxide savings therefore also depends on forms of low carbon heat other than gas fired CHP.

A district heat network across the OA is considered key to delivering zero carbon buildings and meeting emissions targets beyond phase 1 as it will provide the infrastructure necessary to support distribution of energy in the future as technology progresses. The choice of technology will need to be reviewed at the relevant time, given the ongoing development of low carbon technology, and the progression of national efforts to decarbonise electricity supply will also need to be taken into account. Any strategy for the site should therefore retain the flexibility to develop appropriate proposals for later phases closer to the time of delivery, subject to the approval of the relevant authorities.

A key requirement is for initial developments and infrastructure not to preclude the use of whatever the best option will be at the time of future phases. Therefore a clear conclusion of this report is that district heating with gas or renewably fired CHP be installed to supply heat to all buildings in Phase 1. Given that there may be a desire to further roll out district heating in later phases, space should be set aside in the Phase 1 masterplanning for energy centres for decentralised energy plant at least for phase 1 and potentially 2 as well. Given that the viability of district heating is uncertain for later stages, and that distributed energy centres in each of those phases is perfectly viable, it should not be required sufficient energy centre space be left for all phases in Phase 1.

11.2 Recommendations

The key recommendation for ensuring potential for decentralised energy is realised is the establishment of a District Heating Steering Group for the OA. This would determine the optimum ownership and contracting structure of the scheme, agree the preferred delivery approach and coordinate the expansion of the scheme to connect to public sector assets and private sector schemes elsewhere. The steering group would likely include representatives from all major stakeholders including representatives from the GLA, LBHF, RBKC, TfL and landowners.