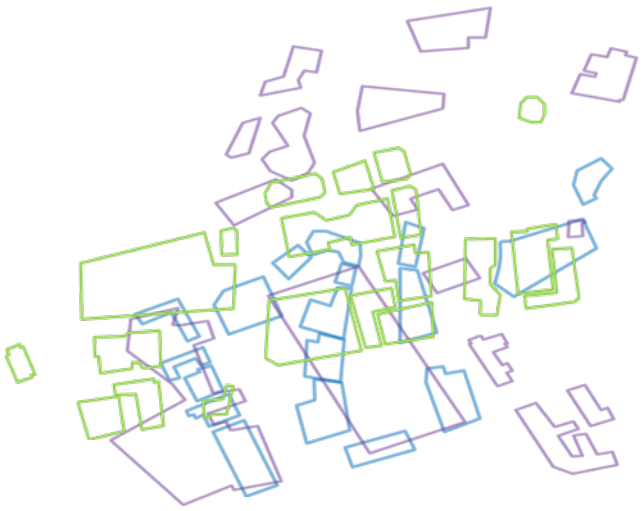
Croydon Decentralised Energy Study



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Croydon District Energy Study

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Capabilities on project:
Energy
Environment

Executive Summary

The global challenge to reduce CO_2 emissions to limit the impact of global warming is being addressed at an international, national and local level. One of the responsibilities of local government is to consider how low carbon energy solutions can be introduced into their area following the Planning Policy Statement 1 Supplement on Climate Change. The CO_2 emissions of Croydon (excluding transport) are estimated from DECC statistics at 1.3 million tonnes p.a.

The centre of Croydon comprises a large number of commercial offices and public sector buildings including Croydon College, Fairfield Halls, the Home Office and the public Library. In addition, there are a number of major new developments planned for the area, including the new Council offices and Ruskin Square. The heat supply to Croydon is currently supplied mainly by gas-fired boilers and electricity is supplied from remote power stations. An alternative system would be to generate electricity within the town centre and to capture the heat released as a result of electricity production, a technology known as Combined Heat and Power (CHP). This heat would be piped to the buildings via a district heating network and connected to the buildings' heating systems by means of a heat exchanger. This study investigates the technical commercial and environmental implications of a CHP/DH scheme.

The high density of development in the centre of Croydon with many high-rise buildings is an advantage in that heat distribution costs will be relatively low. A further advantage is that there are a number of underground car parks which could be used to install the distribution pipework again reducing costs compared to routes involving pipework buried under roads. In addition, the scale of the project is relatively large which means that CHP plant will be the optimum size for energy efficiency and have relatively low capital and maintenance costs.

The disadvantage of the opportunity is that many of the buildings are offices and so there is limited heat demand in summer and at weekends. This means that the operating hours of the CHP are not as great as for a system supplying a larger proportion of residential buildings. As a result of this disadvantage we have also considered operating the CHP system to generate heat for use in absorption chillers during the summer. The market value of the heat supplied for this purpose is however limited compared to the heat sold to displace boilers.

Identification of heat customers and District Heating Zones

Within the study area we have identified potential existing customers and in collaboration with the masterplan process identified potential future customers. The levels of these customers' energy demands and demand profiles have then been assessed using various techniques including heat mapping, census data, Valuation Office data, accessing the LCCA data base for Croydon, information on individual buildings, and by meeting with the various developers and architects involved.

The brief identified four study areas and the masterplan identifies development areas. From this data three District Heating zones were identified, in part defined by the tram routes which would create a potential barrier to laying buried district heating. Broadly these zones can be defined as:

Zone 1 – Southern part of mid-Croydon, Wellesley Rd and College Green

Zone 2 – East Croydon including Ruskin Square

Zone 3 – Northern part of mid-Croydon, West Croydon and northern part of Wellesley Rd

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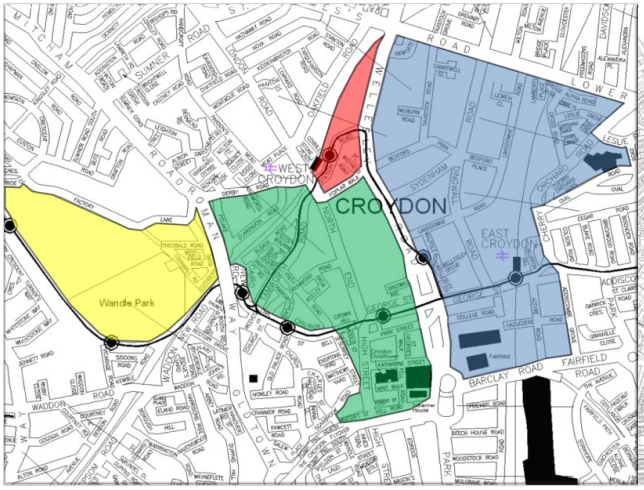
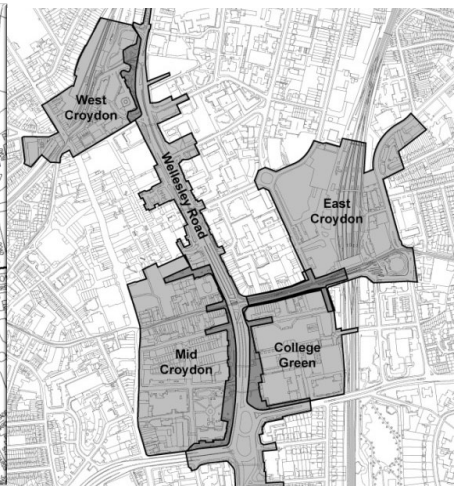


Study Areas



Masterplan Areas

In order to provide energy for these potential customers we defined the profile types of these customers, including estimating when they would require connection and what the likelihood of their commitment to the establishment of this connection would be. This influenced the choice of energy zoning and also the preferred locations of the energy centres to produce the energy. Indentifying the location for energy centres has proved very difficult due to the availability of appropriate public land and the expected reluctance of developers to include space for an Energy Centre that supplies adjacent areas, as this would lead to a loss of income from the site.

Heat supply options

Three options were evaluated:

- A separate CHP system for each of three zones identified
- A single CHP system supplying all three zones
- Heat supplied by the existing Rolls Royce power station

The second option was found to be the least favourable as there were limited efficiency benefits from the larger CHP plant, higher costs for interconnecting of pipework, potential difficulties in connecting to gas and electricity networks at this scale, and uncertainty over finding a suitable site for the larger plant.

The third option is the use of the existing Rolls Royce power plant on Factory Rd to the west of the town centre as a potential source of heat energy. As this heat is essentially a by-product of electrical power generation its production would be low cost and carbon free. The disadvantage is that the source is some distance away and requires the construction of a DH transmission main into the centre of Croydon. The other disadvantage is that the RR power station is only operated for about 5 hours per day through the winter period between 3pm and 8pm. As a result, the amount of heat is limited and a proportion of the heat available will need to be stored for use the following day to meet the early morning peak. Although it would be possible to extend the period of operation, this would involve additional costs for RR and hence increase the cost of heat supply. Evaluation of the extended operating hours and provision of additional heat would require more detailed discussions with RR to see how their costs would rise.

Capabilities on project:
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District Heating Network

From the three energy centres and/or the Rolls Royce power plant we then examined the pipework distribution required to transport the heat energy from the energy centres to the customers. Various routes were considered and due to infrastructure installation costs and maintenance practicalities the routes favoured were those integrated within existing and proposed structures such as in underground car parks, across bridges, through culverts or under-slung below elevated road sections, as opposed to routes in roads and pavements where digging and diversions for installation and maintenance would be difficult.

Business Case

In order to provide the evidence base to satisfy inclusion in the Council's Local Development Framework (LDF), we have looked at the business case for a decentralised energy network. In simple terms the costs of setting up the network, with the capital cost of the energy centres and energy distribution infrastructure has to be offset by the income generated, after operational costs have been accounted for, by customers connecting onto, consuming and ultimately paying for the use of the energy.

The results of comparing Options 1 and 3 with the base case of existing arrangements is indicated in Table 1.

Table 1 – Comparison of Options

		Zone 1 gas-engine CHP	**Zone 2 gas-engine CHP**	**Zone 3 gas-engine CHP**	**Option 1 - three gas-engine CHP**	**Option 3 - RR power station CHP conversion**
Heat supplied	MWh p.a.	54,286	29,372	45,479	129,137	n/a
CHP heat capacity	MW	9.5	4.8	8.9	23	35
Proportion of CHP heat	%	70%	70%	70%	70%	20%
Capital cost	£m	17.8	8.2	15.7	41.7	2.5 (extra over for pipeline and boiler only)
Grant assumed	£m	5.0	2.5	5.0	12.5	n/a
IRR	%	7.2	4.0	7.0	7.8	n/a
CO_2 savings	Tonnes p.a.	14,963	7,684	14,346	36,993	5,837

Capabilities on project:
Energy
Environment

The rates of return without any grant funding were below the levels that attract private investment. LBC may wish to invest themselves using their own capital programme and prudential borrowing. We have discussed in the report the potential risks and opportunities for such investment. It may be preferable to form a joint venture company where the risks can be shared with the private sector. To improve the rate of return so that the JV company can raise sufficient capital can be achieved by the provision of equity or grant funding by the public sector. This equity could be obtained from:

- LB Croydon capital programme
- Prudential borrowing
- The LDA through their support to decentralised energy and the JESSICA fund

The above results assume a grant level of about 30% of the capital cost of the projects.

Air quality

We have also compared the projects with respect to air quality. It can be seen that each of the proposed schemes are predicted to lead to a net reduction in emissions of NO_x and PM_{10} when considered in terms of total regional emissions including that associated with electricity generated during their operation, which would otherwise have been generated regionally.

It is assumed that the reduction associated with the CHP plants reflects the greater efficiencies associated with larger and more modern power plants and the fact that it is easier and more cost effective to control emissions from larger combustion sources than for smaller, more spatially aggregated sources.

Emissions from the Rolls-Royce centre in Do Something Scenario 2, is lower in particulates but higher in levels of NOx than would occur from boilers. However, the use of tall stacks to disperse the emissions and the fact that emissions from boilers are displaced at lower levels means that predicted concentrations at the modelled height of 1.5m across the study area are lower.

Recommendations

As a result of this study we recommend that:

- LBC discuss with internal financial officers and with the LDA the prospects for finding sufficient grant finance or long-term equity participation in a JV district energy company.
- If the outcome is positive commence to select a suitable partner to deliver the scheme.
- Continue to develop the planning policies taking account of the results of this study
- Encourage the developers to plan their developments so that they can be connected to a low carbon district energy scheme in preference to local provision of low carbon systems to meet planning and Building Regulations requirements.
- Establish suitable planning policies that enable connection to the scheme to be seen as the first choice for developers who would have to justify why a connection cannot be made and to demonstrate that equivalent CO_2 savings can be achieved with an on-site solution.
- Hold further discussions with Rolls Royce to explore the potential for operating the plant for a longer period in the winter and some further hours in the summer and to

establish the net costs and benefits to establish the commercial viability of this approach.

- Should the Rolls Royce option continue to be positive a hybrid system would be a possible way forward with the first phase of Zone 1 being taken forward with a gas-engine CHP and when this has been established install the transmission main to the Rolls Royce plant. The gas-engine CHP would then operate in winter to meet peak demands and in summer when the Rolls Royce plant is not likely to be operated.

Capabilities on project:
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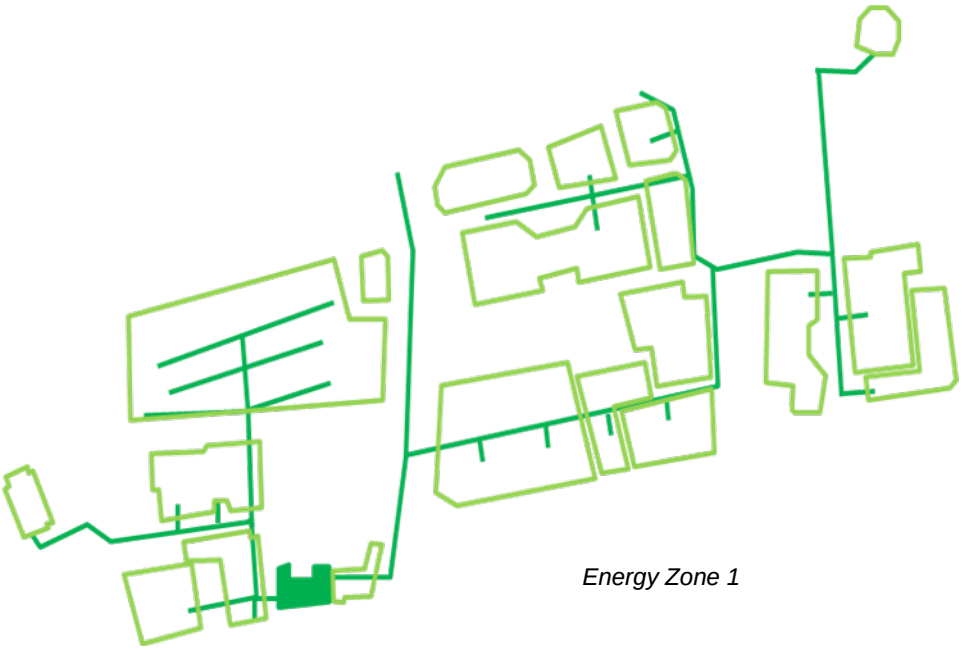
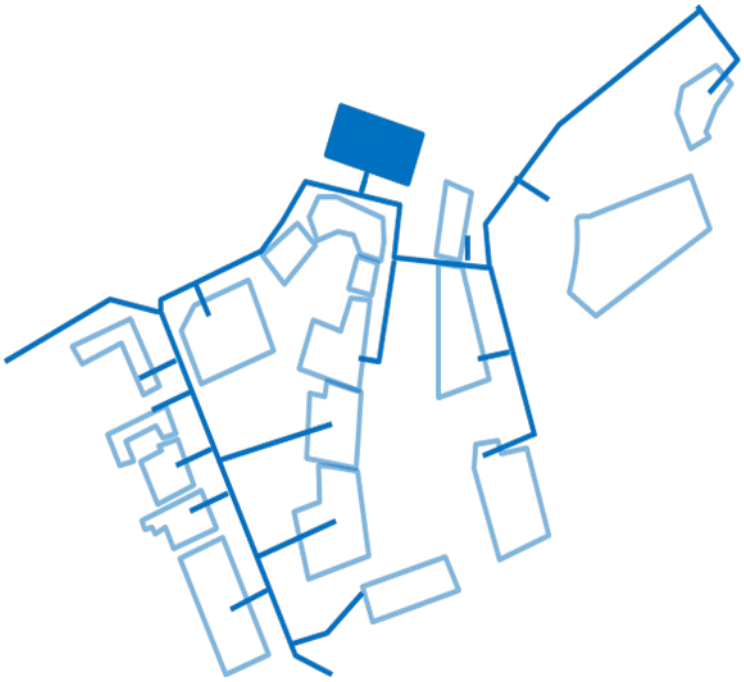
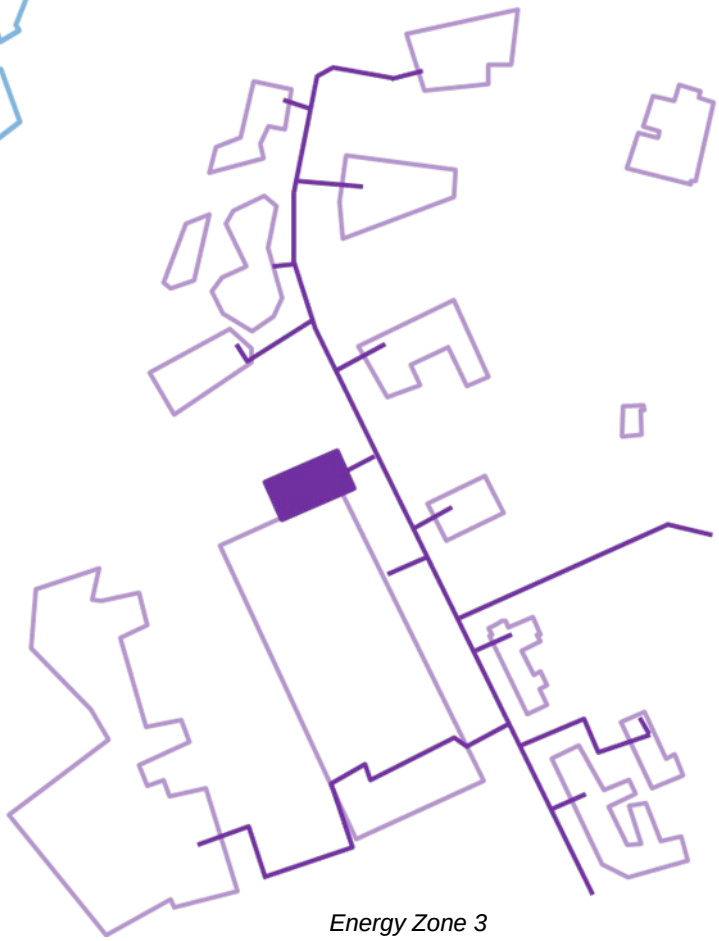
Environment



Energy Zone 1



Energy Zone 2



Energy Zone 3

Capabilities on project:
Energy
Environment

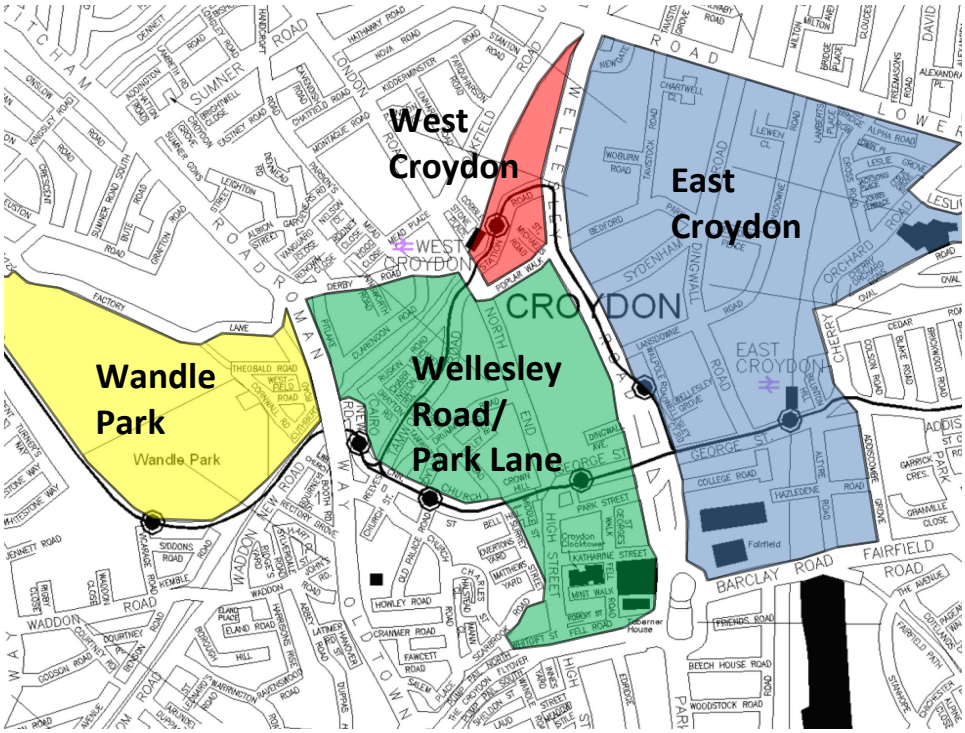
Capabilities on project:

1 Introduction

The purpose of this final study is to provide our detailed findings for the decentralised energy evaluation study for Croydon town centre. The results of the study will provide an evidence base to inform the development of the Core Strategy of the Local Development Framework (LDF) which is currently being prepared by the London Borough of Croydon (LBC).

The main area of the study is defined by four zones as highlighted in the diagram below. These zones are:

- Wellesley Road / Park Lane
- Wandle Park
- East Croydon
- West Croydon



Geographical Site Boundary of Works (town centre area)

Capabilities on project:

2 Programme

Due to the need to feed into the Council's Local Development Framework (LDF), this study consists of two parts, the interim report due on 15 October 2009 and the final report due on 17 December 2009.

3 Scope of Detailed Study

Following the demonstration of the high level case for each scenario within the interim study the scope of the detailed study comprises:

A. Identifies the mechanisms for directing or persuading building owners and operators to utilise a piped energy network.

B. Identifies and locates potential customers who could be provided with thermal (heating and cooling) and electrical energy within the town centre and nearby surrounding areas.

C. Estimates the level of energy demands of potential customers now and in the future.

D. Examines the feasibility of conversion and utilisation of the existing Rolls Royce power plant in Factory Lane

E. Identifies other potential locations for energy centres from which thermal and electrical energy could be produced and distributed to the town centre and any possible outlying residential areas.

F. Estimates the spatial requirements for the energy centres and their energy outputs.

G. Based on these potential demands, reviews the construction and routing of the required pipe distribution system considering:

   a. The interconnection of new and existing energy loads
   b. The obstacles faced and how these might be overcome.

H. Examines the potential impact of a district wide tri-generation system on the existing infrastructure i.e. considers the impact of increased loading on infrastructure where energy centres are located and reduced local demand for gas and electrical energy where buildings are supplied with heat and cooling from a district wide energy scheme.

I. Considers the impacts on local air quality that arise from elimination of local combustion of gas and biofuels and the concentration of combustion at district energy centres.

J. Identifies opportunities and implications for the pipe distribution networks to accommodate gas/liquid biofuels and hydrogen in the future.

K. Considers the long term maintenance and replacement of existing and provision of new services within the pipe distribution network.

L. Estimates costings together with potential income streams for each scenario.

M. Estimates potential carbon savings achieved by the envisaged decentralised energy scenario(s) compared to conventional systems.

To provide the study as a written report showing all the findings from the Council's requirements shown in sections 3 and 4 with supplementary diagrams, maps, graphs and calculations.