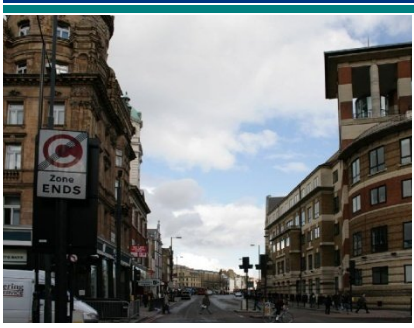
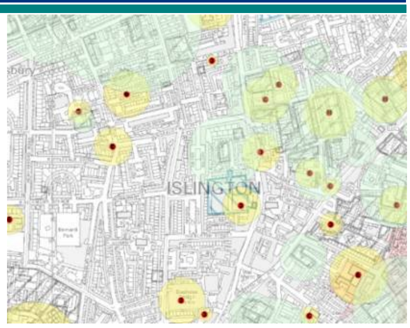
DECENTRALISED ENERGY PROJECT – STAGE 3

Work stream 3: Borough Wide DE strategy





London Borough of Islington

Prepared by Parsons Brinckerhoff Ltd

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Abbreviations

ALMO	*Arms Length Management Organisation*
BDEC	*Birmingham District Energy Company*
BMS	*Building Management System*
CfSH	*Code for Sustainable Homes*
CHP	*Combined Heat and Power*
CO_2	*Carbon dioxide*
DE	*Decentralised Energy*
DH	*District Heating*
DHW	*Domestic Hot Water*
DNO	*Distribution Network Operator*
DPCV	*Differential Pressure Control Valve*
EC	*Energy Centre*
ESCO	*Energy Service Company*
GIS	*Geographical Information System*
GLA	*Greater London Authority*
JESSICA	*Joint European Support for Sustainable Investment in City Areas*
JV	*Joint Venture*
LBI	*London Borough of Islington*
LDA	*London Development Agency*
LDF	*Local Development Framework*
LTHW	*Low Temperature Hot Water*
O&M	*Operation and Maintenance*
PB	*Parsons Brinckerhoff*
SPD	*Supplementary Planning Document*
UDF	*Urban Development Funds*
UDP	*Unitary Development Plan*

Units

°C	Degrees Celsius
bar	Pressure, bar
hr	*Hour*
GWh	*Gigawatt hour (1,000,000 kWh)*
kW	Power, kilowatts (10^3 watts)
kWh	Energy kilowatt hour
MW	Power, megawatts (10^6 watts)
MWth	Thermal Power –, mega watt (10^6 watts)
MWe	Electrical Power –, mega watt (10^6 watts)
p.a.	per annum
tC	tonnes of Carbon
tCO_2	tonnes of Carbon Dioxide

Executive summary

This strategy has been written to provide LBI with the information required to guide the long term delivery of decentralised energy in the borough. The aim of this document is to highlight potential schemes that warrant closer examination through an options appraisal stage and ultimately a design phase before a viable scheme can be delivered.

This document has two main sections:

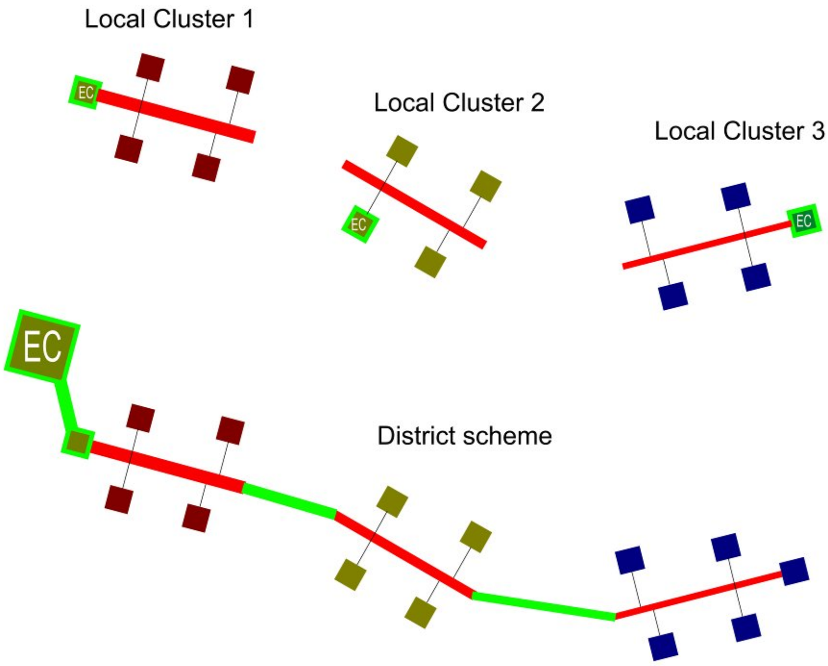
1) **Decentralised Energy Strategic Framework**: contains the proposed strategy for the deployment of DE in Islington

2) **Supporting information** including:

    - Planning guidance
    - Commercial arrangements
    - District Heating technical compatibility
    - Risk mitigation.

PB has devised a methodology to identify potential groupings of buildings to form heat loads or ‘clusters’ that have the potential to be supplied from a DE network. The potential carbon benefit of supplying individual clusters from CHP is quantified at a range of scales. The means by which these clusters can be aggregated to form larger, more efficient DE networks is discussed.

When the spatial distribution of the individual clusters is analysed it is clear that there are three linear groupings of clusters in the borough; these are referred to as the southern, central and northern district schemes. The three groupings of local DE clusters that form the district schemes have a spatial distribution that lends itself to connecting the local DE clusters together to form a linear district scheme. Organic growth of the local clusters to form district schemes, where the end of one local cluster could connect to the other end of an adjacent local cluster, is likely to be facilitated by their distribution. When the district heating network for each of the local clusters is designed it should incorporate a central ‘district heating spine’ that facilitates the interconnection of individual local clusters.



PB has examined the potential for extending the district schemes so that they can begin to supply LBI owned housing that is not already connected to a community heating network.

The theoretical capacity of gas engine CHP required to supply each of the local clusters has been calculated. The total CO_2 reduction that could theoretically be achieved if all local clusters were supplied from gas engine CHP is **28,305** tonnes per year. Aggregating the heat demand from the local clusters to form the district clusters allows the use of larger, more efficient, gas engine CHP units. An additional saving of **7,510** tonnes can be saved if district schemes are supplied from larger gas engine CHP units rather than from smaller engines for each cluster. PB has quantified the potential CO_2 reduction that could be realised if the district schemes were supplied from biomass CHP units, rather than from natural gas fired CHP. It is possible to save **10,661** tonnes can be saved if district schemes are supplied from biomass CHP units rather than from smaller engines for each cluster.

It is anticipated that the CHP plant required to supply the local clusters would be housed in an energy centre located within or adjacent to the boundaries of the cluster. When considering the supply of the district level clusters from an energy centre, the scale of the CHP plant is such that identifying potential sites becomes significantly more problematic. PB and LBI have undertaken a high level examination of the potential sites for district energy centres within the borough.

PB have identified the strategic issues that need to be considered in the short, medium and long term if decentralised energy clusters are to be delivered in line with the strategic framework presented in here.

Short term: 0 - 2 years

1) The decentralised strategic framework that is outlined in this document requires the design of the individual DE clusters to incorporate aspects of the long term strategy. The mechanism by which local clusters are amalgamated to form district schemes is predicated on the incorporation of an initially oversized DH spine that runs through each of the local clusters allowing interconnection at a later date to form district DE schemes. Islington is a highly populous area with a high density of utilities already buried in the congested road network. Installing DH pipe required for the spines that will form the district schemes is likely to be problematic and expensive in Islington's already congested streets.

2) Citigen has been identified by PB and the LDA as a strategic location for an energy centre to supply the southern DE scheme. In the short term however there is the opportunity to use spare capacity on the existing Citigen district heating network to supply cluster B. A decision regarding the preferred heat supply for cluster B needs to be taken as part of the detailed design process for cluster B (reference PB's report on Cluster B). If Citigen is not used to supply cluster B now it does not necessarily preclude the use of this heat source in the future.

3) The redevelopment of strategic sites in Islington offers the opportunity to develop DE networks using the new development as a catalyst. It is feasible that one or more of the energy centres required to supply the local clusters identified in this study could be located within the new developments included in LBI's five year development framework. A discussion of the means by which planning can be used as a catalyst for the deployment of DE is included in section 3.1.

4) Supply of heat from the Kings Cross development to cluster A has the potential to reduce the capital and operational expenditure required for this scheme. LBI should seek to gain a position statement from Metropolitan that defines their official stance with respect to the capacity of heat supply and an indicative heat sales tariff structure.

5) The mechanism for funding further local DH clusters beyond cluster B, which has LDA funding, needs to be explored by LBI. The narrative included in section 3.2 can be used as a starting point for identifying potential funding sources.

Recommendations for short term delivery of strategy

1) PB strongly recommends that a detailed district heating constraints assessment is undertaken along the identified DE growth corridors. This assessment should identify all existing buried utilities and other potential physical barriers along the proposed corridor. This assessment will be used to identify the district heating route that would be the least disruptive.

2) PB would strongly advocate the inclusion of wording in the emerging LDF that requires new developments to demonstrate why they should not be the focal point for a new low carbon DH network that supplies both the new development and facilitates the decarbonisation of existing adjacent building stock. At the very least all new

development in the vicinity of the local clusters identified in this strategy should be designed to be connected to a DE network

3) LBI should aim to secure a heat purchase agreement from Metropolitan if the heat sales price is less than the cost of generation using local CHP to supply cluster A.

Medium term: 2 - 5 years

1) The delivery and long term operation of DE in Islington could be facilitated by an energy services company (ESCO) of some kind. LBI needs to undertake further work to allow them to more fully understand the various ESCO models available and to identify their preferred model. The information contained in section 3.2 can be used by LBI as a starting point for identifying their preferred ESCO model.

2) The supply of low carbon heat from outside of the borough, possibly from Edmonton waste to energy plant via the Lea Valley, could be a mechanism of supplying the central and northern clusters as PB has not been able to identify a potential energy centre location for either of these district schemes, except the Archway redevelopment. LBI should investigate the feasibility of bringing low carbon heat via this route and keep a watching brief on DE developments (physical and policy) in the adjacent boroughs (Hackney, Enfield, Haringey and Waltham Forest).

Long term: 5+ years

The Citigen site as a location for large scale DE plant is strategically important for the decarbonisation of buildings in south Islington and the north and west of the City of London. Though the development of the site itself is subject to considerable constraints, both physical and environmental; there is space available for additional generation plant and the necessary utility infrastructure connections and licences are in place. The future operation of the plant and its district heating network has been the subject of a detailed feasibility study which is under consideration by the plant owners E.ON UK. The key questions that need to be answered are a) what plant should be installed b) when should the facility be re-planted and c) how much heat can be transferred from Citigen to south Islington?

1 Introduction

The UK Climate Change Act 2008 sets legally binding emission reduction targets of 35% by 2020 and a 80% reduction by 2050. This act is therefore the driving force behind the UKs national and local carbon mitigation strategy. In an effort to comply with the impending CO_2 reduction targets the London Borough of Islington (LBI) has been exploring options, including decentralised energy networks, for reducing its carbon footprint.

LBI has been at the forefront of the development of decentralised energy in London for some years, having commissioned studies on DH potential in advance of the GLA's London Community Heating Study. The borough benefits from having areas of high heat load density (particularly in the south), and from the proximity of existing DE infrastructure: the Citigen trigeneration facility, which has been operational in the adjacent authority (City of London) since 1996, and more recently the development of Kings Cross Central which will be supplied from a new DE facility.

Previous development work has identified a number of potential DE schemes: two in the south of the borough (South Cluster A and B), one in the centre of the borough and a northern cluster centred around Archway.

LBI has commissioned Parsons Brinckerhoff (PB) to undertake an assessment of the potential for decentralised energy in the borough. The Council's approach to developing a strategy for decentralised energy is to focus initially on identified schemes in the south of the borough (for which funding is available) but to see this as part of a broader deployment of DE borough-wide. In this context, the work on optimising and engineering the first clusters must align with a broader, strategic view of how DE will be developed throughout the borough and across London.

The LBI brief identified three distinct work strands which address the scheme development and strategic focus mentioned above. The three work strands are:

i. WS1 – Development of a DE scheme based on Old Street Area TFS and South Cluster B

ii. WS2 – Development of a DE scheme based on South Cluster A (Caledonian Road)

iii. WS3 – Development of a borough-wide DE Strategy

1.1 WS3: Borough wide DE strategy

1.1.1 Scope

The Council's vision for reducing the carbon intensity of the borough's building stock is to roll out decentralised energy where the heat demand density makes it viable. Schemes identified in the south of the borough, where development density is greater, will be developed first but, if the full potential across the borough is to be realised, it is important to have a view of what a borough-wide DE approach might look like.

There are a number of reasons for this:

- To ensure that the development of the initial schemes enable the longer-term wider objectives and do not constrain these
- it will help to inform the development of planning policy aimed at encouraging DE uptake
- to safeguard existing district and community heating systems for future connection
- to identify and preserve key energy infrastructure (i.e. potential energy centre sites)
- to ensure that the Council is in the best position to make maximum use of available DE funding programmes when they arise to help the Council to develop a clear understanding of the commercial issues around DE deployment.

The development of a pan-borough DE strategy will need to consider both technical and commercial issues. Individual schemes across the borough will need to be designed and built on a consistent engineering basis to ensure compatibility. The pan-borough strategy should address the way in which schemes are procured, owned, and operated, such that the Borough retains a degree of control over the direction and timescales for the wider scheme.

A risk workshop facilitated by PB and attended by LBI stakeholders has been carried out in order to ensure that the above technical and commercial issues are fully considered.

The following issues are considered in the strategy:

Strategy area	Issue
Design	• The identification of the area or clusters of buildings where DE projects will be most viable and around which a long-term large-scale strategy can be developed • Future proofing connections through planning • Sizing of the DH network

	• Use of technical standards for interface and operation
3rd party issues	• LDA wider scheme compatibility • Possible links to Citigen
Delivery, operation and contractual	• Delivery vehicle and long term contracts • Asset ownership – pipework and plant • Operating the schemes • Funding of the schemes

1.2 Context of this document

This strategy has been written to provide LBI with the information required to guide the long term delivery of decentralised energy in the borough. The aim of this document is to highlight potential schemes that warrant closer examination through an options appraisal stage and ultimately a design phase before a viable scheme can be delivered.

This document has two main sections:

3) **Decentralised Energy Strategic Framework**: contains the proposed strategy for the deployment of DE in Islington

4) **Supporting information** including:

- Planning guidance
- Commercial arrangements
- District Heating technical compatibility
- Risk mitigation.

1.3 Approach

When undertaking this workstream the definition of a borough-wide strategy has been taken to mean one that facilitates the delivery of the borough's DE potential. This could be through the development of several schemes and not necessarily the delivery of a single, interconnected borough-wide DE network.

The DE strategic framework is intended to assist the Council in identifying, developing and delivering individual DE schemes within Islington whilst facilitating the implementation of a wider approach that could result in one or more of the smaller schemes being linked together. The strategy is based on sound engineering principles to ensure that it can be delivered within the technical, regulatory and commercial constraints associated with infrastructure projects of this nature.

When defining individual DE schemes PB has attempted to identify the most likely source of heat for each scale of cluster e.g. a local energy centre for local scale clusters and remote low cost, low carbon heat sources for larger district-wide schemes. We have made the assumption that the location of the most likely long term heat supply source will drive the growth and coalescence of individual clusters, and the conceptual designs have been ‘future proofed’ against the most likely DH network growth scenarios.

2 Strategic framework for deployment of decentralised energy in Islington

2.1 Introduction

PB has devised a methodology to identify potential groupings of buildings to form heat loads or 'clusters' that have the potential to be supplied from a DE network. The potential carbon benefit of supplying individual clusters from CHP is quantified at a range of scales. The means by which these clusters can be aggregated to form larger, more efficient DE networks is discussed in the following sections.

2.2 Identifying potential DE clusters

2.2.1 Data used

PB has utilised data provided by LBI to identify potential clusters of heating loads that could form one or more DE clusters. The following data sources were used:

i. Gas consumption data for buildings supplied from central gas boiler plant, including LBI housing estates with communal heating, and information supplied through the Islington Climate Change Partnership

ii. Islington residential and mixed use development sites for the next 5 years

iii. Fuel poverty indicator data for census output area

iv. Location of Islington owned housing (with individual heating systems)

2.2.2 Calculating the 'circle of influence' for individual loads

PB has used the kWh gas consumption data provided by LBI to calculate the maximum length of district heating pipe that could be installed between individual loads to form a theoretical district heating network. The length of pipe was used to draw a 'circle of influence' around each load on a base map of the borough. The radius of the circle is a function of the magnitude of energy demand for individual loads. The rationale behind this methodology is that if the circle of influence of separate loads overlaps, as a consequence of proximity and/or magnitude of load, then these loads should be considered for inclusion in a local cluster. The methodology to calculate the sphere of influence is as follows:

i. A boiler efficiency of 75% was applied to the gas consumption to arrive at the annual heating demand for the buildings

ii. The annual demand for each building is increased by 5% in order to take account of heat losses on the DH system.

iii. A combined heating and hot water load factor appropriate for each building type is applied to the kWh heat consumption to calculate a peak heat demand for each building.

iv. A 25°C temperature differential between the flow and return water for the district heating system was assumed because of the requirement to interface with existing buildings. The rationale for this temperature differential is discussed in more detail in section 3.3.11.

v. The most appropriate pipe size to supply each load was calculated using a target pressure drop of 100 Pa/m.

vi. PB has assumed that the larger the load the more desirable it is to connect it to a DH network, therefore the greater the distance that it would be deemed viable to travel from one load to the next. The pipe diameter required to supply each of the loads was then used as a proxy for the 'circle of influence' that each load would have, i.e. where the circle of influence of one or more loads overlapped they are considered to form a cluster that could be supplied from a single energy centre.

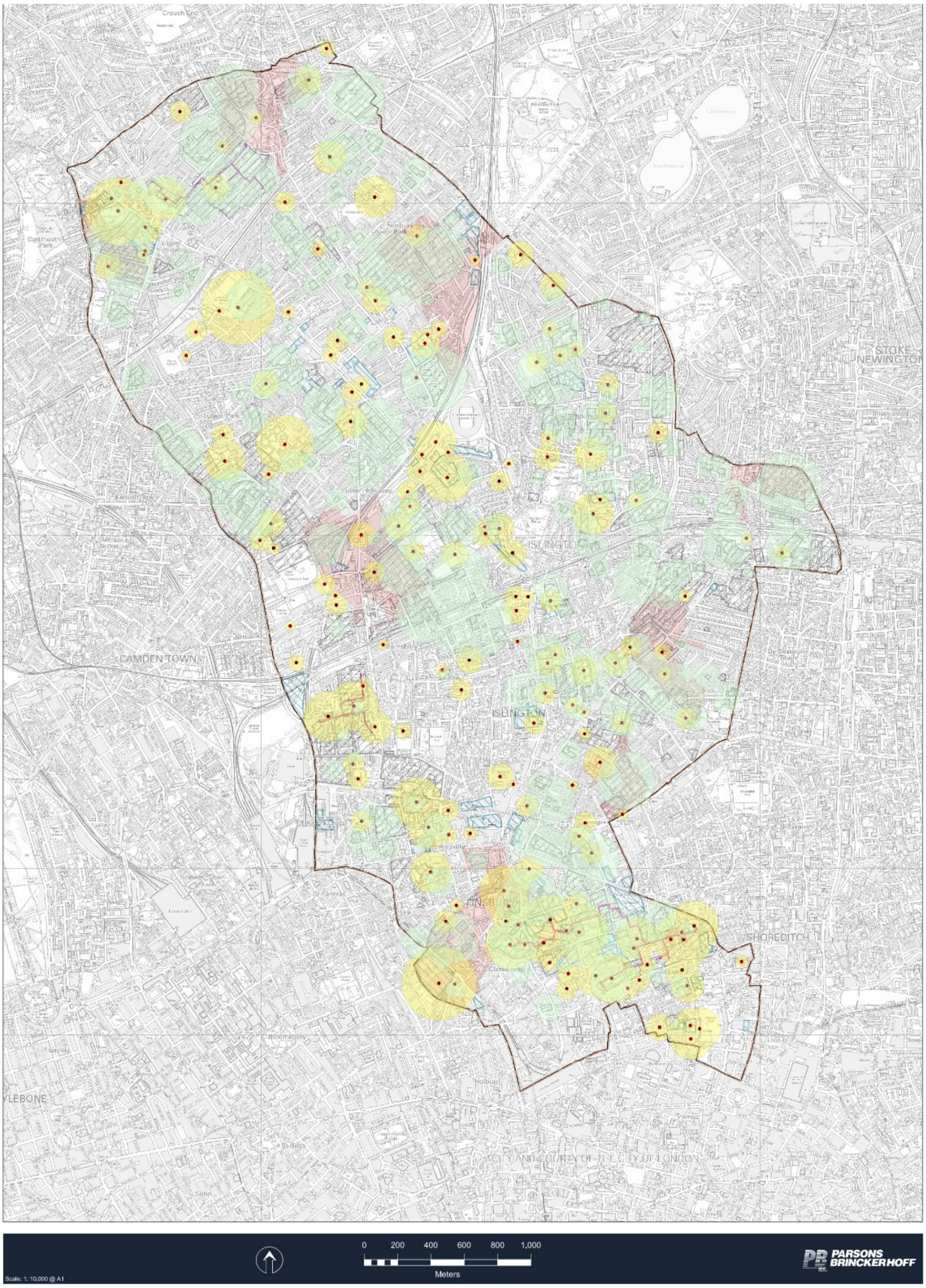
vii. The circles of influence were mapped in GIS, with overlapping circles used to identify potential local scale DE clusters in the borough.

The yellow circles shown in the Figure 2-1 overleaf represent single point heating loads that are currently supplied from large gas fired boilers, for example HFI housing estates already supplied from communal boilers and LBI owned buildings. The green circles represent LBI owned housing that is not already supplied from communal heating. The green circles have not been considered when forming the local clusters and are included for information only. The centre of each of the yellow circles has a code that is used to identify the building type as follows:

Code	Building type
H	Housing
O	Offices
E	Primary and secondary education
C	Community
M	Medical
3p	3rd party loads – non LBI
U	University

The areas of light red shading represent areas that have a fuel poverty indicator greater than 8. The proposed outline of major new development is represented by light blue shading. The location of LBI housing is indicated by a grey shaded outline.

Figure 2-1: Location of heating loads and areas of multiple deprivation in LBI (see text for key)



2.3 Grouping individual loads to form local clusters

The circle of influence approach has been used to determine the extent of the cluster, however, for a variety of reasons (technical, economic and/or commercial) it will not be appropriate to connect all the buildings falling within the circle of influence. In order to bring some focus to the process of selecting loads for inclusion in a cluster PB has devised a connectivity hierarchy. For example, it will be more cost-effective to connect a communally heated housing estate than the equivalent number of homes supplied from individual gas boilers. Application of a connection hierarchy will prioritise loads and allows the Council to direct development resources to buildings and building owners most likely to form part of a DE cluster.

When selecting loads for inclusion in a cluster the following connectivity hierarchy has been applied:

i. Housing estates with existing communal heating

ii. Large single loads under LBI control

iii. New large developments

iv. Large public sector buildings not under LBI control

v. Large private sector buildings

vi. LBI Housing not on DH

vii. Private sector housing

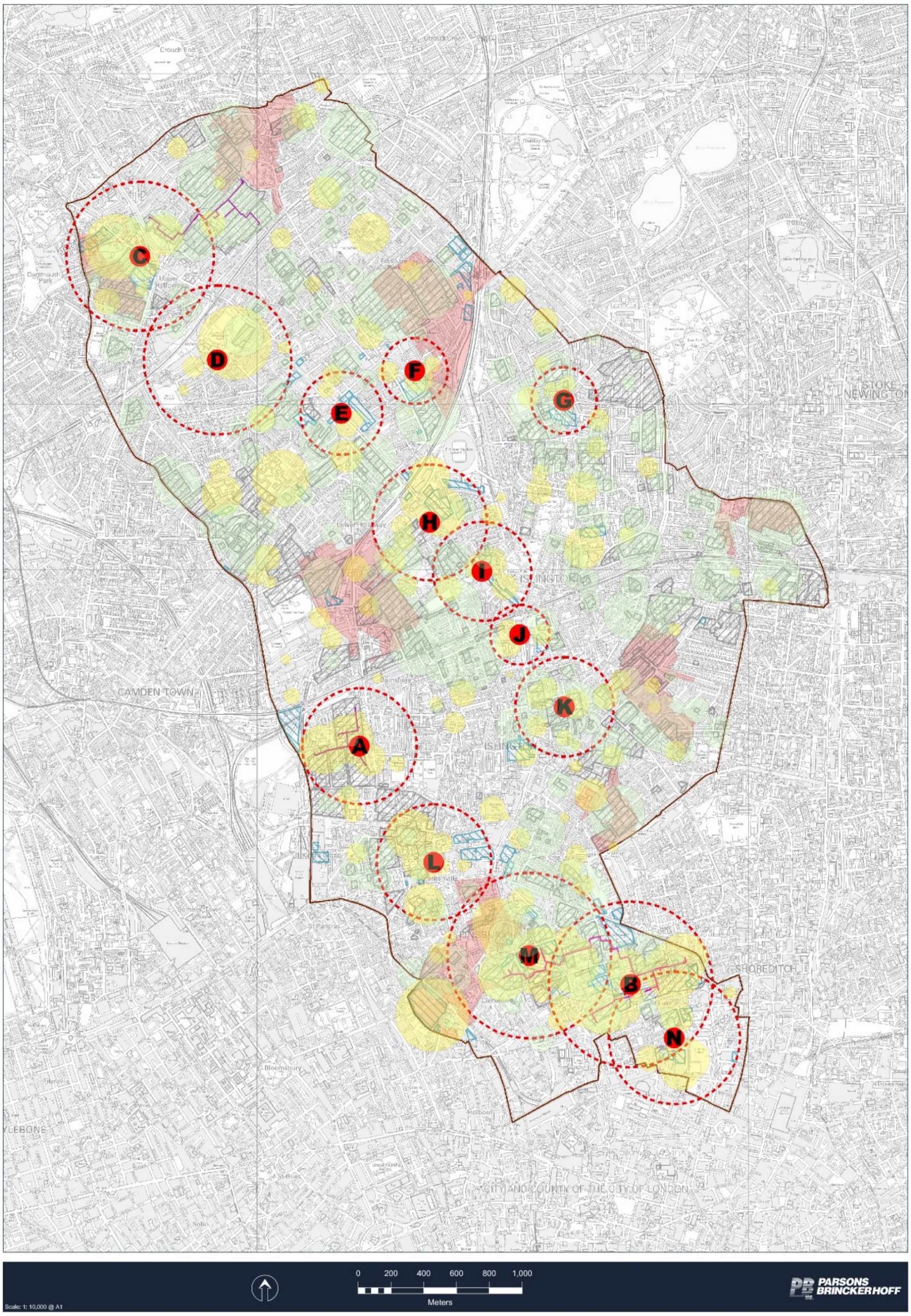
Figure 2-2 below shows how the circles of influence calculated in the previous section have been used to identify groupings of loads that could form local clusters. PB has calculated the circle of influence exerted by the sum of all loads included within each local cluster using the following methodology:

i. Individual loads that have sufficient overlapping circles of influence are grouped together to form local clusters

ii. The heat load and load factor for each individual load is used to calculate a weighted load factor that is applied to the aggregate heating demand in order to calculate the peak demand for each local cluster

iii. The peak demand is used to calculate the diameter of pipe that is required to supply the total heat demand of each local cluster. This pipe size is represented by the dashed red circle of influence shown in the figure overleaf. Each local cluster has been ascribed a reference letter that is shown in the centre of each cluster.

Figure 2-2: Location of local clusters – indicated by red dashed circles



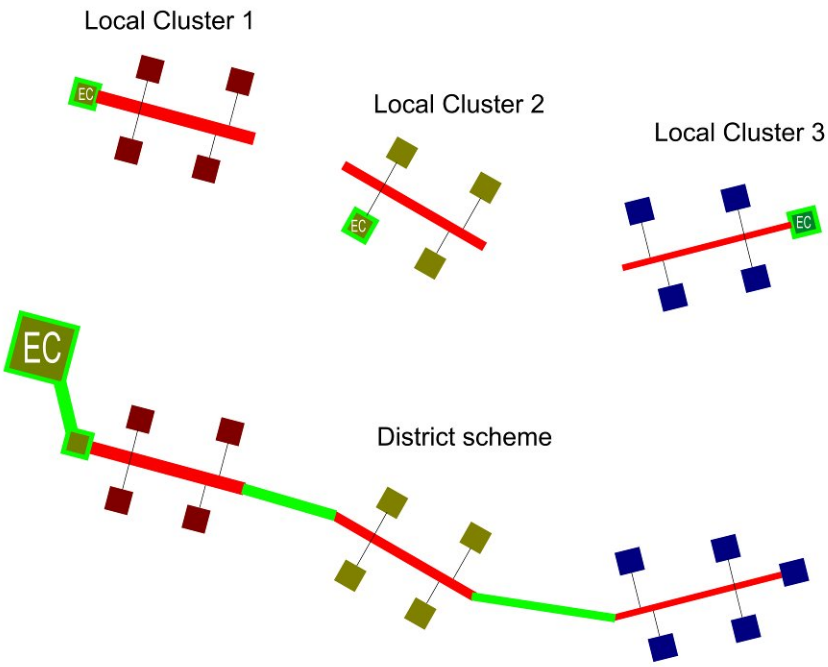
2.4 Growing local clusters to form district schemes

When the spatial distribution of the local clusters is analysed it is clear that there are three linear groupings of clusters in the borough; these are referred to as the southern, central and northern district schemes. In this section we examine how the local clusters could be interconnected to form three district-wide District Heating schemes.

The three groupings of local DE clusters that form the district schemes have a spatial distribution that lends itself to connecting the local DE clusters together to form a linear district scheme. Organic growth of the local clusters to form district schemes, where the end of one local cluster could connect to the other end of an adjacent local cluster, is likely to be facilitated by their distribution.

When designing the conceptual district heating network for each of the of the local clusters the long term, borough-wide, strategy should be considered in order to facilitate the aggregation of local clusters to form district schemes. When the district heating network for each of the local clusters is designed it should incorporate a central 'district heating spine' that facilitates the interconnection of individual local clusters. In order to size the DH spine it is necessary to anticipate the location of the energy centre that will eventually supply the district scheme. The spine should therefore be of sufficient diameter to supply the load of all upstream local clusters from the anticipated location of the district energy centre. The diagram below illustrates this concept. Each of the local clusters is initially supplied from a local energy centre (EC) that contains all requisite plant to supply heat to the buildings in the local cluster. In order to form the district scheme the green sections of pipe between each local cluster shown on the diagram below are installed to connect the existing DH spine in each local cluster together. At this point the heat supply can be switched from the local cluster energy centres to the larger, more efficient district scheme heat supply. This approach does not necessarily require that each of the local schemes be constructed in sequence, so long as the diameter of the DH spine is in line with the eventual district scheme.

Figure 2-3: Mechanism by which local clusters can coalesce to form district clusters



In order to allow a district cluster to be supplied from a single district energy centre the diameter of the DH pipe that forms the central DH spine in the local clusters needs to be sized appropriately. For example, using the example illustrated above the diameter of the spine running through local cluster 1 needs to be sized to take the peak load of local cluster 2 and 3, whereas the spine in local cluster 2 only needs to accommodate the peak load of cluster 3. The diameter of the pipe that connects all three local clusters to the district energy centre needs therefore to be sized to accommodate the peak load of all three clusters.

Section 2.11 outlines the most likely energy centre locations for the three district schemes identified above. Identification of likely energy centre location has allowed PB to plan the likely 'direction of growth' for clusters, and to size the central spine through the local clusters that make up each district cluster, this is included in section 2.11.3.

2.5 Extended district schemes – including additional LBI housing

PB has examined the potential for extending the district schemes so that they can begin to supply LBI owned housing that is not already connected to a community heating network. These dwellings are currently supplied from individual domestic gas boilers; in order to supply them from the district schemes it is necessary to install district heating pipes that connect each dwelling to the network via a hydraulic interface unit that will supply heating and hot water in place of the existing gas boiler.

LBI has provided PB with the details of all LBI owned housing; PB has attempted to correlate this list with the location of LBI housing that has been provided as a GIS layer. It has not been possible to identify the location of all LBI owned housing because of differences in nomenclature between the two data sets. Where a match has not been found between the two data sets PB has excluded the LBI owned housing in question from their analysis.

PB has calculated the heat demand for LBI housing not already supplied from communal heating by calculating the average heating demand per dwelling using the following data set:

Figure 2-4: Calculation of per dwelling average LBI housing heat demand

Communally heated LBI estate	Average heating demand (kWh/yr)
Delhi Outram Estate	15965
Kings Square Estate	13935
Miranda Estate	17128
Spa Green Estate	17683
St Lukes Estate	16470
Stafford Cripps Estate	17628
Average	**16468**

The average heating demand per dwelling was then applied to the number of dwellings provided in the list of LBI owned housing. A combined heating and hot water load factor was applied to the annual demand for each housing estate in order to calculate the peak heating demand. This peak was then used to calculate the circle of influence for all estates that PB could match up with the GIS information provided.

PB has plotted the circle of influence for all LBI housing not already connected to communal heating schemes. PB has considered how these loads could be supplied from one of the three district schemes. Figure 2-5 uses the colour coding to indicate which district scheme each of the LBI housing estates could be supplied from. Where no coloured circle is indicated it is assumed that this housing would not be connected to a district scheme.

South district scheme =	Purple dashed circle
Central district scheme =	Dark blue dashed circle
North district scheme =	Scarlet dashed circle

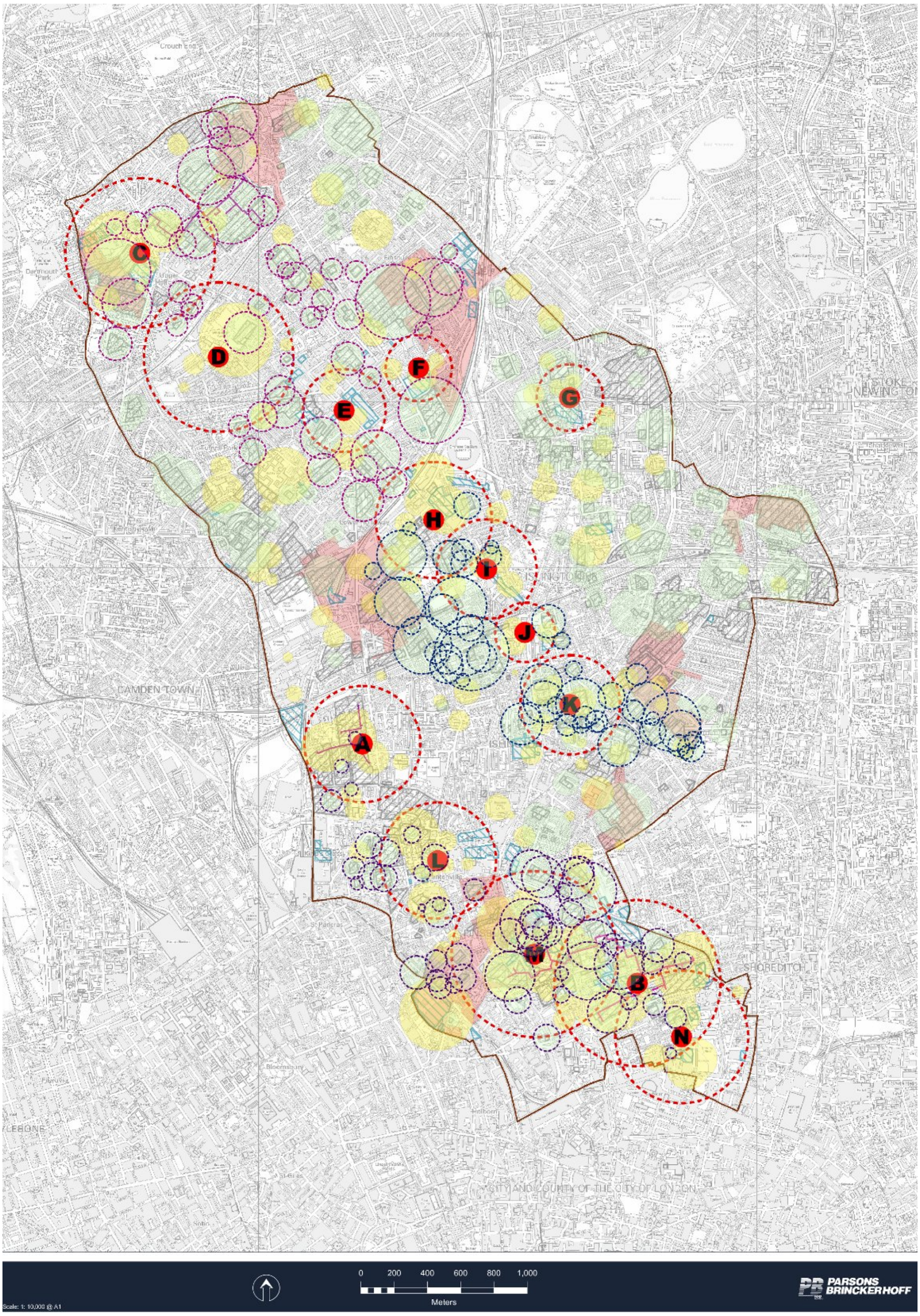
When considering which LBI estates could potentially be connected to the DE network PB has looked for groupings of LBI housing that would allow a logical/organic growth pattern originating from the district schemes. The LBI housing for the south scheme is primarily located around clusters M, B and N and represents a tight grouping of potential loads. The LBI housing in the vicinity of the central scheme is grouped into two moderately tight groupings around cluster K and J. The LBI housing around the northern district scheme is more spread out with the exception of the linear arrangement of housing to the east of cluster C.

The inclusion of the LBI housing represents a significant increase in heat load for each of the three district schemes as can be seen in the table below:

Scheme ref	Annual heat demand of district scheme (kWh)	Annual heat demand with LBI housing (kWh)
District scheme 1	88,192,810	174,258,166
District scheme 2	19,690,846	80,641,455
District scheme 3	47,957,999	164,441,018

When calculating the peak demand arising from the additional housing PB has calculated the peak demand based on an assumed hydraulic interface capacity multiplied by a diversity factor based upon the number of dwellings in each LBI estate.

Figure 2-5: location of LBI owned housing



2.6 Calculating the carbon reduction potential of DE

Islington's gas and electricity consumption figures for 2007 indicate that over 890,000 tonnes of CO_2 emissions are associated with gas and electricity for residential and industrial/commercial use.

Table 2-1: LBI fuel use and CO_2 emissions

	Electricity (MWh)	CO_2 (tonnes)	Gas (MWh)	CO_2 (tonnes)
Domestic consumption	323,238	136,406	1,181,738	226,894
Ind/Com consumption[1]	923,312	389,638	715,476	137,371
Total consumption	1,246,550	526,044	1,897,214	364,265

PB has undertaken a series of calculations to quantify the size of CHP unit that would be required to supply the local clusters and district schemes. The CHP size is based on the annual heating demand of each cluster and district scheme as outlined in sections 2.3 and 2.4. It is assumed that the CHP would operate in heat load following mode and therefore does not reject useful heat. This approach ensures that the operation of the CHP results in the greatest CO_2 reduction.

The CHP sizing calculation has used the following assumptions:

Figure 2-6: CHP operating assumptions

Variable	Input value
Full load equivalent operating hours a year	5000 hours
Maximum percentage of annual heat demand met by CHP	70%
Capacity of thermal store	5 hours of maximum CHP thermal output (kW)
Base case gas boiler efficiency	80%

The calculation uses the annual heat demand for the cluster, and assumes that 70% of this load can be met by the CHP, as per the assumption listed in the table above. This proportion of heat that can be supplied from the CHP, along with the number of annual operating hours is used to calculate a theoretical CHP thermal capacity. The most appropriate CHP capacity is chosen from a list of commercially available gas engine CHP units ranging from 70kW up to 16MW. The electrical and thermal efficiency of the selected CHP unit is then used to calculate the annual energy balance, from which the CO_2 emissions reductions are derived. It is assumed that any heat not supplied from the CHP is met from gas boilers.

2.7 CHP size to supply local clusters

The results below indicate the selected CHP capacity for each of the clusters along with the CO_2 saving that can be achieved over the base case heat supply. The percentage of heat actually supplied from the CHP unit is a function of the discrete CHP capacities that are commercially available; for clusters I and J the percentage is low because there is a mismatch between the theoretical CHP capacity selected by the model and the capacity of commercially available CHPs.

Table 2-2: First tier CHP capacity and CO_2 saving

Local cluster ref.	Annual heat demand (kWh)	Peak heat (kW)	CHP capacity elec (kW)	CHP capacity thermal (kW)	% of heat actually supplied from CHP	CO_2 saved tonnes/year
Cluster A	10,854,426	4,187	1,406	1,343	62%	2,140
Cluster B	31,074,088	10,037	4,029	3,914	63%	6,167
Cluster C	25,701,189	6,849	3,029	3,020	59%	4,722
Cluster D	16,960,045	7,201	1,600	1,792	53%	2,511
Cluster E	2,661,329	1,131	307	358	67%	417
Cluster F	2,635,437	896	307	358	68%	416
Cluster G	2,144,723	998	185	280	65%	281
Cluster H	9,245,409	3,958	1,150	1,195	65%	1,658
Cluster I	4,537,806	1,830	500	527	58%	614
Cluster J	1,120,398	665	70	104	46%	102
Cluster K	4,787,234	1,842	526	640	67%	750
Cluster L	9,068,060	3,849	1,150	1,195	66%	1,656
Cluster M	26,989,596	11,195	3,029	3,020	56%	4,740
Cluster N	10,206,641	4,830	1,406	1,343	66%	2,131
Total						28,305

The total CO_2 reduction that could theoretically be achieved if all local clusters were supplied from gas engine CHP is 28,305 tonnes per year.

2.8 CHP size to supply district schemes

Aggregating the heat demand from the local clusters to form the district clusters allows the use of larger, more efficient, gas engine CHP units. The selected CHP capacity for each of the three district schemes along with the potential CO_2 saving over the base case is displayed below. PB has calculated the saving that can be achieved from using larger engines instead of the smaller engines selected to supply the local clusters.

Table 2-3: District scheme CHP capacity and CO_2 reduction potential using gas engine CHP

Cluster	Annual heat demand (kWh)	Peak heat (kW)	CHP capacity elec (kW)	CHP capacity thermal (kW)	% of heat actually supplied from CHP	CO_2 saved tonnes/ year	additional saving over local clusters
South district scheme	88,192,810	37,297	15,743	14,911	70%	21,809	4,975
Central district scheme	19,690,846	9,158	2,430	2,399	67%	4,138	1,013
North district scheme	47,957,999	17,037	7,744	6,148	64%	9,513	1,522
total							7,510

It can be seen that for all three district clusters the aggregation of the local cluster heat loads results in a greater CO_2 reduction than can be achieved from supplying the individual local clusters. The saving seen here results not only from the greater efficiency of the larger engines but also from the greater proportion of the annual heat demand that can be met from CHP because of the increased diversity[1] of heat load that results from aggregating the local clusters.

2.9 Supplying district schemes from biomass CHP

PB has quantified the potential CO_2 reduction that could be realised if the district schemes were supplied from biomass CHP units, rather than from natural gas fired CHP. Biomass CHP units are less flexible than their gas engine counterparts because of the nature of biomass combustion. The biomass CHP technology is assumed to be organic Rankine cycle for smaller units and steam turbine for the larger machines. The ratio of heat production to electrical generation, referred herein as the heat-to-power ratio, is significantly higher for biomass CHP units compared to gas engine CHP, with some smaller biomass CHP units having heat-to-power ratios as high as 4.9. When biomass CHP systems are sized based upon the heat demand of a given district scheme this can lead to systems that have an electrical capacity that is too small to produce a meaningful CO_2 reduction as a result of the CHP process.

[1] The diversity of heating load refers to the likelihood of buildings requiring heat at the same time. A greater number of connected buildings will result in more regular heat demand profile that is easier to supply from CHP.

Table 2-4: District scheme CHP capacity and CO_2 reduction potential using biomass CHP

Cluster	Annual heat demand (kWh)	Peak heat (kW)	CHP capacity elec (kW)	CHP capacity thermal (kW)	% of heat actually supplied from CHP	CO_2 saved tonnes/ year	CO_2 Saving over local clusters (tonnes)
South district scheme	88,192,810	37,297	5,400	10,000	57%[2]	23,703	6,869
Central district scheme	19,690,846	9,158	625	2,810	70%	4,366	1,241
North district scheme	47,957,999	17,037	1,540	7,105	70%	10,542	2,550
Total							10,661

The table above illustrates that the CO_2 reduction potential for the biomass CHP units is greater than that which can be achieved using gas engine CHP for all three district clusters.

When considering the use of biomass CHP units to supply the three district schemes the following issues need to be considered:

i. Biomass CHP units require a significant amount of space for fuel storage as well as the plant itself, the scale of plant required to supply the district schemes will require a bespoke building that is likely to have a significant footprint

ii. the supply of wood fuel will require a significant number of vehicle movements to transport the fuel from source. This will result in elevated noise levels and potentially generate dust during delivery

iii. The combustion of wood fuel can result in increased particulate levels compared to gas engine CHP, as well as a notable vapour plume and aroma arising from the stack. The stringent emissions guidance from the Environment Agency is likely to represent a significant barrier to the deployment of biomass CHP units of the scale considered here in the borough.

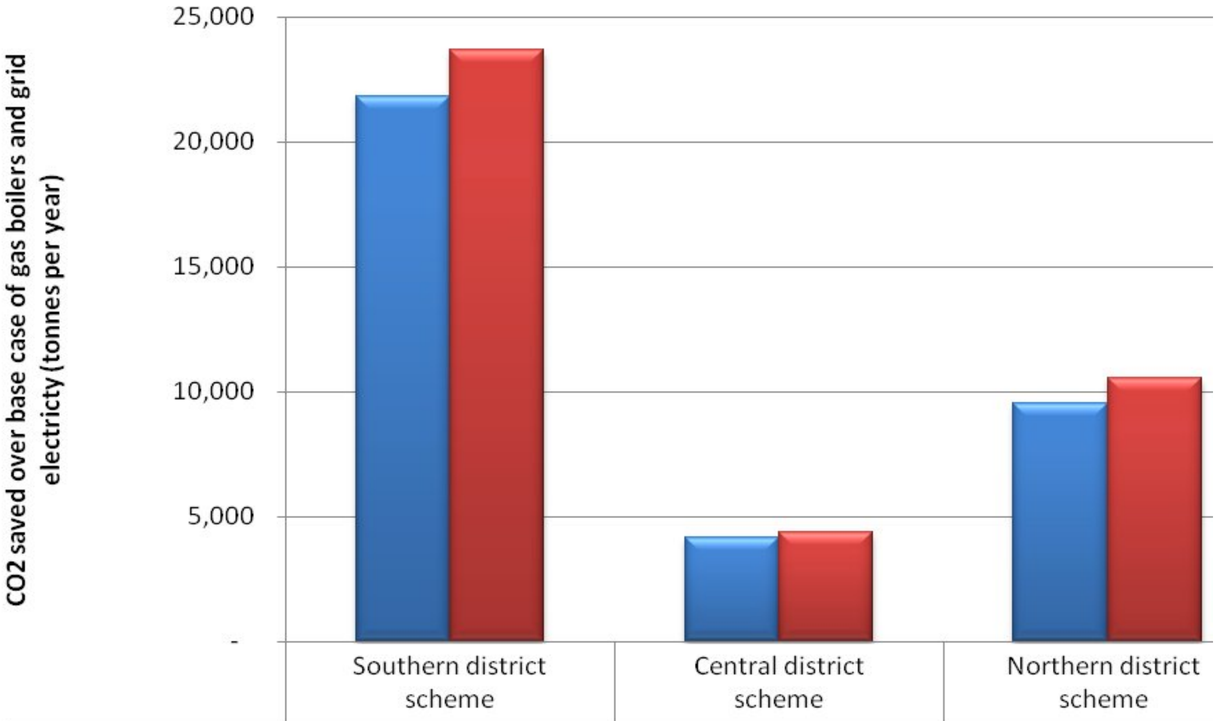
PB anticipates that there will be significant barriers to using biomass CHP to supply the three district schemes. In order to fully understand the impact of the above issues it would be necessary to undertake a detailed study to explore the feasibility of deploying biomass CHP in LBI.

The figure below illustrates the potential saving over the base case supply of gas boiler and grid electricity import that can be realised for the various decentralised energy options presented here. The CO_2 reduction over the base case is a result of the efficiency of the CHP process, the CO_2 content of the fuel and the amount of grid electricity that can be offset. It

[2] Whilst the target % of heat supplied form CHP is 70% it may not be possible to achieve this owing to the discrete size of biomass CHP units that is available. It is not considered economic to have more than one unit at this scale. The units for the central and northern scheme are marginally oversized, as a consequence they actually can supply ≥70% of the heat demand.

can be seen that although the biomass CHP has a very low carbon fuel source there is only a modest increase in CO_2 reduction compared to the gas engine CHP units. This is because the heat to power ratio of the biomass CHPs limits the quantity of electrical generation and therefore the amount of grid electricity that can be offset. The addition of the LBI housing results in a significant increase in CO_2 reduction primarily as a result of the significantly greater electrical generation that can be realised.

Figure 2-7: CO_2 saved over base case heating and electrical supply



	Southern district scheme	Central district scheme	Northern district scheme
Gas engine CHP	21,809	4,138	9,513
Biomass CHP solutions	23,703	4,366	10,542

2.10 CO_2 savings from extending district schemes to supply LBI housing

PB has examined the feasibility of extending the three district schemes to supply LBI owned housing that is currently supplied by individual gas boilers. The connection of these loads is significantly more problematic than connecting houses already supplied from communal boilers because it is necessary to install individual interfaces at each dwelling as well as installing pipes to connect each house/flat to the DH network.

PB has assumed that non-DH LBI housing would only be connected to a DH network once the more viable loads, for example housing already supplied from communal boilers and other public sector buildings, have been connected. The potential CO_2 reduction that can be achieved by supplying these loads from a decentralised energy scheme is quantified below:

There are two potential means by which the heat demand for the district schemes with the addition of LBI housing could be supplied, either from multiple large scale gas engine CHP or using heat supplied from a 3rd party district heating network. When modelling the supply of the district schemes with the addition of LBI owned housing a single value for CHP electrical and thermal efficiency has been assumed for all three district schemes because the magnitude of heat load for all three clusters is sufficiently high to warrant the use of the largest, most efficient gas engine CHP units available. The table below displays the capacity of CHP required to supply 70% of the annual heat demand assuming that more than one gas engine CHP unit would be required at this capacity.

Table 2-5: CO_2 reduction potential realised by supplying LBI housing

Cluster	Annual heat demand (kWh)	Peak heat (kW)	Required CHP capacity elec (kW)	Required CHP capacity thermal (kW)	CO_2 saved tonnes/year	Additional Saving over district schemes without LBI housing
South district scheme	174,258,166	78,234	24,396	25,757	43,092	21,283
Central district scheme	80,641,455	38,149	10,263	10,836	19,942	15,804
North district scheme	164,441,018	72,442	23,022	24,306	37,612	28,099

The table above illustrates that the scale of CHP unit required to supply the expanded district clusters is significantly larger than that required for the district clusters without LBI housing. This results in an improved efficiency for the central and northern clusters, whereas the southern cluster has already achieved the best efficiency possible using gas engine CHP.

The total potential saving in Table 2-4is 65,000 tonnes p.a. which represents 10% of the total CO_2 emissions for the Borough and a third of the CO_2 emissions associated with heating.

2.11 Potential locations for energy centres to supply clusters

2.11.1 Local clusters

It is anticipated that the CHP plant required to supply the local clusters would be housed in an energy centre located within or adjacent to the boundaries of the cluster. The scale of CHP plant that PB has selected to supply the local clusters is moderately compact, as such it is not necessary to identify specific energy centre locations. It is envisaged that energy centres could be free standing bespoke energy centres located in available open ground or incorporated within existing buildings or new developments.

2.11.2 District Clusters

When considering the supply of the district level clusters from an energy centre, the scale of the CHP plant is such that identifying potential sites becomes significantly more problematic. PB and LBI have undertaken a high level examination of the potential sites for district energy centres within the borough. The following sections provide a discussion of the pros and cons for each potential energy centre locations for the district schemes.

2.11.2.1 Southern district scheme

Citigen

The Citigen scheme, located close to Farringdon station, currently has an installed CHP capacity of roughly 15MW thermal and electrical. A second engine of the same capacity is also installed, however this engine is no longer operational, with no scope to make it so. The site although constrained has permission to supply a maximum of 90MWe to the gird, however the existing substation connection is believed to be sized to accommodate the original 30MWe installed capacity. The spare hydraulic capacity on the district heating network supplied from the Citigen CHP unit is 4.7MWth at the Barbican Exhibition Halls and 6MWth at Bunhill row.. The pros and cons of using the Citigen site listed below do not take the current site ownership into account, they merely address the technical aspects of the site.

Pros	Cons
Gas supply believed to be rated to supply more than the 30MWe of CHP capacity that was originally installed	Site is constrained, installing more than 30MWe is possible but would be complex
Planning permission allows for a maximum of 90MWe generation	The existing DH network supplied from Citigen only has a spare capacity of around 5MWth. It would be necessary to construct a new bespoke DH connection directly from Citigen to future proof supply to LBI more than 5MWth of heat supply
Designated generation station, adding more capacity would not require a new building	The site is on the south side of the Thames Link train line. It will be very difficult to get large diameter pipe across the tracks to Islington.

Metropolitan Kings Cross

The Kings Cross redevelopment will be supplied from an energy centre currently under construction on the site that will contain gas engine CHP and biomass boilers. Initial discussions between PB and Metropolitan (the ESCo) indicate that the Kings Cross energy centre will be able to supply in excess of the baseload heat demand of cluster A.

Pros	Cons
Close to Cluster A, results in low cost to connect to this supply	Limited potential to influence the plant capacity to be installed and the capacity is constrained by site allocated
Potentially heat available at low cost during	The mix of CHP, biomass boiler and gas

first phases of Kings Cross build out	boilers supplying heat from the energy centre will make it difficult to control the carbon content of heat supplied to LBI

Delhi Outram

The Homes for Islington (HFI) car park close to the Delhi-Outram estate has been proposed as the location for the Cluster A CHP. Subject to land availability it might be possible to install additional CHP capacity at this location in order to supply Cluster L in addition to Cluster A.

Pros	Cons
Close to loads	Residential area could impose restrictions on the noise and emissions produced from the CHP
LBI owned land	Site is not very large, it is anticipated that it could only accommodate around 3 to 4 MWe[3] of gas engine CHP capacity.
Would reduce the need to install large diameter pipes from Citigen to supply clusters A and L	

Gifford Street railway siding

The railway siding to the north of Gifford Street, located south of the Eurostar rail tunnel between York Way and Caledonian Road, is currently zoned for redevelopment with an industrial or warehousing land use.

Pros	Cons
Zoned for industrial usage	Uncertain about feasibility of utility connections sufficient for CHP
Existing noise and pollution issues from railway may screen CHP operation	
Close to clusters A and L	
Appears to be sufficient room to install large scale CHP capable of supplying district scale scheme.	
Has the potential to be used for a small scale biomass CHP scheme	

2.11.2.2 Central district scheme

It is possible that the Gifford Street site described above could be used to supply the central scheme, however it is not ideally situated for this scheme and could also be used to supply the southern scheme.

No other significant sites for a district scale energy centre were identified in the vicinity of the central scheme. If no suitable site for a district scale energy centre can be identified it may not be possible to connect the local clusters to form the central district scheme.

2.11.2.3 Northern district scheme

The redevelopment of Archway town centre provides the opportunity to incorporate an energy centre within the new development.

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[3] The peak heating demand for clusters A and L is 8MWth

Pros	Cons
Potential for bespoke energy centre	Development land is at a premium, pressure on scale of energy centre
Central to cluster C with potential to supply cluster D if sufficient space available	Potential restrictions on scale of CHP plant resulting from noise and air quality issues.
Close to LBI housing to the north-east of cluster C	Archway is a densely developed area, it may be difficult to install the infrastructure required to supply DE from this point.

No other significant sites for locating a district scale energy centre were identified in the northern scheme. If no suitable site for a district scale energy centre can be identified it may not be possible to connect the local clusters to form the northern district scheme.

It has not been possible to identify a potential location with sufficient space for biomass CHP plant that could supply any of the clusters in the northern scheme.

2.11.3 Indicative network design to link local clusters

PB has used the heating loads of the local clusters to provide an indication of the pipe diameters that will be required to form the DH spine for three district scale schemes. The calculation undertaken is intended to indicate the scale of the DH infrastructure required to form the district schemes and focus attention on the practicality of installing the pipes between local clusters along the DE expansion corridors identified. The calculation has used pressure drop limits to calculate the indicative DH pipe diameters; these have not been optimised against capital and operational expenditure and represent a conservative estimate of the pipe diameter that will be required. Detailed hydraulic modelling for each cluster would need to be undertaken once the loads to be connected are agreed following further development work.

Table 2-6: Indicative DH spine diameter for southern cluster (assuming all supply from Citigen)

From	To	Indicative DH pipe diameter
Citigen energy centre	Cluster N	400mm
Cluster N	Cluster B	400mm
Cluster B	Cluster M	300mm
Cluster M	Cluster L	225mm
Cluster L	Cluster A	175mm

Table 2-7: Indicative DH spine diameter for southern cluster excluding clusters A and L (assuming all supply from Citigen)

From	To	Indicative DH pipe diameter
Citigen energy centre	Cluster N	300mm
Cluster N	Cluster B	300mm
Cluster B	Cluster M	225mm

Table 2-8: Indicative DH spine diameter for clusters A and L from Delhi Outram estate

From	To	Indicative DH pipe diameter
Delhi Outram energy centre	Cluster A	200mm
Cluster A	Cluster L	150mm

Table 2-9: Indicative DH spine diameter for central cluster

From	To	Indicative DH pipe diameter
Cluster H	Cluster I	200mm
Cluster I	Cluster J	200mm
Cluster J	Cluster K	175mm

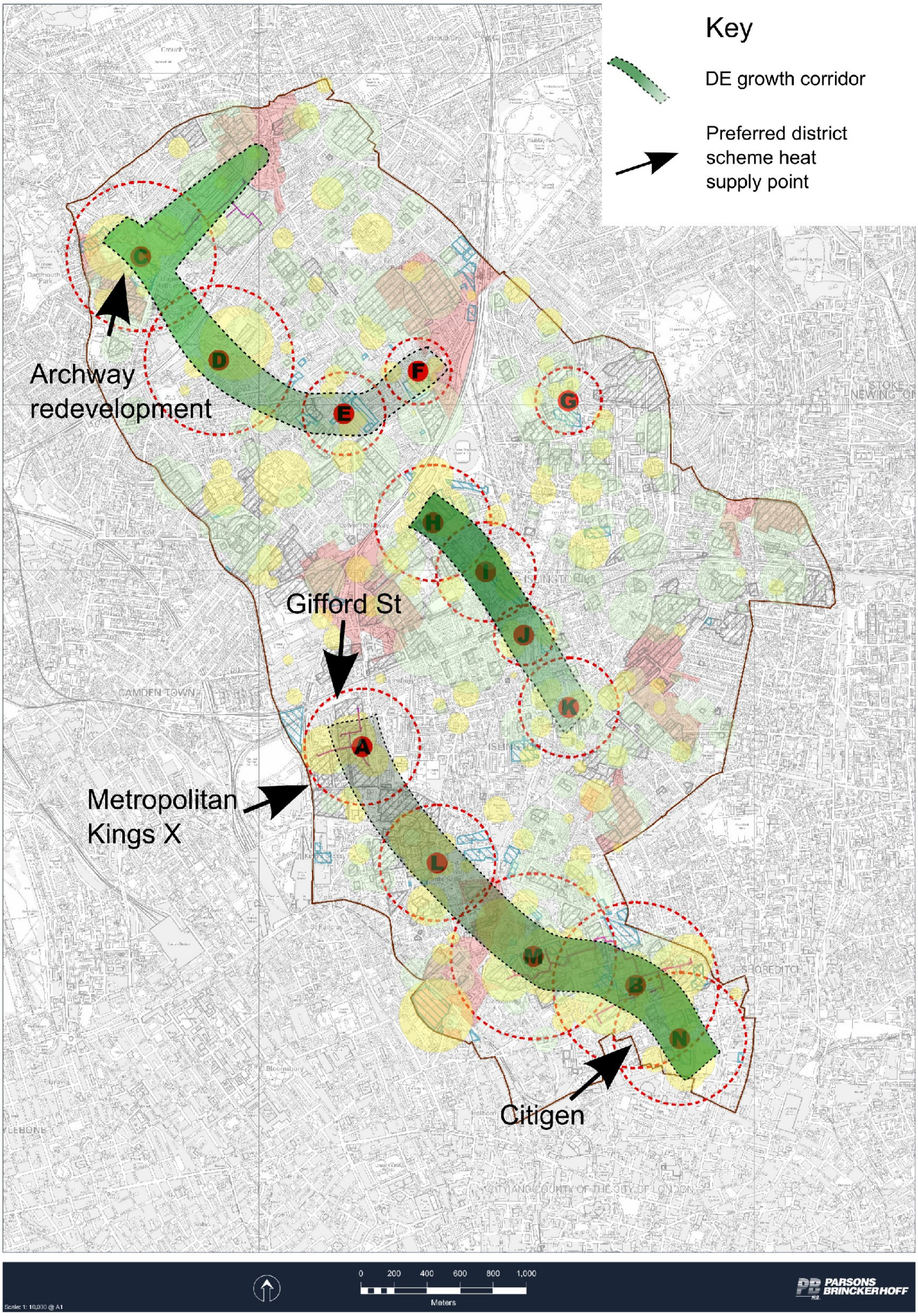
Table 2-10: Indicative DH spine diameter for northern cluster

From	To	Indicative DH pipe diameter
Archway energy centre	Cluster C	300mm
Cluster C	Cluster D	225mm
Cluster D	Cluster E	125mm
Cluster E	Cluster F	90mm

The DH route has not been fixed at this stage as, given the size of the DH spine required to form the district schemes, the routes would require detailed route surveys and buried infrastructure reviews to identify the route that will have the least impact on the already congested road network and the existing buried services. In some cases it may be necessary to construct tunnels for the DH pipes[4]. PB has identified the preferred growth corridors along which the DH route could be installed in Figure 2-8.

[4] The Corporation of London has recently commissioned a study on this subject

Figure 2-8: Preferred DE growth corridors and potential supply points for district schemes



2.12 Strategic considerations for delivery of DE in LBI

The following section identifies the issues that need to be considered in the short, medium and long term if decentralised energy clusters are to be delivered in line with the strategic framework presented in here.

2.12.1 Short term: 0 - 2 years

6) The decentralised strategic framework that is outlined in this document requires the design of the individual DE clusters to incorporate aspects of the long term strategy. The mechanism by which local clusters are amalgamated to form district schemes is predicated on the incorporation of an initially oversized DH spine that runs through each of the local clusters allowing interconnection at a later date to form district DE schemes. Islington is a highly populous area with a high density of utilities already buried in the congested road network. Installing DH pipe required for the spines that will form the district schemes is likely to be problematic and expensive in Islington's already congested streets.

7) Citigen has been identified by PB and the LDA as a strategic location for an energy centre to supply the southern DE scheme. In the short term however there is the opportunity to use spare capacity on the existing Citigen district heating network to supply cluster B. A decision regarding the preferred heat supply for cluster B needs to be taken as part of the detailed design process for cluster B (reference PB's report on Cluster B). If Citigen is not used to supply cluster B now it does not necessarily preclude the use of this heat source in the future.

8) The redevelopment of strategic sites in Islington offers the opportunity to develop DE networks using the new development as a catalyst. It is feasible that one or more of the energy centres required to supply the local clusters identified in this study could be located within the new developments included in LBI's five year development framework. . A discussion of the means by which planning can be used as a catalyst for the deployment of DE is included in section 3.1.

9) Supply of heat from the Kings Cross development to cluster A has the potential to reduce the capital and operational expenditure required for this scheme. LBI should seek to gain a position statement from Metropolitan that defines their official stance with respect to the capacity of heat supply and an indicative heat sales tariff structure.

10) The mechanism for funding further local DH clusters beyond cluster B, which has LDA funding, needs to be explored by LBI. The narrative included in section 3.2 can be used as a starting point for identifying potential funding sources.

2.12.1.1 Recommendations for short term delivery of strategy

4) PB strongly recommends that a detailed district heating constraints assessment is undertaken along the identified DE growth corridors. This assessment should identify all existing buried utilities and other potential physical barriers along the proposed corridor. This assessment will be used to identify the district heating route that would be the least disruptive.

5) PB would strongly advocate the inclusion of wording in the emerging LDF that requires new developments to demonstrate why they should not be the focal point for a new low carbon DH network that supplies both the new development and facilitates the decarbonisation of existing adjacent building stock. At the very least all new development in the vicinity of the local clusters identified in this strategy should be designed to be connected to a DE network

6) LBI should aim to secure a heat purchase agreement from Metropolitan if the heat sales price is less than the cost of generation using local CHP to supply cluster A.

2.12.2 Medium term: 2 - 5 years

3) The delivery and long term operation of DE in Islington could be facilitated by an energy services company (ESCO) of some kind. LBI needs to undertake further work to allow them to more fully understand the various ESCO models available and to identify their preferred model. The information contained in section 3.2 can be used by LBI as a starting point for identifying their preferred ESCO model.

4) The supply of low carbon heat from outside of the borough, possibly from Edmonton waste to energy plant via the Lea Valley, could be a mechanism of supplying the central and northern clusters as PB has not been able to identify a potential energy centre location for either of these district schemes, except the Archway redevelopment. LBI should investigate the feasibility of bringing low carbon heat via this route and keep a watching brief on DE developments (physical and policy) in the adjacent boroughs (Hackney, Enfield, Haringey and Waltham Forest).

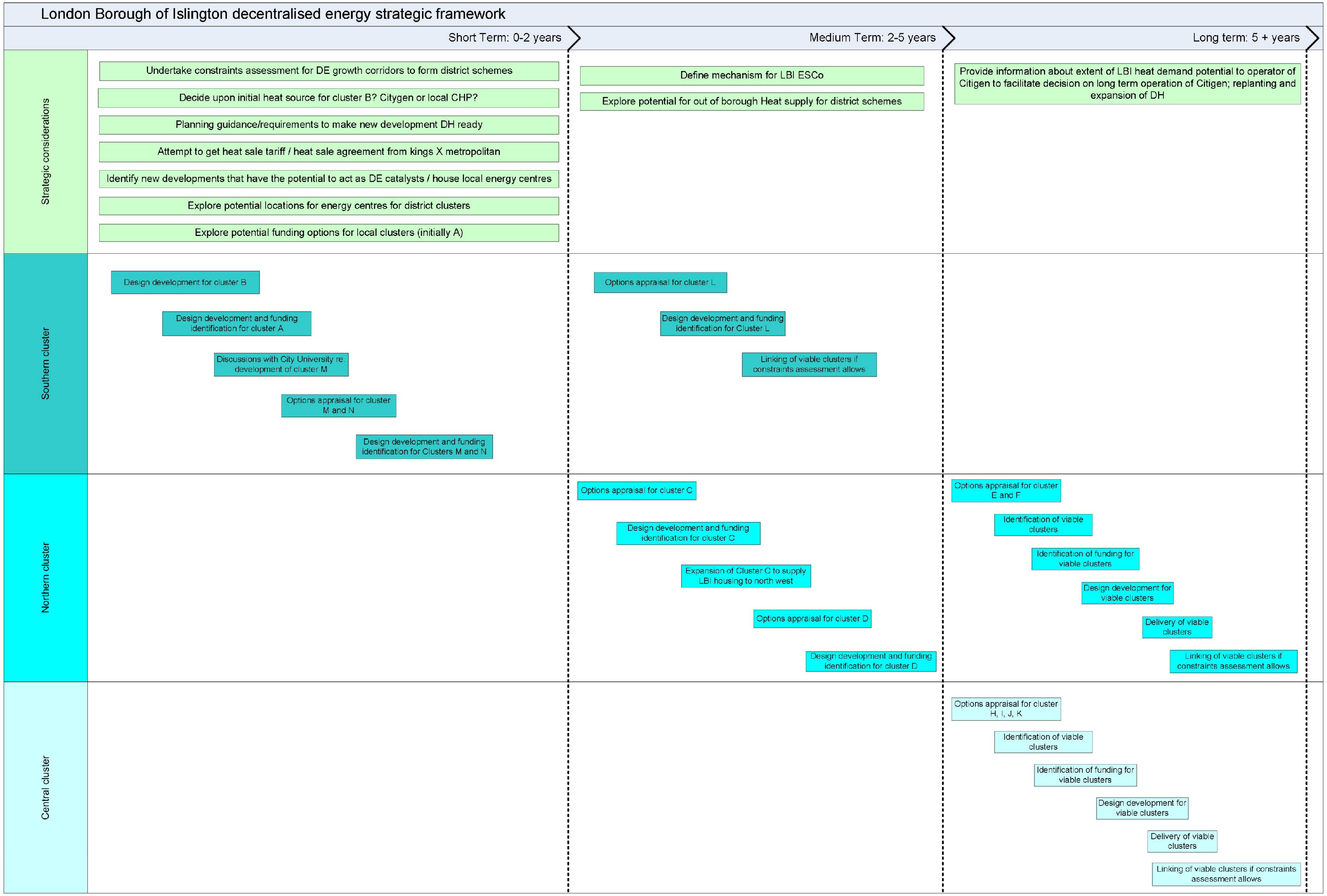
2.12.3 Long term: 5+ years

1) The Citigen site as a location for large scale DE plant is strategically important for the decarbonisation of buildings in south Islington and the north and west of the City of London. Though the development of the site itself is subject to considerable constraints, both physical and environmental; there is space available for additional generation plant and the necessary utility infrastructure connections and licences are in place. The future operation of the plant and its district heating network has been the subject of a detailed feasibility study which is under consideration by the plant owners E.ON UK. The key questions that need to be answered are a) what plant should be installed b) when should the facility be re-planted and c) how much heat can be transferred from Citigen to south Islington?

2.13 Proposed strategic framework for implementation of DE in LBI

The following figure provides a framework to aid LBI in the delivery of DE throughout the borough. This includes the key strategic considerations highlighted above as well as the means by which the three groupings of clusters can be developed over time. The figure is arranged with the strategic considerations at the top with district scheme specific items below. Thee considerations and actions included in the strategy have been grouped according to short term, medium term and long term goals and are arranged in a logical order of deployment.

Figure 2-9: Strategic framework for implementation of DE in LBI



3 Supporting Information

The following section provides information to support the strategic framework with respect to the following subject areas:

- Planning guidance
- Commercial arrangements
- District Heating technical compatibility
- Risk mitigation.

3.1 Planning guidance

3.1.1 Introduction

The opportunity to use the Local Development Framework as a driver for DE has been reviewed by PB. Megan Williams from PB met with Ruth Newton from LBI to review the LBI planning documents with specific reference to DE. PB have produced an overview of the existing LBI planning documents and have collaboratively produced guidance for input into the LDF that will facilitate the creation, expansion and retention of DE schemes within LBI.

This review also considered how new developments can act as a catalyst for DE deployment and the subsequent decarbonising of heat supply to existing stock.

3.1.2 Review of LBI planning documents

This section contains a review of the LBI planning documents that are currently adopted:

3.1.2.1 Adopted Islington Unitary Development Plan

Islington's Unitary Development Plan (UDP) was adopted in 2002 and sets out the detailed land use policies and proposals for development in the borough for a 15 year period up to 2017, as confirmed in subsequent communication with the Council's Planning Policy Department.

3.1.2.2 The London Plan

In the absence of relevant policy contained within the adopted UDP, Islington Council currently refer to Policy 4A.7 of The London Plan which applies The Mayor's Energy Strategy targets for the reduction of carbon dioxide (CO_2) emissions by 20 per cent. The Mayor's Energy Strategy also contains targets in relation to the installation of types of renewable energy schemes to increase London's generation of power and heat from renewable energy schemes up to 2020 which inform the London Plan. The Mayors energy hierarchy, covered by policies 4A.7, 4A.8 and 4A.9, is as follows:

- Use less energy – improve building and system efficiency

- Use renewable energy – increase supply of heat and power from renewable sources

- Supply energy more efficiently – explore the use of cogeneration and decentralised energy

3.1.2.3 Emerging Core Strategy

Islington's Core Strategy is part of a portfolio of documents which will form the emerging Local Development Framework (LDF). The LDF will replace the UDP as a consequence of the new planning system introduced by the Planning and Compulsory Purchase Act 2004. The Core Strategy seeks to address the development pressures and the need for environmental sustainability.

The first Core Strategy Islington Council prepared under the LDF was submitted to the Planning Inspectorate for examination in March 2007. Islington Council decided to withdraw it from the examination process in July 2007 following dialogue with the Inspector (this was not related to energy policy aspects).

A new Core Strategy document ("Core Strategy Direction of Travel 2009") has been prepared and sets out the plan for the borough up to 2025. The Core Strategy went to the Executive Meeting during the week ending 25 September 2009 and following an approval was out for consultation between October 26th and 7th December 2009. A final version will be considered by full Council and, if approved, is intended to be submitted to the Planning Inspectorate in March 2010.

3.1.2.4 Emerging Development Management policies and Site Allocations documents

A Development Management policies document will also be prepared under the LDF which will set out policies that will apply to new planning applications. The policies will contain more detail for facilitating the creation, expansion and retention of the decentralised energy schemes and meeting CO_2 emissions targets though sustainable design. Once prepared, a Site Allocations document will then identify development opportunities for specific locations within the borough.

The Development Management policies document is at a less advanced stage than that of the Core Strategy. Early issues and options consultation was carried out in July 2006. Following this, formal consultation will then inform the drafting of the Development Management policies document.

3.1.2.5 Supplementary Planning Document

A Supplementary Planning Document will also be prepared under the LDF and it is understood that this will contain more details about the approach and requirements to connect to decentralised energy facilities, s.106 agreements and the costs to connect, and the definition of 'proximity' when establishing developments which are considered to be close to an existing or planned development and could provide the means to connect to a decentralised energy network.

3.1.3 Guidance for input into the LDF that will facilitate the creation, expansion and retention of the decentralised energy schemes within LBI

The current version of the Core Strategy document prescribes the following policy on decentralised energy and CO_2 emissions, and seeks to minimise Islington's contribution to climate change:

Policy 10 Sustainable Design

The council will seek to minimise Islington's contribution to climate change and ensure that the borough develops in a way which respects environmental limits and improves quality of life. It will do this by:

A. Promoting zero carbon development by:

- *Requiring all development to demonstrate that it has minimised on-site carbon dioxide (CO_2) emissions by using less energy through maximising energy efficiency, supplying energy efficiently using low carbon heating and cooling systems and using on-site renewable energy generation.*

- *All development should achieve an on-site reduction in total CO_2 emissions of at least 40% against a Building Regulations 2006 compliant building, unless it can be demonstrated that such provision is not feasible. Development in areas where connection to a decentralised energy network is possible should achieve an on-site reduction in total CO_2 emissions of at least 50% against a Building Regulations 2006 compliant building, unless it can be demonstrated that such provision is not feasible. Further detail around these targets, including requirements for minor schemes, will be set out in the Development Management Policies.*

- *Working with partners to promote and develop decentralised energy (DE) networks, with a particular focus on areas of the borough with the greatest potential for such networks. Existing DE networks within the borough will be protected and their expansion supported. All development will be required to contribute to the development of DE networks, including by connecting to such networks where these exist within the proximity of the development. requiring development to offset all remaining CO_2 emissions associated with the building through a financial contribution towards measures which reduce CO_2 emissions from the existing building stock. This contribution would be made on the basis of an established price per tonne of CO_2 which would be based on the cost of reducing emissions from existing buildings, for example through retrofitting of energy efficiency measures. The proposed price per tonne and further details around implementation of the offset policy will be set out in the Sustainable Design Supplementary Planning Document (SPD).*

Section 3.2 of the proposed core strategy includes clear recommendations to facilitate CO_2 reduction through DE networks[5]:

3.2.5	*"The target for a reduction in total CO_2 emissions has been established following detailed technical feasibility and financial viability work, following the principle set out in the London Plan that all development will be expected to make the maximum contribution towards climate change mitigation. The CO_2 reduction policy aims to ensure all development minimises its CO_2 emissions, while ensuring flexibility which can take into account the context of each development – for example, its nature, size, location, accessibility and operation."*
3.2.6	*"The target has been defined as a total level of CO_2 reduction which includes energy efficiency measures, Combined Heat and Power or connection to a DE network and renewable energy. This approach has been developed in order to fit with government policy direction, including the draft definition of zero carbon. It will also provide increased flexibility for developers and should provide a greater incentive for enhanced energy efficiency standards and decentralised energy."*
3.2.9	*"In conjunction with a requirement for on-site CO2 reduction, the Core Strategy and other LDF documents will also strengthen the London Plan policies on heating, cooling and power, particularly to promote Combined Heat and Power (CHP) and Combined Cooling, Heat and Power (CCHP) and Decentralised Energy (DE) networks in the borough. While it is difficult to predict exactly where these networks will occur, significant opportunities exist in areas where networks are already established, as well as those which have high levels of existing heatload and/or are likely to experience significant amounts of new development. Figure 3.1 shows the location of the borough's principal existing DE network, Citigen, alongside the results of a mapping exercise of existing heat loads and the key development areas identified within the Core Strategy. These areas form the current priority areas for development and expansion of DE networks, although others are likely to arise over time, for example through emerging clusters of new developments or their co-location with large existing heat loads. More detailed policies to encourage DE networks, including a requirement on developments to support the development of heat networks, including through physical or financial contributions to future schemes, will be included within the Development Management Policies."*

PB is of the opinion that the borough is following an exemplar route towards delivering DE; it has not been possible to identify additional measures that could be implemented to further increase the potential for DE deployment in the borough. If adopted, the ongoing support and advocacy of these policies will be key to successfully creating, expanding and retaining decentralised energy schemes within Islington borough.

[5] Core_Strategy_Proposed_Submission_Document_Full_Version - 2009, page 63,

3.1.4 Using new development to catalyse DE deployment

The redevelopment of strategic sites in Islington offers the opportunity to develop DE networks using the new development as a catalyst. It is feasible that one or more of the energy centres required to supply the local clusters identified in this study could be located within the new developments included in LBI's five year development framework. Whilst new developments constitute a very small proportion of the total energy demands of existing buildings in LBI, nevertheless they are considered to be strategically important because they not only have to the potential to house an energy centre, but it is easier to supply a new building from a DE network than it is to retro-fit existing buildings. This section discusses the drivers for developers to consider D as well as the potential barriers to installing DE in new development.

The options available for developers to achieve compliance with level 4 to 6 of the Code for Sustainable Homes (CfSH) are limited in urban developments. To achieve code level 6 it is necessary to generate sufficient low carbon electricity on site through allowable solutions to offset emissions arising from the use of non-regulated appliances.. The means by which this electricity can be generated in sufficient quantities in an urban environment are essentially limited to biomass combustion[6]. The nature of solid biomass CHP units results in an imbalance between the heat and power ratio of the CHP and the heat and power requirements of new developments. If biomass CHP units are sized according to the heat demand of the development the electrical capacity of the CHP unit is highly likely to be lower than is required to generate sufficient low carbon electricity to achieve CfSH level 6. However the latest indication from the green building council is that a 70% reduction on 2006 regulated emissions plus allowable solutions could be implemented in place of a wholly on-site solution level 6. If this were the case it may be possible to deliver sufficient CO_2 reduction using DE, with the shortfall met using carbon offset mechanisms.

One option that is available to developers is to supply heat to existing buildings, outside the red-line boundary of the development, therefore creating a combined heat and power demand that is better matched to the heat to power ratio of biomass CHPs. In order to supply the existing buildings from an energy centre in the new development it is necessary to construct a district heating network that connects sufficient additional off-site heat load to the CHP. If the only means by which the development in question can achieve CfSH compliance is to supply existing buildings then this could be viewed as 'the cost of compliance'.

LBI is very proactive in seeking to change the mindset of developers and already encourage sustainable energy principles to be incorporated into proposed schemes, in advance of the adopted Core Strategy and Development Management policies. LBI holds a committed view on promoting new development to act as a catalyst for the deployment of decentralised energy by an ESCO.

[6] Other means of generating low or zero carbon electricity, for example, solar PV, micro wind or biomass gasification are either considered to produce insufficient electricity to be effective or to have too great a technological risk attached. It is possible to generate electricity in energy from waste plant, however PB does not consider this technology suitable for LBI given the high population density and lack of available space.

In the meantime, the Greater London Authority has provided Islington Council with a draft clause for s.106 agreements which has been included in two agreements to date, requiring the proposed schemes to connect to DE networks should they be established in the area prior to the development being built.

3.1.5 References

Greater London Authority, 'Green light to clean power – The Mayor's Energy Strategy', 2004

Greater London Authority, 'The London Plan (consolidated with alterations since 2004)', Feb 2008

London Borough of Islington, 'Islington's Unitary Development Plan', 2002

London Borough of Islington, 'Core Strategy Proposed Submission', 2009.

3.2 Commercial arrangements

The success of any strategy to develop a Borough-wide district energy system will depend critically on the availability of:

1 – Funding

2– An agreed commercial framework

3 – Commercial and regulatory drivers for connections

4 – An acceptable risk profile for investment

5 – Suitably qualified technical resources

In addition to the above the following issues; political commitment, support from stakeholders, successful communications programme to gain widespread support for the scheme. This section of the report considers the structures, approaches and funding sources that are available, discusses the advantages and disadvantages of these, using case studies to illustrate these, and suggests likely preferred route for LBI in delivering their long term objectives.

3.2.1 Background

Historically the development of district heating in the UK has been, with some significant but isolated exceptions (see below) relatively small scale, developed by local authorities to serve social housing, funded from public finances and often not maintained or developed in a commercially sustainable way. More recently there has been a move to develop schemes in partnership with the private sector and specifically towards the creating of Energy Service Companies (ESCOs). This move has been primarily due to the lack of public funding for infrastructure projects but has also been driven by the acceptance that systems need to be managed and maintained in a commercially viable manner and that this requires a range of technical and commercial skills which are not always available in the public sector.

Therefore the process of investigating potential business models for district heating based ESCo's and energy services schemes starts with an acknowledgement that, until recently, there were no private sector companies capable of delivering large scale DH projects connecting existing buildings without specific local authority sponsorship. Whilst this is now a growing market, albeit slowly, the potential is such that the opportunities to develop such projects are substantial. A decentralised energy approach provides the opportunities for energy cost and carbon emission reduction under which developers responsible for large new-build projects may build flexible energy systems for the future. The development of such schemes can also act as a catalyst for the decarbonisation of existing buildings in the surrounding area.

There are two examples of city DH schemes that have successfully developed beyond the “estate project” scale and have delivered significant private sector commercial connections, of new and existing development, in Sheffield and Southampton. Both of these are now wholly private sector owned but were originally developed with significant support from the local authority, both in terms of access to funding and in provision of base load, long term connection agreements.

The development of the private sector ESCo market reflects the requirement from planning authorities that energy generation and supply to buildings be considered with the aim of minimising carbon footprint of buildings overall. This has created a market of developers who are seeking to contract out their commitments under planning permissions. The planning process is likely to remain a key driver in the short-term but there are also more strategic approaches being developed towards the use of district heating, particularly via the LDA in London, but also in other major cities such as Leicester, Coventry and Newcastle. Birmingham in particular is partnering with a private sector firm to develop schemes in the city with a view to developing a city-wide district energy. Two schemes are currently operational, both of which centre around public sector core loads.

3.2.2 The LBI Objective

The current detailed studies on Cluster A and Cluster B are seen as being the starting point for development of a Borough-wide district energy scheme which has the objective of providing secure, low cost, low carbon energy to residents and businesses in the borough. The strategy for the development of this Borough-wide approach needs to consider both the immediate and the long term needs of such an approach, including the potential impact of decisions made in development of the early clusters.

3.2.3 Potential Approaches

There is a range of potential approaches to the general development of district energy schemes under sponsorship by the public sector, which are summarised in the table on the following page. It should be noted that this list is not exhaustive of all the potential commercial arrangements possible for public-private partnerships but it does cover the main types of scheme development that have been undertaken to date. It should also be noted that there is no restriction to using different forms of organisation during different phases of the project life. For example the ownership of the Sheffield scheme was originally a mix of public and private but the local authority disposed of its share once the scheme was developed and could be re-financed. This is a good example of a local authority taking some risk early in a project to reduce the costs of finance and then disposing of its interest once these risks have fallen away.

Description	Funding	Construction	Ownership	O&M	Examples
Public Sector - traditional	LBI funds Grant funding Over public funds	Public procurement of construction contracts by LBI	LBI direct	LBI internal or public procurement of O&M contract	LB Southwark New Place Estate, Lerwick
Public sector – arms length organisation	LBI funds Grant funding Over public funds ALMO Borrowing	Public procurement of construction contracts by ALMO	ALMO	ALMO direct or public procurement of O&M contract	Pimlico District Heating Undertaking, Aberdeen Heat and Power
Public Private Partnership – JV company	Part as Public Sector plus private sector equity plus private sector debt	Public/private sector procurement of construction contracts (depends on JV structure and partner capabilities	JV Co Ltd	JV Co direct or Public/private sector procurement of O&M contracts (depends on JV structure and partner capabilities	Thameswey Woking, initial Sheffield scheme, BirminghamCC/Utilicom
PPP – split responsibilities (eg energy supply private – infrastructure public sector)	Part as public sector plus private sector equity plus private sector debt	Split public/private procurement with interface management	Split public/private	Split public/private procurement of O&M services. Public O&M potentially packaged with private sector partner	Nottingham
Private sector – direct ES contract	Private sector debt/equity Grant funding – limited availability Supported by contract for services	Public procurement for ES Service – fixed scope Private sector construction contracts	Private sector – possible future reversion to public after defined period	Private sector	SSE Woolwich, EOn Dalston Square
Private sector – concession	Private sector debt/equity Grant funding – limited availability Supported by concession	Public procurement for concession – fixed area/service variable scope (likely base case fixed scope required). Private sector construction contracts	Private sector – possible future reversion to public after defined period	Private sector	Olympic Park/Stratford City
Private sector speculative	Private sector debt/equity Grant funding – limited availability	Private sector	Private sector	Private sector	Southampton

The options given in the table above have varying advantages and disadvantages which generally fall under the following headings:

1) Cost of funding

2) Risk versus control

3) Regulations and licensing

4) Availability of resources/skills

3.2.3.1 Cost of Funding

The cost of funding is critical for DH projects as the cost of infrastructure is generally high and the life of the system long. This has been recognised by central Government and also by development agencies like the LDA who have set up, or are setting up, a number of funding arrangements including grant funding and low cost loans for low carbon infrastructure projects. There has historically been a mismatch between the nature of returns for these projects and the needs of private sector finance. Due to the lack of regulatory structure and high costs of market entry DH projects are treated individually (i.e. project financed) and the costs of private sector funds is driven by competition with other generally faster return projects rather than as a low risk long term investment.

Generally the public sector has better access to grant funding and funding from other public sector organisations at lower cost than the private sector. The private sector generally has access to more funding from the debt markets albeit that this is now less easy to obtain and available at a higher rate than has previously been the case. The private sector generally has a shorter timeframe for economic analysis and a stronger focus on pure financial returns than the public sector, which are often able to take account of the value of other potential returns such as environmental and social improvements.

Specific funding schemes are discussed in more detail in Appendix B

3.2.3.2 Risk versus Control

Public sector organisations are generally risk averse and there has historically been a tension between the desire from local authorities, and others, to move all risk to the private sector and the desire to retain control over the development of potentially high profile and high impact projects. If there is a full transfer of risk to one party then that party will, naturally, require full control over management of the risks and will be unwilling to allow outside influence on the operation and development of a project.

The transfer of risk also has implications for the costs of funding and a realistic approach to risk needs to be adopted to give a project a chance of proceeding. The principle by which an ESCo should operate in terms of dealing with risk is the same as any other business operation – allocate the risks to the party most familiar with the specific risk and by implication most able to deal with it easily as a result of their normal operational practices and structures. The means by which risk is dealt with – transfer, distribution, mitigation and tolerance – reflects the aim to reduce the possibility of occurrence and impact as far as is practically possible, thereby minimising obstacles to the long-term financial stability of the organisation ultimately responsible for the projects.

Responsibility for risk has important implications financially for the partners engaged in the development of the ESCo – where risk is allocated within a partnership determines where the financial benefits are distributed. Capital and operational risks will have a proportion of finance or a share of profits associated with them – this is where careful consideration of the objectives of the ESCo from the point of view of LBI should take place. PB facilitated a risk workshop to capture and mitigate the political, technical and financial risks associated with delivering decentralised energy in LBI.

3.2.3.3 Regulations and Licensing

The heat market in the UK is unregulated at present. There are proposals being developed for various types of regulation both at a national and at a London level. This lack of specific regulation may act as both a help and a hindrance to the development of DE. Whilst the lack of regulation provides commercial freedom to develop schemes as required by local circumstances, schemes are generally caught by a range of different regulations related to issues such as town planning, carrying out streetworks and environmental compliance without a national framework for how these will be applied. This can mean a significant amount of work being required to mutually agree the way in which regulations will be applied to this type of scheme and restrictions on ability to access equipment which can create difficulties throughout the project life.

Local authorities can help to get over some of these issues in a number of ways. Firstly it is understood that local authorities have powers to install heat mains in their borough under the Local Government (Miscellaneous Provisions) Act 1976 see Appendix A. PB are not in a position to state that these powers are still in place and this would need to be verified by LBI's legal advisors but if they are then there may be a strong argument for the local authority to have notional control over this element of a project thus minimising the need for planning permissions and Roads and Streetworks Act licenses. In addition the local authority can add value by providing a coordination role for their various departments that will have an input to control of such a scheme, such as Highways, Environmental Health and Planning.

A further issue that will need to be addressed is the extent to which the LA can authorise/empower a private sector partner to deliver DH schemes across the Borough. Careful thought, and legal advice, will be required to ensure that the LA has the necessary powers to, for example, let a concession for delivery of DH schemes Borough-wide or to require/encourage others to connect to such schemes. Any procurement process for this type of arrangement will have to be carefully thought through. There is likely to be a mix of powers available through the planning policy frameworks and other more general powers may be applicable. The potential risks perceived by the private sector in this regard should not be underestimated; private companies will be unwilling to commit significant resources or funds to a process which they are not confident can be completed. In addition the value that can be placed on commitments by the local authority to require connection to new developments will depend critically on the robustness of these commitments as well as the perceived development risk. For large sites the London plan provides some significant support to the robustness of LBI requirements to connect to an existing scheme but care always needs to be given to the wording of potential opt outs. Developers have become adept at finding routes to avoid such commitments where ".. Unless financially or technically unfeasible ." type caveats are included. Such caveats need to have rigorous policing and preferably to set specific standards by which this can be tested to avoid unfounded claims of lack of feasibility.

3.2.3.4 Availability of Resources and Skills

No matter which approach LBI finally chooses to take they will wish to ensure that the delivery of schemes is achieved safely, to programme and to a quality specification. Achievement of this requires the use of high quality resources, with sufficient experience of delivery of this type of schemes. The way in which LBI can ensure adequate resources are available, and engaged on their projects, will vary depending on the final route selected. What must be noted is that, even where an organisation has an excellent track record in project delivery, the specific personnel who will be in key positions will have a significant impact on actual project outcomes. Which ever approach is taken LBI will need to ensure that they have the ability to monitor progress and quality – the self-interest of a concessionaire will not necessarily make up for lack of experience of key people and LBI will always retain some reputation risk whatever the structure adopted for delivery.

3.2.3.5 Funding Available

PB has undertaken a review of available grant and low cost finance funding streams for DH schemes, a full list of those programmes and a brief description of each is provided in Appendix B

Much of the funding on offer comes ultimately from the Environmental Transformation Fund. This was a £400 million settlement from the 2008/9 budget. Many of the schemes do not state intentions beyond 2010/11. The government now sets budgets in three year blocks and the future of many schemes will depend upon the new budget settlement for the period 2011/12 to 2014/15 and is likely to be decided by a different administration.

Applications for many schemes in 2009 and some for 2010 have now closed and there is generally no indication as to the level of funding that may be available under any programme going forward.

Joint European Support for Sustainable Investment in City Areas (JESSICA) is a relatively new scheme that has been developed in partnership between the European Commission (EC) and the European Investment Bank (EIB). LDA have been in the lead in developing routes and mechanisms for bringing this source of funding to bear on projects which could include renewable and cogenerated de-centralised energy (for example Barking Power Station and Royal Albert Basin), waste infrastructure (energy from waste technologies such as anaerobic digestion, gasification or pyrolysis technologies and waste processing and reprocessing plants).

It is understood that these funds will be made available to PPP projects via one of two Urban Development Funds (UDF) – one for decentralised energy and the other for waste projects. UDFs are defined as funds which invest - in the form of equity, loan or guarantee – into projects or public-private partnerships.

The currently understood timetable going forward is “(i) to obtain the necessary approvals to enable the funding agreement to be concluded by the end July 2009 and (ii) formally establish the fund (by paying in ERDF and LWaRB contributions and committing the Portfolio) by August/September 2009.

This would allow the relevant structures to be put in place in order for investments in projects to commence by mid-2010. "[7]

The CESP programme, administered by Department for Communities and Local Government, is a pilot programme obligating energy suppliers. There has been some interest shown in the Islington schemes by suppliers, this interest may become more concrete if the scheme progresses from pilot stage to full implementation.

3.2.3.6 Operation of Schemes

The requirement for skilled and experienced resources is not restricted to scheme development. There has been a history of scheme performance deteriorating over time in the UK due to inadequate training and supervision of operations and maintenance. There has also been a tendency towards short-term thinking in relation to maintenance, particularly of CHP units but also of DH assets. Finally whilst short-term contracting for maintenance is undesirable there are also pitfalls in long term arrangements particularly in ensuring performance is incentivised appropriately over the life of the contract, and in dealing with indexation for cost increases over time.

Arrangements will ideally be:

- long term - preferably matched to the expected life of the asset and with provisions for handback of plant at the end of the term in a suitable condition for ongoing operation for at least 12-24 months

- simple - avoiding trying to address all possibilities for the future now but with straightforward management procedures which allow each party appropriate control over changes requested by the other

- flexible - able to adapt straight forwardly to changing market conditions preferably via defined negotiation and modelling processes

- with sufficient provision for oversight and reporting that the asset owners and end users of the system can be assured they are getting good value over time.

3.2.4 Example Schemes

In this section we discuss how some example existing and proposed schemes have been developed to highlight how the key issues already discussed have been dealt with and the extent to which this is applicable to the LBI proposal.

3.2.4.1 The Warren, Woolwich, SE London – Scottish and Southern Energy

This project is an example of a single developer site – The Warren is part of the redevelopment of the former Woolwich Arsenal site in South East London. The Warren, which was developed by house

[7] Extract from LDA Board Report No: Public Item 2.3 for Meeting dated 20th May 2009 by Sarah Ebanja, Deputy Chief Executive and Group Director Jobs, Skills & Youth

builder Berkeley Homes, is a development of approximately 200 apartments with related retail and leisure facilities. Berkeley Homes selected Scottish and Southern Energy (SSE) as their preferred ESCo to provide energy services to the site as part of a competitive tender process.

The SSE ESCo provides a community heating utility service to each apartment. Energy supply to the networks is provided by a gas engine CHP, gas boilers and a connection to the local electricity distribution network. The capital for the development is provided by SSE with the basic recovery for the investment from bills to the residents. A contribution was required from the developer to allow SSE to achieve their required return on the investment. This approach is equivalent to the connection charge normally levied by a utility for connection of a development site. In this case SSE also provided gas and electrical connections to the site for Berkley Homes thus reducing risk for the developer.

SSE was responsible for design, procurement and installation of the utility connections, CHP plant, electrical and heat distribution and individual dwelling hydraulic interface units. SSE provides ongoing operation and maintenance services for the plant and equipment and billing and customer services for the residents.

3.2.4.2 Kings Cross – Metropolitan

The project is being undertaken by the property developer, Argent St George, on a large site in central London, in between the Kings Cross and St Pancras mainline railway stations. It comprises development of over 2,000 residential units and over 600,000m^2 of commercial space (retail, office, hotels, leisure) over a period of around 10 years.

The business structure most closely reflects that of a joint venture whereby the developer went through a competitive bidding process to identify their preferred partner in delivery of the energy infrastructure. The partnership established with Metropolitan, an infrastructure services and management company, involves sharing the burden of capital investment in the energy centre and the buried infrastructure.

The partnership has commissioned engineering contractors to design and construct the energy centre and the heat networks. On completion, the partnership will purchase the energy assets from the contractors and operate them as an ESCo operation. Argent and Metropolitan will charge tenants for connection to the buildings located on the site and Metropolitan, who will take ownership of the buried infrastructure, will charge rents for use of the network systems. The energy centre assets will be taken over by Argent, who is likely to commission a managing party to supervise operations over a contracted term, likely to be at least ten years, with economic performance assessed against Key Performance Indicators. These Key Performance Indicators will incentivise the delivery of services on a value-for-money basis.

This structure reflects a relatively cash positive business model for infrastructure projects whereby there is a financial commitment by tenants at the outset of occupancy and then an ongoing recovery of investment over the project lifetime.

3.2.4.3 Olympic Park - Cofely

The Olympic Delivery Authority and Stratford City Development Limited decided to cooperate in the provision of utilities and low carbon energy to their adjacent sites at Stratford in east London. They undertook a joint procurement to select a Concessionaire for the supply of heating and cooling services to the two developments. Cofely East London Energy Limited (a subsidiary of Gaz de France Suez) was selected and is currently constructing two energy centres, one at Kings Yard and the other in Stratford City, and more than 20 km of heating and cooling distribution mains.

The energy centres will contain combined cooling heating and power plants (CCHP) comprising gas fired CHP, biomass boilers, absorption chillers, gas/oil boilers and electric chillers. Cofely provide all the investment for the system and will own and operate it for a period of 40 years from full operation. Heating and cooling is sold in bulk to commercial users and residential blocks via metered block heat exchange substations, with an option for developers to request Cofely that install and manage the internal systems up to individual HIU's. Electricity generated is sold to a licensed supplier via the DNO connection.

Cofely has exclusive rights to supply heat and cooling within the concession area and a standard tariff and connection agreement has been agreed as part of the appointment process. The agreements set up a local regulatory structure for the concession area, including standards of service and price variation controls, such that Cofely will act as a pseudo utility within the area. The tariff allows for a fee at connection to be collected from an individual developer, based on the connection capacity (kW) or residential area, along with annual availability charges and metered energy charges to be collected from building owners or management companies. Cofely is also able to compete for supply connections outside the concession area on a commercial basis.

This structure allows flexibility for this extensive development area, where the final masterplan development is not yet known and there will be multiple individual development plot areas, whilst guaranteeing a set of environmental targets, set by planning, can be met.

3.2.4.4 Birmingham District Energy Company

Birmingham City Council identified two potential schemes for district energy in Birmingham in 2003. These were the Broad Street scheme, which would supply the International Conference Centre, National Indoor Arena, a hotel and various BCC buildings, and the Eastside scheme centred around Aston University, Birmingham Children's Hospital (BCH) and other BCC buildings. BCC selected Utilicom as their partners to develop these schemes in 2006.

The Birmingham District Energy Company (BDEC) is wholly owned by Utilicom and currently operates the two originally identified schemes. There are several proposals for further expansion of these schemes but it is not clear that this has been done as yet.

The Broad Street Scheme obtained Community Energy Programme funding and was the first scheme completed in October 2007. The Eastside scheme is being developed in two phases centred around energy centres in Birmingham Children's Hospital and Aston University respectively. The CHP plant for Aston, installed in July 2009, was fully funded by Utilicom and will shortly be operational. The BCH scheme was signed up earlier this year and is applying for funding from the Department of Health. It is not currently clear whether these two phases are interconnected immediately but the future intention to interconnect with the Broad Street scheme is clear. Each scheme has been developed by BDEC under a separate 25 year Energy Services Agreement. The development of the scheme is being supported significantly by the BCC Urban Design team and is championed by Councillor Paul Tilsley.

3.2.4.5 Applicability to LBI

The Woolwich and Kings Cross are examples of how private sector property development companies have addressed the conditions put on them by planning requirements. Whilst either of these options is available to LBI the commercial structures have been focussed around single schemes which are subject to little change, the main difference between the two being project scale and the length of the development programmes.

The Olympic Park and Birmingham city centre schemes reflect different approaches public sector bodies have taken to uncertain development over an extended period in a given area.

At the Olympic Park and Stratford City the approach is to allow a very long term concession with the public sector effectively taking the role of regulator in applying the requirements of the Concession Agreement and policing performance and application of the connection arrangements including indexation of the charges over time. There is no public sector direct funding although the public sector is providing the initial loads and funding the associated connection agreements on the Olympic Park. This model is possible because of the massive scale of the development in the area of London over a relatively short period of time – this means that development risk is limited to the future new build over that already identified and the initial build is sufficient to support the required financing. Issues related to licensing for pipe work planning etc are dealt with by specific land use agreements and area wide planning for new utilities for the initial build-out. In future the Concessionaire will have to negotiate its own arrangements. In terms of future control the Concessionaire has very broad flexibility to develop the scheme as it wishes within a defined framework which requires supply to be provided within a defined area and requires carbon emission reductions to be delivered. The Concessionaire can develop outside the defined boundary but at their discretion.

In Birmingham the city council is effectively promoting the scheme, both politically and practically, and allowing the private sector organisation to agree separate energy services agreements with potential hosts. The funding for the schemes is relatively standard in that the private sector element is supported by a 25 year energy services agreement. In two of the three cases there is direct public sector funding involved – via CEP grant and DoH funding at Broad Street and BCH respectively. In the case of Aston University the finance for the scheme is supported by the long term energy services agreement only. The networks here are relatively small and in most cases much of the route is across land owned by the partners – it is not known if specific network enablement arrangements have been put in place for future expansion.

3.2.5 Conclusions and Recommendations

There are several common factors in successful schemes which develop beyond their initial scope:

1) Strong public sector involvement in promoting and sponsoring the scheme

2) Maximising access to public funding, particularly in the early development stages

3) A clear risk allocation structure which only transfers those risks that can be properly managed

4) Use of experienced and competent resources

5) A recognition of the commercial drivers and limitations of the private sector partners

6) Clear and standard arrangements for ongoing connections and charging

7) Ongoing public sector monitoring and involvement – potentially as regulator of the service or operator of last resort

The main options that LBI could adopt in relation to the two early schemes (Cluster A and Cluster B) are:

1) To build the schemes under LBI control and then contract with the private sector for O&M

2) To build the schemes under LBI control and then transfer to private sector or a joint public/private ESCo later

3) To develop the schemes to the point where the main technical and commercial arrangements are in place in parallel with a procurement exercise to appoint the developer/long term partner and then this partner takes the project forward.

4) Procure the schemes via the private sector partner having undertaken only minimal development of the projects

The future partnership with the private sector could take any of the forms identified above and the final decision on this will reflect the proposed ongoing strategy LBI have for the development rather than specific advantages of one structure over the other.

Of the options we would suggest that option 1 will not meet LBIs desire to transfer risk, bring in private finance and suitably qualified and experienced resource. We would further suggest that option 4 would delay the development of the schemes to the point where their implementation may be jeopardised.

The decision between options 2 and 3 will be made based on the programme for the initial projects and the availability of public funds to develop them. This decision will need to be made after completion of the detailed feasibility study and outline design of each scheme.

We therefore recommend that LBI:

1) Ensure current levels of support from LBI directors and council members for the schemes is maintained.)

2) Liaise closely with LDA in developing both funding and technical and commercial standards for the scheme

3) Identify and engage with key third party DE customers. The emphasis should be on other public sector building owners (hospital trusts, higher education, central government buildings etc.),

4) Carefully consider the options for ownership/development to decide which most closely meets their requirements for ongoing involvement – we would propose that a workshop on the options with key stakeholders could be held as a next step in this regard

5) Develop commercial and technical procurement documents which will match with the ongoing needs of the scheme development e.g. technical standards and connection agreements.

6) Consider council powers to establish a standard delivery mechanism for decentralised energy schemes such that this issue can be dealt with swiftly during discussions with potential partners.

3.3 District Heating System Compatibility Guidance

3.3.1 Introduction

This section describes the scope of the guide and demonstrates its importance for the efficient and economic design of the future DE systems.

It is possible that DE across Islington will be developed by a number of organisations both public and private. To safeguard the potential for future interconnection of individual schemes this section contains details of the technical parameters of the DE systems and operational parameters required to ensure compatibility. Indicative schematics are provided to illustrate the means by which domestic and non domestic buildings can be supplied from a DH system. Consideration has also been given to the means by which a LBI scheme could be connected to other district heating systems that are planned for the future, for example the LDA London Thames Gateway Heat Network.

3.3.2 Technical preamble

This section describes the domestic hot water and heating design strategies to be considered in buildings which are to be connected to new and additional district heating networks in LBI.

The design philosophy is based on variable operational flow and return temperatures and variable flow rate to suit the annual fluctuations in customer demand and to maintain compatibility with proposed LDA heating network standards; all the following information and technical specifications rest on these assumptions. Guidance is given for the connection of the following:

1) New mixed use (residential and non-residential) developments

2) Existing housing stock supplied by a communal system

3) Existing Non-residential buildings supplied from central boiler plant

4) Existing buildings not already supplied from a communal system

In the discussion that follows, the following terminology will be used to describe the various sub-systems that exist within the distribution network:

- The **transmission main** refers to a large diameter heating main that supplies heat from a low carbon source outside the borough;
- The **primary network** refers to the distribution system that connects the LBI energy centre to each individual building development or existing building or groups of buildings on an estate. It is the source of the low temperature hot water supply to each building;
- The **secondary network** is the local network within each building or group of buildings that supplies hot water to the loads;
- **LTHW** represents the Low Temperature Hot Water supply which is defined as a maximum temperature of 95C;
- **MTHW** Is Medium Temperature Hot Water with flow temperatures between 95°C and 120°C.
- **DHW** refers to Domestic Hot Water supply;
- **DH** stands for District Heating;
- **EC** stands for the Energy Centres that house the primary system plant.
- **3rd party transmission main** is a district heating network that supplies heat from outside the boundaries of LBI

3.3.3 The transmission main

It is necessary to consider the supply of heat from third party networks in order to safeguard DE assets in LBI against future developments in this sector. It is anticipated that supply from 3rd party heat networks will operate in the following way.

1) The 3rd party heat network operator will run high volume transmission mains through areas that have a sufficiently high heat load density. Spurs will then be run from the transmission main to specific loads or groups of loads, for example large single point loads or existing DH schemes and clusters.

2) The 3rd party network will remain hydraulically separate from LBI DH networks. The primary reasons for this are to retain contractual demarcation and to maintain water quality between the two systems. Although it is possible to define water quality levels in contracts it will in practice be extremely complicated to identify the source of water quality non-compliance on

networks of the scale being proposed by LDA. The interface between the two systems is likely to be housed within an existing plantroom or energy centre that is supplying the LBI load and containing local peak and standby boilers thereby resulting in savings on the requirement for water treatment and pumping.

3) The LBI heating system would be charged for heat on a unitised basis[8]. It is highly likely that the 3rd party will have restrictions on the return temperature fed back to their network. It is probable that the LBI heat customer would be incentivised by the transmission main company to provide return water below a specified temperature e.g. by penalty payments or bonus payments. In order to achieve this it may be necessary to follow the same steps required to achieve sufficiently low temperatures for the supply from a local gas-engine CHP system.

PB is of the understanding that the proposed LDA transmission main from the Barking power station into London will operate on a variable temperature variable flow system. The flow temperature is proposed to be a nominal 95°C with the ability to increase flow temperatures to a nominal 110°C-120°C during peak heating conditions. The transmission main will therefore need to be rated to operate at MTHW conditions even if the system is only operated at this temperature for a few days a year. All interfaces between any 3rd party transmission main network and the LBI DH network would need to be rated to tolerate MTHW on the primary side. If the 3rd party transmission main is not to be connected immediately it is then LBI networks would be rated to LTHW and be replaced as and when the supply from the 3rd party transmission main was required.

3.3.4 The primary network

The primary network is a variable flow rate system that is controlled by the individual instantaneous heating demands of the connected buildings. Ideally, a constant differential temperature is imposed on the primary circuit irrespective of the demand requirement, with the return temperature kept as low as possible[9] to maximise the thermal efficiency of the network and minimise pumping costs.

To meet these requirements, it is essential that the primary and secondary networks are compatible in their design. The main purpose of this document is to provide guidance on the design of the secondary network and building heating system and controls, so that the primary network can be operated at its optimum efficiency.

The design of the secondary network in new developments to be connected to a DH network can be more easily controlled than the modification of existing systems. This guide provides the suggested means by which existing buildings can be connected to a DH in addition to containing clear guidance on the design of new secondary systems.

8 It is likely that a capacity charge would be included to repay the capital of the pipeline. Simplest method would be to charge on volume flow to encourage low return temperatures

9 Customers could be offered a financial incentive to keep return temperatures within an agreed range

3.3.5 Primary and secondary network interface

Although it is possible to connect the building network directly to the district heating supply, the preferred option is to use an indirect connection. A heat exchanger is used to transfer heat from the primary LTHW supply to the secondary building LTHW system. The advantage of the heat exchanger is that it provides hydraulic separation of the two circuits, creating a contractual demarcation and eliminating the risk of contamination to the primary LTHW supply network from the secondary (consumer) systems and vice versa. Plate heat exchangers, if correctly insulated have a very high efficiency, with the temperature differential between primary and secondary systems being around 5°C.

The hydraulic interface is achieved via a heat exchanger sub-station located in a plant room within the building. To achieve compatibility with the primary network, it is important that these substations are designed, installed and operated to a common set of rules that are described in the next section.

3.3.6 Connection of New buildings to a DH

Depending on the required load of the individual connection, the substation may incorporate up to 3 heat exchangers, which will operate in parallel to provide the peak requirement, whilst incorporating a level of resilience.

The primary circuit nominal temperatures used to size the networks and the devices on the energy substations are as follows,

Flow temperature (Maximum)	95°C
Return temperature (maximum)	55°C

It will be an obligation of the end user to provide suitable designs of the secondary system mechanics and control functions to ensure that the return temperature on the primary system is maintained in line with the maximum figure indicated in the table above. It is important that requirement is constant throughout the annual demand profiles down to an acceptable minimum requirement of nominally 10% of the maximum demand. It should be noted that incentives for good operation and provision of the required design return temperatures will be incorporated into the energy supply agreements for each customer.

A reasonable design temperature differential (e.g. 5°C) should be maintained between the primary and secondary flow temperatures and between the primary and secondary return temperatures to ensure adequate control margins, therefore, it is recommended that the return temperature in the secondary systems does not exceed 45°C.

With regard to the heating connection, it is envisaged that all DHW requirements will be served from the customer secondary side of the substation interface.

- The primary circuit will be sized for a nominal maximum pressure of 16 bar (PN16);

- The head loss at the primary circuit connections within the building and the plant room will be a maximum of 1bar.

A differential pressure control valve (DPCV) should also be installed at each connection, with the actuator capillary lines connected across the heat exchanger and / or the control valve (CV) Once commissioned, the DPCV will self regulate to limit the flow rate to the maximum design figure, irrespective of fluctuations within the main system and will close down in parallel with any flow regulation requirement of its associated CV, which regulates to suit the demand of the connection.

A form of flow measurement device will need to be included at each connection to allow for flow checks and to commission the installed DPCV. Energy metering is incorporated at the connection point, the flow-sensing element of this package would be suitable for measuring flow rate. Due to their compactness and their ability to operate with close approach temperatures between the primary and secondary return, the heat exchanger at the hydraulic interface is generally a plate heat exchanger. One of the benefits of these systems to the developer is the potential for additional space, since heat exchanger substations are significantly smaller than conventional boiler plant (occupying as little as one tenth of the space). However, because plate heat exchangers are prone to fouling the use of strainers and side-stream filters is essential, as is the water treatment regime of the secondary circuit.

3.3.7 Domestic hot water supply

As stated earlier, the generation of DHW shall be supplied from the customer secondary side system and should be designed such that the mix of return temperatures from this and the other heating circuits will provide the overall required return temperature at times of peak demand. An instantaneous heating approach should be considered for the domestic hot water heating, providing the benefit of not only space reduction, heat loss reduction from standing water and the reduction of the risk of infection from Legionella, but will also benefit in providing a minimum return temperature as the cold feed is connected directly to the heat exchanger and this can be sized to give close approach temperatures.

Alternatives to this would include a traditional storage system with an internal heating coil, although this will raise return temperatures as the cylinders are recharged, or a plate heat exchanger with integral storage cylinder.

3.3.8 Design and control methods

Secondary systems can be either variable temperature or constant temperature depending on the requirements of the building servicing strategy; all connected loads must use a variable flow rate system. The required terminal load is used to regulate the control valve opening, ensuring that the pump is kept at the optimum operation point for the overall circuit. This keeps the electrical consumption of the pump to a minimum and maintains a maximum temperature differential between the flow and the return. It is recommended that the pump speed regulation is controlled through the differential pressure measured at the secondary circuit index run. This is normally the most distant load.

Due to the possibility that all the regulation valves may be closed it is necessary to install an automatic temperature controlled bypass valve adjusted to keep a minimal flow within the circuit so that the temperature does not drop below a minimum level at times of low or zero demand.

The differential pressure set up value should be nominally the same as the head loss downstream of the pressure sensor including a margin. Alternatively a controlled by-pass can be incorporated linked to the differential pressure set point and the minimum speed requirement of a single pump operation.

3.3.9 Best practice guidelines for secondary systems

Differential temperature in the secondary distribution networks must be kept as large as possible to minimise pipe size and to optimise CHP output. The temperature differential at the primary / secondary interface will depend on the design of the internal building services. Therefore, all internal systems must ensure compatible designs that maintain optimum differential temperature at the interface during all demand scenarios.

Key considerations for the design of building internal systems are as follows:

- Low flow rate radiator circuits for buildings, complete with thermostatic control. Radiator circuits can be designed to operate satisfactorily at 70°C / 50°C as opposed to the traditional 82°C / 71°C without compromising the ability of the system to deliver the required level of heat. Quite often, boiler plant, pipework and radiators are oversized and therefore the modified conditions can be applied without any loss of performance in the heating system;

- Ensuring minimum return temperature from hot water service connections, whether storage or instantaneous. This can be as low as 25 C during high draw off times and for storage systems can be reduced by designing in additional coil surface;

- Instantaneous hot water generation should be considered. This removes the need for hot water storage, reducing energy consumption and results in low return temperatures. Even lower return temperatures can be achieved by adopting a double heat exchanger arrangement that uses the DH return water to pre-heat the cold water makeup;

- Lowering return temperatures from connections such as swimming pool water heating to reduce the overall return mix;

- Selecting low temperature operating systems such as underfloor heating to significantly reduce return temperature.

Whilst by-pass arrangements should be kept to an absolute minimum, they will be necessary during low demand periods, when the supply temperature on the primary and secondary network deteriorates due to control valves remaining closed for a period of time. If continual flow by-passes are utilised the system loses efficiency because even at peak times, there is a continual mix between the flow and return streams. To overcome this, self-acting temperature control by-passes should be installed at the end of main branch legs or at any remote equipment connection. These should be adjusted so that they open within a predetermined tolerance of the design flow temperature set point. This will allow a small constant flow to occur during low demand periods, to prevent the occurrence of “dead legs”.

It should be noted that small lengths of “dead legs” are perfectly acceptable on large-scale two port control systems and that as long as there is a main system branch, in reasonably close proximity, which is maintained at the design flow temperature, there is no need to install these bypasses over and above where they are absolutely necessary. The actual size of the by-pass and self-acting valve, where essential, should be kept to the smallest bore that will allow the flow rate required to maintain the “dead leg” at its design temperature.

3.3.9.1 Shunt Pump and Low Loss Header

The common shunt pump and low loss header is a common inclusion in heating systems but should **not** be used on a new district heating system. This arrangement will only serve to return supply temperature water back to the heat exchanger as demand reduces on the main building sub-circuits.

3.3.9.2 Two-port Control Valves and Variable Speed Pumping

The use of two port control valves in constant temperature system applications is fundamental in ensuring that the unnecessary return of supply water temperature back to the heat exchanger is avoided. The use of variable speed pumps, in conjunction with differential pressure control valves for system balance, provides an efficient method of delivering only the energy that is needed and when combined with the parallel pumping, described in detail below, provides the required turn down of the system to maintain optimum return temperatures throughout the annual demand profiles.

3.3.9.3 Circuit Mixing

Wherever possible, water returning from one heating circuit at a high temperature should be used in a second circuit operating with lower temperatures. This is not always possible since one circuit may demand energy at a different time to another.

3.3.10 Pumping System

It is recommended that the required pumps are installed in parallel within the flow circuit just after the heat exchanger as shown in the following drawing. Differential pressure control is then incorporated in each sub-circuit after the pump, to provide system balance during all demand scenarios and flow / pressure fluctuations

3.3.10.1 Pump selection methodology.

The number of pumps selected will depend on the maximum and minimum flow rates at which the system will operate throughout the year and the characteristics of the inverter of the variable speed pump. For connections where the difference between the annual maximum and minimum demands is less onerous than others, an example being a swimming pool, then a single duty pump may have sufficient turndown capacity to meet the required operation throughout the year. For most connections the difference in loads throughout the year is significant and therefore, the use of parallel pumping should be adopted. The minimum flow requirements described above should be based on the minimum speed requirement for a single pump in the parallel set up.

3.3.11 Connection to existing dwellings already supplied from DH

The secondary systems of the majority of buildings currently supplied from communal heating systems utilise an 82°C/71°C flow and return temperature for the secondary systems. If these systems are to be supplied from a CHP/DH system there are significant implications on efficiency and total annual operating hours if return temperatures exceed 75°C. If return temperatures exceed 70°C the CHP will be forced to shut down because it requires the return water to cool the engine There are three potential solutions to this issue:

1) Lower the flow temperature of the secondary system so that it operates with the same ΔT but has a flow return temperature of 75°C/64°C. Existing radiators in existing domestic and non-domestic buildings are generally oversized and are able to supply sufficient heat into buildings at the reduced temperatures. The flow temperature on the primary system will be variable in order to allow for systems to be returned to 82°C/71°C during extreme cold periods.

2) Ensure loads that produce low return temperatures, for example swimming pools and modern developments with underfloor heating and instantaneous DHW provision, are connected to the system. For example a swimming pool may produce return temperatures of around 45°C, which when combined with a 82°C/71°C residential load has the potential to produce a return temperature at the energy centre of less than 70°C; this however depends on the relative flow rates of the connected loads and needs to be considered during the design stage of a DH scheme.

3) Rebalance the radiators to deliver a 64°C retrun temp instead of 71°C. This reduces the heat output but not by as much as 75/64. Flow rates are reduced as well which reduces pumping energy. This approach will involve visits to properties and may need new TRVs installed to facilitate the balancing.

The replacement of secondary system is expensive and intrusive for existing residents. PB proposes the following methodology is employed when considering the connection of existing dwellings to a DH system supplied from a CHP.

1) Before the go-ahead is given for connection to a CHP DH scheme the specification of existing heat emitters is recorded, i.e. dimensions and rated output at design flow temperatures (nominal 82°C/71°C)

2) Indicative design calculations are undertaken for heat emitters when operating at revised temperatures (nominal 75°C/64°C) to quantify the heat output at revised temperatures.

3) If heat emitters are shown to be fit for purpose at revised temperatures a monitored temperature conversion trial should be undertaken by reducing the flow temperature on the existing gas boiler plant.

4) If the results of the trial are acceptable the go-ahead for connection to the DH scheme is given. During extreme cold periods it may be necessary to revert to 82°C/71°C operation, forfeit CHP operation and use gas boilers in order to guard against under heating of any buildings.

3.3.12 Connection of existing buildings not already supplied by DH

PB would advocate the connection of large single point loads to a DH system because they generally assist with diversifying the heating peak and lead to a greater heating baseload. Such buildings are usually supplied from gas boilers that supply internal heating systems and domestic hot water supply. The DH would supply the building systems via a heat exchanger for the reasons previously explained. The issues associated with connecting existing buildings to a DH and suggested solutions have been explained in the previous section.

The heat exchanger would replace the existing gas boiler with resilience being provided by gas boiler located in the DH energy centre. In situations where multiple gas boilers are fitted it may be possible to retain one or more gas boilers to provide a degree of local resilience.

3.3.13 Building Management System

A well designed Building Management System (BMS) is required to ensure ongoing operational compatibility between the district heating primary and the secondary circuits. The Energy Centre will continually monitor the flow and return temperatures on both the primary and secondary sides of the substation interface, as well as the primary flow rate, instantaneous energy consumption and cumulative energy consumption for billing. It is envisaged that given the disparate local and or district energy centres the BMS data via would be remotely accessed with automatic alarm.

An electrical enclosure and control panel would be installed, that will house control devices and the communication system link to the energy centre. This will be capable of transmitting the data obtained from the installation, as described above, as well as alarms and receiving control inputs.

3.3.14 Metering

Energy meters measure volume flow rates and supply and return temperatures to provide an accurate record of energy usage. The early meters employed turbine based systems to record flow rates, but these were affected by deposits in the water circuit and they were prone to mechanical failure. The preferred choice in a modern system is an ultrasonic device. These solid state devices are less susceptible to deposits in the water, because they contain no moving parts. Furthermore they require very little maintenance and are accurate even with very low flow rates.

The energy meter shall be IP addressable so that data can be relayed to the energy centre via the data network. However, many systems employ an M-bus communications output. Such systems may be satisfactorily networked via a meter interface unit that collates the data before transmitting it to the energy centre across a conventional telecommunications network.

Metering should be installed to record flow volumes and energy delivered on the primary circuit. For residential connections, meters should also be installed on the secondary circuit where individual building or dwelling billing is required. The energy metering system must include a flow meter, two temperature sensors and a stand alone integrator unit complete with battery back up.

3.4 Risk mitigation

The following section includes 'live' risk registers for the environmental, financial, programme and reputational risks associated with the implementation of the approach outlined this report. Separate registers are included for each of the three categories, with the risks summarised to remove duplication of risks raised.

SEE ACOMPANYING EXCEL WORKSBOOK FOR LIVE RISK REGISTERS.

Appendix A

Articles 11 and 12 Extracts from Local Government (Miscellaneous Provisions) Act 1976

Heating etc
11 Production and supply of heat etc. by local authorities
(1)Subject to subsections (2) and (3) of this section, a local authority may—
(a)produce heat or electricity or both;
(b)establish and operate such generating stations and other installations as the authority thinks fit for the purpose of producing heat or electricity or both;
(c)buy or otherwise acquire heat;
(d)use, sell or otherwise dispose of heat produced or acquired [F1or electricity produced]by the authority by virtue of this section;
(e)without prejudice to the generality of the preceding paragraph, enter into and carry out agreements for the supply by the authority, to premises within or outside the authority's area, of such heat as is mentioned in the preceding paragraph and steam produced from and air and water heated by such heat.
[F2(2)Nothing in subsection (1) of this section shall be construed as exempting a local authority from the requirements of Part I of the Electricity Act 1989.
(3)Except in such cases as may be prescribed, a local authority shall not be entitled to sell electricity which is produced otherwise than in association with heat.]
(4)A local authority may—
(a)construct, lay and maintain pipes and associated works for the purpose of conveying heat produced or acquired by the authority by virtue of this section and steam produced from and air and water heated by such heat;
(b)contribute towards the cost incurred by another person in providing or maintaining pipes or associated works which are connected with pipes provided by the authority in pursuance of the preceding paragraph.
(5)Parts V and VI of Schedule 3 to the M1Water Act 1945 (which relate to the laying of mains and the breaking open of streets) shall apply in relation to pipes and associated works provided or to be provided in pursuance of paragraph (*a*) of the preceding subsection as those Parts apply in relation to water mains and pipes but as if—
(a)sections 19(4) and 21 of that Schedule (which relate to the erection of street notices and the laying of service pipes) were omitted, and in section 22 of that Schedule the words "which they are authorised to lay" were omitted; and
(b)for any reference to undertakers or limits of supply there were substituted respectively a reference to the authority in question and the area of the authority; and
(c)for the reference to the special Act in section 25(4) of that Schedule there were substituted a reference to this subsection.
(6)It shall be the duty of a local authority by which an installation for producing heat is operated in pursuance of this section in any year to furnish to the Secretary of State, as soon as practicable after the end of that year, such particulars relating to the installation and heat produced at it as are prescribed.
(7)In this section—

> "associated works", in relation to pipes, means any of the following connected with the pipes, namely, any valve, filter, stopcock, pump, meter, inspection chamber and manhole and such other works as are prescribed;
> F3. . . and
> "prescribed" means prescribed by regulations made by statutory instrument by the Secretary of State [F4which, in the case of regulations under subsection (3) of this section, shall be subject to annulment in pursuance of a resolution of either House of Parliament];

and nothing in this section (except the restrictions imposed by subsection (3)) shall be construed as prejudicing any power exercisable by a local authority [F5(in its capacity as such)]apart from this section.
Annotations:
Amendments (Textual)

F1Words inserted by Electricity Act 1989 (c. 29, SIF 41:1), s. 112(1)(3), Sch. 16 para. 20(2), Sch. 17 paras. 33, 35(1)
F2Subsections (2) and (3) substituted by Electricity Act 1989 (c. 29, SIF 44:1), s. 112(1)(3), Sch. 16 para. 20(2), Sch. 17 paras. 33, 35(1)
F3Definition repealed by Electricity Act 1989 (c. 29, SIF 44:1), s. 112(1)(3)(4), Sch. 16 para. 20(4)(a), Sch. 17 paras. 33, 35(1), Sch. 18
F4Words added by Electricity Act 1989 (c. 29, SIF 44:1), s. 112(1)(3), Sch. 16 para. 20(4)(b), Sch. 17 paras. 33, 35(1)
F5Words inserted by Electricity Act 1989 (c. 29, SIF 44:1), s. 112(1)(3), Sch. 16 para. 20(4)(c), Sch. 17 paras. 33, 35(1)
Marginal Citations
M11945 c. 42.
12 Provisions supplementary to s. 11
(1)A local authority which supplies or proposes to supply heat, hot air, hot water or steam in pursuance of the preceding section may make byelaws—
(a)with respect to the works and apparatus to be provided or used by persons other than the authority in connection with the supply;
(b)for preventing waste and unauthorised use of the supply and unauthorised interference with works and apparatus used by the authority or any other person in connection with the supply;
(c)providing for any specified contravention of the byelaws to be an offence punishable on summary conviction with a fine of such an amount, not exceeding [F1level 3 on the standard scale], as is specified in the byelaws.
(2)Subsections (1) to (5) of section 82 of Schedule 3 to the M1Water Act 1945 (which relates to the entry of premises by authorised officers of water undertakers) shall have effect for the purpose of authorising the entry of premises by authorised officers of an authority which provides or proposes to provide such a supply as is mentioned in the preceding subsection as if for any reference to undertakers there were substituted a reference to the authority and as if in subsection (1) of that section—
(a)for paragraph (*a*) there were substituted the following paragraph—
“(a)for the purpose of installing, examining, adjusting, removing or reading any meter used or to be used by the authority for measuring the heat, hot air, hot water or steam supplied or to be supplied by the authority;”
(b)for the words from “the special Act” onwards in paragraph (*b*) there were substituted the words “byelaws in force by virtue of section 12 of the Local Government (Miscellaneous Provisions) Act 1976”; and
(c)for the words “the special Act” in paragraphs (*c*) and (*d*) there were substituted the words “section 11 of that Act”.
(3)[F2Subsections (1) and (2) above have effect subject to paragraph 11(2) of Schedule 1 to the Building Act 1984; and]section 80 of the M2Health and Safety at Work etc. Act 1974 (which among other things provides that regulations under subsection (1) of that section may repeal or modify any provision to which that subsection applies if it appears to the authority making the regulations that it is expedient to do so in consequence of any provision made by or under Part I of that Act) shall have effect as if the provisions to which subsection (1) of that section applies included subsection (1) of this section and byelaws in force by virtue of subsection (1) of this section.
(4)The accounts of a local authority by which expenditure is incurred under any of the provisions of the preceding section and this section shall include a separate account of that expenditure and of any income connected with functions conferred on the authority by those provisions.
Annotations:
Amendments (Textual)
F1Words substituted by virtue of Criminal Justice Act 1982 (c. 48, SIF 39:1), ss. 40, 46
F2Words substituted by Building Act 1984 (c. 55, SIF 15), s. 133(1), Sch. 6 para. 17
Modifications etc. (not altering text)
C1Power to repeal or alter s. 12(1) conferred by Building Act 1984 (c. 55, SIF 15), s. 1(3), Sch. 1 para. 11(2)(*a*)
C2Power to modify s. 12(2) conferred by Building Act 1984 (c. 55, SIF 15), s. 1(3), Sch. 1 para. 11(2)(*b*)
Marginal Citations
M11945 c. 42.
M21974 c. 37.

Appendix B

a. Summary

The majority of the grant and loan schemes available ultimately source funding from the Environmental Transformation Fund. This is a £400 million settlement from the 2008/09 budget for the three years to 2010/11. The majority of schemes do not state any intentions beyond 2010/11 with funding dependent on a new budget settlement to cover 2011/12 to 2014/15.
Applications for the majority of schemes in 2009 and some for 2010 have now closed.

b. Homes and Communities Agency

The Home and Communities Agency received funding to help stimulate the housing market. The funding is delivered through five programmes:[10]

- Kickstart Housing Delivery
- Energy Saving Programme
- Low Carbon Infrastructure Fund
- Public Land Initiative
- Additional Affordable Homes

Low Carbon Infrastructure Programme

This programme had £20.96 million allocated from the housing stimulus package to fund model projects which reduce carbon emissions from housing in growth points and areas.[11]
The programme deadline passed on 21st July 2009, there is no further news of any successor.

c. London Mayor Targeted Funding Stream

The Targeted Funding Stream (TFS) allocates London's portion of the nations housing resources. The programme funds areas including improving the homes of vulnerable people, assisting homeless households, increasing supply of larger homes, and assisting the Travelling community.
The TFS includes an Innovation and Opportunity Fund to help accelerate the pace of new developments and reduce the impact of housing on the environment.
The programme was allocated £27 million for 2010/11, submissions for funding this year closed in July 2009.[12]

d. Renewable Heat Incentive

The renewable heat incentive is in consultation (summer 2009) with the scheme expected to in place in April 2011. Current expectation is the incentive will apply to all scales, cover a wide range of technologies, and rewarded accorded to size or technology.[13]

e. Environmental Transformation Fund

The Environmental Transformation Fund (ETF) started in April 2009 with a £400 million settlement to fund projects from 2008/09 to 2010/11. The scheme administered by BERR and DEFRA aims to accelerate the development of low carbon energy and energy efficiency technologies in the UK.[14]
The ETF supplies funding to a number of schemes through which grants and loans are available. Schemes the ETF funds include:

- Hydrogen Fuel Cell and Carbon Abatement Demonstration Programme
- Marine Renewables Deployment Fund
- Low Carbon Buildings Programmes
- Bio-energy Capital Grants and Bio-energy Infrastructure Schemes

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10 Housing Stimulus Programme, Homes and Communities Agency, [http://www.homesandcommunities.co.uk/housing_stimulus]

11Low Carbon Infrastructure, Homes and Communities Agency, [http://www.homesandcommunities.co.uk/low-carbon-infrastructure.htm]

12 Targeted Funding Stream Propectus, Mayour of London, [http://www.london.gov.uk/mayor/housing/docs/fund_stream_prospectus.pdf]

13 Renewable Heat Incentive, BERR, [http://www.berr.gov.uk/energy/sources/renewables/policy/renewableheatincentive/page50364.html]
14 Environmental Transformation Fund, BERR, [http://www.berr.gov.uk/energy/environment/etf/page41652.html/environment/etf/page41652.html]

- Offshore Wind Capital Grants programme
- Carbon Trust's innovation programme, including research accelerators, technology accelerators, and incubators
- Carbon Trust funding for new low carbon technology enterprises, including Partnership for Renewables
- Carbon Trust investments in low carbon technology businesses
- Carbon Trust energy efficiency loans scheme for small and medium sized enterprises (SMEs)
- Salix Finance public sector invest-to-save loan schemes

Bio energy Capital Grants Scheme
The bio energy capital grants scheme aims to accelerate the deployment of heat and heat & power fuelled by biomass. The scheme assists by helping with the cost of equipment. There is no minimum grant and the maximum is £500,000
The fifth round of funding closed in April 2009. An announcement on the six round is expected shortly.
Green Neighbourhoods
The green neighbourhoods scheme part of the ETF, has £10 million to help 100 neighbourhoods reduce their carbon emissions by 60%.[15]
Funding requires an alliance of many stakeholders public and private, who will also supply additional funding. The scheme also aims to tackle properties that have particular difficulties in reducing their carbon emissions.
Low Carbon Buildings Programme
The Low Carbon Buildings Programme (LCBP) offers capital grants for micro generation technologies, with the aim of reducing the costs by creating a sustainable market.
The programme managed by the Energy Saving Trust for the Department of Energy and Climate Change is split into two phases. Phase one is aimed at households and awards a maximum grant of £2,500 and phase two aimed at the public sector or charitable bodies and awards a maximum of 50% of the cost (limit £200,000).
The programme received £86 million of funding and applications are accepted until March 2010 for power generation and April 2011 for heat only applications.
Salix Financing
Salix Financing managed by the Carbon Trust provides loans to public sector organisations to implement low carbon capital projects. The loans are repaid through energy savings made by the projects, and the money recycled to create finance new projects.
Salix projects must be additional to an organisations mandatory requirements and meet the following payback requirements. [16]

- Energy efficiency projects finance by Salix, require a maximum 5 year payback period and a £100 per tonne CO_2 lifetime cost.
- Approved energy efficiency and renewable projects financed by Salix, require a maximum 7.5 year payback and a less than £50 per tonne CO_2 lifetime cost.

f. Other Options

The following options identified in Cutting the Capital's Carbon Footprint by Buro Happold[17] are additional sources of finance, which may be of potential use to organisations depending on their size and project scope.

- Carbon Bonds
- Private Finance Initiative
- Prudential Borrowing
    - Introduced as part of the Local Government Act 2003, prudential borrowing allows Local Government to publicly finance projects at a low borrowing rate through the Public Works Loan Board.
- Supplementary Business Rates
    - A government White Paper in October 2007 outlined the potential for Local Authorities to retain supplementary business rates to fund specific projects.
- Joint European Support for Sustainable Investment in City Areas (JESSICA)

15 Green Neighbourhoods, DEFRA, [http://www.defra.gov.uk/news/2008/080402a.htm]
16 Salix, [http://www.salixfinance.co.uk]
17 Cutting the Capital's Carbon Footprint - Delivering Decentralised Energy October 2008 Report by London First / Buro Happold, Final Report 2008

European collaboration to allow the use of EU Structural Funds to finance sustainable urban development.