Camden Large Scale CHP Pilot Site Identification

Final REPORT

Prepared September 2007

Executive Summary

Introduction

SEA/RENUE has been commissioned by LB Camden to assist with the identification of a pilot site for a large scale CHP installation.

This follows on from a scenario modelling exercise entitled "Delivering a Low Carbon Camden", which recommended a borough wide heating network supplied by CHP in order to meet CO_2 reduction targets of at least 60% by 2050.

Approach

The approach taken to determine the best scheme was to map LB Camden Estates with community heating, corporate stock and other potential customers such as hospitals and housing associations and estimate heat and electricity demands. These were then grouped into 20 separate clusters. From these, three schemes were shortlisted for more detailed analysis using bespoke CHP analysis software. Capital costs were estimated by drawing a provisional heat network to interconnect the buildings within each cluster using GIS software and estimating pipe lengths. Typical per m and kW capital costs figures for CHP plant and heat network were used for financial analysis.

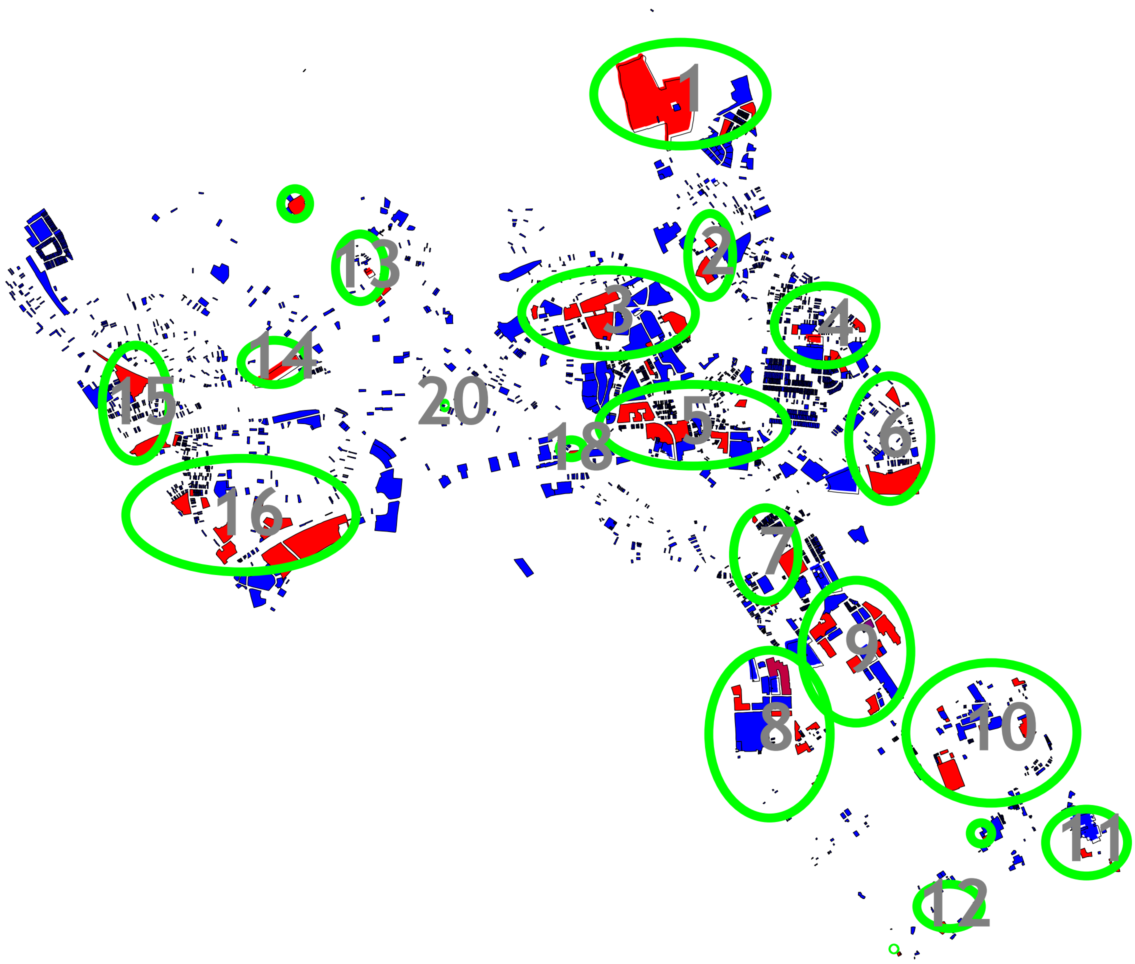

Figure 1 CH Estate Clusters

Shortlisting

Clusters 3, 5 and 9 were shortlisted for detailed analysis. These all have relatively high gas consumption in existing community heating systems and all have planned expenditure on heating and gas infrastructure. They are located in a line through the centre of the borough, so are well placed to form the start of a potential wider heating network.

Cluster 3 is primarily housing with a few corporate properties in the area. Cluster 5 is also predominantly residential and also has several corporate properties including two leisure centres with swimming pools, offering more potential for a mixed use scheme based around local authority property. Cluster 9 offers the greatest potential to link up to non council property including Housing Association properties, commercial buildings around Euston Road and the Kings Cross regeneration area.

After discussions with LB Camden, cluster 9 was later dropped from consideration in this piece of work although is continuing to be investigated elsewhere.

Detailed Analysis

It is clear from the analysis undertaken here that all 3 schemes would produce substantial CO_2 savings with heat loads identified - allowing for gas engine CHP units of between 3MWe and 8.5MWe. It is also clear that all schemes are attractive in financial terms as public sector investments (using a discount rate of 3.5%) over a 25 year period. However as private sector investments (using a discount rate of 10%) they would not be viable[1]. No external grant funding has been assumed.

Cluster	Engine Size kW_e	Capital Cost	NPV @ 3.5%	NPV @ 10%	CO_2 Savings
3	5,100	£ 5,580,164	£ 970,144	-£ 2,269,800	6,291
5	6,800	£ 6,368,974	£3,119,451	-£1,573,743	6,924
9	3,047	£ 3,808,901	£ 123,432	-£ 1,821,590	3,358
3 with non domestic	5,100	£ 6,487,042	£ 187,700	-£ 3,113,781	6,494
5 with non domestic	6,800	£ 7,036,503	£ 4,304,785	-£1,304,877	7,814

Table 1 Summary of Results

However it should be noted that the analysis conducted here has been undertaken as a desktop study using rough capital cost estimates and with pipework routes drawn over a digital map. It is of course recommended that more detailed analysis be undertaken before proceeding with the schemes. Critically a survey of each site to provide more detailed capital cost figures and to check proposed routes for heat mains is needed.

An important assumption in the analysis has been the use of a direct sales approach, which provides for a higher value of electricity sales by selling electricity directly to residents. A further assumption is that any upgrading work required for the systems would have been needed anyway and therefore does not constitute part of the capital costs of the system – though it will probably be sensible to conduct such work in tandem with the CHP installation.

[1] The discount factor of 3.5% is the figure set out by the Treasury as the rate to be used in assessing public sector investments. Private sector discount rates are typically around 10% though this will vary from company to company.

Barriers and Risks

A number of potential barriers to implementation were considered in this report. At this level of detail scheme 3 would appear to provide the least level of barrier in terms of leaseholder connection and conservation area penetration. Cluster 9 has slightly more immediate interconnection possibilities, if a scheme develops at Kings Cross. However cluster 5 sits between 9 and 3 and so could interconnect to either at a later date.

The most significant barrier occurs for schemes 3 and 5 as the optimal engine size would require a supply license for electricity sales over the 5MWe limit. A solution to this would be to sell the balance of electricity produced to a licensed supplier. This would decrease the viability in proportion to the volume of electricity produced over the 5MWe limit.

Conclusion

Cluster 5 gives the highest carbon savings at the lowest capital cost with best net present value. Its geographical location also makes it ideal for future expansion work. It is recommended that cluster 5 be taken ahead for more detailed examination for these reasons. It may be that a slightly slimmed down scheme would be preferable given the supply license limits discussed above 5MWe above. However before such work is conducted site surveys of schemes 3 and 5 should be conducted to eliminate uncertainty associated with the costs of siting CHP on these schemes.

Abbreviations

CHP	Combined Heat and Power
CO_2	Carbon dioxide
DCF	Discount Factor
kWe	Kilowatts electrical
kWh	Kilowatt-hour
MWh	Megawatt-hour
NPV	Net Present Value
Tpa	Tonnes per annum

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1 Introduction

SEA/RENUE has been commissioned by LB Camden to assist with the identification of a pilot site for a large scale CHP installation.

This follows on from a scenario modelling exercise entitled "Delivering a Low Carbon Camden", which recommended a borough wide heating network supplied by CHP in order to meet CO_2 reduction targets of at least 60% by 2050.

1.1 Findings from "Delivering a Low Carbon Camden"

This report made some initial recommendations for the phasing of a heat network.

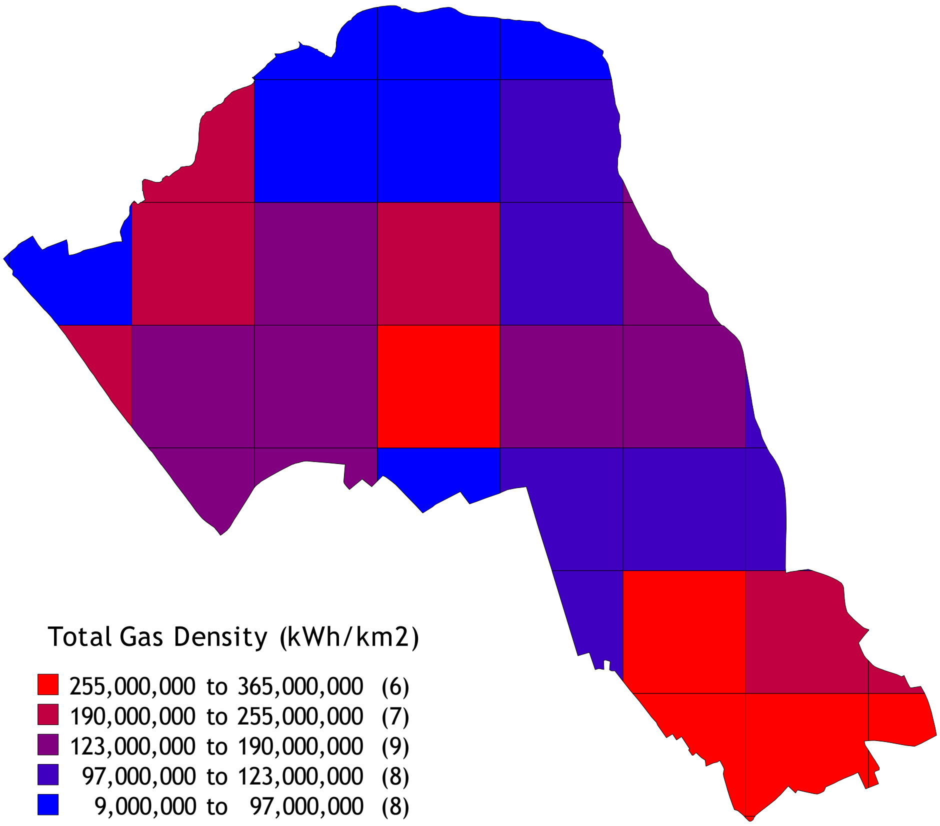

Figure 2 Gas density

Figure 2 above shows the gas use density across the borough, which is a proxy for thermal demand. There are clearly two areas of high gas consumption in the centre and in the south of the borough. It has been shown that the area in the south of the borough is dominated by Commercial and Industrial demand, while the high consumption in the centre of the borough is primarily domestic.

It was recommended that the development of a heat network could be started from existing community heated estates and also from opportunity areas or areas for intensification as shown in Figure 3 and Figure 4 below.

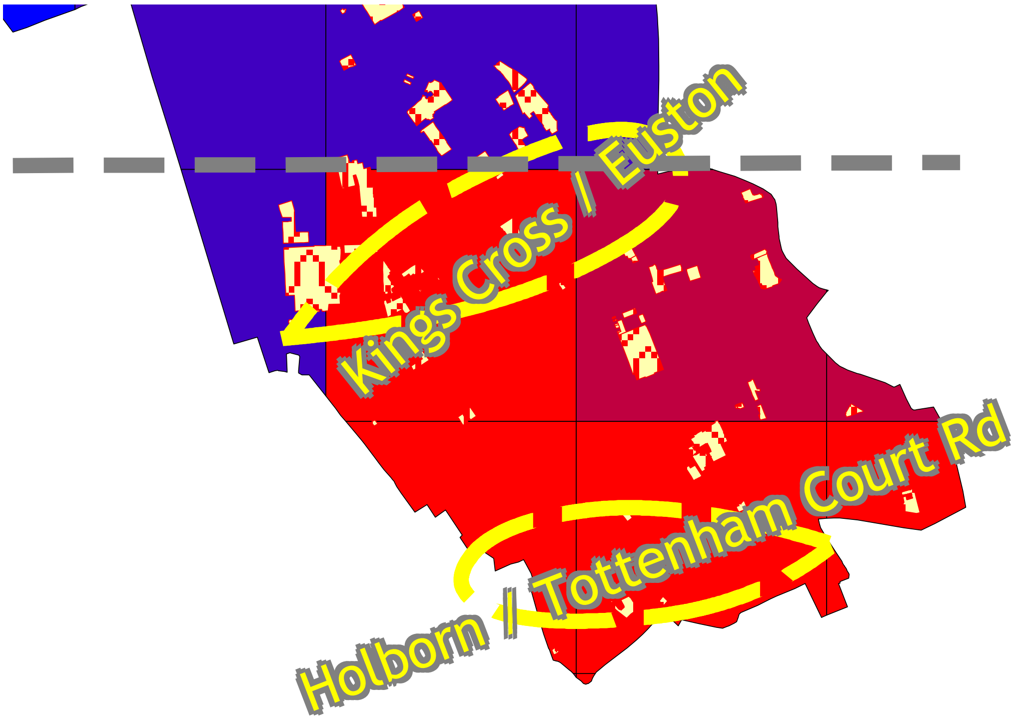

Figure 3 Opportunity areas and CH estates in the south of the borough

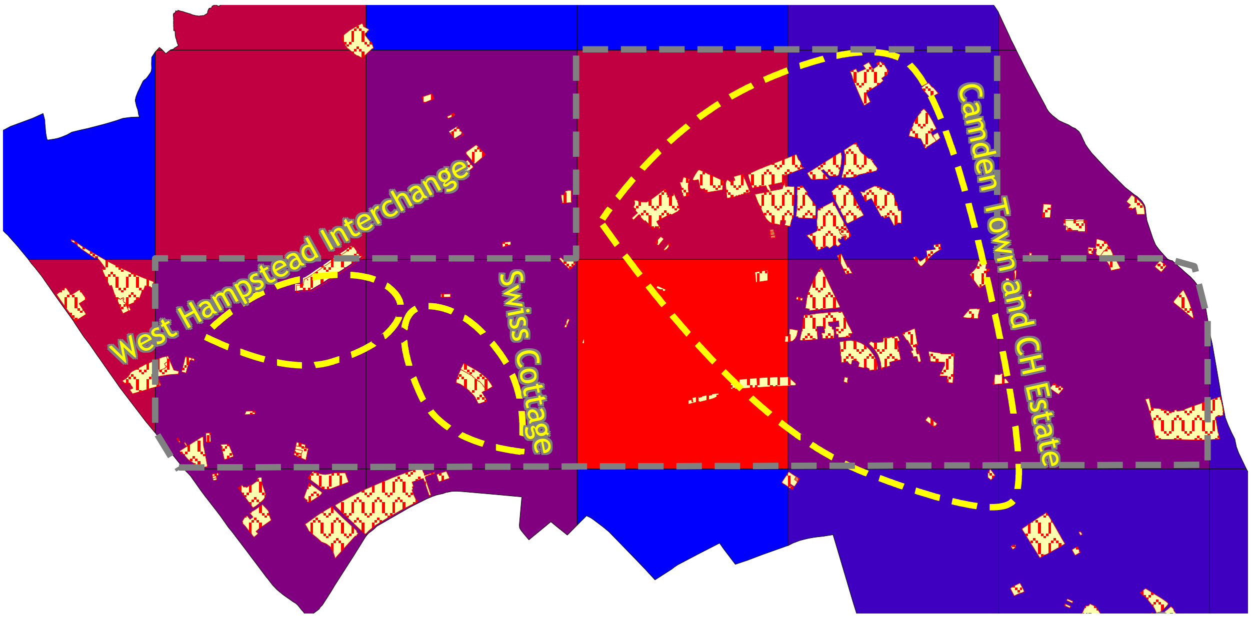

Figure 4 Opportunity areas and CH estates in the centre of the borough

1.2 Approach

The aim of this work is to examine potential sites for a CHP and heat network installation in more detail in order to produce a short list of sites. One or more of these can then be chosen for a more detailed technical feasibility study leading to an installation.

Following discussions with officers from LB Camden it has been decided to focus initially on LB Camden building stock. This is where the council has the greatest control and influence and also allows LB Camden to maximise benefit from energy revenues.

A starting point for this work will be housing estates with existing community heating systems, examining them in terms of clusters of estates with relatively high energy demands. This information will then be combined with data on other buildings that might be potential customers such as hospitals and other LB Camden corporate stock. Finally proximity to areas where development is expected and the existing work programmes for LB Camden buildings will be considered.

The choice of site will also be made with a view to expanding to a wider heating network in the future.

2 Factors influencing choice of site

2.1 Housing estates

LB Camden have provided a list of local authority housing estates with estimates of gas consumption, numbers of units, tenancy and whether or not community heating is in use.

As a starting point, this list has been filtered according to whether full district heating is in use (some estates have only partial district heating with individual boilers).

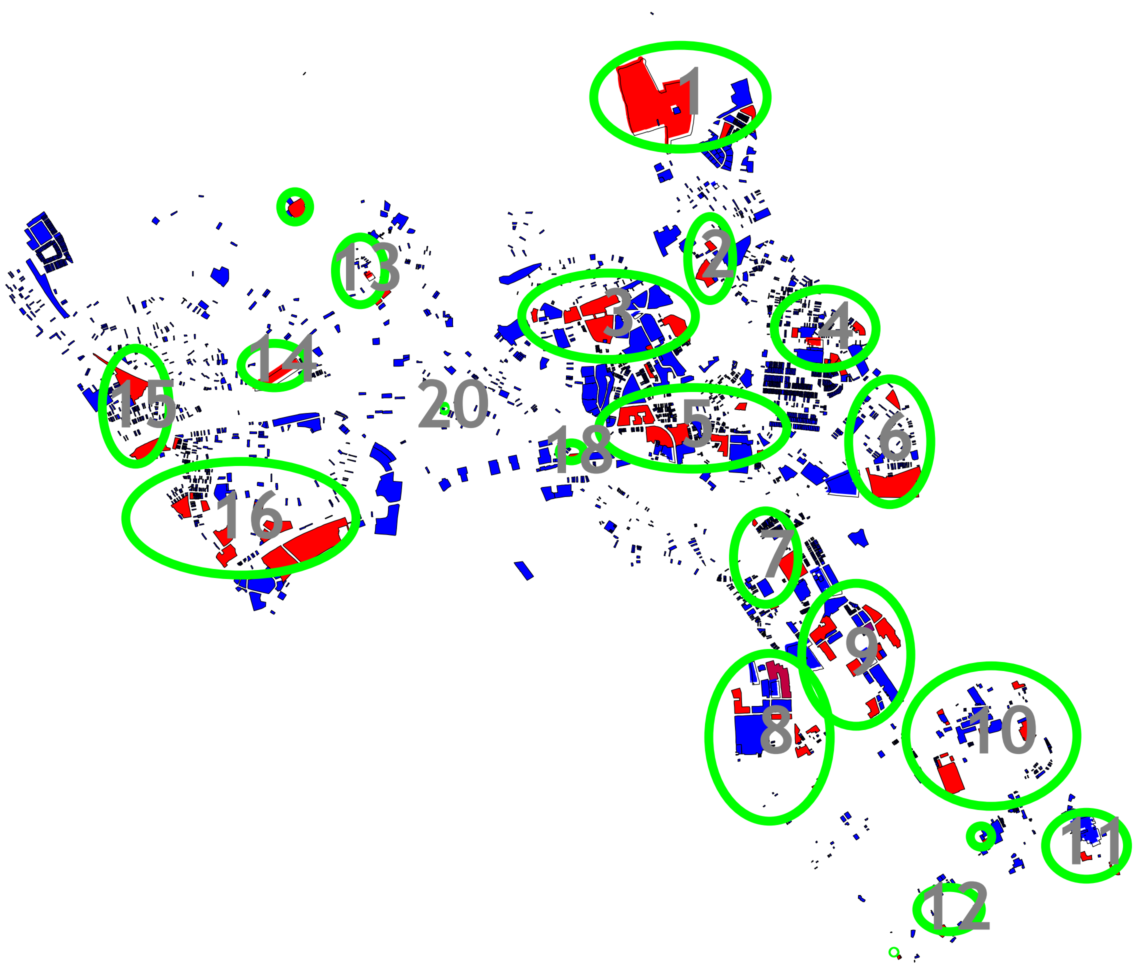

Figure 5 CH estate clusters

Figure 5 shows all the housing estates in Camden. These are colour coded with the red estates being those with full CH and known gas consumption. These have been grouped into natural clusters indicated in green. These clusters can then be ordered by gas consumption (from CH sites only) as shown in Table 2 below.

Cluster Number	Gas consumption (kWh/yr)
16	36,388,830
5	33,639,169
3	31,008,068
9	18,016,711

10	17,191,582
1	16,079,577
6	15,745,847
15	11,400,005
8	10,216,422
7	9,469,201
11	8,765,485
4	8,594,157
14	5,833,194
2	4,447,490
19	4,256,822
12	4,111,071
13	3,427,241
17	2,163,332
22	1,355,301
18	1,299,333
21	659,586
20	147,421

Table 2 Gas consumption by cluster

Clearly this list can be broken down into ranges:

Range of consumption (kWh/yr)	Number of clusters in range
Greater than 30,000,000	3
Between 10,000,000 and 20,000,000	6
Less than 10,000,000	13

Table 3 Gas consumption ranges

Since CHP is likely to be more economical when meeting a larger heat load and the pilot site is intended to be for large scale CHP, it makes sense to focus the search around the top nine clusters with particular attention to the top three. Note that these top three clusters (numbers 16, 5 and 3) coincide with the areas singled out for the start of a heat network in Figure 4.

2.2 Other factors

In addition to mapping the housing estates with community heating, various other factors affecting the choice of site were mapped or calculated:

- Planned expenditure on district heating (DH) and gas infrastructure
- Number of LBC corporate properties in each cluster
- Number of hotels and hospitals in each cluster. From the number of hotel rooms an estimate of gas and electricity consumption from hotels was calculated using CIBSE benchmarks

- The area enclosed by the circle drawn around each cluster and an indication of the gas and electrical demand density for the area

The results of this analysis are summarised in Table 4 below.

2.3 Choice of site shortlist

In consultation with LB Camden officers, it was decided that a shortlist of three clusters should be chosen for further analysis. The clusters chosen were numbers 3, 5 and 9. Following this decision, cluster 9 was dropped from consideration as it is being considered as part of other work. While this work is therefore focused on clusters 3 and 5, results for cluster 9 are included for indicative purposes.

These three all have relatively high gas consumption in existing community heating systems and all have planned expenditure on heating and gas infrastructure. These clusters are located in a line through the centre of the borough, so are well placed to form the start of a potential wider heating network.

Cluster 3 is primarily housing with a few corporate properties in the area. Cluster 5 is also predominantly residential and also has several corporate properties including two leisure centres with swimming pools, offering more potential for a mixed use scheme based around local authority property. Cluster 9 offers the greatest potential to link up to non council property including Housing Association properties, commercial buildings around Euston Road and the Kings Cross regeneration area.

Cluster Number	Full CH consumption (Gas)	Electricity consumption	Number of Units	5yr DH Expenditure	5 yr Gas infrastructure Expenditure	Area of drawn circle(sq km)	Count of Corporate Properties	Count of Hospitals	Count of Hotels	Number of rooms	Hotel gas consumption	Hotel Electricity Consumption	Domestic CH gas consumption/km2	Total Gas consumption/km2
1	16,079,577	3,641,400	867	2,750,000	0	0.66	4	0	0	0	0	0	24,344,737	24,344,737
2	4,447,490	764,400	182	0	0	0.15	3	0	0	0	0	0	29,626,625	29,626,625
3	30,988,918	7,177,800	1,709	5,403,250	0	0.56	17	0	0	0	0	0	55,793,565	55,793,565
4	8,594,157	1,281,000	305	0	0	0.30	7	0	0	0	0	0	28,196,609	28,196,609
5	33,639,169	5,258,400	1,252	926,000	200,000	0.57	19	0	0	0	0	0	59,102,250	59,102,250
6	15,745,847	2,436,000	580	0	800,000	0.39	2	0	0	0	0	0	40,714,296	40,714,296
7	9,469,201	1,537,200	366	200,000	0	0.23	7	0	0	0	0	0	40,552,282	40,552,282
8	10,216,422	2,062,200	491	1,750,000	400,000	0.74	12	2	4	845	17,030,975	6,493,825	13,726,252	36,608,182
9	18,016,711	3,196,200	761	1,064,000	500,000	0.58	17	0	1	312	6,288,360	2,397,720	31,310,539	42,238,835
10	17,191,582	3,901,800	929	0	800,000	0.87	13	1	14	2,128	42,889,840	16,353,680	19,684,574	68,793,972
11	8,765,485	1,591,800	379	0	0	0.21	1	0	0	0	0	0	41,423,418	41,423,418
12	4,111,071	882,000	210	250,000	0	0.12	4	0	1	153	3,083,715	1,175,805	35,210,486	61,621,879
13	3,427,241	596,400	142	0	0	0.13	5	0	0	0	0	0	25,429,917	25,429,917
14	5,833,194	1,033,200	246	0	0	0.12	0	0	0	0	0	0	48,239,307	48,239,307
15	11,400,005	1,848,000	440	504,000	0	0.30	9	0	0	0	0	0	38,478,301	38,478,301
16	36,388,830	5,800,200	1,381	7,730,000	0	0.95	14	0	0	0	0	0	38,274,379	38,274,379
17	2,163,332	176,400	42	0	400,000	0.04	2	0	0	0	0	0	54,186,791	54,186,791
18	1,299,333	189,000	45	0	0	0.02	0	0	0	0	0	0	56,925,621	56,925,621
19	4,256,822	743,400	177	0	0	0.02	0	0	0	0	0	0	183,580,223	183,580,223
20	147,421	29,400	7	0	0	0.00	0	0	0	0	0	0	79,480,672	79,480,672
21	659,586	109,200	26	0	0	0.00	0	0	0	0	0	0	441,548,902	441,548,902
22	1,355,301	201,600	48	0	0	0.00	0	0	0	0	0	0	1,579,571,174	1,579,571,174

Table 4 Cluster summary

3 Shortlisted clusters

This section shows maps of the three shortlisted clusters. The estates in red are those with existing district heating systems. These maps also show potential pipe routes in pink for heat mains. Note that the locations of the boiler houses are not known.

Figure 9 also shows St Pancras Housing (housing association) properties in yellow.

Figure 6 Cluster 3

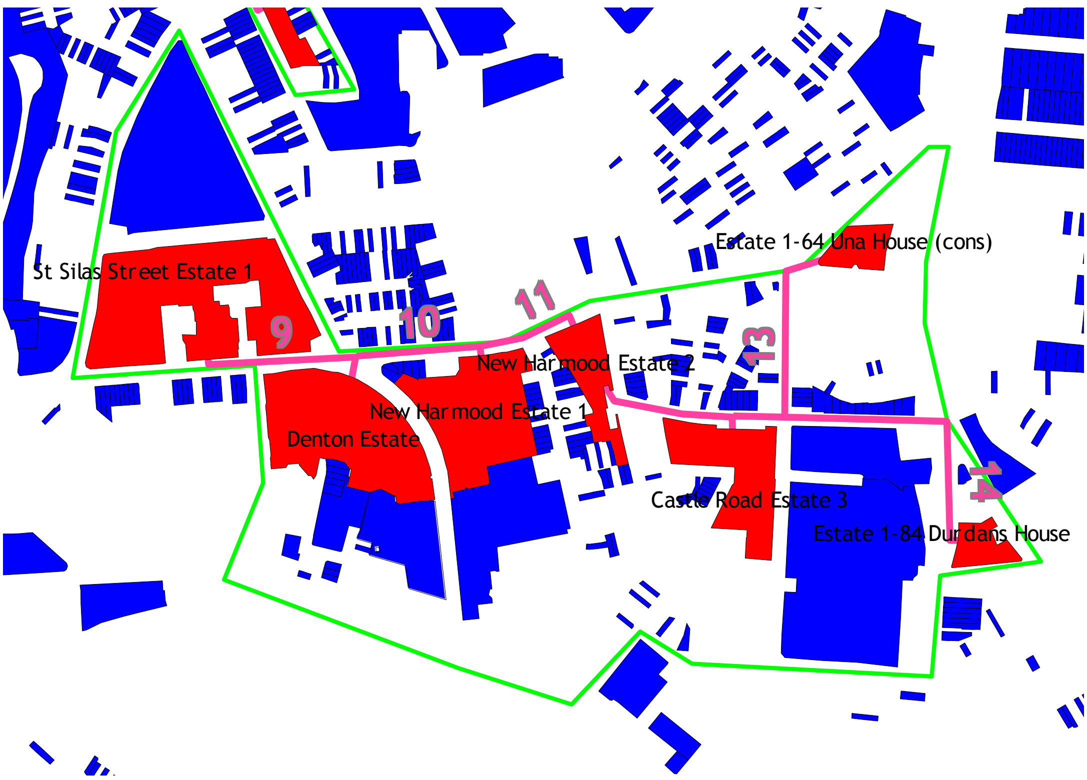

Figure 7 Cluster 5

Figure 8 Cluster 9

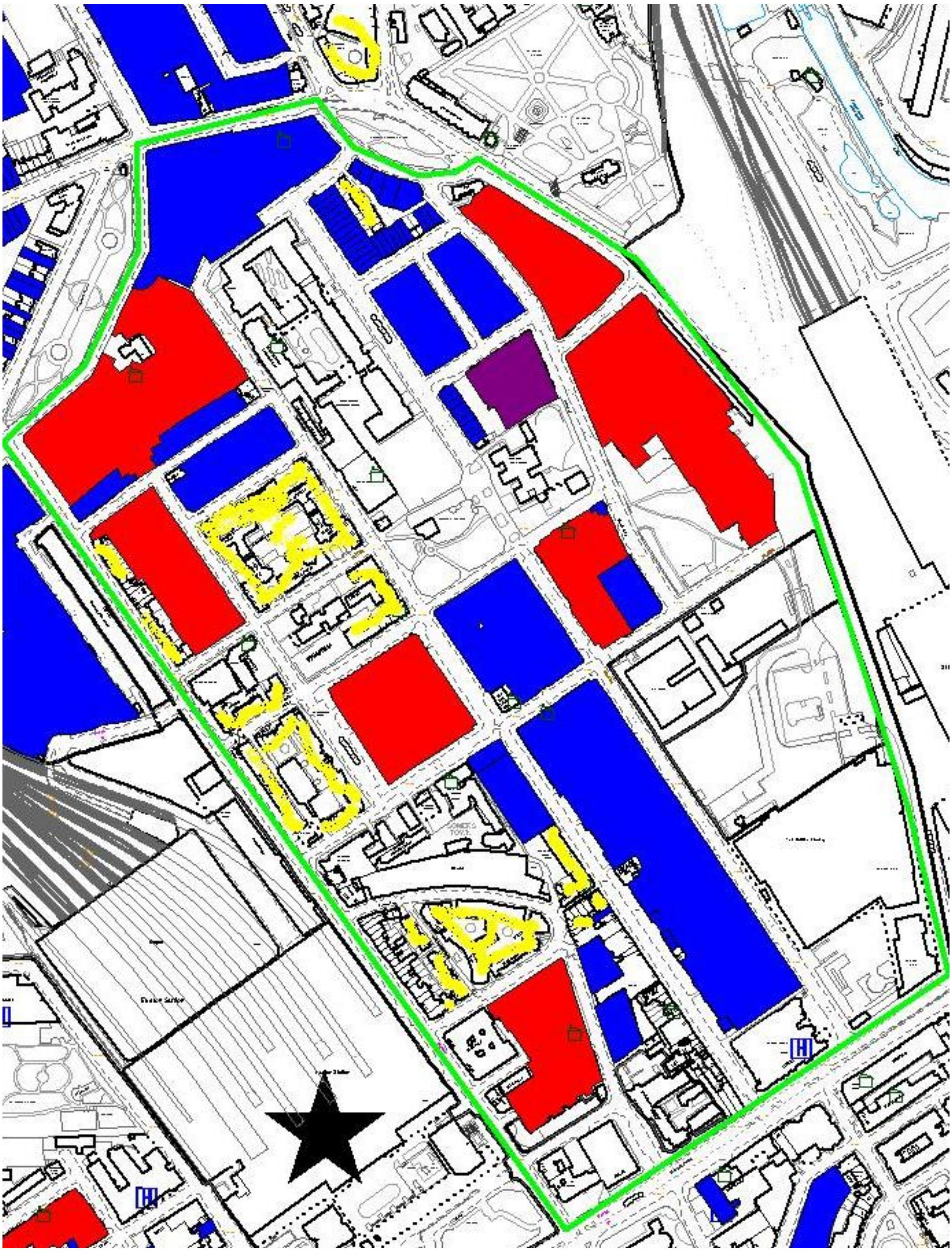

Figure 9 Cluster 9 showing St Pancras Housing properties

4 Financial and Carbon Analysis

4.1 Assumptions

The analysis conducted proposes that gas engine CHP plant would be installed. This could be located either externally as a packaged unit, within an existing boiler house if there is space, or in a new Energy Centre. The heat produced by the plant would feed into the central system providing heating and hot water. In times of low load demand, heat could be rejected to atmosphere, depending on the control strategy adopted. There are a number of options of how electricity could be utilised.

CHP is complex because of the relationship between heat and power produced in a fixed ratio (for gas engine plant), and the demand for heat and power. To understand this, hourly profiles need to be developed for a typical day in each calendar month for both electricity and heat. Further complexity arises from the choice of routes to dispose of the electricity produced and the different costs and revenue streams associated with these choices. These issues are explored further below.

4.1.1 Tariff and Charges

This section explains the choice of parameters for the price of input fuels and electricity and heat sold.

It is extremely complex to predict the future variations of gas and electricity, so for the purpose of this CHP sizing strategy, it was decided to use fixed values. These could be varied to provide an assessment of the sensitivity to these changes.

4.1.1.1 Input Fuels

Gas prices have changed significantly over recent years. A fixed price of 2.5p / kWh is assumed for this analysis.

4.1.1.2 Electricity Sales

For each scheme in question we have assumed the following

- Direct sales of electricity to those individuals or sites that supplied with the heat by that CHP scheme ie they are supplied to residents
- Any surplus electricity is sold to a utility company.

4.1.1.3 Charges for the use of Distribution System and Meters

There are a number of different charges that apply for the use of EDF's wires and meters:

- DUOS charges (Distribution Use of System charges)
- Metering charges
- Line Loss Penalties (in effect a charge)

4.1.1.3.1 Duos Charges

Duos Charges for London vary considerably depending on the tariff. For a typical residential account the charge is 0.922p/kWh plus a fixed charge of around 5p/day for each domestic meter (depending on powerkey or credit meter etc) which for a household using 3MWh a year works out at 1.46p/kWh. At the other end of the scale the charges for a 100kW tariff vary between 0.171 p and 1.128p/kWh depending on the time of year and day. There are a range of other charges that apply to a HH tariff that mirror those on a typical bill eg standing charge, availability charge and reactive power charge.

4.1.1.3.2 Metering Charges

Further charges are applied by EDF Networks for metering – predominantly renting the meters. This works out at about £2.82 per year for a domestic tariff and £8.76 for non-domestic.

4.1.1.3.3 Line Loss Adjustment Factors

These effectively represent a charge for electricity lost in the distribution network. They are based on averaged losses across the network. They assume that around 10% of the electricity generated may be lost. Again these vary depending on the tariff.

4.1.2 Conclusions

Under the current framework for CHP, a direct sales approach is essential to providing a reasonable income for the electricity produced by the plant. Because of the size of the schemes under analysis a private wire analysis has not been undertaken as this would require a distribution license. Instead a direct sales approach has been adopted whereby electricity is sold over the existing network and costs associated with this approach have been included in the analysis.

4.1.2.1 Summary of Tariffs and Charges

As stated above, the ESCO will supply heat and power to the customers of the CH scheme. In order to calculate cash flows for the scheme, the following energy tariffs have been used for the modelling.

Tariff / Charge	Assumed value	Comments
Power Sales to Domestic customers	9.0 p/kWh	Current EDF tariffs are 9.14p/kWh ex VAT plus a standing charge which equates to a further 1.75p/kWh
Heat Sales to Domestic customers	3.125p/kWh	This assumes that the gas cost is 2.5p/kWh and the efficiency of conversion to heat is 80% & no profit is made.
DuoS/ Line Loss Charges Domestic	2.5 p/kWh_e	
Administration Costs	2 p/kWh_e	This is equivalent to £60/meter/year[2]
CHP Maintenance Costs	£6/MWh_e	
Natural Gas cost	2.5 p/kWh	
Power Imported	Variable STOD Tariff	STOD is a Seasonal Time of Day Tariff
Power Exported	Variable STOD Tariff	

Table 5 Energy Tariffs and Charges used by the model

4.2 Other Assumptions

- For the **financial modelling** we have assumed a public discount rate of 3.5%, inflation at 3% and an analysis period of 15 years. The discount factor of 3.5% is the figure set out by the Treasury as the rate to be used in assessing public sector investments. Private sector discount rates are typically around 10% though this will vary from company to company.

[2] DETR New Practice Profile 112 states that St Richard's and Hillwood houses (from St Pancras Housing) administration costs were approximately £33/meter/year. This scheme only considered 95 dwellings and a 54kW_e CHP engine.

- The **carbon dioxide emission factors** used are taken from building regulations approved document L2a[3]. These are:
  - Natural gas 0.194 kg CO_2 / kWh
  - Grid supplied electricity 0.422 kg CO_2 / kWh
  - Grid displaced electricity 0.568 kg CO_2 / kWh
- The **CHP unit performance figures** are based on a database maintained by SEA/RENUE. Some of these figures are based on manufacturers' data obtained under test conditions that may be different for a particular installation

4.3 Results

The following sections outline the modelling results for each scheme in terms of Net Present Value (NPV) and CO_2 savings. For each scheme at least 6 different engine sizes have been modelled.

The clusters are modelled using residential load profiles and include the capital costs for heating mains (shown in Figure 6, Figure 7 and Figure 8) based on a price of £1000/m.

In addition, load profiles for non domestic buildings have been added in each case. The capital costs of connecting these non domestic buildings have been calculated for clusters 3 and 5. For these capital cost estimates, the costs not including any distribution pipes are estimated to be 5-10% of the cost of heat mains and have been incorporated by using a relatively high price per metre for heat mains.

The results of this analysis are shown in Table 7. The list of corporate properties in the three clusters is shown in the appendix (section 6).

Cluster	Length of heating main	Capital cost
3	1908	£1,908,000
5	1473	£1,473,000
9	1371	£1,371,000

Table 6 Capital costs for heat mains to residential sites

Cluster	Capital cost
3	£906,878
5	£667,529

Table 7 Capital cost of non domestic connections

4.3.1 Cluster 3

For Cluster 3 the figures below show that in terms of carbon emissions a 6,800 kWe engine would give the best performance but in terms of NPV, 5,100 kWe would be optimal.

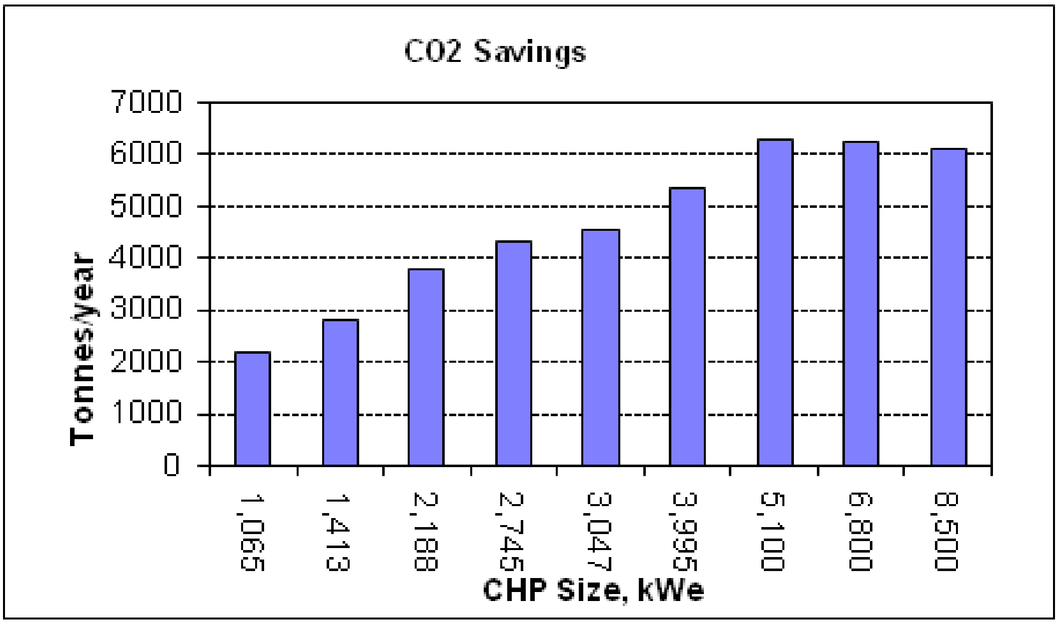

Figure 10 Cluster 3 CO_2 Savings for various engine sizes (residential profile)

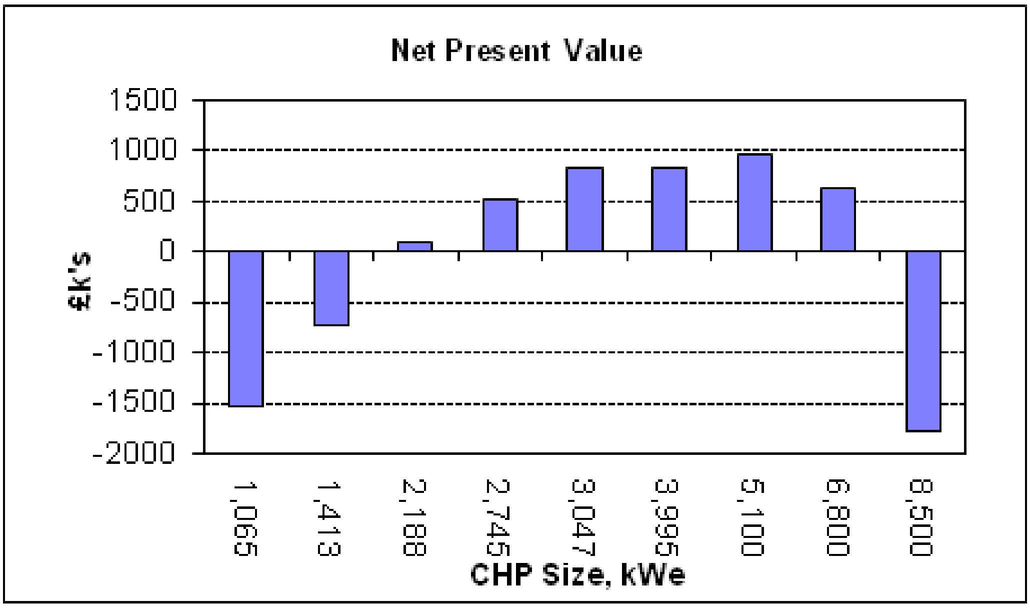

Figure 11 Cluster 3 NPV @3.5% DCF for various engine sizes (residential profile)

Including non domestic buildings results in the following changes:

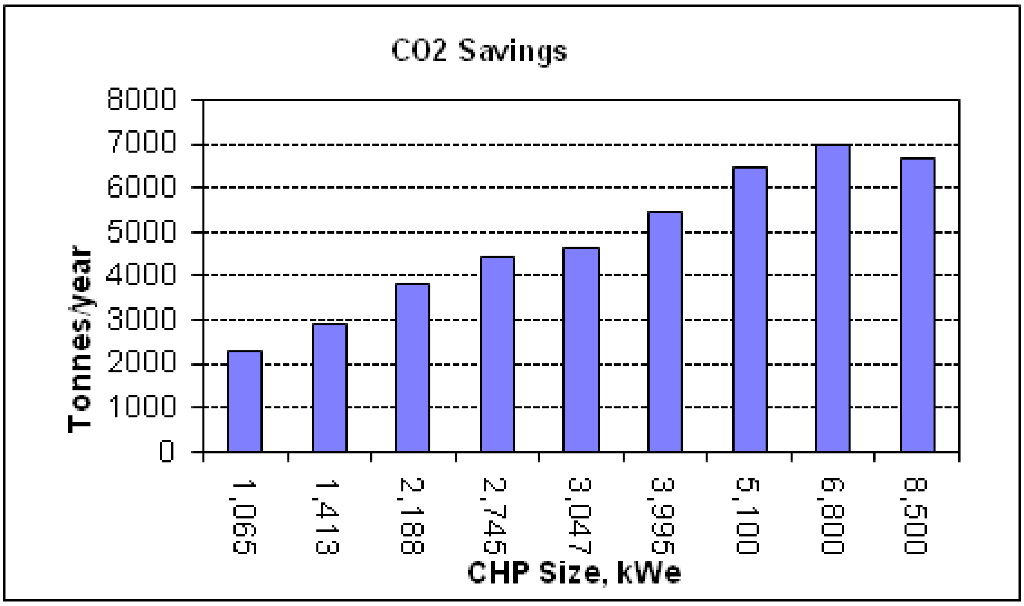

Figure 12 Cluster 3 CO_2 savings including non domestic buildings

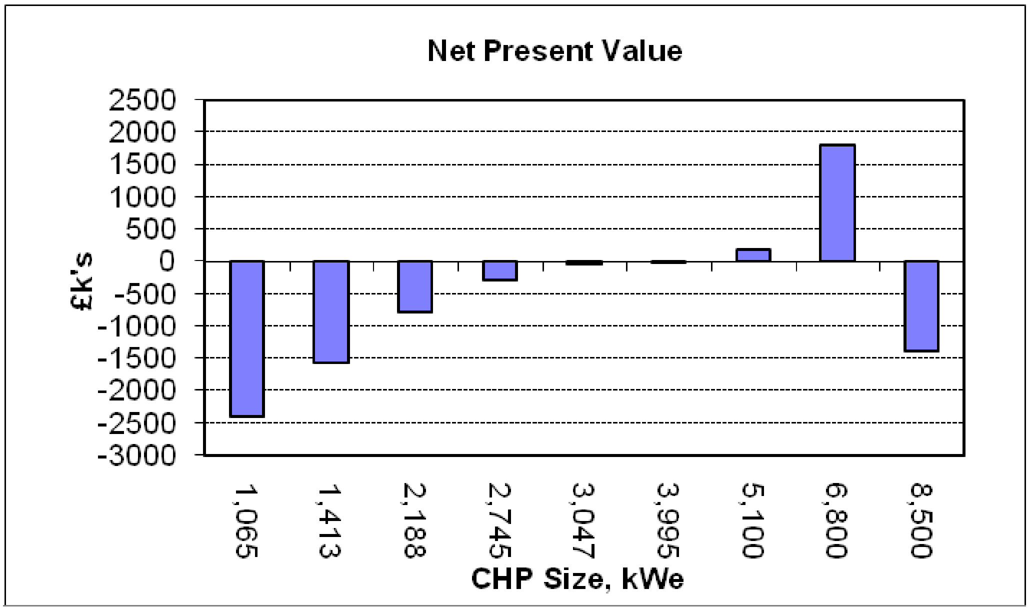

Figure 13 Cluster 3 NPV @3.5% DCF including non domestic buildings

4.3.2 Cluster 5

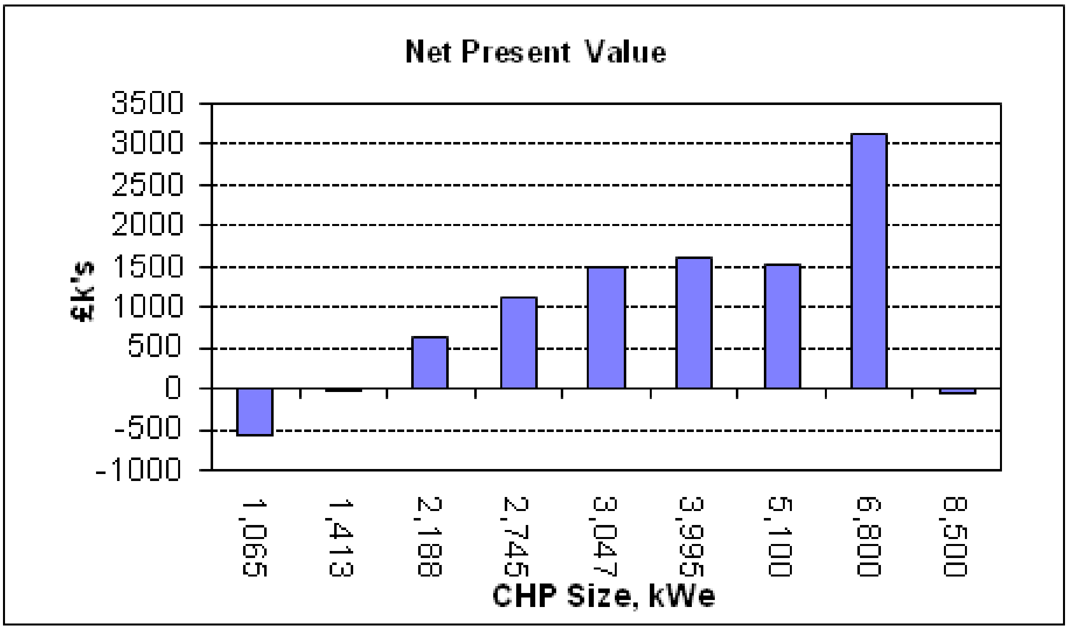

Figure 14 Cluster 5 NPV @3.5% DCF for various engine sizes (residential profile)

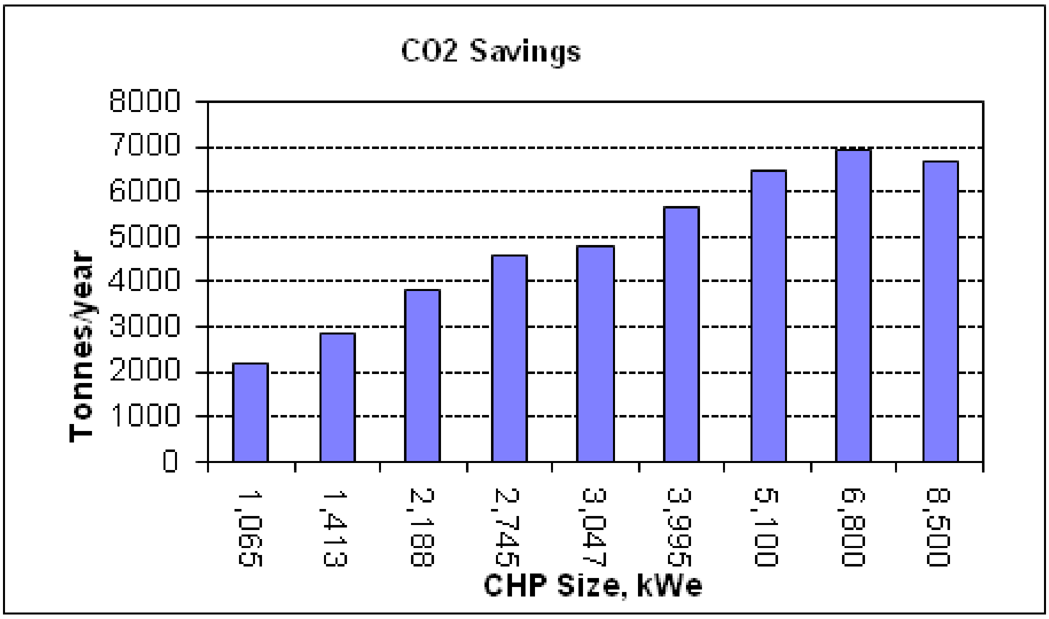

Figure 15 Cluster 5 CO_2 Savings for various engine sizes (residential profile)

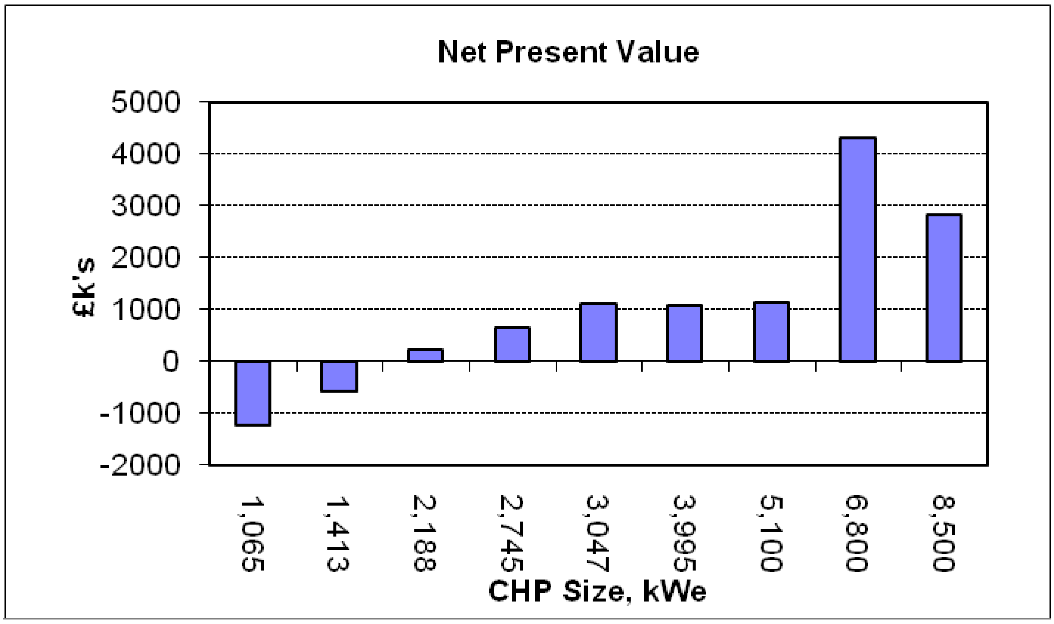

Figure 16 Cluster 5 NPV @3.5% DCF including non domestic buildings

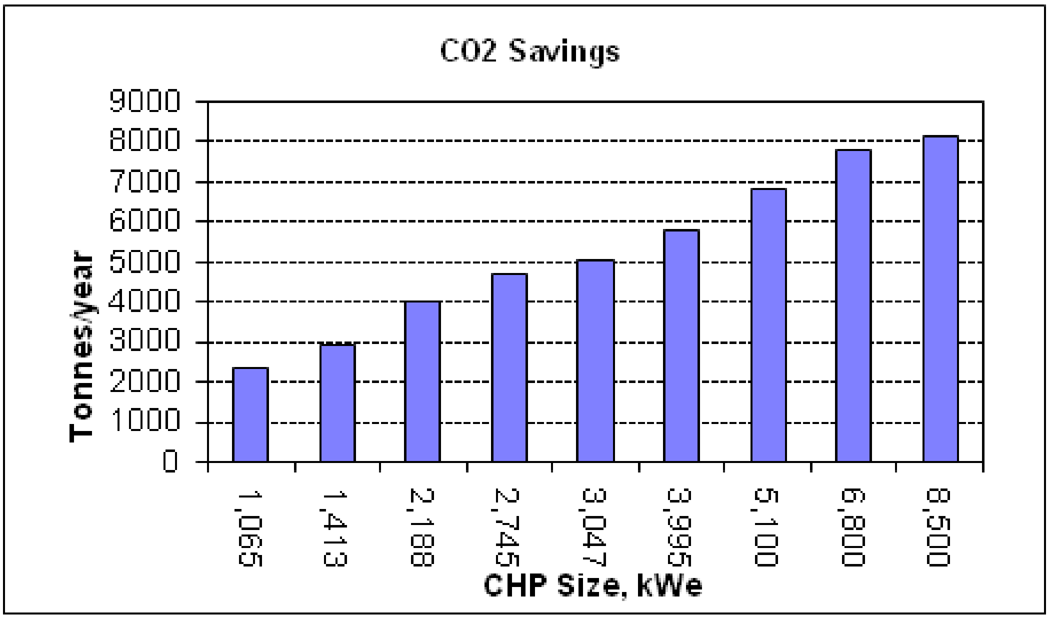

Figure 17 Cluster 5 CO_2 savings including non domestic buildings

4.3.3 Cluster 9

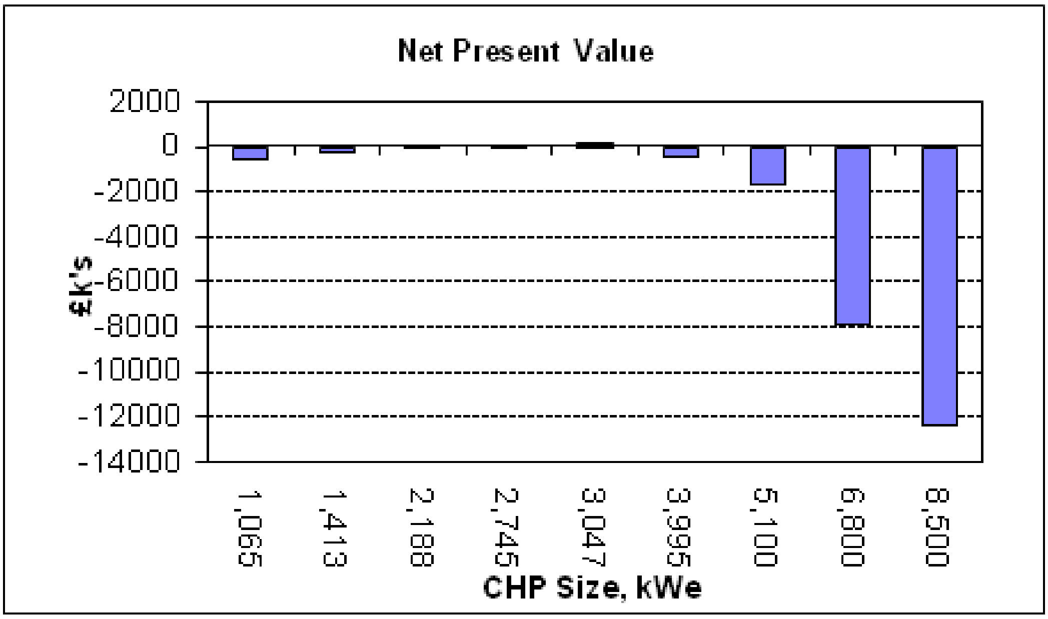

Figure 18 Cluster 9 NPV @3.5% DCF for various engine sizes (residential profile)

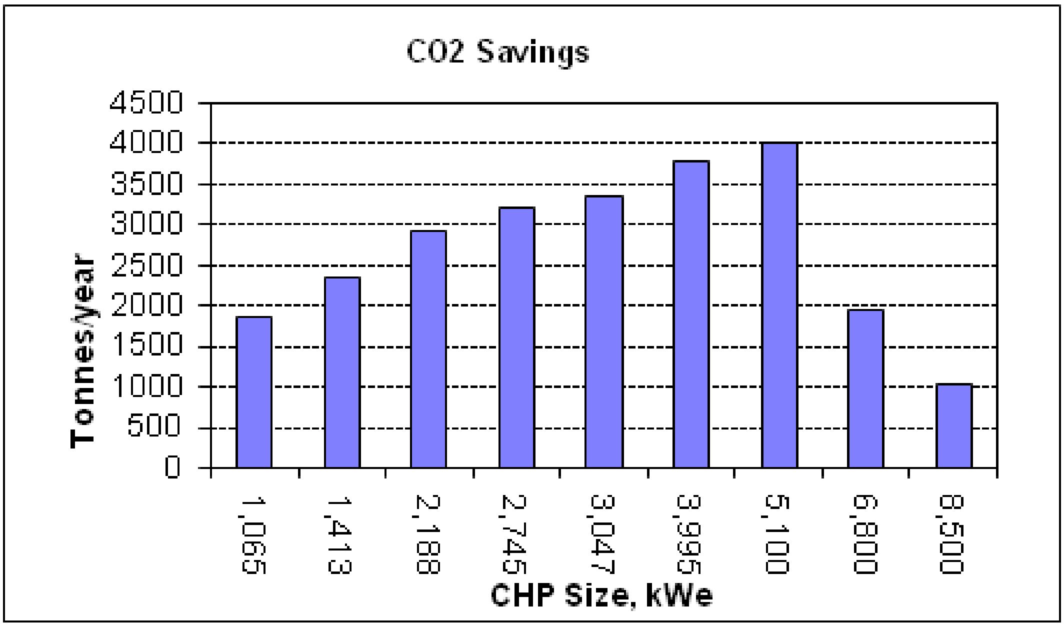

Figure 19 Cluster 9 CO_2 Savings for various engine sizes (residential profile)

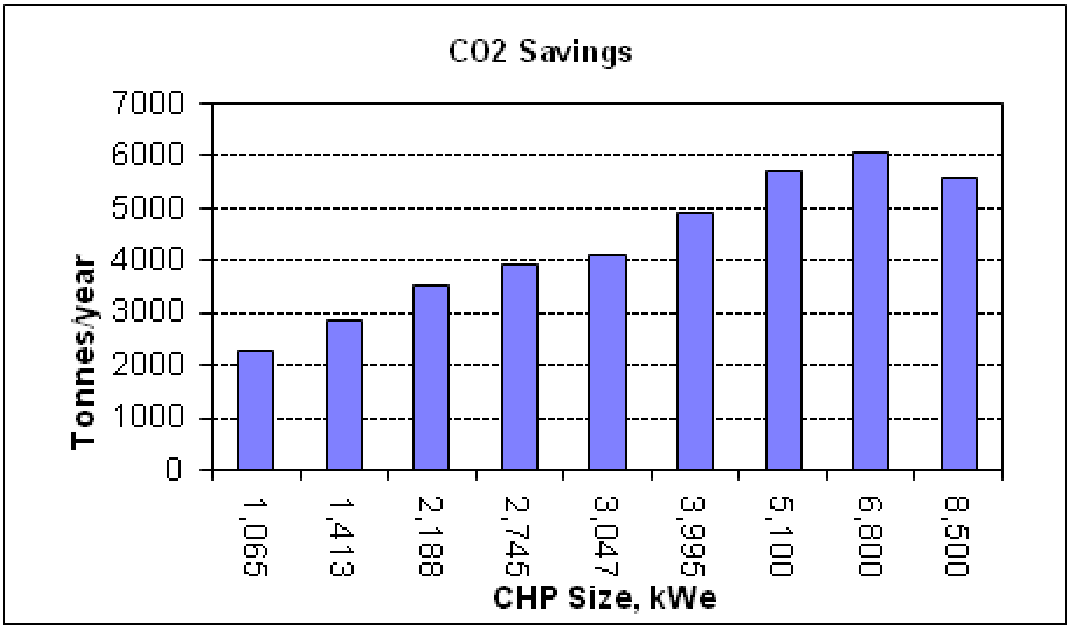

Figure 20 Cluster 9 CO_2 savings including non domestic buildings

4.4 Discussion

It is clear from the analysis undertaken here that all 3 schemes would produce substantial CO_2 savings with heat loads identified - allowing for gas engine CHP units of between 3MWe and 8.5MWe. For cluster 5, including non domestic consumers in the scheme significantly improves the CO_2 benefits and the net present value of the scheme; for cluster 3 there is only a modest increase in CO_2 savings which are outweighed by the large reduction in the net present value of the scheme.

It is also clear that all schemes are attractive in financial terms as public sector investments (using a discount rate of 3.5%) over a 25 year period. However as private sector investments (using a discount rate of 10%) the schemes would not be attractive. No external grant funding has been assumed.

Cluster	Engine Size kW_e	Capital Cost	NPV @ 3.5%	NPV @ 10%	CO_2 Savings
3	5,100	£ 5,580,164	£ 970,144	-£ 2,269,800	6,291
5	6,800	£ 6,368,974	£3,119,451	-£1,573,743	6,924
9	3,047	£ 3,808,901	£ 123,432	-£ 1,821,590	3,358
3 with non domestic	5,100	£ 6,487,042	£ 187,700	-£ 3,113,781	6,494
5 with non domestic	6,800	£ 7,036,503	£ 4,304,785	-£1,304,877	7,814

Table 8 Summary of Results

However it should be noted that the analysis conducted here has been undertaken as a desktop study using rough capital cost estimates and with pipework routes drawn over a digital map. It is of course recommended that more detailed analysis be undertaken before proceeding with the schemes. Critically a survey of each site to provide more detailed capital cost figures and to check proposed routes for heat mains is needed.

An important assumption in the analysis has been the use of a direct sales approach, which provides for a higher value of electricity sales by selling electricity directly to residents. A further assumption is that any upgrading work required for the systems would have been needed anyway and therefore does not constitute part of the capital costs of the system – though it will probably be sensible to conduct such work in tandem with the CHP installation.

4.5 Conclusions

- Clusters 3 and 5 can both be economically viable and make substantial CO_2 savings.
- Cluster 9 would rely on connection to a reasonable number of non Camden properties but has good potential to do this due to proximity of commercial buildings in the Euston Road area and St Pancras Housing properties (none of which are included in this model). It could also link up to Kings Cross regeneration.
- Cluster 5 offers better CO_2 savings and NPV and has the advantage of being more central in the borough so could extend to cover the areas around clusters 3 and 9 later.
- The inclusion of non domestic consumers in cluster 5 makes a substantial contribution to the amount of CO_2 saved and has a greater NPV than a residential only scheme in cluster 5.

Cluster 5 gives the highest carbon savings at the lowest capital cost with best NPV. It is therefore recommended that cluster 5 be taken ahead for more detailed analysis. It may be that a slightly slimmed down scheme would be preferable given the supply license limits discussed above 5MWe above. However before such work is conducted site surveys of schemes 3 and 5 should be conducted to eliminate uncertainty associated with the costs of siting CHP on these schemes.

5 Risks

5.1 Introduction

There are a number of additional factors that could affect the feasibility of CHP installations at the identified sites, including:

- Land/space availability
- Gas safety issues (HSE safety case)
- Extent of leaseholder presence
- Presence of listed buildings or location in conservation areas
- State of repair and impact of improvement measures on energy demand
- Licensing issues
- Utility connection issues
- Potential for future heat network expansion

Each of these are dealt with in turn in the following sections.

5.2 Land/Space Availability

The issues as regard land and space availability relate to:

a) pipework routes

b) installation of CHP

The interconnection of buildings in each scheme necessarily requires new pipework to be laid. Generally this is underground mains though overground solutions are also possible. Cases have arisen where the space for additional underground utilities has been insufficient (such as at Canary Wharf), though this is a generally rare occurrence. A more likely issue is that space within one of the existing boilerhouses will be insufficient to accommodate CHP plant. However this is not a barrier in itself as:

a) an extension to an existing boilerhouse could be built

b) a purpose built energy centre could be built

c) distributed or packaged CHP solution could be adopted.

The optimal solution for any scheme could be determined at detailed feasibility stage.

5.3 Gas Safety Issues

Gas safety is generally improved by the centralisation of heating plant in a single boilerhouse. Around 30 people die per year in the UK due to carbon monoxide poisoning because of unsafe gas appliances within dwellings.

Furthermore the adequate provision of affordable heating minimises the temptation for residents to use bottled gas heaters which are linked to condensation and mould growth, ill health and risk of explosion.

A significant advantage in terms of maintenance is that annual gas safety checks can be avoided with a centralised system – if gas supplies are completely removed from the property. (The provision of pipe for a gas cooker will still require an annual inspection).

There have however been cases where accidents have occurred with central boiler plant. A case in point is the Kerrin Point explosion in Lambeth. A boiler house at the base of the tower block exploded. No-one was injured, but the block was damaged and later demolished.

On balance, however, properly maintained central gas plant should provide safety improvements over individual systems. This should not be a barrier to any of the three schemes but rather an advantage.

A separate issue is that Camden own a sizeable proportion of the local gas network. The location of this network in relation to these schemes has not been considered here. The addition of increased demand on this network through the use of local CHP might cause problems in relation to the stability of the network. Whilst overall gas demand at a national level is usually slightly reduced by the use of local CHP, the effect within Camden would be to increase gas use so this is an issue that will require further analysis.

5.4 Extent of Leaseholder Presence

The presence of leaseholders on estates to be served by CHP has implications in terms of time – there is a statutory consultation period - and the possibility that within that consultation they may oppose the installation of CHP on the grounds of the recharged cost or disruption.

In an ideal world heat would be considered as any other utility whereby the need to renew mains is the responsibility of the utility provider and charge for this is simply part of the ongoing cost. There appears to be some flexibility in the possible treatment of CHP however as to whether local authorities recharge the capital cost.

The table below shows that scheme 3 has the least leaseholders in percentage terms at 16%.

Scheme	Leaseholders	Total Dwellings	% Leaseholder
3	279	1709	16%
5	313	1252	25%
9	202	761	27%

Table 9 Extent of Leaseholder Presence

5.5 Presence of listed buildings or location in conservation areas

CHP is an ideal solution for listed buildings and conservation areas as, unlike external cladding, it implies very little if any change to the appearance of a building. In a sense therefore the presence of either is unlikely to be barrier on any of the schemes in question. If a new energy centre is required, to house CHP and boiler plant, then clearly this would require planning permission. It is likely that this would be located near an existing boilerhouse.

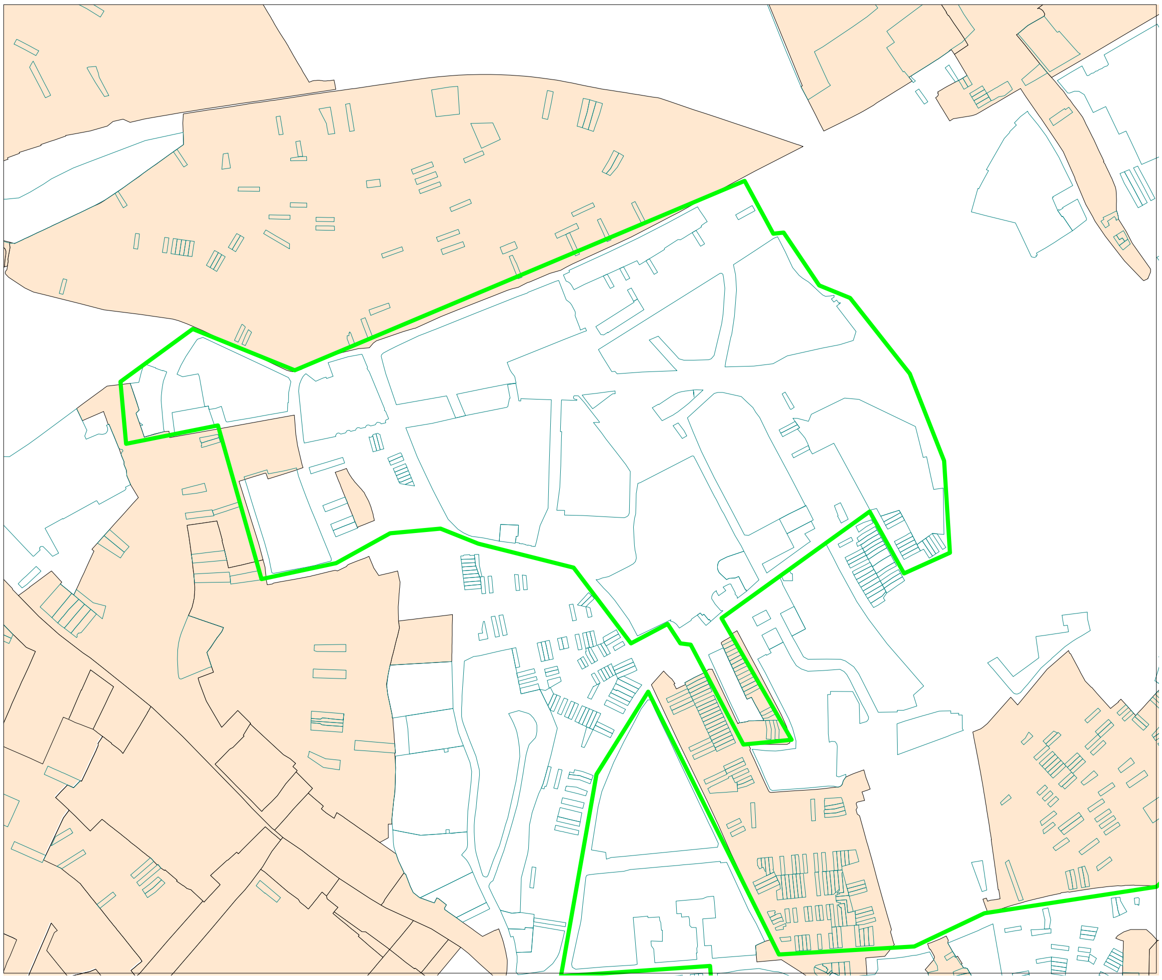

Figure 21 Cluster 3 Conservation Areas

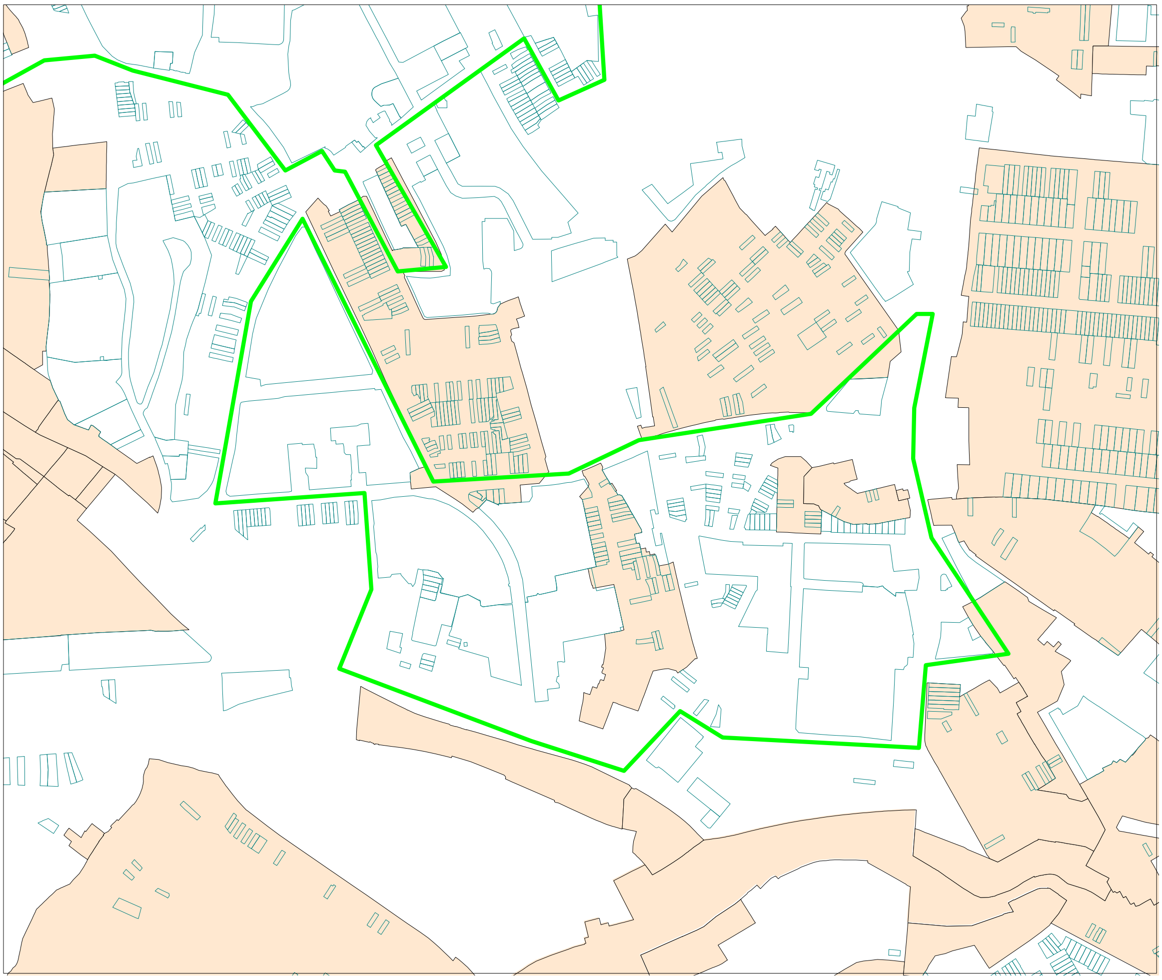

Figure 22 Cluster 5 Conservation Areas

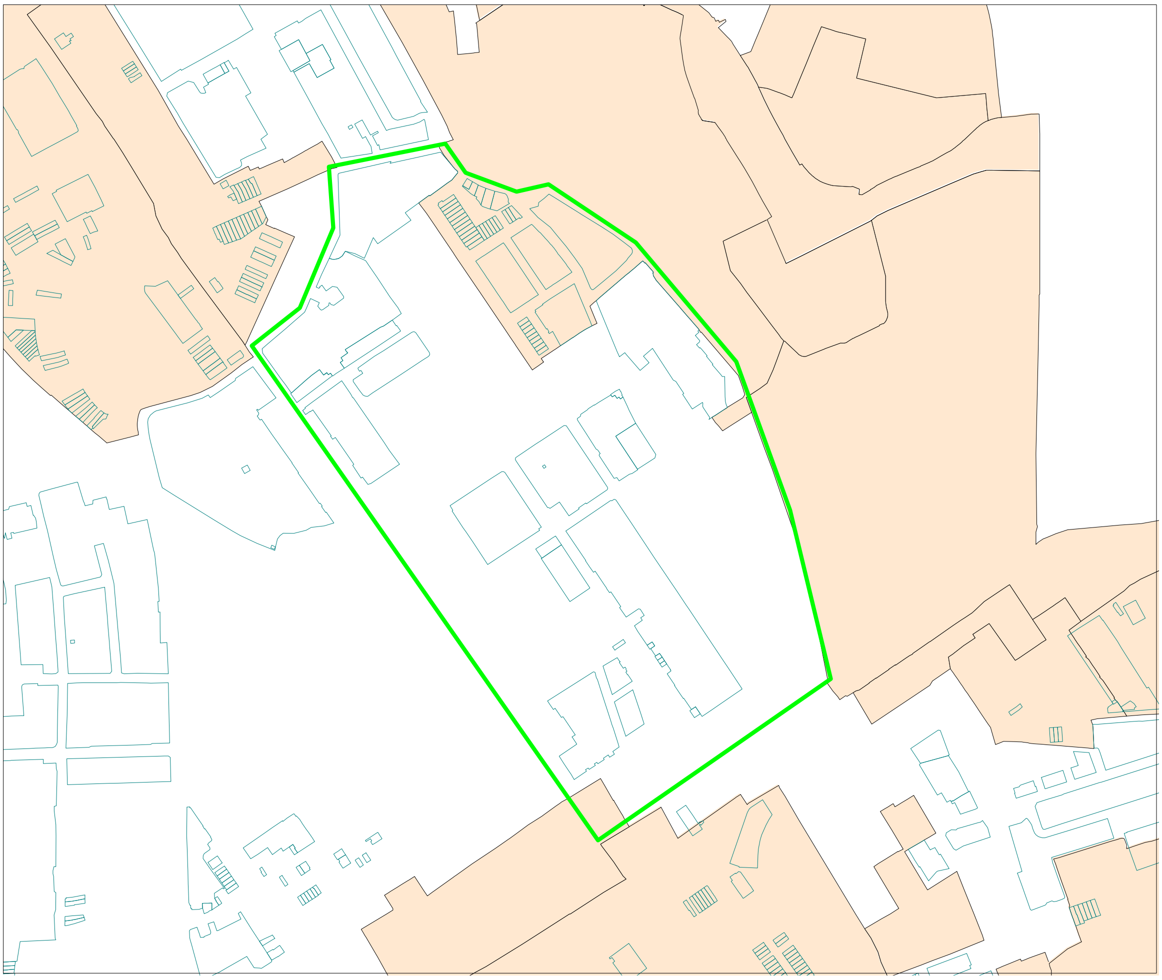

Figure 23 Cluster 9 Conservation Areas

As the above maps show, there are low levels of conservation area penetration (pink areas) in all three clusters (outlined in green). Cluster 3 has no conservation areas within it at all.

5.6 State of repair and impact of improvement measures on energy demand

There may be significant advantages that would derive from upgrading systems in tandem with the interconnection and installation of CHP. Unfortunately it has not been possible to assess this factor at the level of detail at which this study was conducted.

5.7 Utility connection issues

CHP requires both gas and electricity connection. Historically of the two, electrical connection appears to have been the most problematic for embedded generation within London. Generally NGT and EDF networks would provide analysis of connection costs at the detailed feasibility stage. However, it should be noted that solutions exist for both if it found that a single large CHP engine cannot be connected directly into a local network point. Distributed CHP can be used whereby each engine is sized to feed into a network at a local transformer. Again this should not be a barrier for any of the three schemes.

5.8 Potential for future heat network expansion

All of the schemes provide opportunities for future heat network expansion. As noted elsewhere they are located in a line through the centre of the borough, so are well placed to form the start of a potential wider heating network. Cluster 9 offers the greatest potential to link up to non council property including Housing Association properties, commercial buildings around Euston Road and the Kings Cross regeneration area.

5.9 Licensing Issues

The sale of heat is largely unregulated. This is not the case with electricity generation, distribution and supply where a tight regulatory framework is in operation:

- **Generation -** It is unlikely that LBI will require a generation license at any point soon given the licensing limit of 100MW_e. In the longer term this might need to be addressed but this is unlikely to occur in the next 15 years.

- **Distribution -** The laws are crafted in such a way as to split the distribution and supply and electricity. A company that holds a supply license cannot hold a distribution license and vice versa. There has been much discussion about installation of private wire networks in the London context. Whilst it makes no sense in resource/sustainability terms to install a parallel network where the current network is adequate, it may make financial sense to do this under the regulatory inadequacies of the current system. Distribution (DUOS) charges are indeed high for small generators to supply buildings a very short distance away and they need to be changed to reflect the short transportation distances.

- **Supply -** A licence is required where a supply exceeds 5MWe – of which only 2.5MWe can be domestic. This is critical for the current schemes, as 2 of the clusters would warrant engines of just over 5kW (5.1kWe and 6.8kWe) but it might become relevant if the council starts selling heat and power directly to residents right across the borough.

The analysis conducted here is based on a direct sales approach. A supply license would therefore be required for this approach for clusters 3 and 5 just on the residential demand analysis. . A solution to this would be sell the balance of electricity produced to a licensed supplier. This would decrease the viability in proportion to the volume of electricity produced over the 5MWe limit.

5.10 Conclusion

At this level of detail scheme 3 would appear to provide the least level of barrier in terms of leaseholder connection and conservation area penetration. Cluster 9 has slightly more immediate interconnection possibilities, if a scheme develops at Kings Cross. However cluster 5 sits between 9 and 3 and so could interconnect to either at a later date. The most significant barrier occurs for schemes 3 and 5 as the optimal engine size would require a supply license for electricity sales over the 5MWe limit. A solution to this would be sell the balance of electricity produced to a licensed supplier. This would decrease the viability in proportion to the volume of electricity produced over the 5MWe limit.

6 Appendix: corporate property list

Name	Postcode	Cluster	Type	Gas consumption (kWh)	Electricity consumption (kWh)
Carlton primary school	NW5 4AX	3	School	1,211,202	76,872
Queens crescent (191)	NW5 4DS	3	Unknown		
Queens Crescent, 104a (Crescent Project)	NW5 4DU	3	Office	25,844	13,003
Queens crescent library	NW5 4HH	3	Higher Education		55,273
Weedington road play centre	NW5 4NU	3	School		78,797
Kentish town city farm	NW5 4BN	3	Unknown		
VICARS ROAD (12-12a)	NW5 4NN	3	Unknown		
Chaston nursery site	NW5 4JH	3	School		
Gospel oak jmi school	NW3 2JB	3	School	859,709	121,252
St dominics rc primary	NW5 4JS	3	School	395,885	73,356
Wellesley road (115)	NW5 4PA	3	Unknown	388,032	246,922
Wellesley road eph	NW5 4PN	3	Unknown	869,398	496,361
Careline control centre (ludham)	NW5 4SE	3	Unknown		
Lawn road (32)	NW3 2XR	3	Unknown		
Grafton road, 22 (residential unit)	NW5 3DU	5	Unknown		
Willes road, 15	NW5 3DT	5	Unknown		
Gospel oak nursery centre	NW5 3LE	5	Unknown		
Kentish town sports centre	NW5 3LE	5	Sports & Recreation	3,044,600	611,095

Prince of Wales Road, 18	NW5 3LG	5	Unknown		
Ellen terry court (1) day centre mh	NW1 8SE	5	Unknown		
Holy trinity jmi	NW1 8DE	5	School	121,291	50,197
Chalcot [spec] school	NW1 8DP	5	School	243,826	50,053
Kentish town project day care	NW1 8SE	5	School		
Talacre community sports centre	NW5 3AF	5	Sports & Recreation	298,011	236,326
Talacre road youth club (talacre action group)	NW5 3AG	5	School		
Rhyl school jmi	NW5 3HB	5	School	681,670	113,142
Ferdinand place (2)	NW1 8EE	5	Unknown		
Chalk farm road (81-83)	NW1 8AR	5	Unknown		
Haverstock school secondary	NW1 8AS	5	School		842,113
Charlie ratchford centre	NW1 8HF	5	Sports & Recreation	254,599	78,588
St pancras boys club	NW5 3PH	5	School		
Prince of Wales Road, 174 (Care Centre)	NW5 3QB	5	Unknown		
Plot 10 community centre / junior club	NW1 1JD	9	Unknown		
Camden unison	NW1 1ES	9	Unknown		
Phoenix court car park	NW1 1HB	9	Unknown		
Hampden nursery centre	NW1 1HQ	9	School	7,085	

Chalton street (85)	NW1 1HY	9	Unknown		
Churchway parking meter maintenance depot	NW1 1LJ	9	Unknown		
Medburn centre	NW1 1RX	9	Unknown		
The lodge (st pancras gardens lodge)	NW1 1UL	9	Unknown		
St aloysius rc junior school	NW1 1PS	9	School	222,803	100,755
St aloysius st rc infants	NW1 1PS	9	School	158,129	53,437
St mary & st pancras ce primary s	NW1 1SR	9	School	103,450	33,669
Margaret staff creche	NW1 1TA	9	Unknown		
Maria fidelis upper school	NW1 1TA	9	School	1,041,271	538,301
South camden community school	NW1 1RG	9	School	2,283,883	797,427
Mayford (93)	NW1 1NY	9	Unknown	108,270	31,788
Mayford day centre - special needs unit	NW1 1NY	9	Unknown		
Environment local - crowndale	NW1 1TU	9	Office	1,291,762	1,449,757
Total Cluster 3				**3,750,070**	**1,161,836**
Total Cluster 5				**4,643,996**	**1,981,514**
Total Cluster 9				**5,216,653**	**3,005,133**

Table 10 Corporate properties in clusters 3, 5 and 9