

5 Renewable Energy Constraints and Opportunities Analysis

5.1 Introduction

This section reviews the linkages for renewables and decentralised energy potential, feeding into the Heat Mapping Study, and provides an analysis of low carbon and renewable technologies within Redbridge Borough. The Study reviews existing energy studies relevant to Redbridge where available and assesses the renewable energy potential across Redbridge with respect to:

- Wind
- Biomass, including Energy from Waste (incineration only)
- Solar
- Hydropower
- Heat pumps

This section also investigates specific opportunities for implementing renewable energy within the Strategic Sites (Gants Hill, Ilford Town Centre and the Crossrail Corridor) agreed upon with LBR Council, commenting on the implications of different levels of carbon reduction and Code Levels.

Redbridge has a carbon footprint of 1,033 kilo tonnes CO₂ per annum. 50% of this comes from the domestic market, with the Industrial and Commercial sector and road transport each contributing to around 25% of the total emissions.

This Chapter explores the low and zero carbon energy potential in Redbridge, broken down into the different technologies. We have followed the methodology outlined in the latest PPS1 Supplement – Planning for a Low Carbon Future in a Changing Climate, which refers to DECC guidelines, titled *Renewable and Low Carbon Energy Capacity Methodology*. For each technology, there are three sections:

- An introduction, describing the technology;
 - A Borough-wide opportunity analysis that includes Stage 1 – Naturally Available Resource and Stage 2 – Technically accessible resource of the Renewable and Low Carbon Energy Capacity Methodology; and
 - A Borough-wide constraints analysis that includes Stage 3 – Physical Environment Constraints and Stage 4 – Planning and Regulatory Constraints of the Renewable and Low Carbon Energy Capacity Methodology.
- All conversion rates, yield and other parameters used in this section are based on the DECC methodology unless otherwise stated.

5.2 Wind Energy Potential

5.2.1 On-shore (commercial scale)

There is a wide variety of wind turbines with different power capacities. Commercial scale wind refers to on-shore wind farm developments for commercial energy generation and supply. Most such developments are connected to the grid, however, private-wire schemes are also an option and some already exist. Configurations of groups of wind turbines or individual turbines are used.

Assessing the resource potential and the deployment opportunities relates primarily to the wind speeds available within the region and the ability of current technology to harness this resource in terms of turbine design (size, efficiency) and installation requirements. Figure 5-1 below shows the size and power of a range of Vestas wind turbines⁵³. The largest turbine, the V90, is able to generate up to 9,152 MWh/year, which is enough to supply the electrical demand for approximately 2,000 homes.

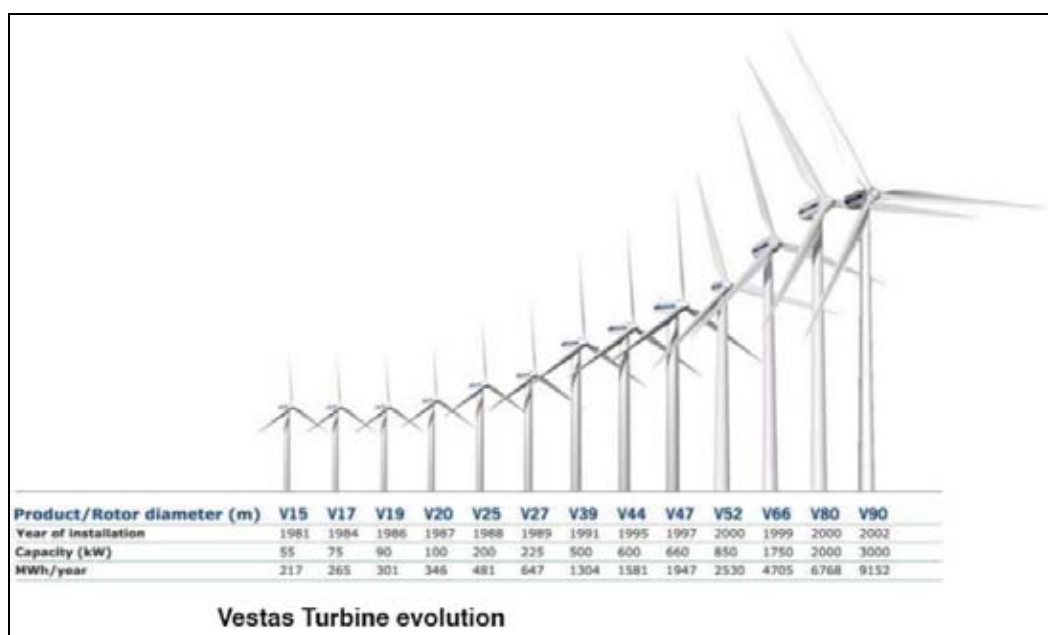


Figure 5-1: Turbine Capacity and Output

The following GIS representation (Figure 5-2) provides a summary of wind speeds in Redbridge at 45m above ground level.

⁵³ <http://www.vestas.com/>

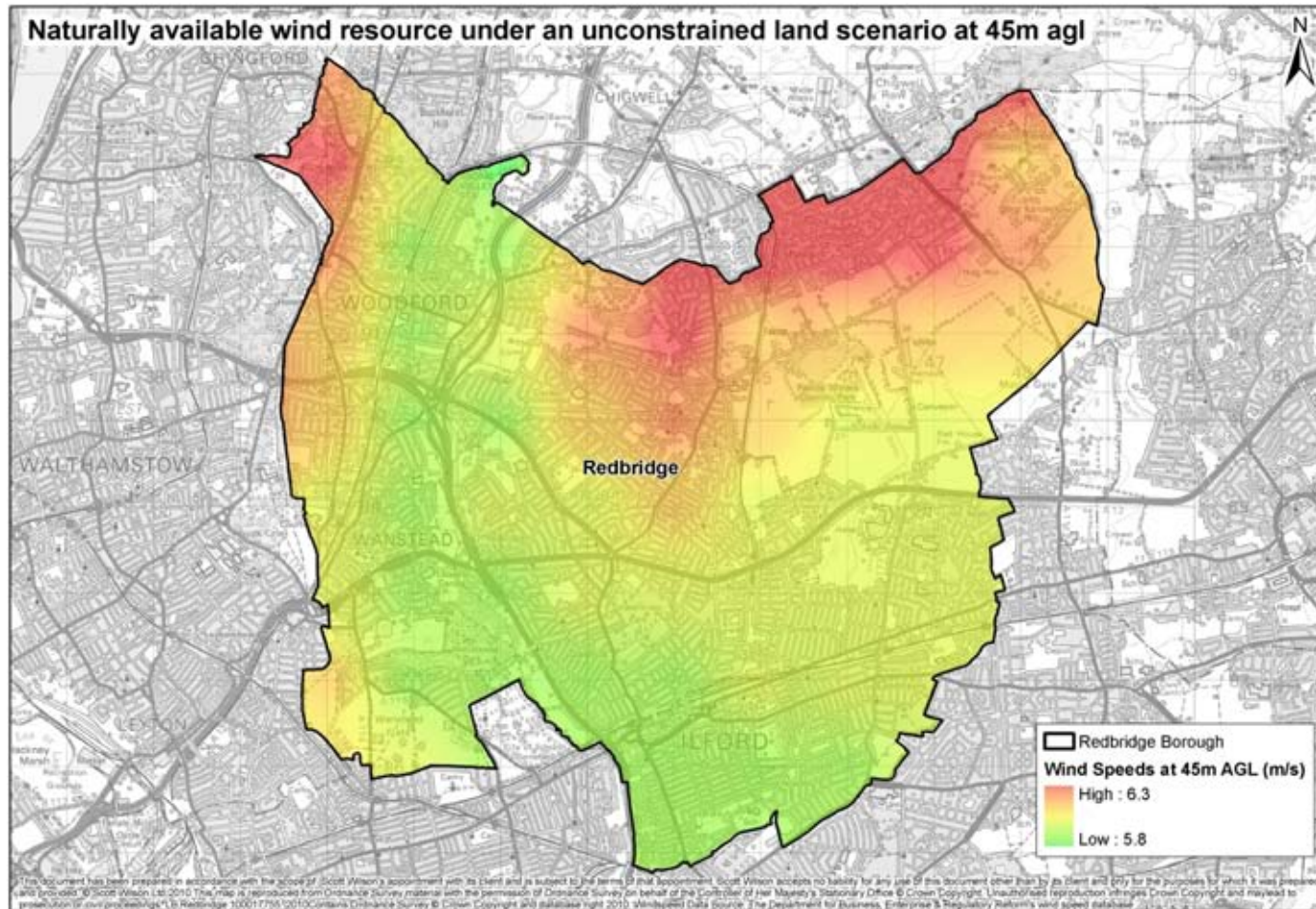


Figure 5-2: Naturally available wind resource⁵⁴ under an unconstrained land scenario at 45m agl.

⁵⁴ <http://www.bwea.com/index.html>

Opportunity analysis

The assumptions for calculating the naturally available wind resource have been summarised below based on the following analysis of environmental constraints and land designations.

Parameter description	Data
Total area in Redbridge with wind speeds above 5 m/s at 45 m above ground level	56.4 km ²
Wind turbine density (as per DECC methodology)	9 MW/km ²

Given the assumptions above, the theoretical potential installed capacity in Redbridge from large-scale wind is 508 MW (56.4Km² x 9MW/Km²). Theoretically, this is sufficient to power around 200 2.5MW wind turbines.

Constraints analysis

The theoretical value derived from the opportunity analysis above is reduced following a constraints analysis that includes the following:

- Non-accessible areas, such as roads, railways, inland waters, built-up areas, airports and MOD training sites (not present within Redbridge);
- Exclusion areas, such as ancient semi-natural woodland, sites of historic interest, buffers around roads and rail lines, buffers around build-up areas, buffers around airports and airfields, Civil Air Traffic Control constraints, MOD training areas and explosive safeguard areas;
- Designated landscape and nature conservation areas; and
- MOD constraints, such as MOD sites, air defense and air traffic control radar, other safeguarded areas, danger areas and MOD byelaws.

See GIS figures for constraints and opportunities evaluation below (figures 5-3 and 5-4).

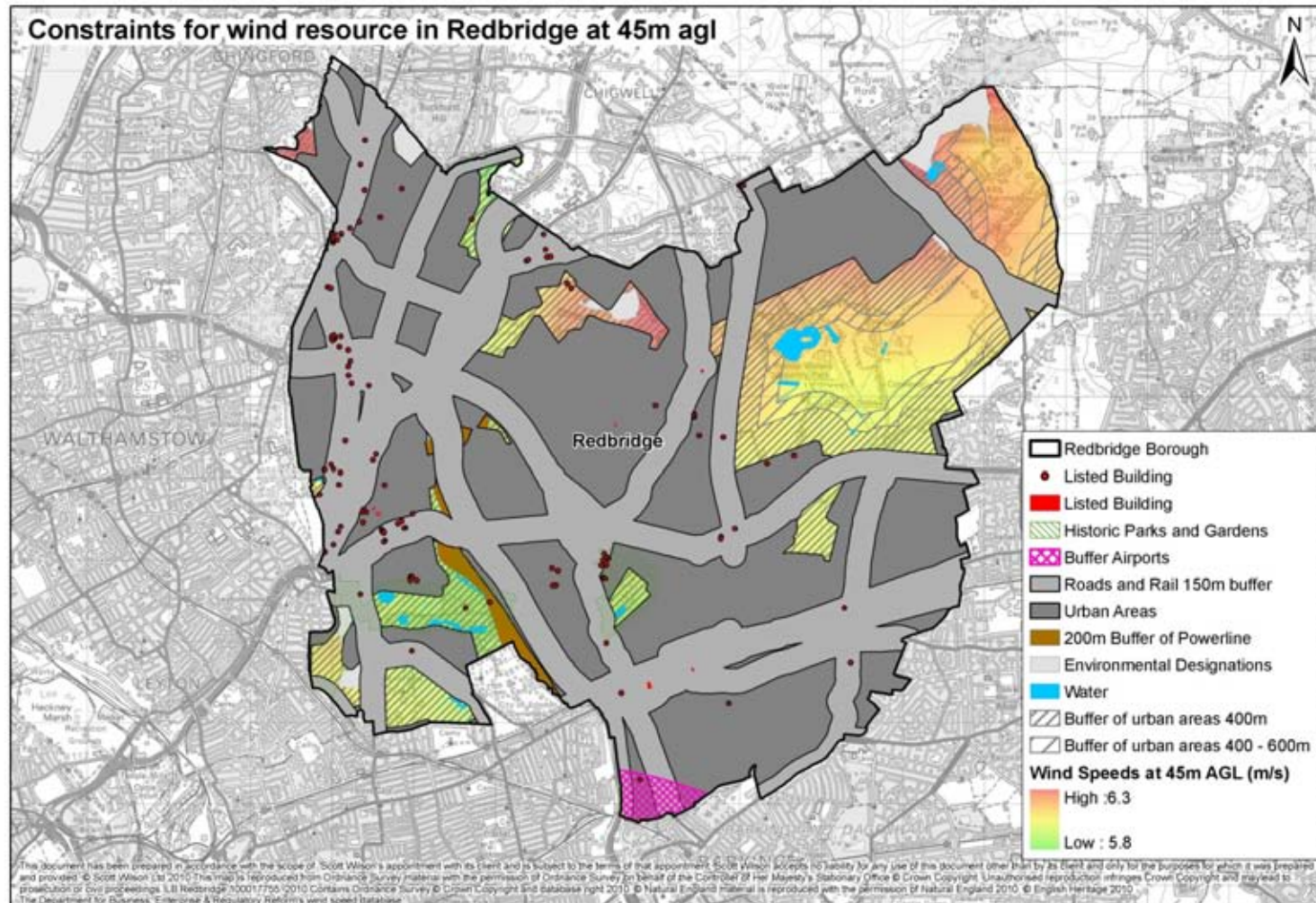


Figure 5-3: Constraints for wind resource in Redbridge at 45m agl

The GIS map below shows the constrained scenario for large-scale wind:

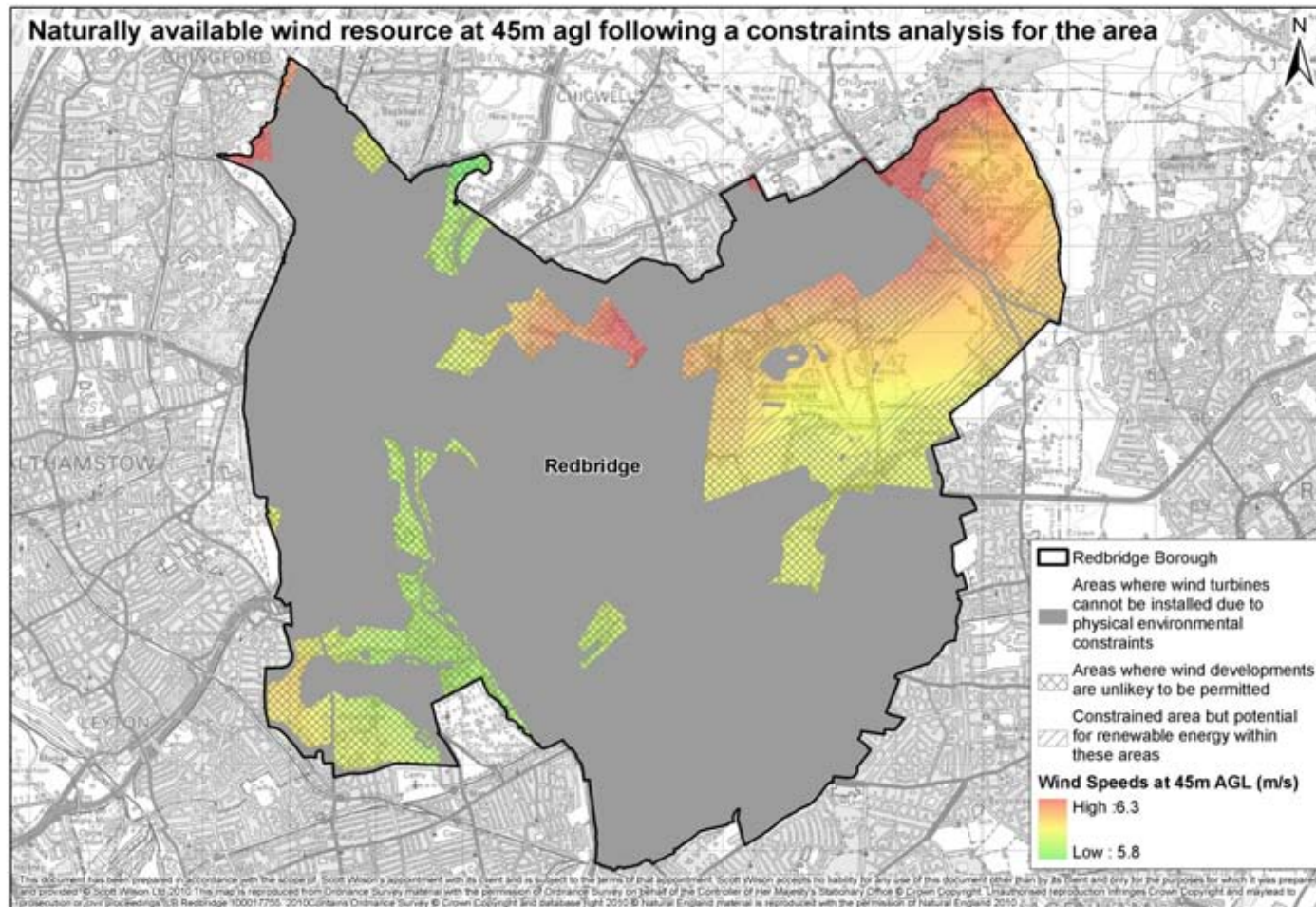


Figure 5-4: Naturally available wind resource at 45m agl following a constraints analysis for the area.

Parameter description	Data
Total unconstrained area in Redbridge with wind speeds above 5 m/s at 45 m above ground	3.45 km ²
Wind turbine density	9 MW/km ²

Following an assessment of all constraints, the actual potential for wind capacity in Redbridge is 32 MW (3.45KM2 x 9MW/Km2). Theoretically, this is sufficient to power 12 wind turbines of 2.5MW each. However, keeping in mind wind speed scaling factors and the urban nature of Redbridge, large scale wind is not considered to be suitable for Redbridge based on existing technology.

Particular consideration will need to be given to the following on a site-by-site basis before commercial wind can be deployed:

- Land ownership
- Noise
- Telecommunications and existing distribution networks
- Visual impact
- Distance from development
- Electrical connection

5.2.2 On-shore (small scale)

A sub-category of on-shore wind is the small scale installation, which can be defined as having capacity of less than 100 kW and typically comprise single turbines. Small scale wind schemes have different characteristics to large scale developments, which is reflected in the assessment parameters and the values applied.

The majority of small scale wind installations are ground-based developments with only a few that are building integrated (roof top). They are typically installed to supply the on-site demand first, before exporting to the grid. This means that they need to be located suitably. The potential number of small wind installations is in practice, therefore, a function of the number of buildings or sites rather than the land area available.

The following GIS representation provides a summary of wind speeds in Redbridge at 10m above ground level.

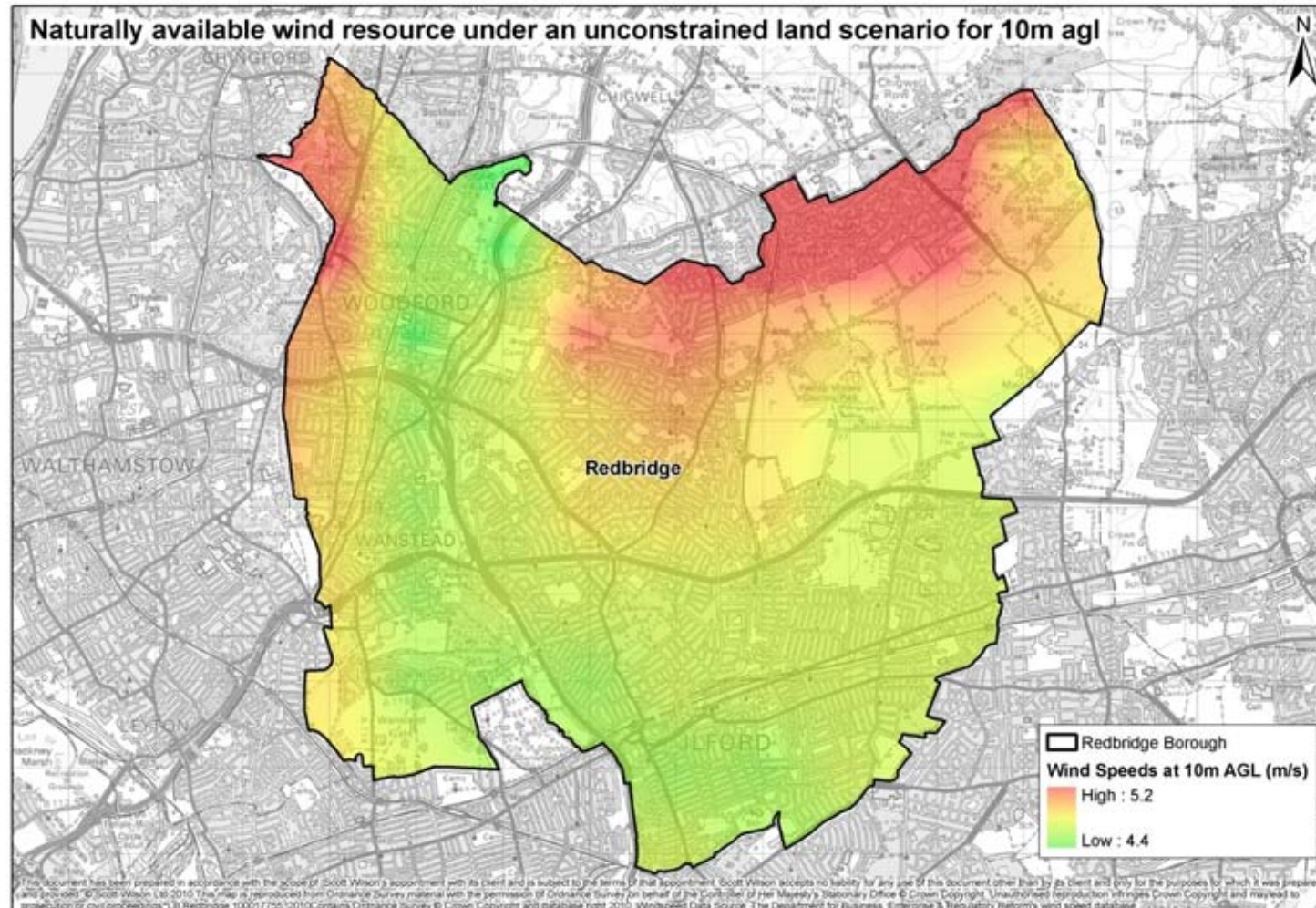


Figure 5-5: Naturally available wind resource under an unconstrained land scenario for 10m agl

Assuming areas with wind speeds greater than 5.0 m/s are suitable for small wind, a typical density of 20 dwellings per hectare (dph) (taking into account a mix of spaces, including non-residential floorspace) and a turbine rated output of 2 kW, the following results have been obtained:

Parameter description	Data
Total area with wind speeds greater than 5.0 m/s at 10 m above ground	3.56 km ²
Total number of dwellings in urban areas with average wind speeds above 5.0 m/s at 10 m above ground	7,120
Wind turbine size (installed capacity per turbine)	2 kW

Based on the assumptions above the theoretical potential installed capacity from small scale wind in Redbridge is 14 MW, which is sufficient to power around 28,000 homes assuming an average annual electricity consumption of 4301KWh per household for Greater London⁵⁵. Wind speed scaling factors have not been taken into account at this stage, as these will be applied on a site by site basis on more accurate and site-specific wind speed data.

Particular consideration will need to be given to the following on a site-by-site basis before commercial wind can be deployed:

- Land ownership
- Noise
- Telecommunications and existing distribution networks
- Visual impact
- Distance from development
- Electrical connection

The DECC methodology assumes that wind speeds above 4.5 m/s are sufficient for small scale wind. However, keeping in mind the highly urban nature of Redbridge, and Scott Wilson's practical experience with deploying small scale wind turbines, a minimum threshold of 5m/s is considered more suitable. Although the DECC methodology assumes 6kW as suitable for small scale wind, this is considered to be unrealistic for Redbridge with high density housing and not much external space for the deployment of 6kW turbines, therefore 2kW turbines have been selected as suitable for Redbridge based on ease of structural integration.

⁵⁵ <http://www.dti.gov.uk/files/file20328.pdf>

5.3 Biomass Resource Potential

5.3.1 Overview

Biomass is biological material derived from living, or recently living organisms. Biomass is a diverse category with regard to the type of available fuels, fuel conversion technology and type of energy output.

Raw materials that can be used to produce biomass fuels are widely available across the UK and come from a large number of different sources and in a wide variety of forms. All of these forms can be used for fuel production purposes; however, not all energy conversion technologies are suitable for all forms of biomass.

- **Virgin wood** - Wood can be derived from conventional forestry practice, such as thinning and trimming, as part of sustainable management of woodland. It can also be derived from tree surgery operations and the management of parks, gardens and transport corridors. The wood can come in a range of physical forms such as bark, logs, sawdust, wood chips or wood pellets.
- **Energy crops** - Energy crops are grown specifically for use as fuel and offer high output per hectare with low inputs. The main type of energy crop is short rotation coppice such as willow, or forestry species such as eucalyptus or poplar. Poplar and willow are the most popular crops with an achievable yield of around 8 tonnes per annum.
- **Agricultural residues** - Agricultural residues are of a wide variety of types, and the most appropriate energy conversion technologies and handling protocols vary from type to type. Sources can include arable crop residues such as straw or husks, animal slurries or organic material from excess production or insufficient market, such as grass silage.
- **Industrial waste and co-products** - Many industrial processes and manufacturing operations produce residues, waste or co-products that can potentially be used or converted to biomass fuel. Wood waste can be utilised by a range of thermal conversion technologies such as boilers for the generation of heat for space heating or process heat, or used for electricity generation in a dedicated system or a combined heat and power (CHP) co-generation system.



Conversion Technology

There are three main processes currently available and used:

- Direct combustion of solid biomass;
- Pyrolysis (thermal gasification in the absence of oxygen) of solid biomass; and
- Anaerobic digestion of solid or liquid biomass.

Energy Output

Biomass can be in the form of electricity or heat, depending on the conversion technology. Both options are explored in this section and for fuels that can viably be converted to either output, both options are provided.

This section reviews information publicly available to determine the opportunities and constraints for biomass deployment in Redbridge for the following biomass types:

- Managed woodland
- Energy crops
- Waste wood
- Agricultural arisings (straw)
- Animal biomass – wet organic waste and poultry litter (not applicable to Redbridge due to its highly urban character)
- Municipal Solid Waste

200ha of the 5644 ha of Redbridge comprises woodland cover⁵⁶. The woodland area in Redbridge accounts for less than 2.5% of the total London woodland cover (approximately 7300ha)⁵⁷.

5.3.2 Key Constraints to Biomass use within Redbridge

Air Quality Management Area (AQMA)

Redbridge Borough was declared an Air Quality Management Area (AQMA) on 31 December 2003, and this is illustrated in the figure below:

⁵⁶ Redbridge Biodiversity Strategy, 29th April 2005

⁵⁷ <http://www.bexley.gov.uk/index.aspx?articleid=6063>

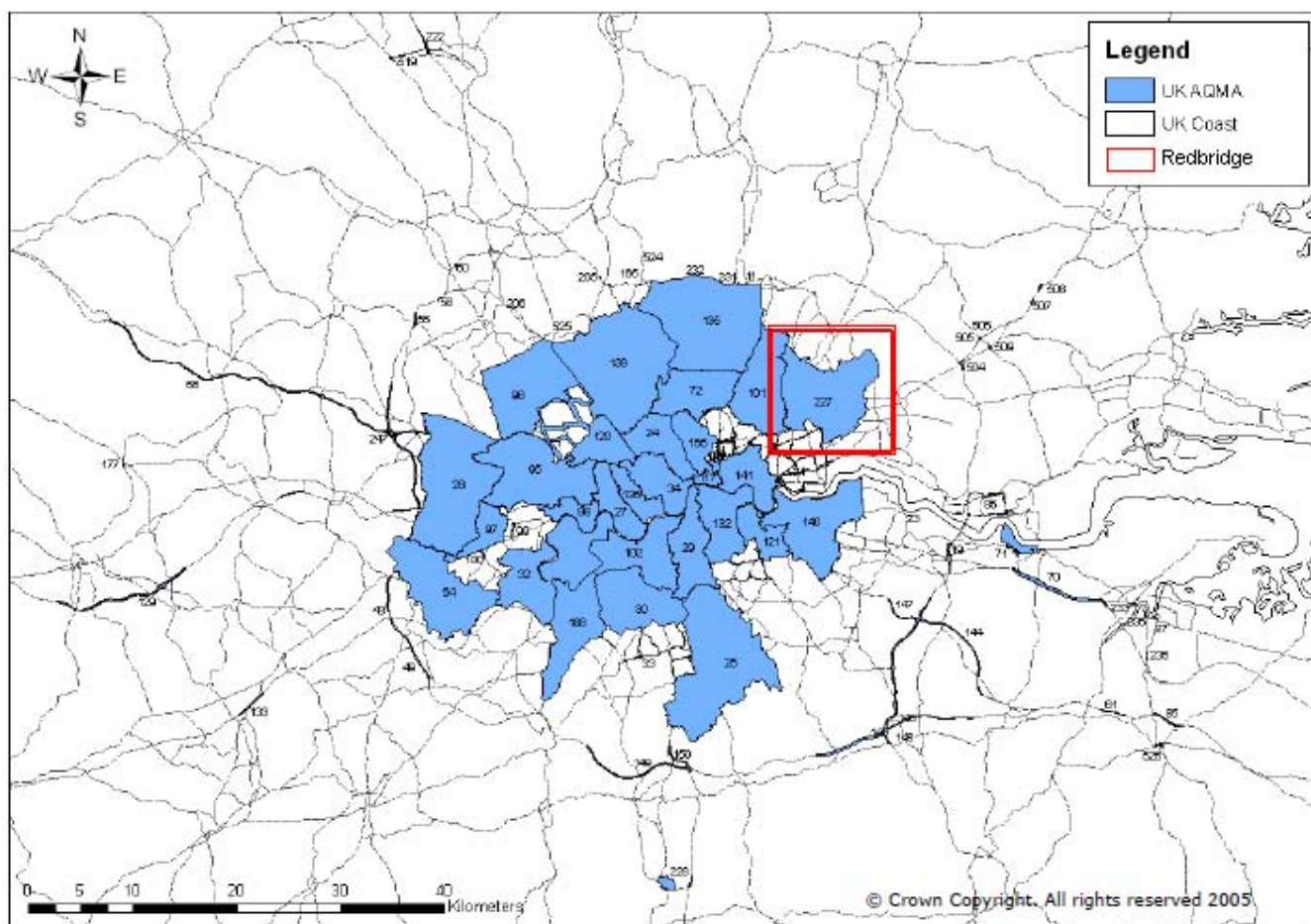


Figure 5-6: AQMAs of London and surrounding areas⁵⁸

The figure below illustrates the predicted annual mean NO₂ results for Redbridge⁵⁹. The areas in yellow and red on the figure below indicate areas within Redbridge with NO_x emissions greater than 40 micrograms per m³.

⁵⁸ Sturman J, King K, *GIS Dataset of AQMA's in UK*, March 2005, netcen

⁵⁹ Redbridge Air Quality Action Plan 2007

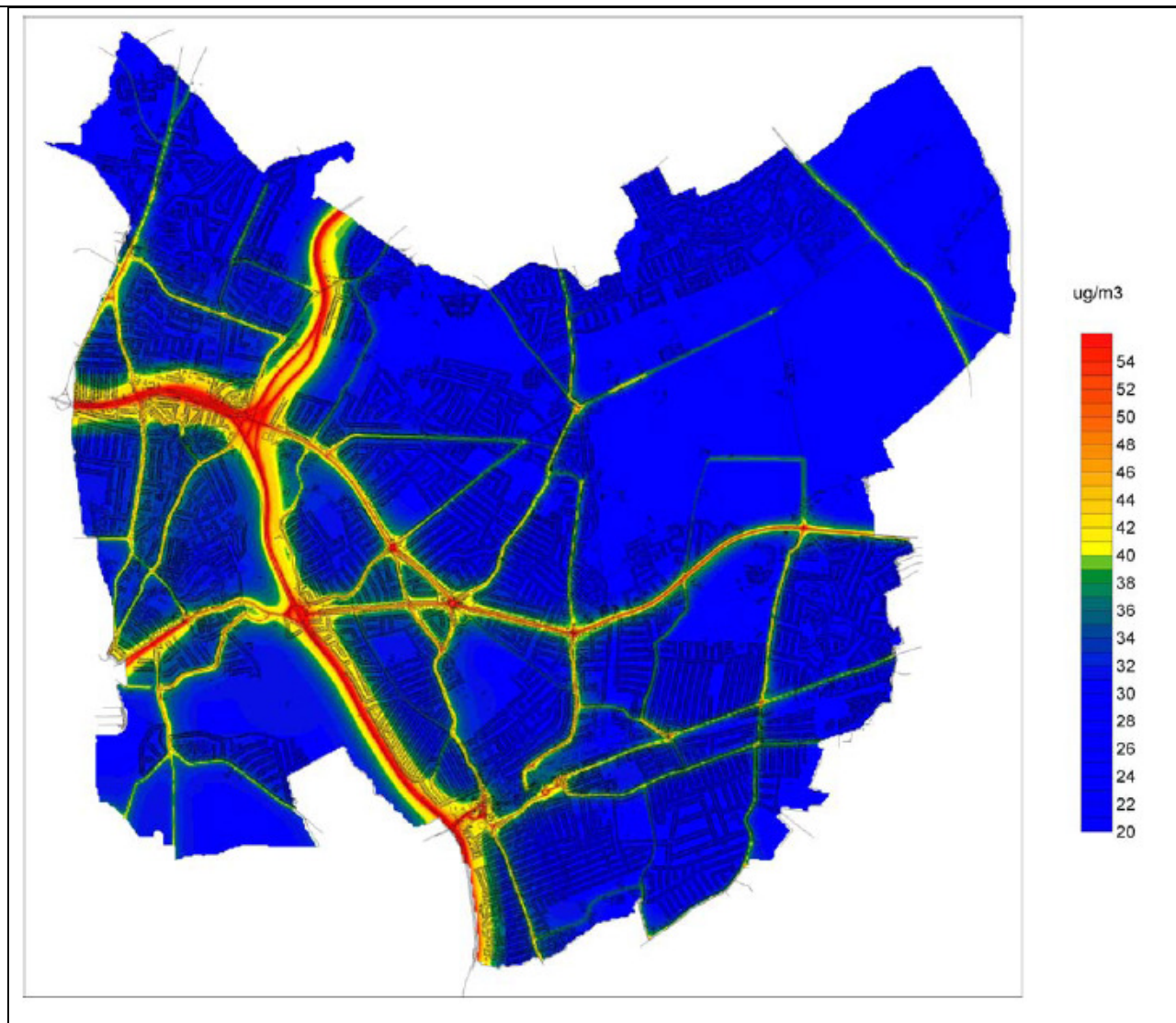


Figure 5-7: Predicted annual mean NO₂ results for Redbridge

The Mayor's draft Air Quality Strategy indicates that small biomass boilers (below 500kWth) in Air Quality Management Areas are considered unsuitable unless they can demonstrate that they have no adverse effects on local air quality when compared with conventional gas fired boilers⁶⁰.

Where the use of biomass is proposed, the biomass boiler must be certified as an exempt appliance in accordance with the Clean Air Act 1993. A list of exempt appliances can be found at: <http://www.uksmokecontrolareas.co.uk/appliances.php>. On the small to medium scale, there is a selection of wood chip and pellet boilers which have been classified as exempt appliances and are therefore able to be installed and operated in smoke control areas as they comply with the Mayor's standards. Air quality objectives included in the Air Quality Regulations (2002)⁶¹ for the purpose of Local Air Quality Management in the UK stipulate that an annual mean of 40 micrograms per m3 of nitrogen dioxide and PM₁₀'s must not be exceeded. Therefore the use of biomass as a resource would be severely constrained in areas with NOx emissions greater than 40 micrograms per m3 as illustrated in Figure 5-7.

Planning Policy: Conflict with recycling targets

The use of waste wood or green waste may conflict with recycling targets set by the Borough. Waste can be recycled, sent to land fill, or diverted (from land fill, for example, biomass processes where used as a fuel). Since green waste makes a significant contribution to these targets, there is an incentive to recycle the waste rather than incinerate it in order to meet stringent recycling targets.

Fuel Supply and demand

The following figure illustrates a review of biomass wood fuel suppliers with head offices in closest proximity to Redbridge, indicating that the Renewable Fuel Company (within Redbridge), Land Energy Limited, Hertswood fuel Ltd., and Writtle Park Tree Services Ltd are preferred suppliers as they are within 35km of Redbridge:

⁶⁰ GLA Energy Team Guidance on Planning Energy Assessments, October 2009

⁶¹ http://www.airquality.co.uk/reports/cat18/0806261519_methods.pdf

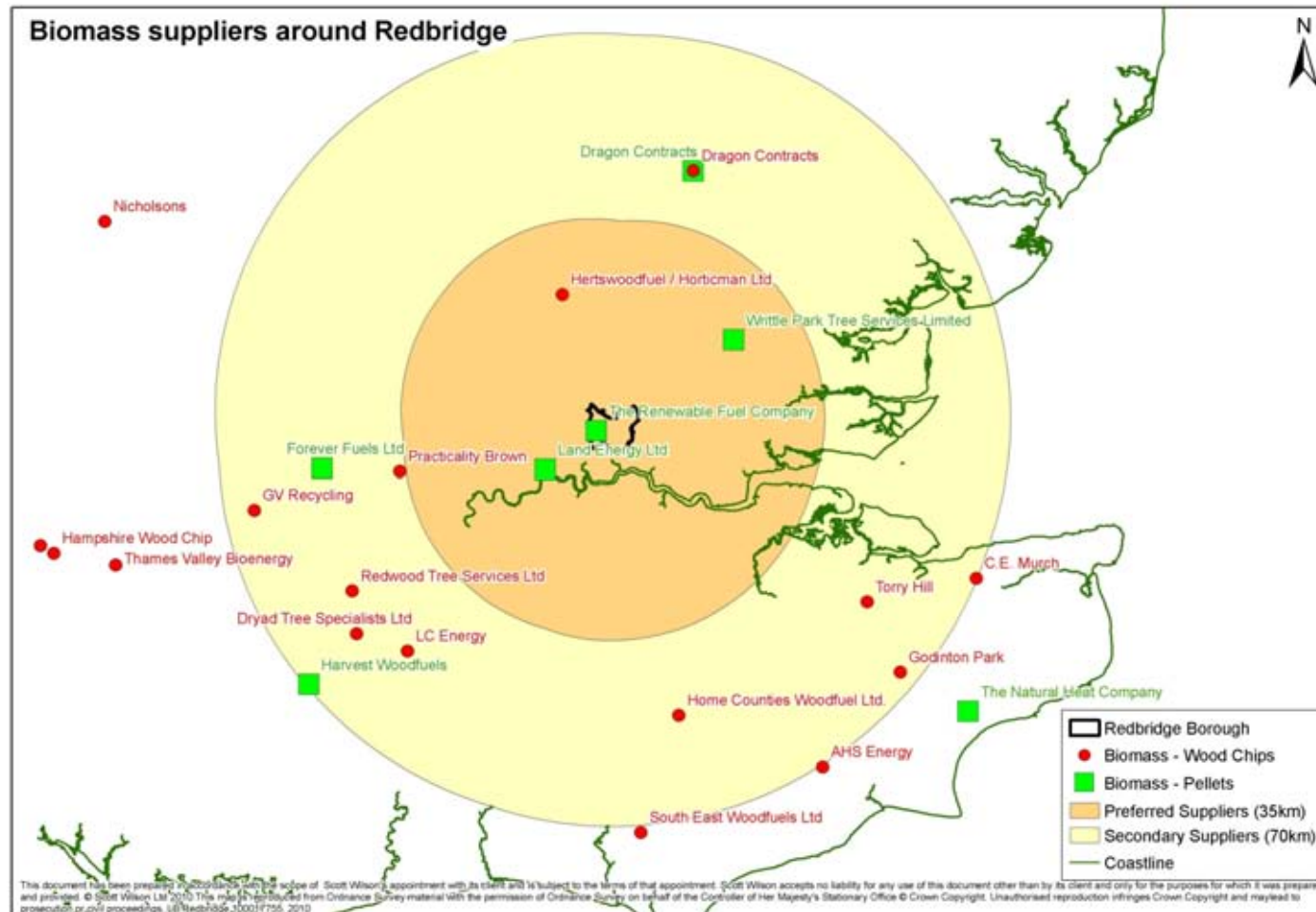


Figure 5-8: Biomass suppliers around Redbridge⁶²

⁶² http://www.biomassenergycentre.org.uk/portal/page?_pageid=77,225275&_dad=portal&_schema=PORTAL

The North East London Biomass study⁶³ estimates that arboricultural arisings from tree surgeons and woodland are estimated to yield around 1.01 MW capacity annually in North East London for Havering, Barking & Dagenham and Redbridge, which is higher than the estimated capacity from the South East Region pro-rata methodology (0.08MW electricity and 0.12MW heat)⁶⁴. This may be attributed to the fact that the North East London Biomass study takes into account the possibility of international biomass supply including supply from Canada, based on the rationale that transport emissions related to international supply of biomass would be lower than using natural gas as a fuel. Therefore, taking into account international supply attributes a higher figure for energy generation potential than has been calculated within the South East Study.

The table below provides a summary of all planning proposals in Redbridge incorporating biomass and the capacity, fuel type, fuel quantity, and the status of the data provided.

	Place	Capacity (kW)	Fuel	Mass (t/yr)	Postcode	Note
Redbridge	Mansion House	117	Pellet	50	IG1 1TJ	Existing
	Ray Park visitor centre	36	Pellet	15	IG9 6ES	Existing
	Grove Farm	330	Pellet	140	RM6 4AQ	Planned
	246-250, High Road,	300*	Pellet	127	IG10 1RB	Existing
	Britannia Music Site	100	Pellet	42	IG1 2PX	Proposed
	Total	883		374		

Table 5-1: Wood fuel demand from planning applications 2005-present⁶³

The existing, planned and proposed biomass installations listed in Table 5-1 are shown in the figure below. Biomass installations using pellets as a fuel clearly represent the bulk of installations taking place at the moment largely due to ease of storage of pellets.

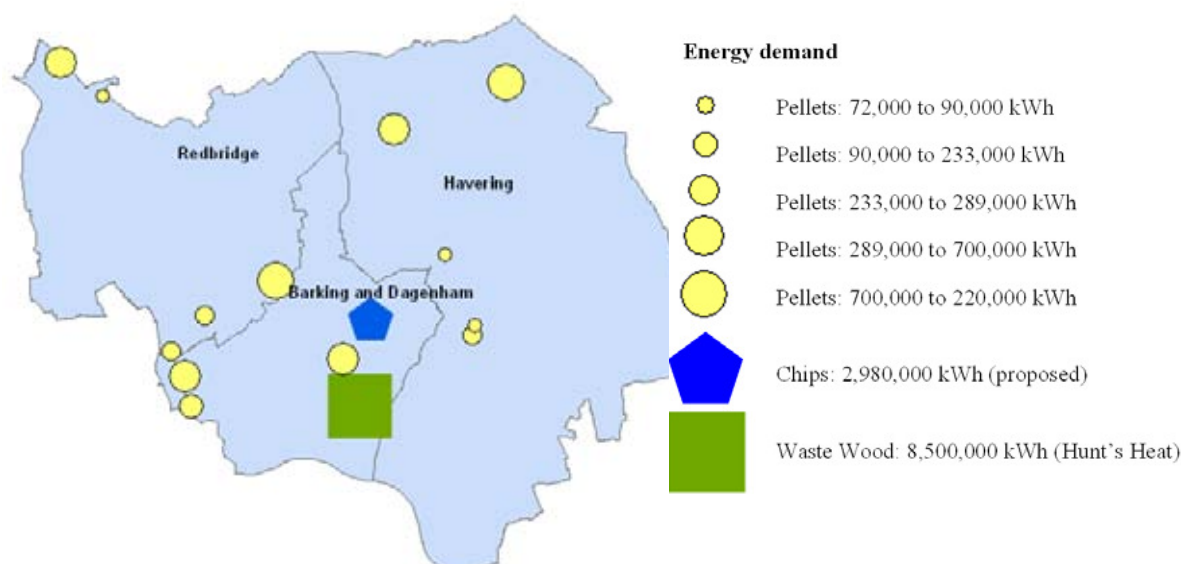


Figure 5-9: Visual representation of biomass demand (kWh)⁶³

⁶³ Biomass supply chains in North East London, CEN Services Ltd, March 2010

⁶⁴ <http://www.forestry.gov.uk/>

5.4 Managed Woodland

5.4.1 Opportunity analysis

The Forestry Commission provides statistical data on the woodfuel resource available in the UK, broken down into regions. Data estimates for the felling and thinning of biomass products in the South East has been extrapolated and presented below. It includes biomass from pines, spruces, conifers and broadleaves and shows a trend of increasing harvest of biomass products to the year 2021. It is forecast that in the year 2021, there will be an annual production of around a million tonnes of biomass potentially available as woodfuel in the South East as illustrated in Figure 5-10 below. It is worth noting that the South East of England has by far the highest percentage of woodland cover in the country at 14.1%, or 270,000 hectares (out of a total land area of 1,909,600 hectares).

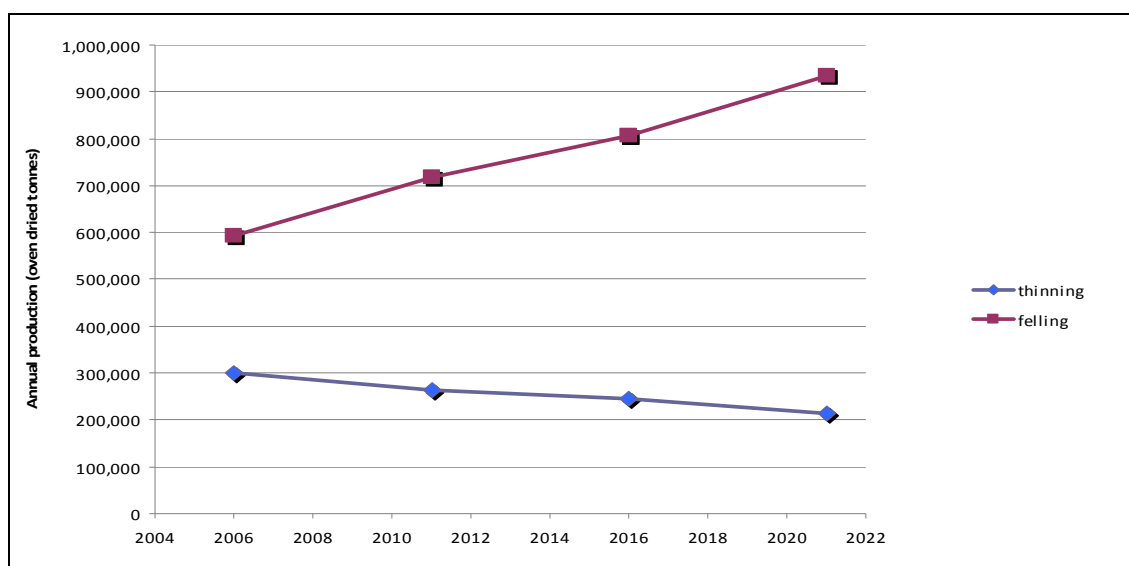


Figure 5-10: Graph showing forecast of woodfuel production in South East⁶⁵

Available data for evaluating biomass has been limited to South East regional data derived from the Forestry Commission Statistics Unit. Data specific to Redbridge and other areas is currently not available.

Forest Research, who is the research arm of the Forestry Commission, has estimated the amount of Forest and Woodland tonnage in the South East region to be 446,396 ODT (oven dried tones). Forest and Woodland tonnage in East of England amounts to 272,810 ODT/year⁶⁶ Redbridge woodland area amounts to about 0.07% (200ha) of the total South East woodland area.

⁶⁵ www.forestryresearch.gov.uk

⁶⁶ <http://www.eforestry.gov.uk/woodfuel/FR.do#>

Electricity: Based on the South East Region estimations, 6,000 ODT per year correspond to 1 MW capacity, therefore total capacity in the South East is 74.4 MW per year. This gives an estimated figure of **0.055 MW** capacity in Redbridge.

Heat: There is inadequate detail to accurately assess the potential heat output in Redbridge specifically. A worst case scenario, which assumes a calorific value of 12.5 GJ/ODT, 80% plant conversion efficiency and 80% plant availability gives 99.1 MW capacity in the South East, which translates to **0.07 MW** in Redbridge.

5.4.2 Constraints Analysis

Woodfuel that is uneconomic to harvest and woodfuel that could go to alternative markets, such as construction, paper, etc. should be excluded from the calculation of total capacity in the South East and Redbridge. Unfortunately, no information on these quantities was available on forestry.gov.uk, therefore SW have made an assumption of 30% being unsuitable for biomass, leaving the South East with a capacity of 52.1 MW of electricity and 69.4 MW heat. Redbridge would have a generation capacity of just over **0.04 MW** electric or **0.05 MW** heat.

5.5 Energy Crops

There is no information available in the public domain specific to energy crop generation within Redbridge. The information within this section has largely been derived from pro rata information for the South East region.

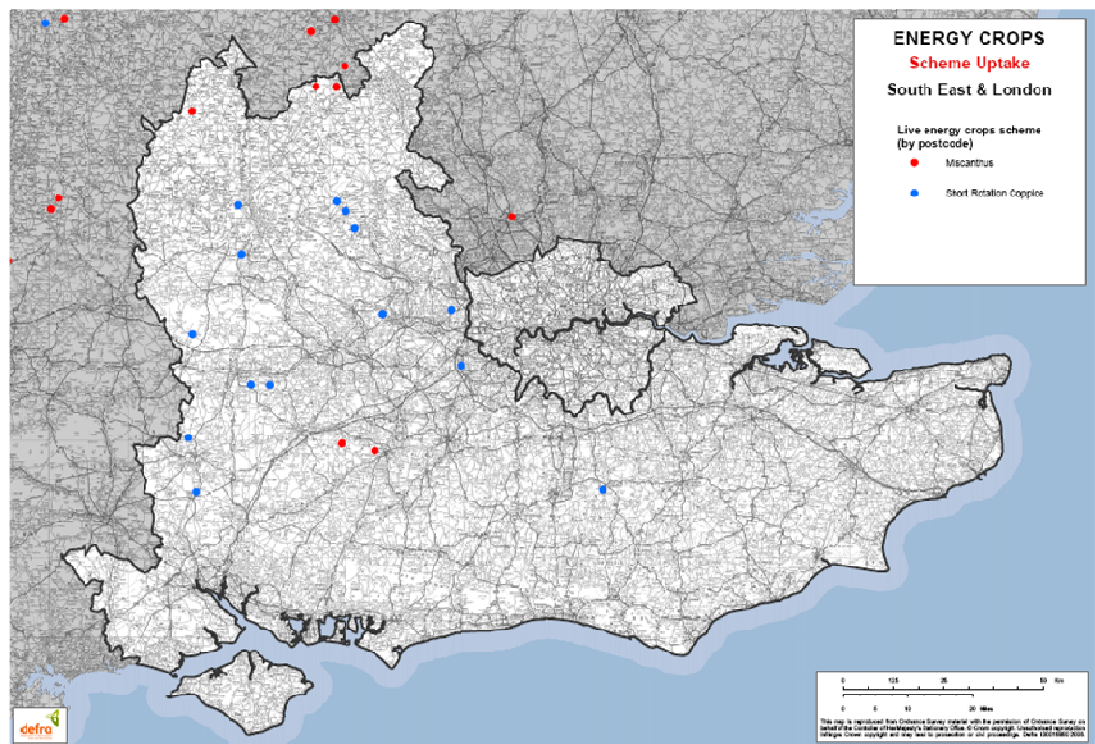


Figure 5-11: Existing Energy Crop Locations in the South East and London

The outputs of the Defra study⁶⁷ shown above suggest that there are currently no existing energy crop schemes in Redbridge. There are several limitations to the modeling work carried out by Defra, acknowledged in their study. The model input data includes data on soil types and structure, average rainfall and climatic conditions used to estimate the potential yield of the energy crops. The analysis also used data derived from disaggregation of selected sample studies carried out in the region and therefore locally specific conditions have not been assessed. The following sections will assess the potential for energy crops such as Miscanthus and Short Rotation Coppice within Redbridge.

5.5.1 Miscanthus

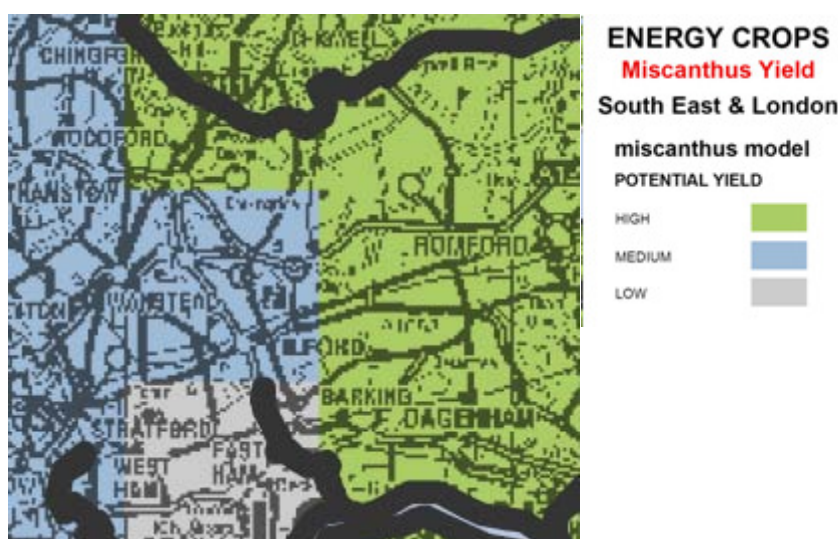


Figure 5-12: Yield Map for Miscanthus in Redbridge

The above figure from Defra⁶⁸ identifies areas where high, average and low Miscanthus yields may occur. About 85% of the total area of Redbridge has been identified as having Medium potential for yield of Miscanthus, while East Redbridge has been identified as an area of high potential yield. These figures are inconsistent with the highly urban nature of Redbridge, and have therefore not been used in this Study.

4.6% of Redbridge, equating to 260Ha constitutes arable land⁶⁹. It is assumed that 10% (SW estimate based on estimated other uses for arable land) of this will be used for Miscanthus. This translates into a total area of around 26 hectares. At a yield of 15 ODT/ha/year there is a production of 390 ODT_{miscanthus}/year.

Electricity: For a standard calorific value of 1MW per 6,000 ODT/year this translates into **0.065 MW** of capacity from Miscanthus generated within Redbridge.

⁶⁷ <http://www.defra.gov.uk/foodfarm/growing/crops/industrial/energy/index.htm>

⁶⁸ Maps for Energy Crop potential yields: <http://www.defra.gov.uk/foodfarm/growing/crops/industrial/energy/opportunities/se.htm>

⁶⁹ LBR Nature Conservation SPD, June 2006

Heat: For a worst case scenario for a standard calorific value of 12.5GJ/ODT this translates into a **0.14 MW** capacity of heat from Miscanthus generated within Redbridge.

5.5.2 Short Rotation Coppice (SRC)

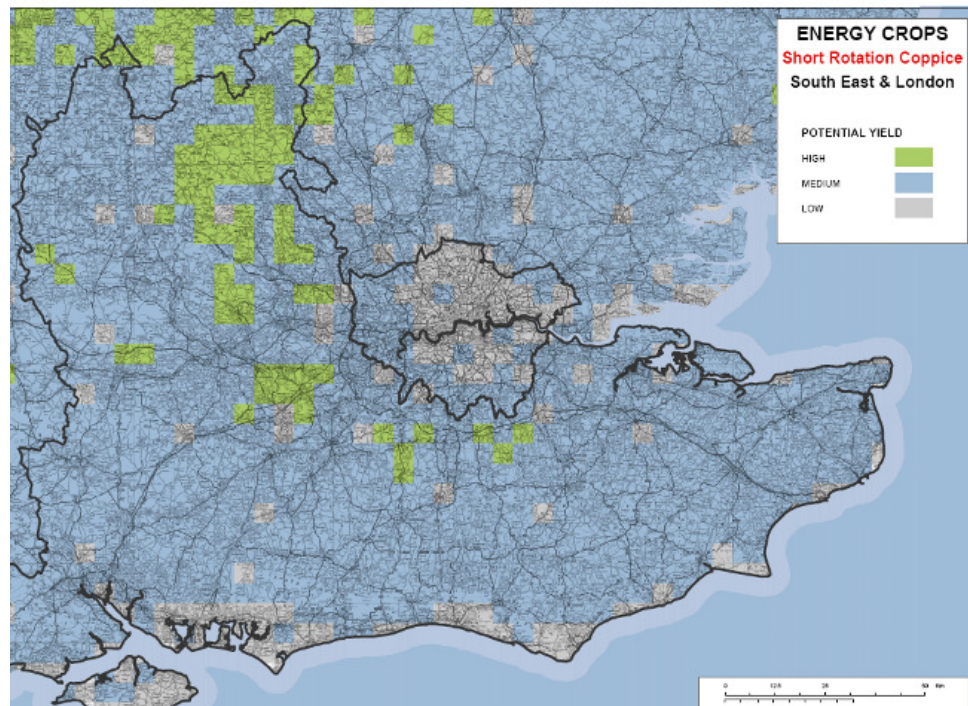


Figure 5-13: Yield Map for Short Rotation Coppice in Redbridge.

The above map from Defra identifies areas where high, average and low SRC yields may occur. The vast majority of Redbridge, about 90% of it, is classified as having medium potential yield. These figures are inconsistent with the highly urban nature of Redbridge, and have therefore not been used directly in this Study, but have been factored down based on aerial maps of the borough.

Assuming most of the land with relatively favourable conditions for Miscanthus is likely to also be used for agriculture, infrastructure and buildings, it is likely that no more than 10% can be used for SRC. Since SRC is less efficient than Miscanthus, it is reasonable to assume that even a smaller proportion of available land will be used for SRC crops, i.e., a percentage of 5%. This translates into a total area 13 hectares. At a yield of 10 ODT/ha/year there is a production of 130 ODT_{SRC}/year.

Electricity: For a standard calorific value of 1MW per 6,000 ODT/year this translates into **0.02 MW** of capacity from SRC generated within Redbridge.

Heat: For a worst case scenario for a standard calorific value of 13GJ/ODT this translates into a **0.05 MW** capacity of heat from SRC generated within Redbridge.

As mentioned in the sections above, the area available for energy crops is severely restricted by the highly urban character of Redbridge. Therefore, although Redbridge is classified as a

high/medium potential area for Miscanthus and SRC in the Defra Study, the sections above identify that the actual potential for energy crops is low for Redbridge.

5.6 Waste Wood

5.6.1 Opportunity Analysis

Waste wood in the South East is estimated at 850,000 ODT.⁷⁰ This translates into a theoretical capacity of **14.2 MW** of electricity and **12.9 MW** of heat generated from waste wood within the South East. Redbridge woodland area amounts to about 0.07% of the total South East woodland area, amounting to a theoretical capacity of **0.01 MW** of electricity and **0.009 MW** of heat generated from waste wood.

5.6.2 Constraints Analysis

Due to competing uses it has been assumed that only 50% of the total waste wood resource is available for energy. This translates into a capacity of **0.005 MW** of electricity and **0.004 MW** of heat generated from waste wood in the South East.

5.7 Agricultural Arisings

5.7.1 Opportunity Analysis

Forest Research has estimated the amount of agricultural arisings to be 144,645 ODT. This translates into **24.1 MW** potential electrical generation from agricultural arisings within the South East, and approximately **0.01MW** generation for Redbridge.

5.7.2 Constraints Analysis

We assume that 50% of the above resource could be used as feedstock for power generation, bringing the estimated potential for generation to **12.1 MW** for the South East and **0.009MW** for Redbridge.

5.8 Municipal Solid Waste (MSW)

5.8.1 Opportunity Analysis

According to Defra's quarterly MSW statistics report⁷¹ (2008/2009, updated November 2009) there are 116,378 tonnes of MSW generated in Redbridge each year. Based on this figure above and on the assumption that each 10 kilo-tonne of MSW equates to 1 MW power generation capacity, total capacity in Redbridge amounts to **11.6 MW** from Municipal Solid Waste.

⁷⁰ [http://www.forestry.gov.uk/pdf/eng-see-3-woodfuel-resources.pdf/\\$FILE/eng-see-3-woodfuel-resources.pdf](http://www.forestry.gov.uk/pdf/eng-see-3-woodfuel-resources.pdf/$FILE/eng-see-3-woodfuel-resources.pdf)

⁷¹ <http://www.defra.gov.uk/evidence/statistics/environment/wastats/archive/mwb200809a.xls>

5.8.2 Constraints Analysis

There are no significant technical constraint parameters identified. However existing contracts for waste disposal (based on trends within London boroughs) and the constraints related to identification of suitable locations for energy from waste plants within the Borough suggest that it is unlikely that energy from waste could be a viable option for Redbridge. Energy recovery is specified as the least favourable option for waste treatment in the ELWA Joint Waste DPD⁷². Theoretically **11.6 MW** of energy could be generated through MSW in Redbridge, however it is likely that cross border initiatives will have to be explored to utilise existing waste treatment facilities.

The following types of biomass have been considered and are presented below along with their availability in Redbridge or the South East region according to bodies such as the Forestry Commissions, National Inventory of Woodlands and Trees, Defra and the Environment Agency. Their potential capacity to generate electricity and/ or heat is further summarised below.

Type of biofuel	Electricity (MW)	Heat (MW)	Reference Area
Managed Woodland	0.04	0.05	Redbridge
Energy Crops – Miscanthus	0.06	0.14	Redbridge
Energy Crops - SRC	0.02	0.05	Redbridge
Waste Wood	0.005	0.004	(Redbridge)*
Agricultural Arisings (straw)	0.009	Not efficient	(Redbridge)*
Municipal Solid Waste (MSW)	Not applicable	11.6	Redbridge
TOTAL	0.13	11.84	

**This is an indicative figure, calculated on an area-based scaling factor of 0.0007 (Redbridge as part of the South East).*

Compared with the South East predicted energy capacity of 111 MW by 2010 and 154 MW by 2016, Redbridge in terms of its capacity is estimated to contribute **0.13MW_e** and **12MW_t**.

5.9 Animal Biomass

Due to its highly urban nature, animal biomass/biogas are not viable resources for energy generation in Redbridge and have therefore not been explored within this study.

⁷² Sustainability appraisal of the Joint Waste Development Plan Document, East London Waste Authority, May 2007

5.10 Hydropower

Hydropower involves harnessing the power of flowing or falling water through a turbine in order to produce electricity. The parameters determining the amount of electricity produced include the turbine generating capacity, the turbine discharge flow (the water passing through the turbine at any given time, which will change depending the time of the year) and available head (the vertical distance between the point where the water is at its highest and the turbine).

Hydroelectric schemes are classified into three major categories based on their installed capacities; large hydro; medium hydro; and small hydro schemes. Small hydro schemes are further categorised as mini-, micro- and pico-hydro schemes.

5.10.1 Opportunities within Redbridge

The Environment Agency has identified the potential for hydropower potential within Redbridge which has been illustrated in the figure below:

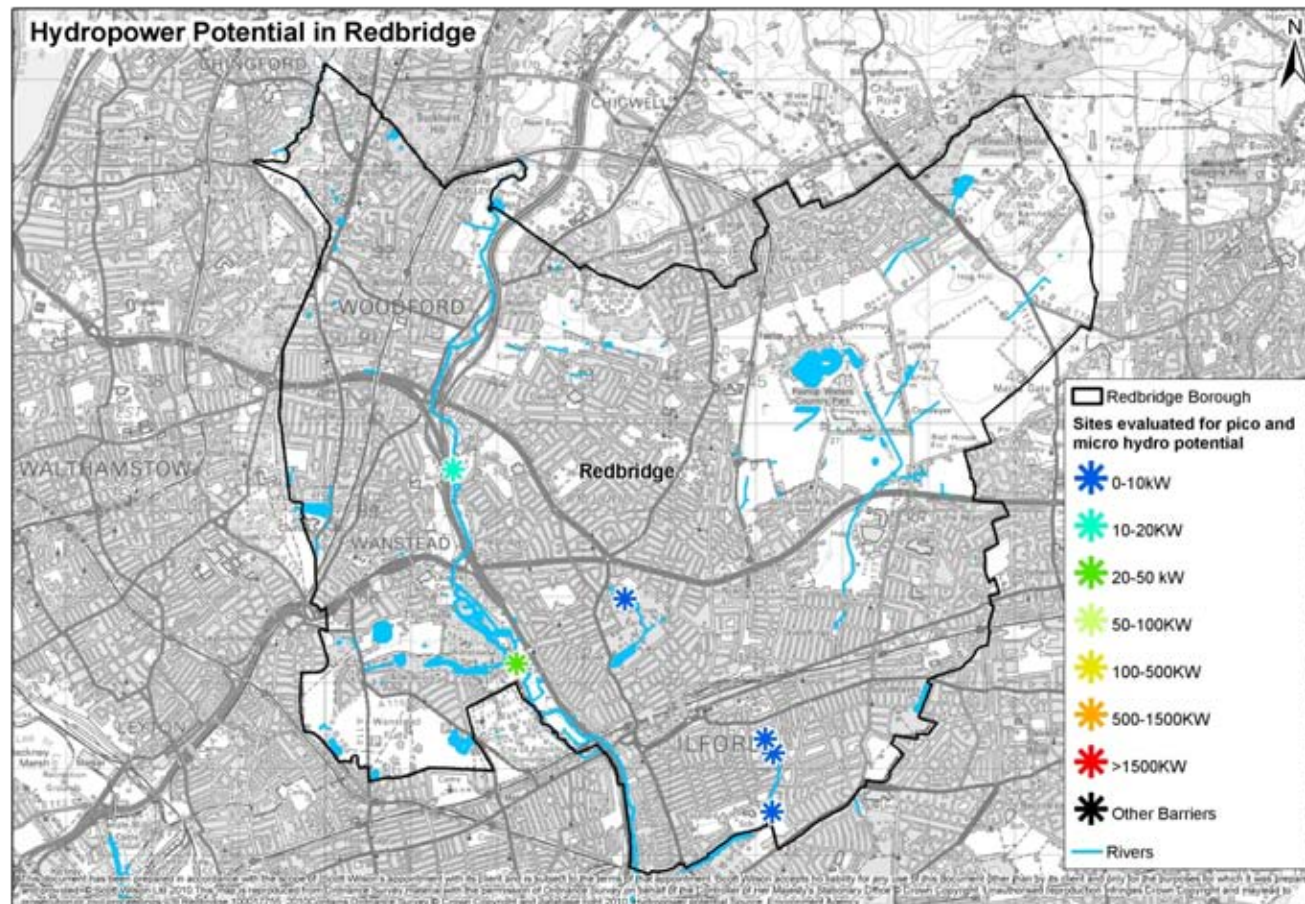


Figure 5-14: Hydropower potential in Redbridge

A detailed analysis of the various factors affecting hydropower potential, including head, and flow data within Redbridge was carried out to ascertain the potential for Hydropower in Redbridge.

An analysis at the highest level demonstrates that Redbridge offers no opportunities for large, medium and small scales of hydro installations due to limited available head and the river flow conditions of the Borough. However, results from a preliminary feasibility review to explore opportunities for Micro- and Pico-scale installations within Redbridge are presented in Appendix E. The results indicate that neither the flow nor the head conditions are appropriate for hydro.

5.11 Microgeneration

Microgeneration typically refers to renewable energy systems that can be integrated into buildings to primarily serve the on-site energy demand. They are applicable to both domestic and non-domestic buildings and can be connected to the grid although this is not required as most of the output is used onsite. Thus Microgeneration systems are typically designed and sized either in relation to the onsite demand or in proportion to the physical constraints onsite, such as available space, whichever is more appropriate.

Microgeneration technologies cover the full range of renewable energy categories: wind, solar, biomass, hydropower and heat pumps. In terms of assessing the regional opportunities and constraints for deployment, some of these categories are already captured previously in this chapter. The full potential of certain technologies such as biomass and hydropower is not directly constrained by the built environment and more specifically by what can be installed onsite as other deployment options are available, such as off-site or large scale capacity deployment. For example, community scale CHP plants utilising biomass in multi-storey buildings may be a more feasible option than individual biomass boilers if a sufficiently high flue height would mitigate potential air quality issues.

Technologies that directly depend on the built environment capacity to take Microgeneration systems are solar (solar water heating and solar photovoltaics) and heat pumps (ground source and air source). The potential for each of these sub-categories is assessed in this section.

5.11.1 Solar Water Heating (SWH)

Solar thermal collects heat from the sun to produce hot water. A typical (3m² system, based on the DECC methodology) solar collector can generate around 500kWh/m²/yr. To put this into context, a typical 72m² house consumes around 9000kWh/year of energy, comprising of around 3478kWh_e/year and 5580kWh_t/yr. Therefore, using a typical 3m² panel would generate 1500kWh/yr or 17% of the domestic energy requirement. Solar Water Heating (SWH) depends on three site-specific factors:

- Available roof space to install the system;
- Orientation and exposure of the roof to be able to capture enough solar radiation; and
- Hot water demand onsite (SWH is typically sized to supply 50-60% of the hot water demand, although some systems offer space heating as well).

SHW systems are suitable for most domestic buildings, where the biggest potential exists and for some energy-intensive non-domestic buildings. For the purpose of the study our capacity figures are derived from domestic buildings.

Assumptions

Description	Proportion of appropriate roof space (%)	Total number of buildings	Capacity per building type (kW)	Capacity (MW)
Existing roof space				
<i>Domestic properties</i>	25%	99,928	2	50.0
New development				
<i>Domestic properties</i>	50%	6,996	2	7.0
			Total Capacity (MW)	57.0

Following the Government methodology, the total capacity for Solar Hot Water in Redbridge is **57 MW**.

DECC methodology does not indicate any further constraints as these are incorporated into the assumptions above.

5.11.2 Solar Photovoltaics (PV)

Photovoltaic systems produce electricity from sunlight through semiconducting cells utilising the photo-electric effects to generate electrical energy. Photovoltaic panels come in modular panels, which can be fitted to the top of roofs, but other building-integrated panels are also available. A typical PV panel can generate around 100kWe/m²/yr. To put this into context, a typical 72m² house consumes around 9000kWh/year of energy, comprising of around 3478kWh_e/year and 5580kWh_t /yr. Therefore, using a typical 3m² panel would generate 300kWh_e/yr or 9% of the domestic electrical requirement. Similarly to SHW, solar PV depends on:

- Available roof space to install the system
- Orientation and exposure of the roof to be able to capture enough solar radiation

The figure below provides an indication of the areas with roof orientation and size considered to be suitable for PV's and SHW within Redbridge. It should be noted that the areas specified as suitable for PV's are based on existing buildings, areal maps, GIS maps and images on Google Streetview; areas not specified as suitable for PV's or SHW on the map should not be excluded from consideration as PV's will likely be suitable over majority of Redbridge.

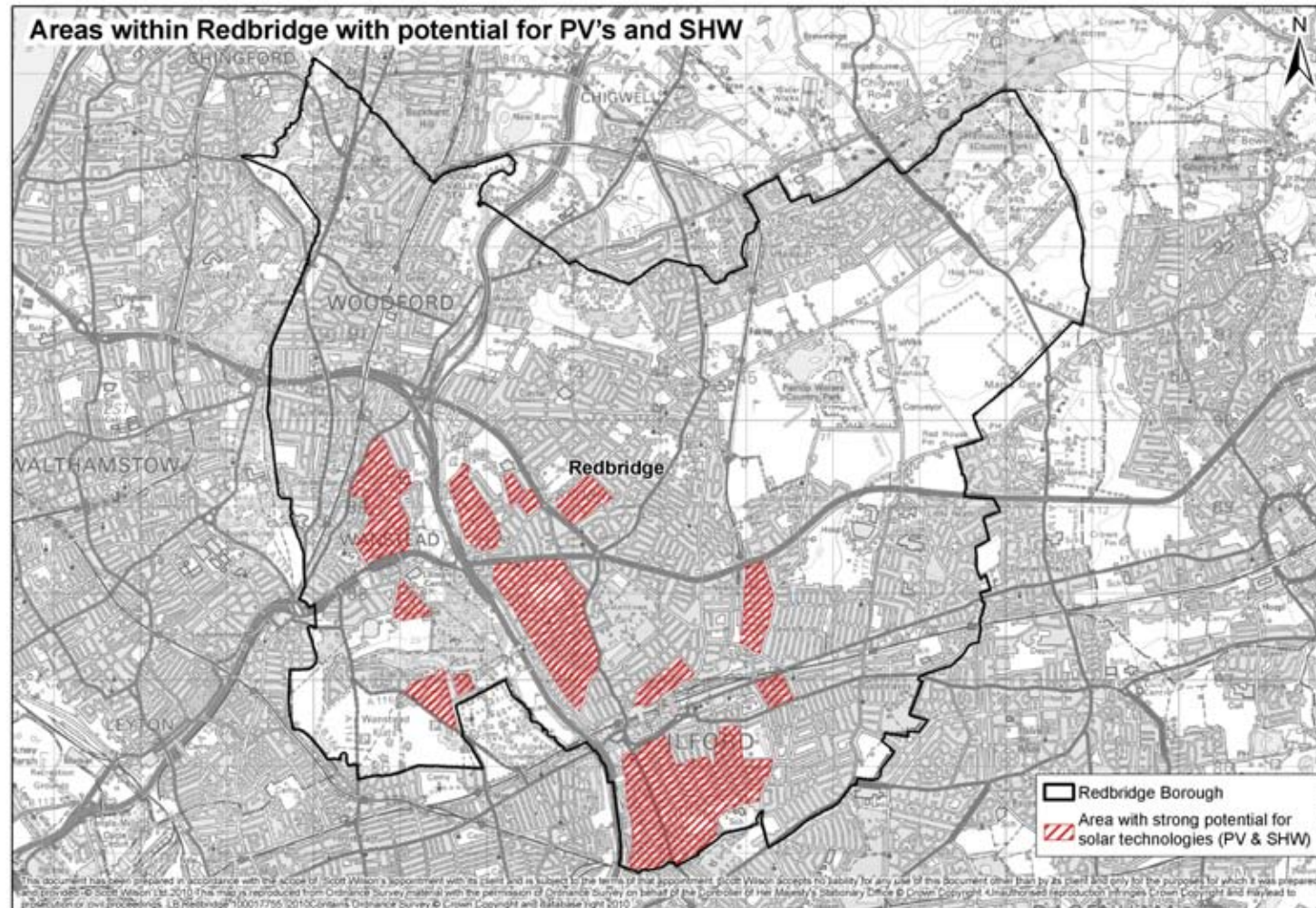


Figure 5-15: Areas within Redbridge with potential for PV's and SHW (indicative only)

Solar PV systems are equally suitable for domestic and non-domestic buildings with greater emphasis on domestic. Domestic buildings tend to have pitched roofs and therefore orientation is a strong factor, unlike commercial and industrial buildings, which often have flat roofs. The capacity assessment explores the entire regional building stock.

Assumptions

Description	Proportion of appropriate roof space (%) ⁷³	Total number of buildings	Capacity per building type (kW)	Capacity (MW)
Existing roof space				
<i>Domestic properties</i>	25%	99,928	2	50.0
<i>Commercial properties</i>	40%	7,110 ⁷⁴	5	14.2
<i>Industrial properties</i>	80%	790	10	9.5
New development				
<i>Domestic properties</i>	50%	6,996	2	7.0
			Total Capacity (MW)	80.7

Following the DECC methodology the potential capacity in Redbridge from solar Photovoltaics is **81 MW**.

Feasibility of solar technologies is site-specific, depending on the constraints of individual households and buildings such as orientation, roof structures, roof areas, surrounding obstacles as well as individual financial considerations.

5.11.3 Heat Pumps

Ground Source Heat Pumps (GSHP) extract the heat stored in the ground to provide space and water heating. They use electricity in the process. There are two broad sub-categories:

- Open loop systems typically pump warmer water up from an aquifer returning it at a lower temperature; these systems tend to be larger and more suitable for commercial buildings; and

⁷³ Derived from the DECC methodology

⁷⁴ Sub national authority electricity consumption statistics 2008, DECC January 2010, 'assumption that 10% of commercial and industrial buildings are industrial'

- Closed loop systems, where liquid circulates through a closed tube put in the ground, which absorbs the ground heat.

The ground component of closed loop systems can be installed horizontally in trenches or vertically in boreholes and, while the former option requires a considerable amount of land per installation, the latter is relatively compact and can be installed in a small area of land adjacent to the building. Generally GSHP is more suitable for suburban and rural areas where drilling down is more accessible. They are particularly suitable and economically viable in areas with no mains gas supply.

Air Source Heat Pumps (ASHP) extract the ambient heat in the air to provide space and water heating. They use electricity in the process. As the outside air temperature varies considerably during the year, their energy and carbon efficiency varies as well and is overall lower compared with GSHP. Their advantage, however, is their low space requirement and their applicability to most locations, including urban, where they are an alternative to GSHP.

The borough wide assessment of the potential for heat pumps is based on the premise that most buildings (existing stock and new build) are suitable for the deployment of at least one of the heat pump options.

Assumptions

Description	Proportion of appropriate roof space (%)	Total number of buildings	Capacity per building type (kW)	Capacity (MW)
Existing stock⁷⁵				
<i>Domestic: off-grid</i>	100%	70	5	0.35
<i>Domestic: detached and semi-detached</i>	75%	30,426	5	114.1
<i>Domestic: terraced</i>	50%	37,999	5	95.0
<i>Domestic: flats</i>	25%	25,421	5	31.8
<i>Commercial properties</i>	25%	7,110 ⁷⁴	100	35.6
New development				

⁷⁵ www.rightmove.co.uk

<i>Domestic properties</i>	50%	6,996 ⁷⁶	5	17.5
			Total Capacity (MW)	294.4

Although theoretically there appears to be a high potential for energy generation through heat pumps, specific analysis is likely to be far lower due to local constraints such as space and geology. The DECC methodology does not take these constraints into account, and this is considered to be an anomaly in the results.

5.12 Summary of Renewable Energy Capacity in Redbridge

Following the implementation of the Government methodology, we have calculated the following renewable energy capacity in Redbridge:

Technology	Potential Capacity (MW)
Large wind	32
Small wind	14
Biomass – Electric (Waste Wood, energy crops, managed woodland and Agricultural Arisings)	0.134
Biomass – Heat (energy crops, managed woodland and Waste Wood)	0.24
Biomass – Heat (Municipal Solid Waste)	11.6
Hydropower	0
Solar Hot Water	57
Photovoltaics	81

⁷⁶ Information provided by the Redbridge Council in the form of a Borough wide phasings table

Heat Pumps	294
TOTAL	490 MW

The above capacities are indicative only and consideration should be given to the principle of additionality; for example, if all available roofspace in domestic buildings is used for Solar Hot Water, then the capacity estimate for Photovoltaics is unrealistic.

It is worth noting that the vast majority of this renewable energy capacity is derived from heat pumps. However, in order to translate this technical potential into actual installations, the inertia for building owners/ occupiers to overcome would significantly limit the realistic authority-wide potential.

Wind energy potential is also considered to be minimal in Redbridge once wind speed scaling factors and the highly urban nature of Redbridge are taken into account.

Barring MSW, biomass resource potential is considered to be negligible within Redbridge, which is consistent with the highly urban nature of the Borough. Although biomass can be imported from abroad to supplement local supply, this is beyond the scope of this study.

Taking into account the above points, we have estimated the total capacity in Redbridge at present to be approximately **138 MW**. This figure is based on the exclusion of heat pumps, wind and MSW from the total contribution. Sufficient information is not available to accurately estimate the contribution from heat pumps, wind energy would need to be considered on a case by case basis, and as energy from waste is not a favoured technology in the area⁷², these technologies have both been excluded at present pending a further detailed viability assessment.

5.12.1 Energy Opportunities Map and Conclusions

Following the above analysis of the potential for low and zero carbon technologies in Redbridge, an Energy Opportunities Map has been developed using GIS, illustrated in the figure below, which identifies areas favourable for specific technologies in Redbridge.

Suitable conditions for medium to large wind exist on the area (over 5m/s), shown below, subject to restrictions from built-up areas, environmental land designations, etc. Small wind is illustrated to be viable on the north of the Borough and in small parts of the north-west.

The Energy Opportunities Map also illustrates district heating opportunity areas and, based on location of potential anchor loads.

Areas suitable for solar technologies are also identified (through a review of GIS aerial maps, and Google Streetview, streets with a south west orientation were identified) where built environment is likely to have a south, south-east or south-west aspect. Finally, areas designated as Air Quality Management Areas, with NO_x emissions higher than 40micrograms per m³, where biomass boilers would be restricted, are identified on the Map.

GSHP are potentially suitable for all new developments, however their viability needs to be addressed on a site by site basis (Please refer to Section 5.11.3 for further details), and therefore

have not been included in the figure below on the basis that their applicability extends across the borough.

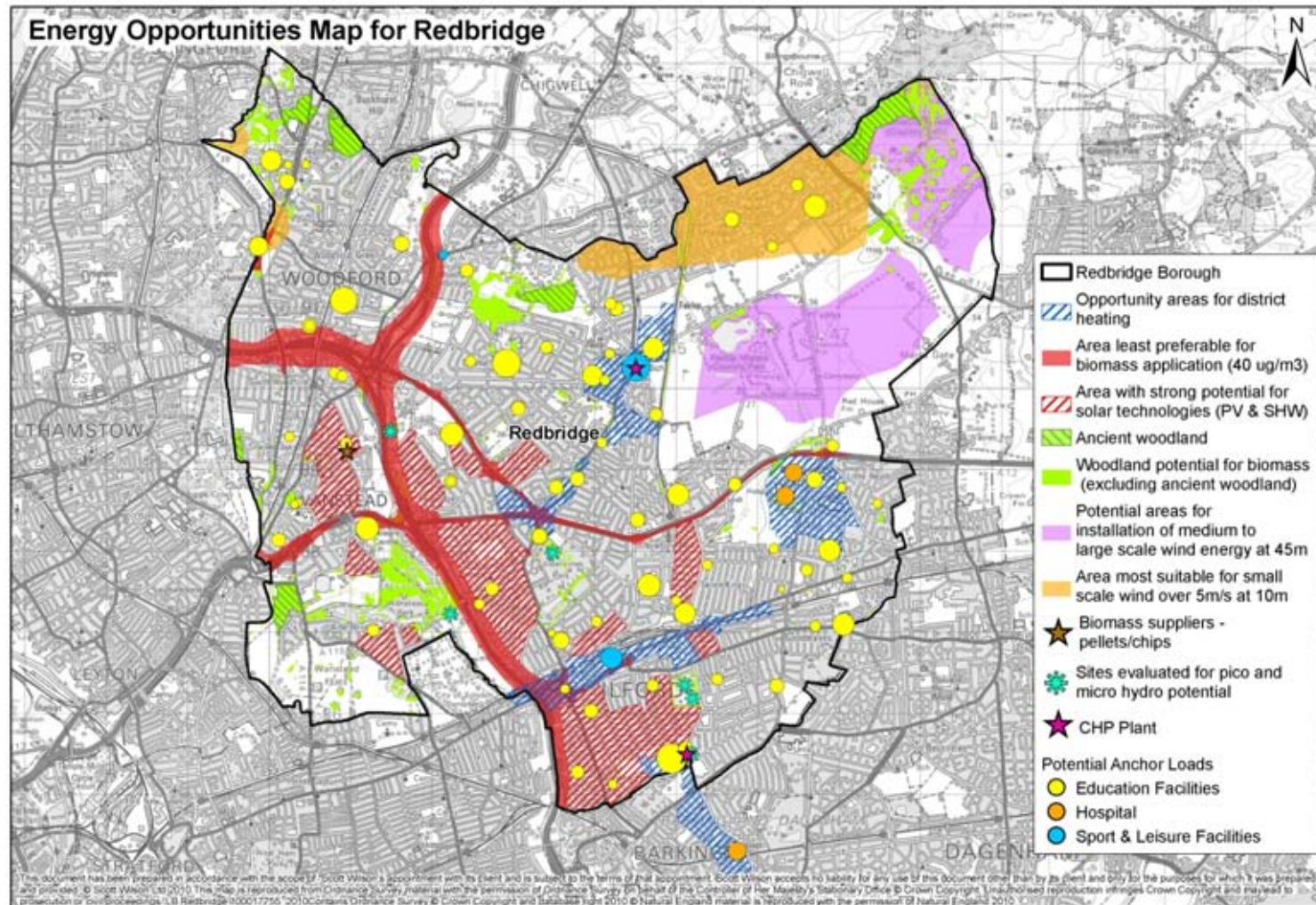


Figure 5-16: Energy Opportunities Map for Redbridge

6 Strategic Development Sites

6.1.1 Introduction

PPS 1 Climate Change Supplement encourages Local Authorities to set higher area or site-wide percentage targets to secure the potential for low or zero carbon energy where there are significant opportunities⁷⁷.

Strategic Sites were identified and agreed with the Council to be looked at in more detail regarding low carbon and renewable energy technologies. These reflect an appropriate cross-section of Redbridge in respect to development characteristics, typology and the focus of new development in the Local Development Framework. This chapter focuses on the low and zero carbon energy potential in each of the three Strategic Sites, tying them to different Code for Sustainable Homes (CSH) levels and percentage improvement over Building Regulations 2006 for non-residential buildings. The sites explored in details are: Ilford Town Centre, Gants Hill and the Crossrail Corridor.

Targets in the Code are expressed in terms of the Dwelling Emission Rate over the Target Emission Rate as calculated through the government's Standard Assessment Procedure (SAP). These emission rates take into account both passive measures (orientation, internal heat gains, building fabric performance, etc.) and active measures (low or zero carbon technologies) to reduce carbon dioxide emissions. Expressed in percentage dioxide emissions for the different Code levels; a 25% reduction from 2010 (Level 3), 44% from 2013 (Level 4), and zero carbon from 2016 (150% reduction, including unregulated emissions) (Level 6). This is the Governments current timetable.

In terms of the non-residential development, the percentage improvements over Building Regulations 2006 that are based on Scenario 2 (outlined in chapter 3) – balancing on-site and off-site as presented in the Communities and Local Government consultation document *Zero Carbon for new Non-domestic Buildings* (February 2010). This assumes the following timescale; a 25% improvement from 2010, 44% from 2013, 49% from 2016 and zero carbon by 2019 (54% improvement and the remaining unregulated emissions through allowable solutions). Please note that this is a consultation document and we have selected the option that is generally considered as the most likely case going forward based on Scott Wilson attendance at consultation events. Similarly to domestic buildings, passive and active measures are taken into account when calculating the improved performance and resulting carbon dioxide emissions reductions.

In order to derive our results, we have followed the methodology described below.

6.1.2 Methodology

For each of the Strategic Sites we have used information provided from LB Redbridge regarding the number of dwellings and floorspace of non-domestic buildings and their phasing over the plan period. Using industry benchmark and government figures for their energy requirements for space and water heating and regulated and unregulated electricity use, we have calculated the overall carbon dioxide emissions and, hence, the baseline from which any improvement/emissions reduction is calculated.

⁷⁷ Page 10, Planning Policy Statement: Planning and Climate Change, Supplement to PPS 1, CLG, December 2007

In order to meet the various requirements for domestic and non-domestic development over time (higher Code levels and improved Building Regulations respectively) we have looked at the following technologies and tested the technical viability of different combinations on each of the Strategic Sites. For each of the technologies we have used appropriate criteria to assess their technical viability, as summarised below.

- Small wind – due to the dense development and its urban location, we have assumed that no more than 5-6 small-scale turbines can be installed on each of the Sites based on spatial requirements outlined in the DECC methodology.
- Biomass boilers – while these can greatly contribute towards meeting the lower levels of the Code and Building Regulations up to 2018, they are inappropriate for zero carbon homes and non-residential buildings, unless for individual dwellings, and so have been excluded. Biomass boilers mentioned in the tables below refer to centralised systems, unless stated otherwise.
- Solar Hot Water (SHW) – Based on the DECC assumption that an average individual capacity of 2kW per domestic system should be specified, for Redbridge we have assumed that no more than 4.5 m² (i.e. producing 3kW based on the assumptions in the DECC methodology that the peak thermal output of 1m² of panel is around 0.7kW) per dwelling or per 70 m² of non-residential floorspace is viable. This limit applies to blocks of flats.
- Air and Ground Source Heat Pumps – the contribution of these technologies is limited by the space heating load. Therefore, up to 4% of emissions reductions can be met through Air Source Heat Pumps and up to 14% through Ground Source Heat Pumps (based on calculations carried out by SW). This discrepancy is related to the different Coefficients of Performance that we have assumed for each (3:1 for Ground Source and 2.5:1 for Air Source⁷⁸).
- Biomass Combined Heat and Power (CHP) – the cost of installation would be too high for the lower levels of the Code and early Building Regulations. The efficiency of conversion into electricity has been taken as 25% and into heating as 45%.⁷⁹
- Gas-fired CHP – similar to biomass CHP. The efficiency of conversion into electricity has been taken as 34% and into heating as 39%.⁷⁹

The sizing of these technologies is based on the amount of installed capacity, area or electrical output required to mitigate the required carbon dioxide emissions following the reduction from simple or advanced energy efficiency measures. Following a separate analysis of the domestic and non-domestic elements of development for each of the Strategic Sites, we have recombined the results into a single number for each technology under different scenarios for each of the Sites. These results are presented in the relevant sections below, along with an interpretation of what these overall figures mean on a single-building or community-scale development.

⁷⁸ <http://www.energysavingtrust.org.uk/Generate-your-own-energy/Ground-source-heat-pumps>

⁷⁹ Gross calorific value efficiencies: Typical CHP efficiencies from a selection of suppliers data – e.g. EnerG, Congenco, Jenbacher in the size range appropriate for the scale considered in this study

6.2 Ilford Town Centre

6.2.1 Introduction

As the largest town centre in the Borough and one of only 10 Metropolitan Centres in London, Ilford is effectively the “capital” of Redbridge. Ilford Town Centre lies within the North-East London Sub-Region, a priority region in terms of future growth and intensification of development in London. The Council has identified a number of development sites within the Town Centre that it considers have the potential for mixed-use redevelopment within the lifetime of the Local Development Framework (2007 – 2017). These sites, which are in a variety of public/private sector ownership are identified below:

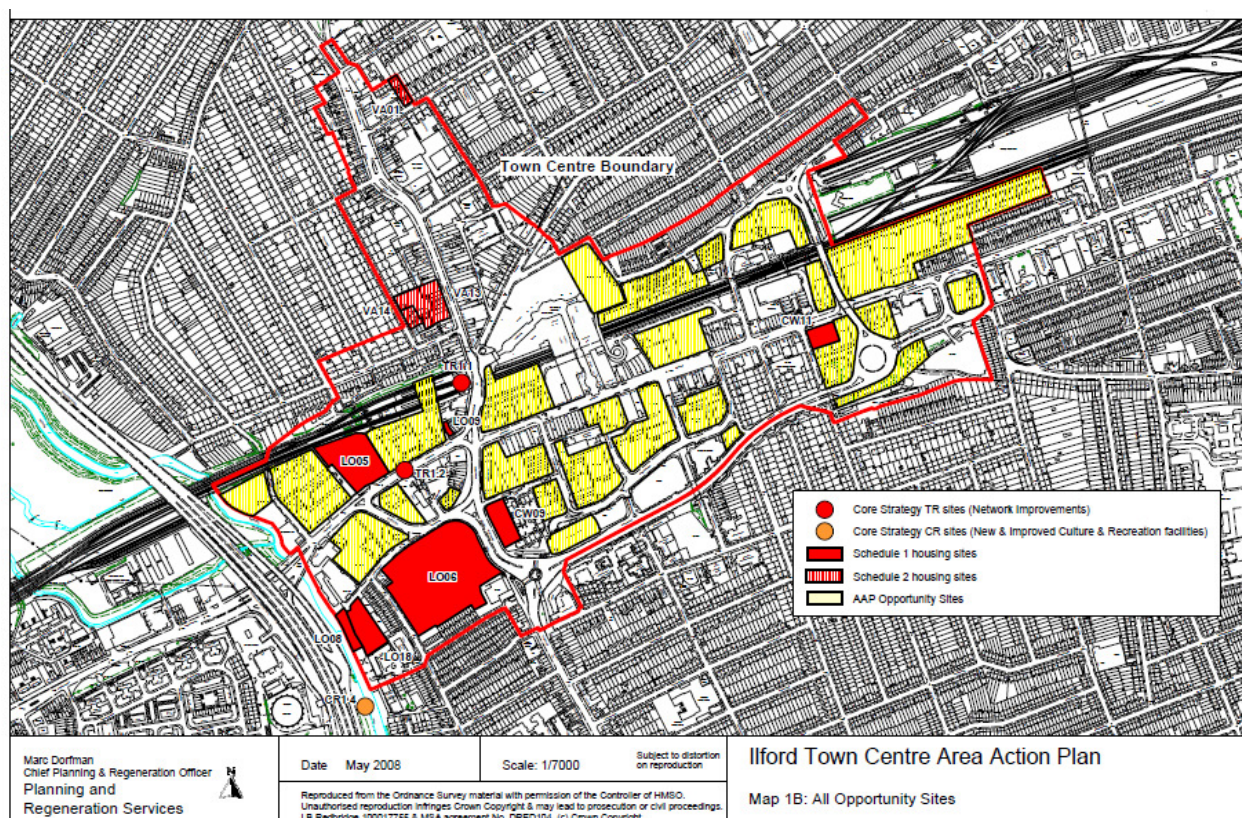


Figure 6-1: Ilford Town Centre opportunity sites

The housing type being delivered in the town centre is mainly one and two bedroom apartments in tall buildings. The town centre has a number of good quality historic buildings such as the Town Hall and two groupings of statutory and locally listed buildings. All the sites within Ilford Town Centre with acknowledged development potential have been listed in Appendix B.1

6.2.2 Site Development Context

Development in Ilford between 2010 – 2019 will result in the creation of 3,882 new dwellings and a total area 88,495 m² of non-residential floorspace (as shown in Appendix B.2). Total regulated CO₂ emissions for the site after completion assuming current benchmarks (e.g. Part L 2006

Compliance) amount to 16,740 tCO₂/year and the total energy demand to 70,080 MWh/year. The tables 6.1, 6.2 and 6.3 below summarises the phasing and the implications the Code for Sustainable Homes and improved Building Regulations will have on Ilford Town Centre in terms of emissions reductions.

Number of dwellings	Phasing	Code level (% improvement over BR 2006)	Regulated CO ₂ emissions (kgCO ₂ /year)	Emissions to be displaced (kgCO ₂ /year)
1,230	2010/13	3 (25%)	1,576,835	394,209
1,623	2013/16	4 (44%)	2,080,654	915,488
1,029	2016/19	6 (150%)	1,319,157	1,978,736

Table 6-1: Breakdown of domestic development at Ilford Town Centre by phasing, Code levels and regulated CO₂ emissions.

Floorspace (m ²)	Phasing	Building Regulations improvement over BR 2006	Regulated CO ₂ emissions (kgCO ₂ /year)	Emissions to be displaced (kgCO ₂ /year)
15,863	2010/13	25%	1,784,323	446,081
21,568	2013/16	44%	2,426,061	1,067,467
36,757	2016/19	49%	4,134,643	2,025,975
14,308	2019+	120%	1,609,500	1,931,400

Table 6-2: Breakdown of non-domestic development at Ilford Town Centre by phasing, Building Regulations percentage improvement and regulated CO₂ emissions.

To summarise:

Phasing	Emissions to be displaced (kgCO ₂ /year)
2010/13	840,290
2013/16	1,982,955
2016/19	4,004,711
2019+	1,931,400

Table 6-3: Summary of Emissions Reductions

6.2.3 Technology Feasibility

The analysis of wind speeds and site constraints indicates that due to the heavily urbanised nature of this site, large scale wind would not be feasible. The potential for **small scale wind** would also be fairly limited due to low wind speeds and high number of potential obstructions.

As discussed in Section 5.3 above, there is some potential for **biomass** although high existing NOx levels may impose restrictions on its deployment.

Finally, **district heating** and biomass-/ gas-fired CHP are comparatively feasible at the high development densities proposed, but viability needs to be tested through detailed feasibility modelling.

6.2.4 Energy Strategies for Different Phases of Development

Based on the available technologies at Ilford Town Centre as presented above, the following tables summarise different scenarios for meeting the residential and non-residential targets over time.

Phase 1: 2010 – 2013

The table below presents options for meeting the CO₂ reduction target required for the 1,230 dwellings under Code level 3 and 15,863 m² that require an improvement of 25% of Building Regulations over Building Regulations 2006. The three scenarios look at combining energy efficiency with microgeneration.

2010 – 2013		
Domestic: Code 3 – 25% reduction in regulated CO ₂ emissions Non-domestic: Building Regulations 2010 – 2013 (25% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions)
	Solar Hot Water	1,200 m ² (840kW) of SHW panels installed on suitable roofspace, i.e., about 1 m ² installed on each of the expected new dwellings (or about 2 m ² on each, if only half the dwellings are suitable). 5% reduction in CO ₂ emissions
	Air Source Heat Pumps	A total of just under 265 kW _{th} output capacity to meet just over half the space heating needs of the residential element of the development. 5% reduction in CO ₂ emissions

B	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions)
	Photovoltaics	1,590 m ² (1113kW) of PV panels installed on suitable roofspace, i.e. less than 1.5 m ² installed on each of the expected new dwellings (or about 2.5 m ² on each, if only half the dwellings are suitable). 5% reduction in CO ₂ emissions
	Ground Source Heat Pumps	A capacity of 526 kW _{th} for the whole development in this phase, equivalent in output to meeting about a third of the space heating requirement of each new dwelling. Assumed to be installed in larger, ground floor dwellings without solar technologies. 5% reduction in CO ₂ emissions
C	Energy efficiency	Improved building fabric and optimal orientation. (15% reduction in CO ₂ emissions)
	Biomass boiler	A biomass boiler rated at approximately 180 kW _{th} to meet space heating and hot water requirements. This is equivalent to a small commercial or large domestic sized unit. installed on a site wide basis. 10% reduction in CO ₂ emissions

The above preliminary calculations show that both Code level 3 and an improvement of 25% over Building Regulations 2006 can be met through energy efficiency and different combinations of microgeneration technologies. Each of the above scenarios reduces carbon dioxide emissions by 25%, i.e. by 394 tCO₂/year. Scenarios A and B are considered to be more suitable in areas with south facing roofs, which Scenario C is considered to be more suitable in areas with NOx emissions less than 40mg/m³, as illustrated on the energy potential map.

6.2.4.1 Energy Efficiency

Passive design measures are strongly encouraged by Government as a means to reduce emissions.

Preliminary calculations (carried out by SW based on past project experience) show that an energy efficiency of 15% can be achieved in a typical home, including flats and semi-detached homes which are typically seen across Redbridge, with best practice U-values and south-west or south-east orientation. Up to 25% energy efficiency can be achieved, which would meet Code 3 compliance requirements, without the contribution of any LZC technologies; however this may not always be the most cost-effective option for meeting Code 3. It is generally not possible to meet Code levels above level 3 through energy efficiency alone.

Phase 2: 2013 – 2016

The table below presents scenarios for meeting the CO₂ reduction target required for the 1,623 dwellings under **Code level 4** combined with the **44% improvement of the Building Regulations** compared to 2006 levels for the 21,568 m² of non-residential floorspace. The three scenarios look at combining energy efficiency with microgeneration and medium/ large scale technologies.

2013 – 2016		
Domestic: Code 4 – 44% reduction in regulated CO ₂ emissions Non-domestic: Building Regulations 2013 – 2016 (44% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Advanced energy efficiency	Advanced practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Photovoltaics	3,665 m ² of PV panels generating around 2,599kW, installed on suitable roofspace, i.e. about 2 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (9% reduction in CO ₂ emissions).
	Small wind	12 no. turbines of capacity 6 kW each, amounting to a total of 70 kW _e capacity (2% reduction in CO ₂ emissions).
	Ground Source Heat Pumps	A capacity of 1,942 MW _{th} for the whole development, equivalent in output to meeting about a third of the space heating requirement of each new dwelling. Assumed to be installed in larger, ground floor dwellings/non domestic properties without solar technologies (13% reduction in CO ₂ emissions).
B	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).
	Biomass boiler	A biomass boiler rated at approximately 691 kW _{th} to meet space heating and hot water requirements. This is equivalent to a large commercial unit. Installed on a centralised basis (29% reduction in CO ₂ emissions).

C	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).
	Photovoltaics	1,832 m ² of PV panels, generating around 1,282kW, installed on suitable roofspaces, i.e., 1 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace. (5% reduction in CO ₂ emissions).
	Gas-fired CHP	An output of 504 kW _e (24% reduction in CO ₂ emissions).

The above combinations of technologies can reduce carbon dioxide emissions from new development by 44% between 2013 and 2016.

6.4.2.5 Small wind

Under Scenario A, small scale wind could only displace a very small proportion of emissions (up to 2%) due to the urban nature of the development, i.e., about 40 tnCO₂/year. Financial and aesthetic factors would need to be considered for areas with adequate wind speeds before installing the turbine(s), in particular in terms of cumulative impacts. A 6kW turbine is approximately 12 m high.

6.4.2.6 Combined Heat and Power (Gas-fired)

In order for Combined Heat and Power (CHP) and district heating to be viable, the density of development will need to be appropriate. It is worth noting, that as the required emissions to be displaced increase, CHP becomes a more cost-effective option compared to microgeneration. Therefore, in order to ensure that the energy requirements can be met in the most cost-effective way during the later phases of development, it is suggested that the CHP unit be oversized for the requirements of the early phases. In order to meet total requirements from 2013 to 2019+, a plant with an output in the order of **1,735 kW_e** would need to be installed.

Phase 3: 2016 – 2019

The table below presents scenarios for meeting **Code Level 6** energy requirements for the 1,029 dwellings expected to be built from 2016 until 2019 and an improvement of **49% over Building Regulations 2006** for the non-residential element of the development. Code 6 includes all regulated energy and occupant electricity, resulting in an overall percentage requirement of 150% improvement over Building Regulations Part L 2006 for domestic regulated energy.

While microgeneration could contribute towards meeting the overall target, most of the reductions will need to be met through efficient, large scale technologies or through the allowable solutions mechanism. The scenarios below assume all emissions are displaced by on-site technologies. As large scale wind has been found unsuitable for the site, examples for gas-fired and biomass CHP are presented below.

2016 – 2019		
Domestic: Code 6 – 150% reduction in regulated CO ₂ emissions (includes unregulated emissions) Non-domestic: Building Regulations 2016 – 2019 (49% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Gas CHP	An output of 1,063 kW _e . See previous note on sizing the gas-fired CHP between 2013/16 (87% reduction in CO ₂ emissions).
	Ground Source Heat Pumps	A capacity of 1,377 MW _{th} for the whole development, equivalent in output to meeting about a third of the space heating requirement of each new dwelling. Installed in larger, ground floor dwellings without solar technologies (13% reduction in CO ₂ emissions).
	Photovoltaics	7,720 m ² of PV panels, generating around 5400kW, installed on suitable roofspace, i.e., less than 5 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (30% reduction in CO ₂ emissions).
B	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Biomass CHP	Biomass CHP to generate 308 kW _e per year (120% reduction in CO ₂ emissions).
	Small wind	37No. turbines of capacity 6 kW each, amounting to a total of just over 221 kW of electricity per year (10% reduction in CO ₂ emissions).

6.4.2.7 Biomass CHP

Biomass CHP combines the efficiency in fuel conversion of CHP with the low carbon intensity of biomass to enable significant CO₂ savings to be delivered. Similarly to gas-fired CHP, it should be considered at the earliest opportunity whether this technology should be oversized to meet the requirements of several phases. While for the needs of this particular phase a biomass CHP unit of 308 kW_e would be adequate, it is recommended that a unit of total output of **328 kW_e** be

installed. This would meet the needs in Ilford Town Centre for all development between 2013 and 2019. It would not be possible to meet requirements after 2016 through gas-fired CHP coupled with microgeneration due to requirements for zero carbon, as gas CHP, which is based on fossil fuels, is not considered to be a renewable energy technology.

Phase 4: 2019+

The table below presents options for meeting the **zero carbon** requirements for the remaining non-residential element of the development expected from 2019 and until the end of the plan period. This includes all regulated energy and occupant electricity, resulting in an overall percentage requirement of 120% improvement over Building Regulations Part L 2006.

Similarly to 2016-2019, while microgeneration could contribute towards meeting the overall target, most of the reductions will need to be met through efficient, large scale technologies.

2019+ Non-domestic: Building Regulations 2019+ (54% reduction in regulated CO₂ emissions plus allowable solutions for zero carbon non-domestic buildings, i.e., 120% reduction)		
Scenario	Options	Description
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Gas-fired CHP	An output of 100 kW _e . See note on sizing the gas-fired CHP between 2013/16 (100% reduction in CO ₂ emissions).
B	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Biomass CHP	Biomass CHP to generate 20 kW _e per year (100% reduction in CO ₂ emissions).

6.2.5 Conclusions for Ilford Town Centre

The analysis suggests that in the earlier phases of scheme development, several options are available for microgeneration combinations. For the later phases of development biomass or gas-fired CHP would enable carbon reduction targets to be met in a cost-effective way due to the high densities of development. A biomass CHP unit of 328 kW_{th} capacity or a gas-fired CHP unit of 1,735 kW_{th} could be installed. In order to maximise technical efficiency it would be recommended

that infrastructure compatible with wider site systems, such as DH pipe work and an energy centre, are installed during the early phases.

6.3 Gants Hill

6.3.1 Introduction

Gants Hill is a well-connected district centre and is situated at a busy roundabout junction with the A12 forming a major connection east-west and the A123 and A1400 crossing at this point to provide routes north and south. Valentines Park is also located close to and just south of the district centre. This provides Gants Hill with a major recreational open space and sporting facilities.

There is no industrial property in the vicinity of Gants Hill. The centre does have a number of office buildings dating back to the 1960s which employ 300 to 500 people.

6.3.2 Site Development Context

Development at Gants Hill between 2010 – 2019 will result in the creation of 650 new dwellings and a total area of 5,000 m² of non-residential floorspace. Total regulated CO₂ emissions for the new development at completion assuming current benchmarks amount to 835 tCO₂/year and the total energy demand to 7,843 MWh/year. The tables below summarises the phasing and the implications the Code for Sustainable Homes and improved Building Regulations will have on Gants Hill in terms of emissions reductions.

Number of dwellings	Phasing	Code level (% improvement over BR 2006)	Regulated CO ₂ emissions (kgCO ₂ /year)	Emissions to be displaced (kgCO ₂ /year)
269	2010/13	3 (25%)	344,853	86,213
189	2013/16	4 (44%)	242,294	106,610
192	2016/19	6 (150%)	246,140	369,210

Table 6-4: Breakdown of domestic development at Gants Hill by phasing, Code levels and regulated CO₂ emissions.

Floorspace (m ²)	Phasing	Building Regulations improvement over BR 2006	Regulated CO ₂ emissions (kgCO ₂ /year)	Emissions to be displaced (kgCO ₂ /year)
0	2010/13	25%	0	0
3,333	2013/16	44%	428,816	188,679
1,667	2016/19	49%	214,408	105,060

Table 6-5: Breakdown of non-domestic development at Gants Hill by phasing, Building Regulations percentage improvement and regulated CO₂ emissions.

To summarise:

Phasing	Emissions to be displaced (kgCO ₂ /year)
2010/13	86,213
2013/16	295,289
2016/19	210,120

Table 6-6: Summary of Emissions Reductions

6.3.3 Technology Feasibility

The analysis of wind speeds and site constraints indicates that due to the heavily urbanised nature of this site, large scale wind would not be feasible. The potential for small scale wind would also be fairly limited due to low wind speeds and high number of potential obstructions.

As discussed in Section 5.3 above, there is some potential for biomass around London, which would need appropriate supply chains to be set up for its full exploitation. The use of biomass could be constrained by the AQMA status of Redbridge, and particularly in Gants Hill where very high traffic volumes are seen.

6.3.4 Energy Strategies for Different Phases of Development

Based on suitable potential technologies at Gants Hill, the following tables summarise different scenarios for meeting the residential and non-residential targets over time.

Phase 1: 2010 – 2013

The table below presents scenarios for meeting the CO₂ reduction target required for the 269 dwellings under **Code Level 3** (no non-residential floorspace is expected between 2010 and 2013). The three scenarios look at combining energy efficiency with microgeneration.

2010 – 2013		
Domestic: Code 3 – 25% reduction in regulated CO ₂ emissions Non-domestic: Building Regulations 2010 – 2013 (25% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions)

	Solar Hot Water	230 m ² (161kW) of SHW panels installed on suitable roofspace, i.e. about 1 m ² installed on each of the expected new dwellings (5% reduction in CO ₂ emissions)
	Air Source Heat Pumps	A capacity of 370 kW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (5% reduction in CO ₂ emissions)
B	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).
	Photovoltaics	305 m ² (213kW) of PV panels installed on suitable roofspace, i.e., less than 1.5 m ² installed on each of the expected new dwellings (or about 2.5m ² on each, if only half the dwellings are suitable). (5% reduction in CO ₂ emissions)
	Ground Source Heat Pumps	A capacity of 230 kW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (5% reduction in CO ₂ emissions).
C	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions)
	Biomass boiler	A biomass boiler rated at approximately 60 kW _{th} to meet space heating and hot water requirements. Installed on a centralised basis (10% reduction in CO ₂ emissions)

The above preliminary calculations show that both Code level 3 and an improvement of 25% over Building Regulations 2006 can be met through energy efficiency and some different combinations of microgeneration technologies.

Energy Efficiency

Please refer to Section 6.2.4.1 above.

Phase 2: 2013 – 2016

The table below presents scenarios for meeting the CO₂ reduction target required for the 189 dwellings under **Code level 4** combined with the 3,333 m² of non-residential floorspace that requires a **44% improvement of the Building Regulations** compared to 2006 levels. The three scenarios look at combining energy efficiency with microgeneration and medium/ large scale technologies.

2013 – 2016		
Domestic: Code 4 – 44% reduction in regulated CO ₂ emissions Non-domestic: Building Regulations 2013 – 2016 (44% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Photovoltaics	PV panels installed on 1,393 m ² of roofspace, generating 975kW i.e., under 6 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (9% reduction in CO ₂ emissions).
	Small wind	2No. turbines of capacity 6 kW each (2% reduction in CO ₂ emissions).
	Ground Source Heat Pumps	A capacity of 2,603kW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (13% reduction in CO ₂ emissions).
B	Energy efficiency	Improved building fabric and optimal orientation. (15% reduction in CO ₂ emissions).
	Biomass boiler	Boiler efficiency of 90% to generate 518 kW _{th} . (29% reduction in CO ₂ emissions).
C	Energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (15% reduction in CO ₂ emissions).

	Photovoltaics	215 m ² (150kW) of PV panels installed on suitable roofspaces, i.e., 1 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (5% reduction in CO ₂ emissions).
	Gas-fired CHP	An output of 439 kW _e (24% reduction in CO ₂ emissions).

The above combinations of technologies can reduce carbon dioxide emissions by 44% between 2013 and 2016.

Small wind

Please refer to Section 6.4.2.5 above.

Combined Heat and Power (Gas-fired)

While a gas-fired CHP unit of 439 kW_e would meet the requirements for this phase, in order to ensure that the energy requirements can be met in the most cost-effective way during the later phases of development, it is suggested that the CHP unit be oversized for the requirements of the early phases. Therefore, in order to meet total requirements from 2013 to 2019+, it is suggested that plant with an output of **766 kW_e** should be installed.

Phase 3: 2016 – 2019

The table below presents options for meeting **Code Level 6** energy requirements for the 192 dwellings expected to be built from 2016 until the end of the plan period and an improvement of **49% over Building Regulations 2006** for the 1,667 m² of non-residential development. Code Level 6 includes all regulated energy and occupant electricity, resulting in an overall percentage requirement of 150% improvement over Building Regulations 2006.

While microgeneration could contribute towards meeting the overall target, most of the reductions will need to be met through efficient, large scale technologies. As large scale wind has been found unsuitable for the site, examples for gas-fired and biomass CHP are presented below.

<u>2016 – 2019</u>			
Domestic: Code 6 – 150% reduction in regulated CO ₂ emissions (includes unregulated emissions) Non-domestic: Building Regulations 2016 – 2019 (49% reduction in regulated CO ₂ emissions)			
Scenario	Options	Description	
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).	
	Gas-fired CHP	An output of 327 kW _e . See note on sizing the gas-fired CHP between 2013/19 (97% reduction in CO ₂ emissions).	
	Ground Source Heat Pumps	A capacity of 836 MW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (13% reduction in CO ₂ emissions).	
	Photovoltaics	867 m ² of PV panels installed on suitable roofspace, i.e., just over 4 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace, generating 607kW (20% reduction in CO ₂ emissions).	
B	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).	
	Biomass CHP	Biomass CHP of 102 kW _{th} (128% reduction in CO ₂ emissions).	

	Small wind	2No. turbines of capacity 6 kW each, amounting to a total of just over 12 kW of electricity per year (2% reduction in CO ₂ emissions).
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Biomass CHP

Biomass CHP should be considered at the earliest opportunity whether this technology should be oversized to meet the requirements of several phases. While for the needs of this particular phase a biomass CHP unit of 102 kW_e would be adequate, it is recommended that a unit of total output of **241 kW_e** for Gants Hill is considered. This would meet the requirements for all development between 2016 and the end of the plan period.

6.3.5 Conclusions for Gants Hill

Development density at Gants Hill is likely to be reasonably high, increasing the cost-effectiveness for district heating infrastructure. In order to meet carbon reduction targets for the later phases of development, a biomass CHP unit of 241 kW_{th} capacity or a gas-fired CHP unit of 766 kW_{th} could be installed. In order to maximise technical efficiency it would be recommended that infrastructure compatible with wider site systems are installed during the early phases.

6.4 The Crossrail Corridor: Seven Kings and Goodmayes

6.4.1 Introduction

The Crossrail Corridor runs from the eastern edge of Ilford Town Centre to the boundary with the London Borough of Barking and Dagenham in Chadwell Heath along the High road. The High Road contains 6 of the 10 most deprived wards in Redbridge, including the rapidly growing wards of Loxford and Clementswood.

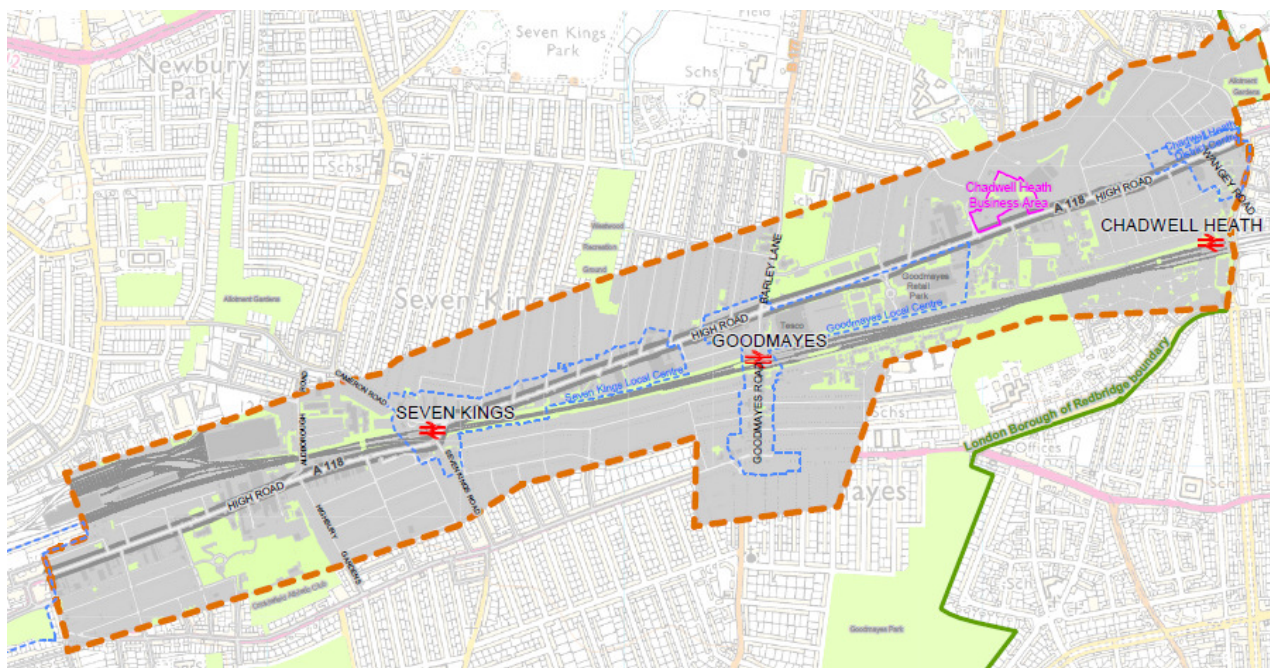


Figure 6-2: Crossrail corridor

6.4.2 Site Development Context

Development at the Crossrail Corridor between 2010 – 2019 will result in the creation of 2,451 new dwellings and a total of 26,020 m² of non-residential floorspace. Total regulated CO₂ emissions for the site after completion assuming current benchmarks amount to 3,142 tnCO₂/year and the total energy demand to 39,400 MWh/year. The table below summarises the phasing and the implications the Code for Sustainable Homes and improved Building Regulations will have on the Crossrail Corridor in terms of emissions reductions.

Number of dwellings	Phasing	Code level (% improvement over BR 2006)	Regulated CO ₂ emissions (kgCO ₂ /year)	Emissions to be displaced (kgCO ₂ /year)
1033	2010/13	3 (25%)	1,324,285	331,071
910	2013/16	4 (44%)	1,166,602	513,305
343	2016/19	6 (150%)	439,719	659,579
165	2019+	6 (150%)	211,527	317,291

Table 6-7: Breakdown of domestic development at the Crossrail Corridor by phasing, Code levels and regulated CO2 emissions.

Floorspace (m ²)	Phasing	Building Regulations improvement over BR 2006	Regulated CO ₂ emissions (kgCO ₂ /year)	Emissions to be displaced (kgCO ₂ /year)
6,638	2010/13	25%	548,439	137,110
9,046	2013/16	44%	747,434	328,871
6,697	2016/19	49%	553,328	271,131
3,640	2019+	120%	300,764	360,912

Table 6-8: Breakdown of non-domestic development at the Crossrail Corridor by phasing, Building Regulations percentage improvement and regulated CO2 emissions.

To summarise:

Phasing	Emissions to be displaced (kgCO ₂ /year)
2010/13	468,181
2013/16	842,176
2016/19	930,710
2019+	678,208

Table 6-9: Summary of Emissions Reductions

6.4.3 Technology Feasibility

Large scale wind is not feasible in this location. The potential for small scale wind would also be fairly limited due to low wind speeds and high number of potential obstructions. Nevertheless, indicative wind speeds are above the threshold commonly used to indicate viability.

As discussed in Section 5.3 above, there is some potential for biomass installation. The use of biomass could be constrained by the **AQMA** status of Redbridge. However, from this perspective the Crossrail Corridor is considered less constrained than the other two strategic sites addressed in this Study (Please refer to Figure 5-7 which illustrates that the majority of the Crossrail Corridor lies in a region with NO_x emissions less than 40 micrograms per m³).

Finally, **district heating** and biomass / gas-fired CHP are feasible at the development densities proposed, but the railway crossings are likely to increase DH installation costs in this area.

6.4.4 Energy Strategies for Different Phases of Development

Based on the available technologies at the Crossrail Corridor, the following tables summarise different scenarios for meeting the residential and non-residential targets over time.

Phase 1: 2010 – 2013

The table below presents scenarios for meeting the CO₂ reduction target required for the 1,033 dwellings under **Code level 3** and the 6,638 m² of non-residential floorspace, which require an improvement of **25% over Building Regulations 2006**. The three scenarios look at combining energy efficiency with microgeneration.

2010 – 2013		
Domestic: Code 3 – 25% reduction in regulated CO ₂ emissions		
Non-domestic: Building Regulations 2010 – 2013 (25% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).
	Solar Hot Water	1,605 m ² (1124kW) of SHW panels installed on suitable roofspace, i.e., about 1.5 m ² installed on each of the expected new dwellings (or about 3 m ² on each, if only half the dwellings are suitable) (5% reduction in CO ₂ emissions).

	Air Source Heat Pumps	A capacity of 708 kW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (5% reduction in CO ₂ emissions).
B	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).
	Photovoltaics	2,131 m ² (1492kW) of PV panels installed on suitable roofspace, i.e., less than 2 m ² installed on each of the expected new dwellings (or about 4 m ² on each, if only half the dwellings are suitable). (5% reduction in CO ₂ emissions).
	Ground Source Heat Pumps	A capacity of 442 kW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (5% reduction in CO ₂ emissions) (5% reduction in CO ₂ emissions).
C	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).
	Biomass boiler	A biomass boiler rated at approximately 199 kW _{th} to meet space heating and hot water requirements. Installed on a centralised basis. (10% reduction in CO ₂ emissions).

The above preliminary calculations show that both Code level 3 and an improvement of 25% over Building Regulations 2006 can be met through energy efficiency and some different combinations of microgeneration technologies.

Energy Efficiency

Please refer to Section 6.2.4.1 above.

Phase 2: 2013 – 2016

The table below presents scenarios for meeting the CO₂ reduction target required for the 910 dwellings under **Code level 4** combined with the 9,046 m² of non-residential floorspace that requires a **44% improvement of the Building Regulations compared to 2006 levels**. The three scenarios look at combining energy efficiency with microgeneration and medium/ large scale technologies.

2013 – 2016		
Domestic: Code 4 – 44% reduction in regulated CO ₂ emissions Non-domestic: Building Regulations 2013 – 2016 (44% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation.
	Photovoltaics	2,131 m ² (1492kW) of PV panels installed on suitable roofspace, i.e., under 2 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (10% reduction in CO ₂ emissions).
	Small wind	7No. turbines of capacity 6 kW each (2% reduction in CO ₂ emissions).
	Ground Source Heat Pumps	A capacity of 1,583 MW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (12% reduction in CO ₂ emissions).
B	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).
	Biomass boiler	A biomass boiler rated at approximately 591 kW _{th} to meet space heating and hot water requirements. Installed on a centralised basis (29% reduction in CO ₂ emissions).
C	Energy efficiency	Improved building fabric and optimal orientation (15% reduction in CO ₂ emissions).

	Photovoltaics	1,027 m ² (719kW) of PV panels installed on suitable roofspaces, i.e., 1 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (5% reduction in CO ₂ emissions).
	Gas-fired CHP	An output of 460 kW _e (24% reduction in CO ₂ emissions).

The above combinations of technologies can reduce carbon dioxide emissions by 44% between 2013 and 2016.

Small wind

Please refer to Section 6.4.2.5 above.

Combined Heat and Power (Gas-fired)

While a gas-fired CHP unit of 460 kW_e would be adequate to meet the requirements of this phase, in order to ensure that the energy requirements can be met in the most cost-effective way during the later phases of development, it is suggested that the CHP unit be oversized for the requirements of the early phases. In order to meet total requirements from 2013 to 2019+ (i.e. including requirements for Phases 3 and 4), it is suggested that plant with an output of **1,763 kW_e** should be installed.

Phase 3: 2016 – 2019

The table below presents options for meeting **Code level 6** energy requirements for the 343 dwellings expected to be built from 2016 until the end of the plan period and an improvement of **49% over Building Regulations 2006** for the 6,697 m² of non-residential development. Code 6 includes all regulated energy and occupant electricity, resulting in an overall percentage requirement of 150% improvement over Building Regulations 2006. While microgeneration could contribute towards meeting the overall target, most of the reductions will need to be met through efficient, large scale technologies. As large scale wind has been found unsuitable for the site, examples for Gas-fired and Biomass CHP are presented below.

2016 – 2019		
Domestic: Code 6 – 150% reduction in regulated CO ₂ emissions (includes unregulated emissions) Non-domestic: Building Regulations 2016 – 2019 (49% reduction in regulated CO ₂ emissions)		
Scenario	Options	Description
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Gas CHP	An output of 460 kW _e . See note on sizing the gas-fired CHP between 2013/16 (87% reduction in CO ₂ emissions).
	Ground Source Heat Pumps	A capacity of 1,583 MW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (13% reduction in CO ₂ emissions).
	Photovoltaics	4,159 m ² (2911kW) of PV panels installed on suitable roofspace, i.e., just over 4 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (30% reduction in CO ₂ emissions).
B	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Biomass CHP	Biomass CHP to generate 141 kW _e per year (128% reduction in CO ₂ emissions).

	Small wind	3No. turbines of capacity 6 kW each, amounting to a total of just over 15 kW of electricity per year (2% reduction in CO ₂ emissions).
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6.4.4.1 Biomass CHP

Biomass CHP should be considered at the earliest opportunity whether this technology should be oversized to meet the requirements of several phases. While for the needs of this particular phase a biomass CHP unit of 141 kW_e would be adequate, it is recommended that a unit of total output of **358 kW_e** be installed. This would meet the needs of the Crossrail Corridor for all development between 2016 and 2019.

Phase 4: 2019+

The table below presents scenarios for meeting the **zero carbon** requirements for the remaining non-residential element of the development expected from 2019 and until the end of the plan period.

2019+ Non-domestic: Building Regulations 2019+ (54% reduction in regulated CO₂ emissions plus allowable solutions for zero carbon non-domestic buildings, i.e., 120% reduction)		
Scenario	Options	Description
A	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Gas-fired CHP	An output of 867 kW _e (87% reduction in CO ₂ emissions).
	Photovoltaics	PV panels installed on 2,322 m ² (1625kW) of roofspace, i.e., just over 5.5 m ² installed on each of the expected new dwellings or per 70 m ² of non-residential floorspace (30% reduction in CO ₂ emissions).
	Ground Source Heat Pumps	A capacity of 1,583 MW _{th} , equivalent in output to meeting two thirds of the space heating requirements of the expected development. Installed in larger, ground floor dwellings without solar technologies (13% reduction in CO ₂ emissions).
B	Advanced energy efficiency	Advanced Practice U-values, air-tight buildings, high performance mechanical ventilation with heat recovery, optimal orientation (20% reduction in CO ₂ emissions).
	Biomass CHP	Biomass CHP to generate 217 kW _e per year (128% reduction in CO ₂ emissions).
	Small wind	2No. turbines of capacity 6 kW (2% reduction in CO ₂ emissions).

6.4.5 Conclusions for the Crossrail Corridor

Similar to Ilford Town Centre and Gants Hill, development density at the Crossrail Corridor is likely to be high. In order to meet carbon reduction targets for the later phases of development, a biomass CHP unit of 358 kW_e capacity or a large gas-fired CHP of 1,763 kW_e capacity could be adopted along side suitable district heating infrastructure.

6.5 Conclusions for the Strategic Sites

Overall, the three Strategic Sites are highly conducive to district heating solutions due to their high densities. Nevertheless, microgeneration can contribute to overall targets, especially during the earlier phases of development. Early oversizing of CHP/ district heating infrastructure would facilitate widespread implementation. In terms of biomass boilers, the Crossrail corridor appears to be least constrained provided road traffic volumes are within acceptable limits for NO_x emissions.

7 Economic Analysis – CSH & BREEAM

This chapter presents the viability testing methodology. Three levels of policy viability testing have been carried out, to reflect the potential to accelerate the policy implementation of the Code for Sustainable Homes in advance of Government targets. The viability testing results are presented in the sections following a brief review of Government incentives to encourage decentralised energy.

7.1 Government Incentives

7.1.1 Feed-In Tariffs

Feed-in tariffs (FITs) for small-scale low-carbon electricity generation, up to a maximum limit of 5 megawatts (MW) capacity - 50 kilowatts (KW) in the case of fossil fuelled CHP were introduced in April 2010. FITs guarantee a price for a fixed period for electricity generated using small-scale low carbon technologies, currently estimated to be 38p/kWh, thus encouraging the installation of small scale low carbon technologies. The Renewables Obligation (RO) continues to be the main support mechanism for large scale renewable energy deployment.

7.1.2 Renewable Heat Incentive (RHIs)

In order to meet the 2020 15% renewable energy target as set out by DECC, generating heat from current and new forms of renewable energy will be required. Examples of renewable heat technologies include: air- and ground-source heat pumps, biomass fuelled stoves and boilers, solar thermal water heaters and combined heat and power plants, which use renewable fuels.

Heat generated from renewable sources accounts for only 0.6% of total heat demand – which will need to rise to 12% to hit the UK's binding EU targets. DECC have confirmed that financial assistance will be provided to compensate for cheaper alternatives to heating sources. This financial assistance is expected to expand the market and create economies of scale for renewable heat generation.

Powers in the Energy Act 2008 allow the setting up of a Renewable Heat Incentive (RHI). The Act allows the RHI to provide financial assistance to generators of renewable heat, and producers of renewable biogas and biomethane. Separate tariffs for each type of eligible renewable heat technology or source are proposed, and within each supported technology tariffs will be differentiated based on size of the technology used.

Through a consultation process, DECC propose to develop the RHI which will be set out in regulations to be approved by Parliament and aim to have it in place by April 2011.

7.2 Delivery Partners (ESCos)

The draft Practice Guidance to support PPS1 Supplement emphasises the value of ensuring adequate delivery arrangements are in place to secure new low and zero carbon energy infrastructure. This is of particular importance where decentralised energy equipment requires significant investment that is to be funded entirely or in part through revenue generated by

energy sales and/ or there will be a requirement for co-ordinated operation and management arrangements to be put in place. The Practice Guidance recognises the value of third party involvement in the investment in, and operation of, heating and power networks and recommends the use of Energy Services Companies (ESCOs) as a partner to delivery.

There is no fixed definition or form for an ESCo. Their primary purpose can include promoting fuel security, combating fuel poverty, promoting energy efficiency and retailing energy to private, public or commercial customers. Similarly there is no single model for the establishment of an ESCo, with a range of different approaches in place including Local Authority-led ESCos (either singularly or via cross-border joint initiatives), joint venture enterprises, public-private partnerships and commercial energy providers. Depending on its business objectives, an ESCo can provide design expertise, investment finance, dedicated operation and management resources and customer services.

The involvement of an ESCo as a delivery partner will often mean a developer is more willing to include decentralised energy networks in a scheme as this can help to reduce the developer's capital expenditure and provides a means of avoiding legacy responsibilities beyond completion of a development.

If a Local Authority elects to take a lead role in the formation of an ESCo this may offer a number of benefits:

- As a dedicated entity with the primary purpose of delivering a Council's climate objectives, an ESCo can operate with a sharper focus and purpose than is available to existing Council services.
- An ESCo can operate as a commercial entity outside a Council's existing services and business structures. This creates a business-orientated environment in which to progress an ESCo's objectives with the consequence that it may be more entrepreneurial in its activities and less directly affected by shorter term Local Authority service objectives.
- The creation of an ESCo provides a means by which a Council can identify and manage its investment risk, maintaining separation between the ESCo and its core services.

The presence of an ESCo within a locality can help to stimulate further development of low carbon energy infrastructure. An initial development with a small distributed energy network operated by an ESCo can provide the catalyst for further expansion and connection to serve later phases of a large scheme, or subsequent developments nearby. This is reflected in paragraph 27 of the Supplement to PPS1 which states that:

'Where there are existing decentralised energy supply systems, or firm proposals, planning authorities can expect proposed development to connect to an identified system, or be designed to be able to connect in future.'

Additionally, the presence of an ESCo will also incentivise the connection of existing buildings to an energy network, by providing enlargement of the ESCo's customer base. This may take the form of physical connection via a heat main to provide district heating to existing buildings; a distributed cooling network to provide air conditioning and cooling; and/ or electricity supply via a private wire network. Alongside the pipe and cable infrastructure, some ESCos also supply local buildings with electricity via the existing local Distribution Network Operator's (DNO) network. These 'virtual' private wire networks have enabled ESCos to supply surplus electricity generated

through CHP equipment to customers such as schools and civic buildings within a local community when they are located too far from the CHP to justify the cost of providing a dedicated private wire connection.

7.3 Costs & Delivery Options – Code for Sustainable Homes

House prices in Redbridge are above-average by national standards; at £272,905⁸⁰, the average house in the borough is 43.4 % higher than the average in England and Wales⁸¹ as a whole. However, house prices are considerably in comparison to average house price of £408,608 in Greater London (Jan-March 2010 data).

A number of studies into the technologies and projected costs for the delivery of varying levels of the Code for Sustainable Homes have been carried out for the DCLG by Cyril Sweett. Scott Wilson has used the outputs of these studies to inform the viability testing of policy measures considered within this study.

There will be a variety of development styles within Redbridge over the plan period and hence for each of the dwelling types (flats, mid-terrace, semi-detached/ end terrace, detached), the projected uplifts in base build costs are illustrated below⁸² (see Figure 7-1–Figure 7-4). The key development types are as follows:

- Small development: fewer than 10 units of different housing types, but no flats, representing low density, rural sites, and making up around 15 per cent of new build.
- City infill: flats only, with an average of 18 units, high density city sites, and making up around 3 per cent of new build;
- Market town: an average of 100 units, of 75 per cent houses and 25 per cent flats, making up around 70 per cent of new build. These sites could be part of a larger site, but are treated separately for the purposes of modelling;
- Urban regeneration: large sites of on average 750 units, comprising 90 per cent flats, representing large brownfield, high density, mixed use sites making up around 10 per cent of new build.

Figures 7.1 – 7.4 illustrate the various ways in which specific development types can achieve various levels of the Code for Sustainable Homes, the % uplift in capital cost and the % saving on the target emission rate.

For example, Figure 7.1 illustrates for city infill and urban regeneration that Best Practice Energy efficiency (BPEE) alone can achieve Code Level 3, with a capital cost uplift of approximately 2.5% on 2008 base build costs, achieving a 15% saving on carbon emissions (based on the Target Emission Rate, TER).

⁸⁰ http://news.bbc.co.uk/1/shared/spl/hi/in_depth/uk_house_prices/html/bc.stm

⁸¹ <http://www.londoncouncils.gov.uk/London%20Councils/Redbridge.pdf>

⁸² Costs and Benefits of Alternative Definitions of Zero Carbon Homes, DCLG, February 2009,

In contrast to this Ground Source Heating (GSHP) and BPÉE would achieve Code level 3 but would incur a 7% increase in capital cost and reduce emissions by 40%.

In terms of Code 6, biomass heating, photovoltaics and BPÉE could be achieved with a 16% cost uplift but would achieve 100% saving in emissions from the TER and biomass CHP with photovoltaics and advanced practice energy efficiency (APEE) could be achieved with an 18% cost uplift and between 105-150% saving in emissions from the TER.

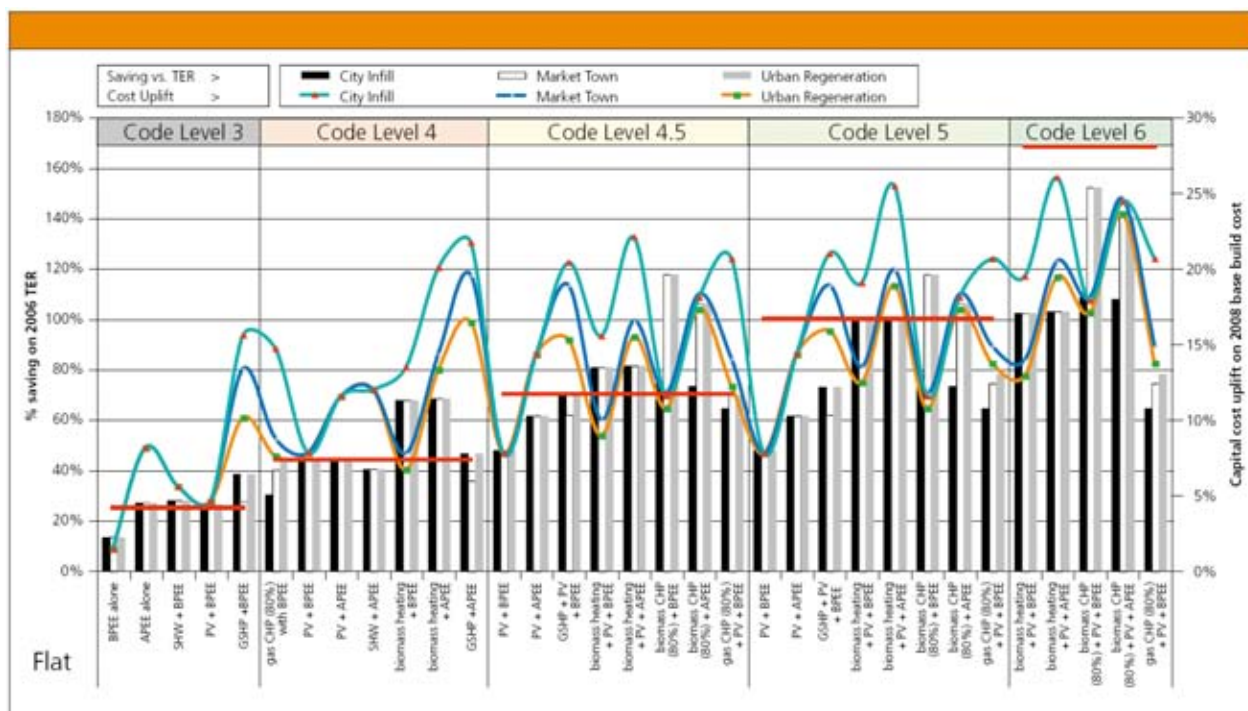


Figure 7-1: DCLG Cost uplift and carbon saving projections (flats)⁸³

⁸³ *BPÉE- Best Practice Energy Efficiency; APEE- Advanced Practice Energy Efficiency

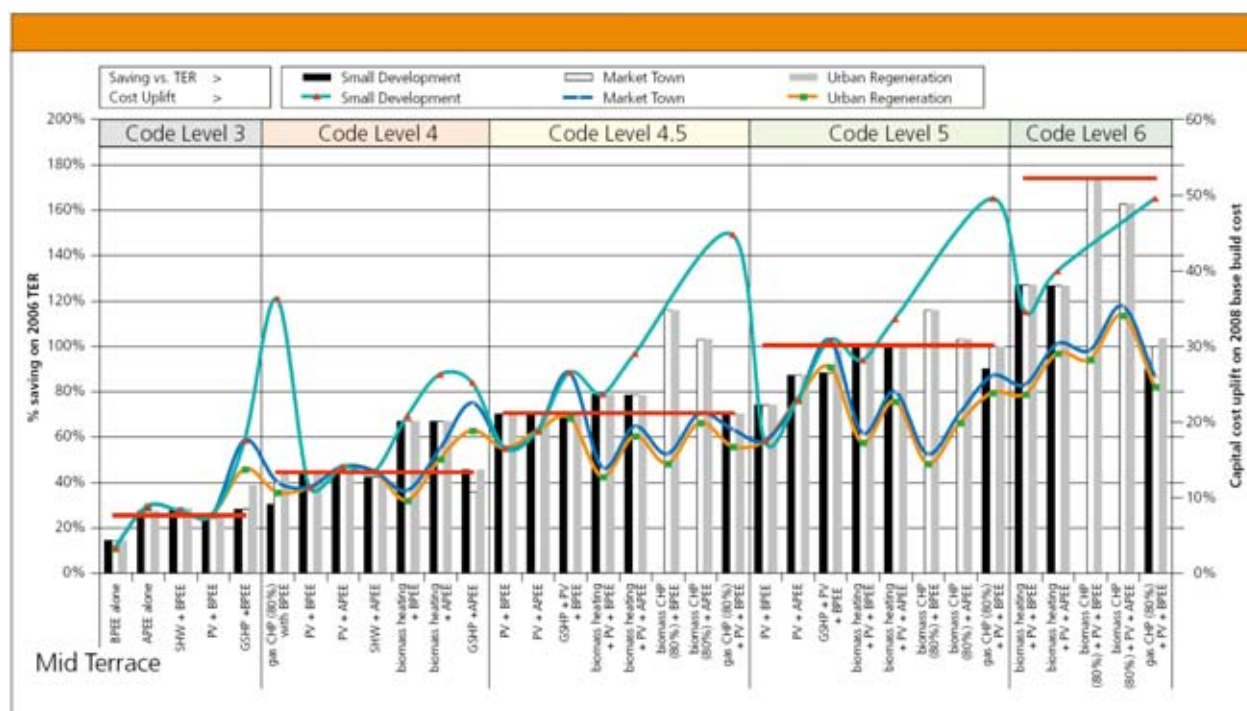


Figure 7-2: DCLG Cost uplift and carbon saving projections (mid-terrace)

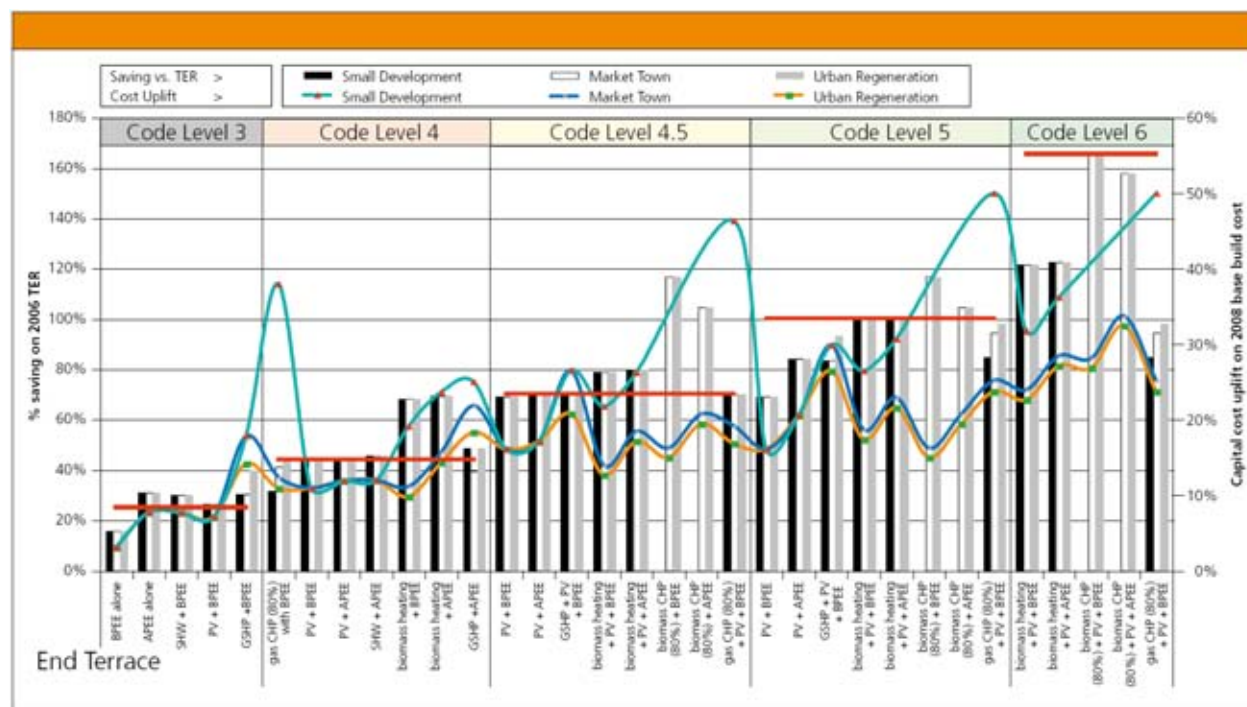


Figure 7-3: DCLG Cost uplift and carbon saving projections (semi-detached/ end-terrace)

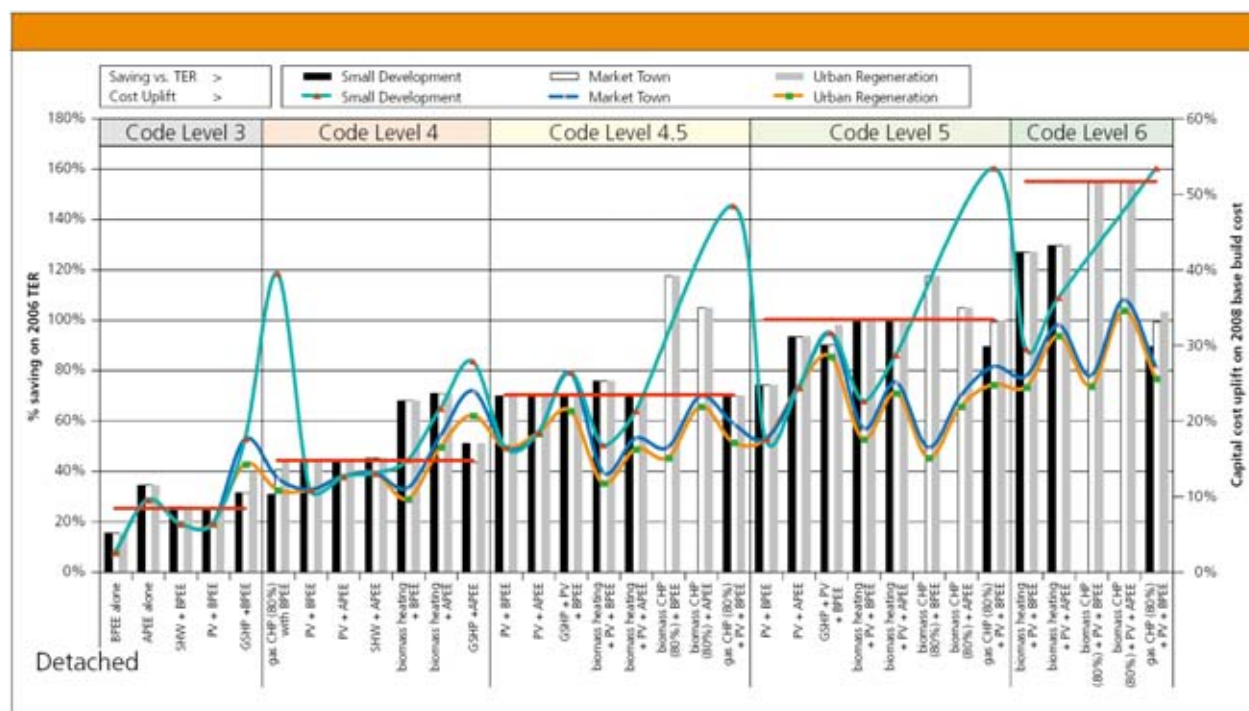


Figure 7-4: DCLG Cost uplift and carbon saving projections (detached)

These graphs provide an indication of the uplift cost for achieving the energy targets for differing Code levels in respect to energy-specific technology which will have wide-ranging implications.

Figure 7-5 summarises the above (indicatively) and provides an indication of the likely build cost (of residential buildings) for achieving both energy and sustainability targets up to Code level 6.

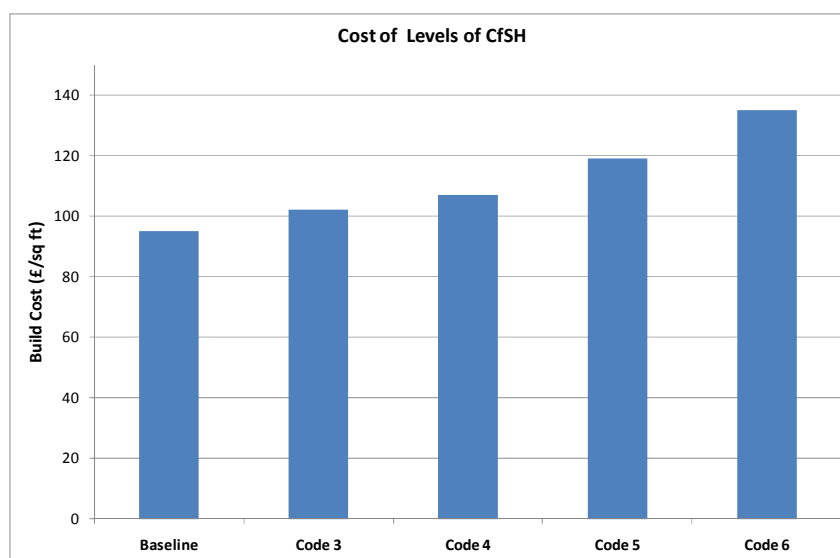


Figure 7-5: Cost Uplift for Code Levels⁸⁴

The above illustrates the general trend for uplift in build costs over the baseline (2006 Building Regulations) associated with the CSH with Code Level 3 at just over £100/sqft rising to over £130/sqft for Code Level 6. The scope of this study relates only to the energy element of the Code, this is illustrated in the figure below via energy extra over costs. The energy extra over costs are measured from a baseline of constructing a 2006 Building Regulation compliant dwelling

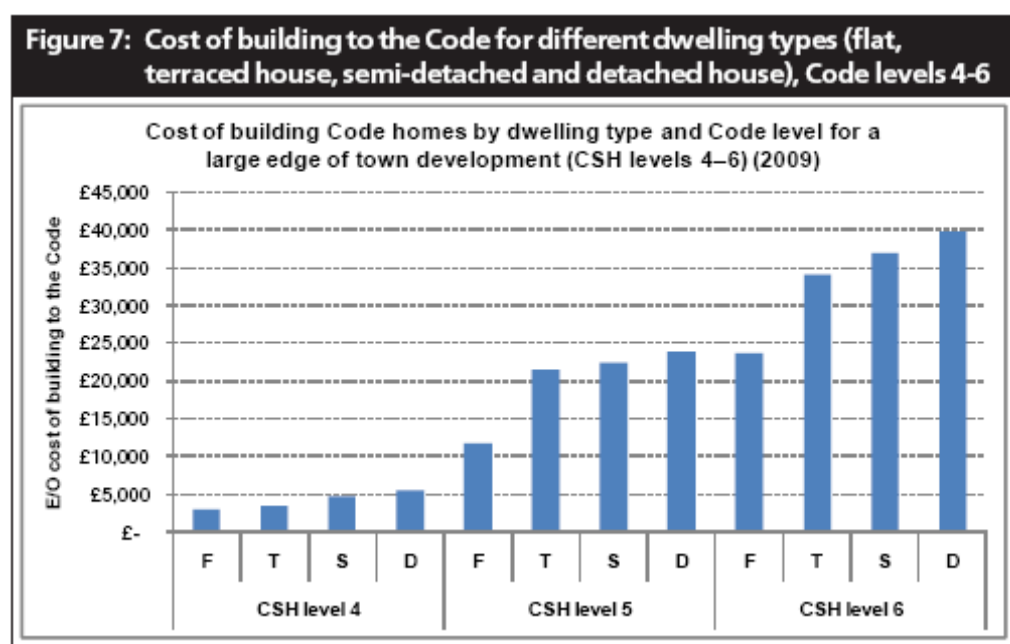


Figure 7-6: Energy over Cost for Different Code Levels⁸⁵

Although the example of a large edge of town development, which has been used as a case study in the DCLG CSH impact assessment study, is not directly relevant to Redbridge, the general trends observed can be extrapolated to Redbridge.

Cost ranges from approximately £2,500 to £40,000 from Code Level 4 to Code Level 6 and differ subject to dwelling type. It should be noted that the steep increase in costs of attaining Code Levels 5 and 6 relative to Code Level 4 is a result of the increasingly stringent CO₂ emission reductions required.

7.4 Costs of Delivering BREEAM Targets

The cost of delivering BREEAM targets is derived from research carried out by the BRE in conjunction with Cyril Sweett and Faithful and Gould for offices⁸⁶ and schools⁸⁷ respectively.

⁸⁴ <http://www.communities.gov.uk/documents/planningandbuilding/doc/codecostanalysis.doc>

⁸⁵ Code for Sustainable Homes Impact Assessment, DCLG, December 2009

⁸⁶ *Putting a price on Sustainability – BRE, 2005*

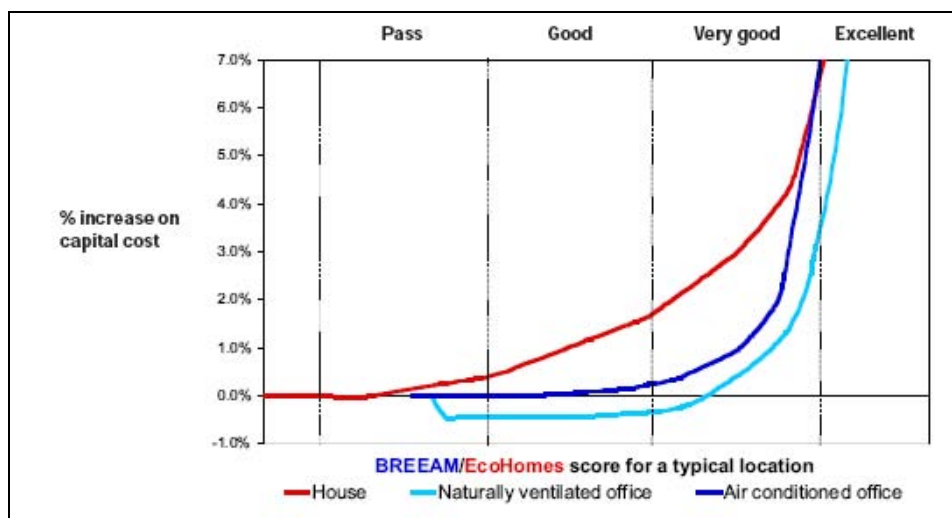


Figure 7-7: Cost for Achieving BREEAM Targets, Offices compared to Housing

In summary, Figure 7-7 identifies the base build cost to deliver Good, Very Good and Excellent ratings under BREEAM Offices 2004 and Figure 7-8 identifies the cost to deliver relevant ratings under BREEAM Schools 2006, giving consideration to locational aspects.

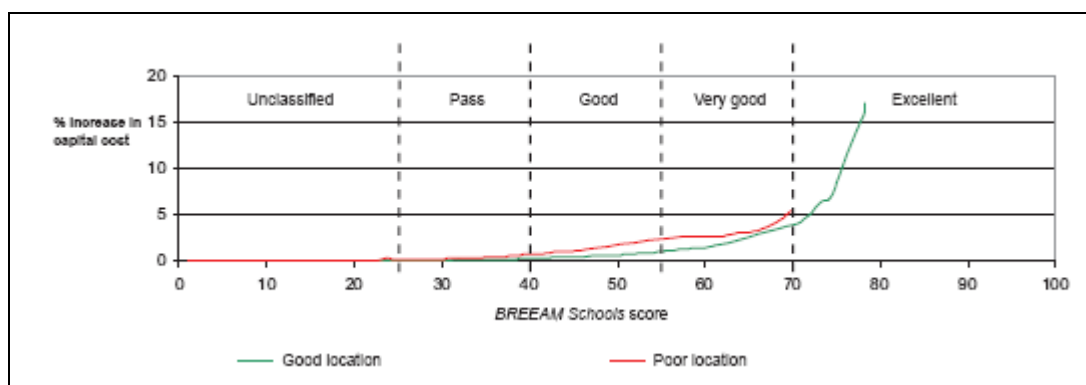


Figure 7-8: Cost for Achieving BREEAM Schools

The BRE report, *Pricing Sustainability in Schools* suggests an uplift of between 3-15% to deliver BREEAM 'Excellent' based on a secondary school block (3,116m²).

There is very limited published information on the costs to deliver energy targets for non-domestic buildings and no published cost data based on meeting BREEAM Offices targets since 2004, therefore cost data is not currently available for the new 2008 BREEAM methodology which has mandatory targets for energy (based on the EPC rating – as discussed in Section 2.1.4).

⁸⁷ Putting a price on sustainable Schools – BRE 2008

7.5 Development Viability

The general approach adopted for viability testing is illustrated by the flow chart below. In essence this takes the methodology outlined by the document 'Renewable and Low-carbon Energy Capacity Methodology' in order to help identify technologies suitable for each site, and then conducts land-value based viability test on the basis of market sales values.

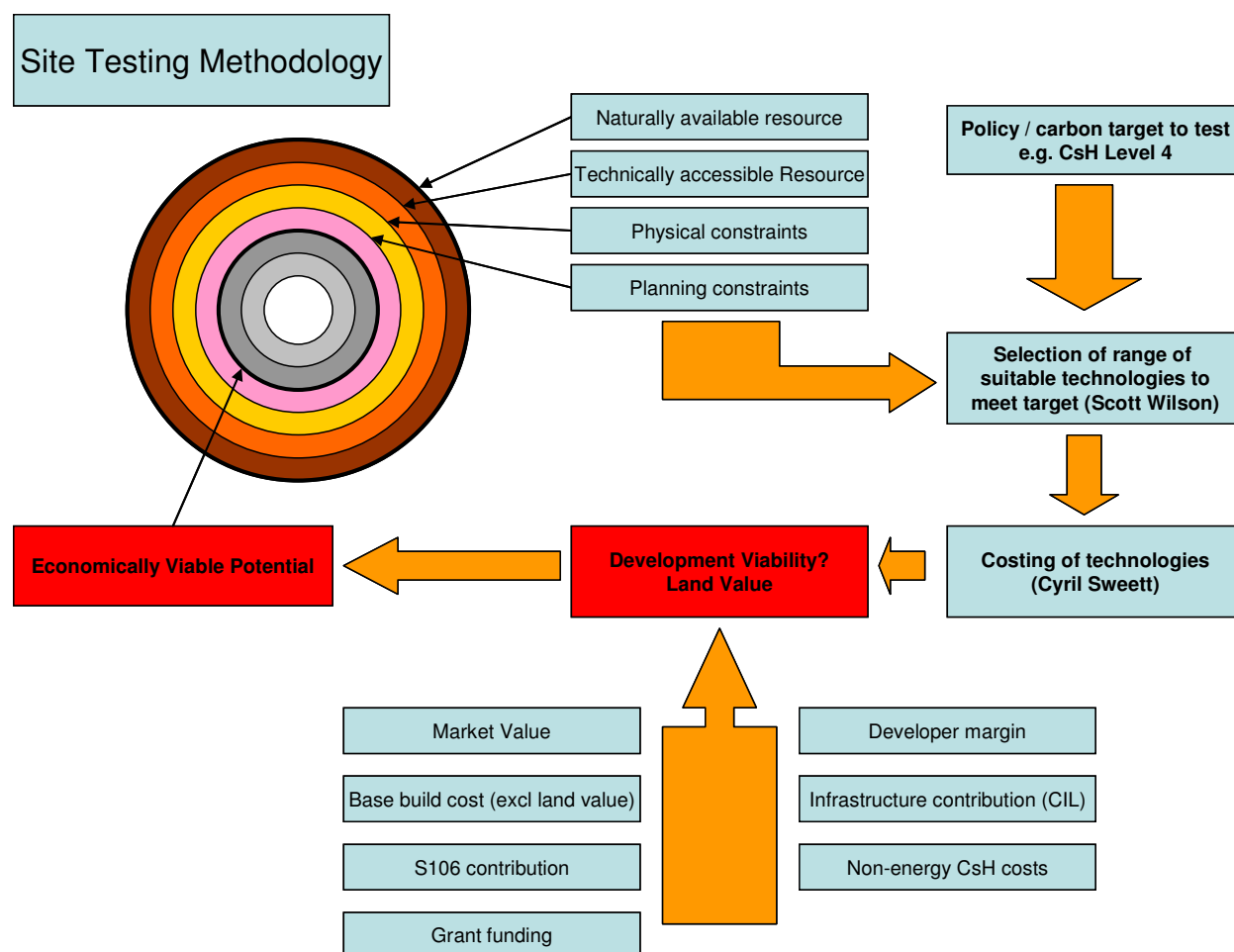


Figure 7-9: Viability testing methodology flow chart

The outputs of this process are further illustrated by the notional graphic below, which highlights relative contributions to costs and revenues of the various elements of the development process.

Figure 7.9 outlines the methodology for evaluating development viability and how it is tested specific to a site. Having evaluated physical and planning constraints, illustrated via the outer concentric rings above, suitable technologies identified are costed. Trends in development viability can then be identified through site specific costs including market value, build costs, S106 costs, CSH costs we can determine the impact on the residual land value as compared to the projected revenue as illustrated in Figure 7.10

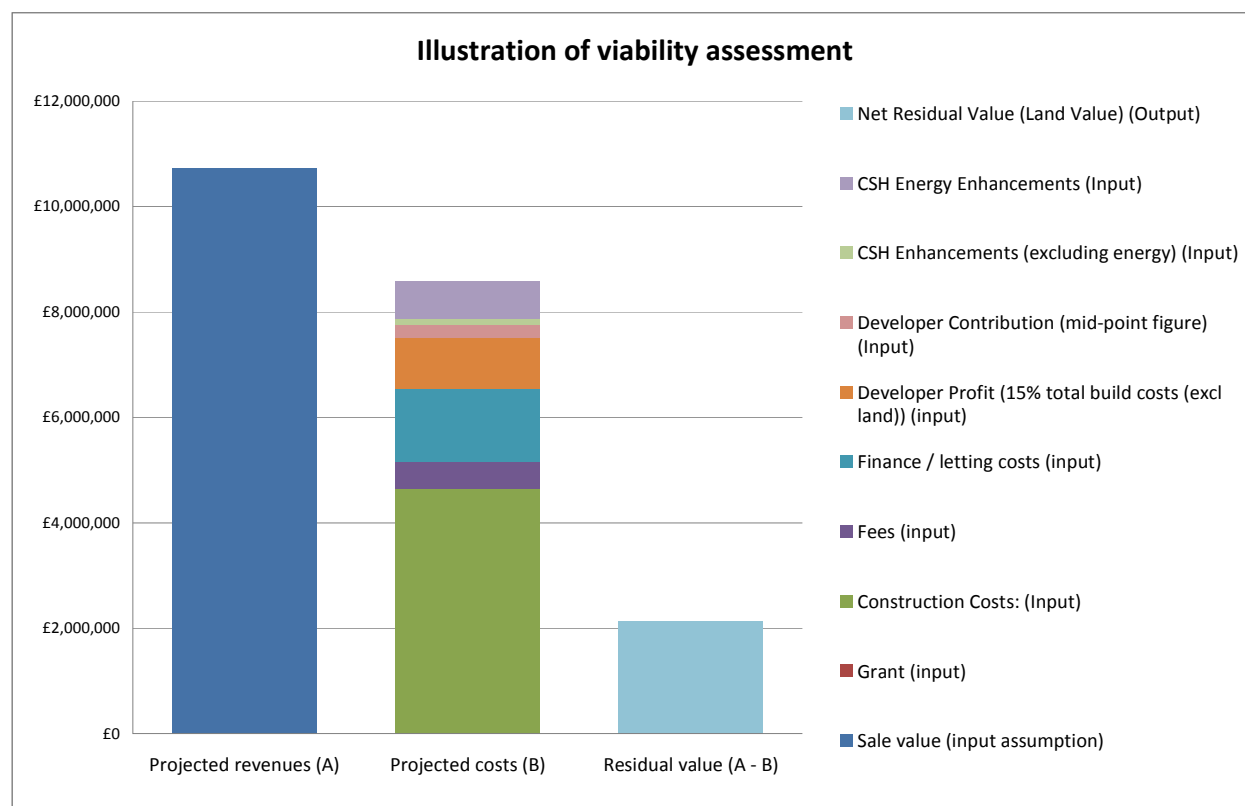


Figure 7-10 : Land value / Residual value illustration

It can be seen from the flow diagram and residual value illustrations above that there are a large number of variables that form part of this model. The inputs used in the site-specific testing are based on Code for Sustainable Homes cost figures generated by Cyril Sweett, information provided by the Council, and other assumed costs agreed amongst the project team. A full list of these assumptions is contained within Appendix F. It should be noted here that these costs assume the installation of on-site technologies to meet the required emissions reductions targets – e.g. the proposed costs of ‘allowable solutions’ is not modelled here.

As an initial assessment, three levels of policy viability testing have been carried out, to reflect the potential to accelerate the policy implementation of the CSH in advance of Government targets as they currently stand. The geographic zones currently selected for viability testing have been agreed with the Council and include the post code areas IG1 (including Ilford Town Centre), IG2 (including Gants Hill), IG3 (including the Crossrail Corridor), E11 (Wanstead) and RM6 (East Redbridge). The areas selected for viability testing are shown in figure 7-11.

The various parameters considered in the land value (which is the residual value once all assumed costs have been derived from the total projected revenue) viability assessment study are illustrated in the figure below. In order for the land value to be positive it must exceed the existing use value (EUV). Figure 7.10 is only an illustration and although cost inputs are specific to LBR the residual value or land value is generic and not specific to a site within LBR although the cost 1m+ is in the order of cost expected for LBR.

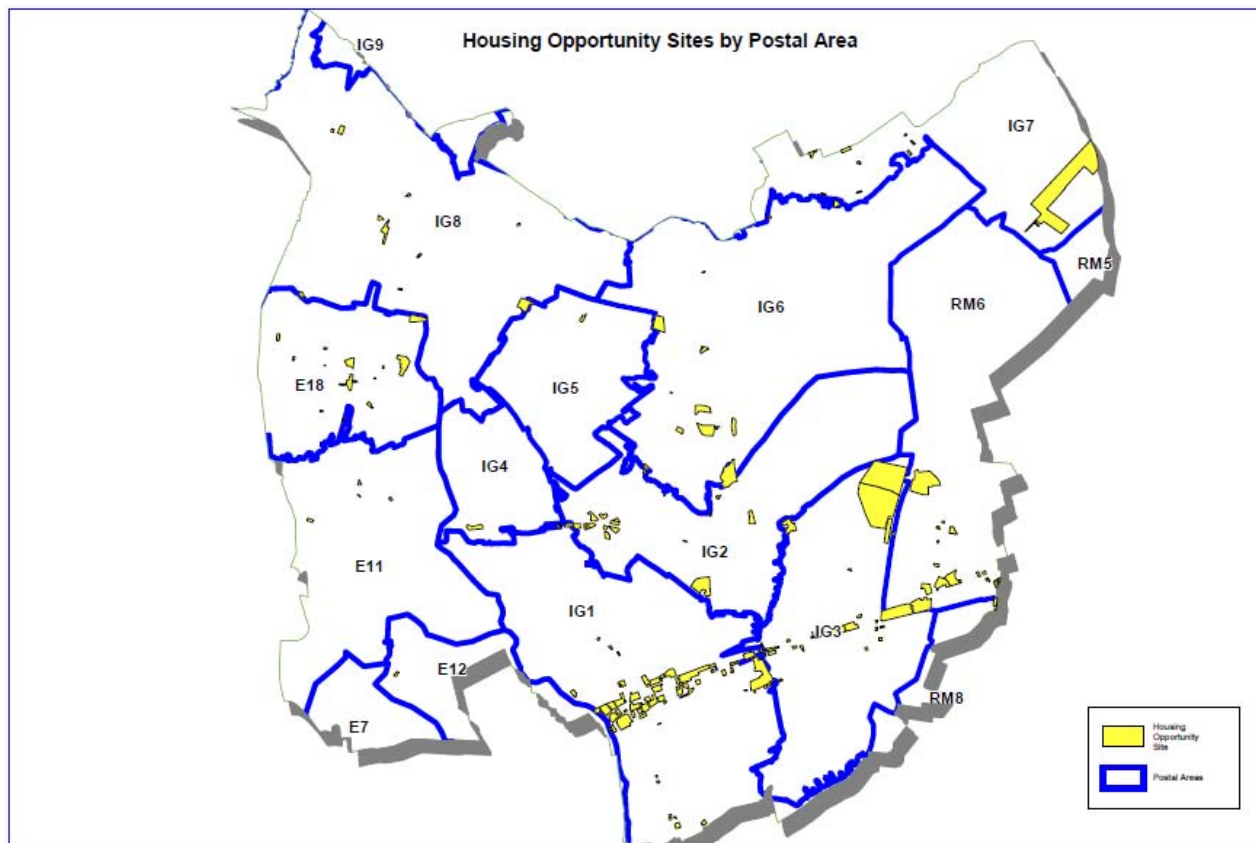


Figure 7-11: Post code areas for development viability testing

Within each of these areas, the following results have been obtained.

7.5.1 Viability Testing Results

A selection of development sizes (5 dwellings, 50 dwellings and 100 dwellings) has been analysed, alongside the policy options as outlined in Section 3.5. Only the 50 dwelling scenario is displayed in this main body of the report, and the remaining figures are included in Appendix G.

How to interpret these results:

It is not necessarily the case that a development will be 'viable' just because the land value is greater than zero. Viability depends upon the proposed scheme's land value being greater than:

- a) Retaining the existing use;
- b) Alternative uses to which the land might be put;
- c) The present value of some future value that might be realised;
- d) The regulatory climate and land-owner's views of future prospects for higher sale values.

Whilst the value of non-development uses are not well documented to Scott Wilson's knowledge, it is thought that figures in the low hundreds of thousands of pounds per hectare are more likely than the million of pounds figures that are shown in the results that follow here which is supported by the LBR Community infrastructure Levy Report⁸⁸, June 2010

It is also critical to note that there are a number of other site-specific costs that can significantly alter land values that are excluded from the viability model put forward here. A selection of some of these includes:

- Substructure costs
- Below ground and site drainage development costs
- Remediation of site contamination
- Highway works

These additional items are potentially very significant in cost terms when extrapolated to the sizes of developments under consideration here. The highly variable nature of these items has led to the decision not to attempt to cost them on a generalised basis, however, their omission effectively means that a viability threshold should be considered to be at a point above zero land value (as discussed above).

This commentary on land value figures illustrates that they cannot and must not be applied to specific sites and cannot be a substitute for site-specific viability testing. However, it is the aspiration of this modelling to reveal trends across the Borough of Redbridge on a geographic basis and also in terms of the overall comparative impact on viability of various factors.

⁸⁸ LBR CIL Report, Prepared by BNP Paribas Real Estate and Christopher Marsh & Co

7.5.2 Policy Option 1 (Government Standards) – 50 Dwellings

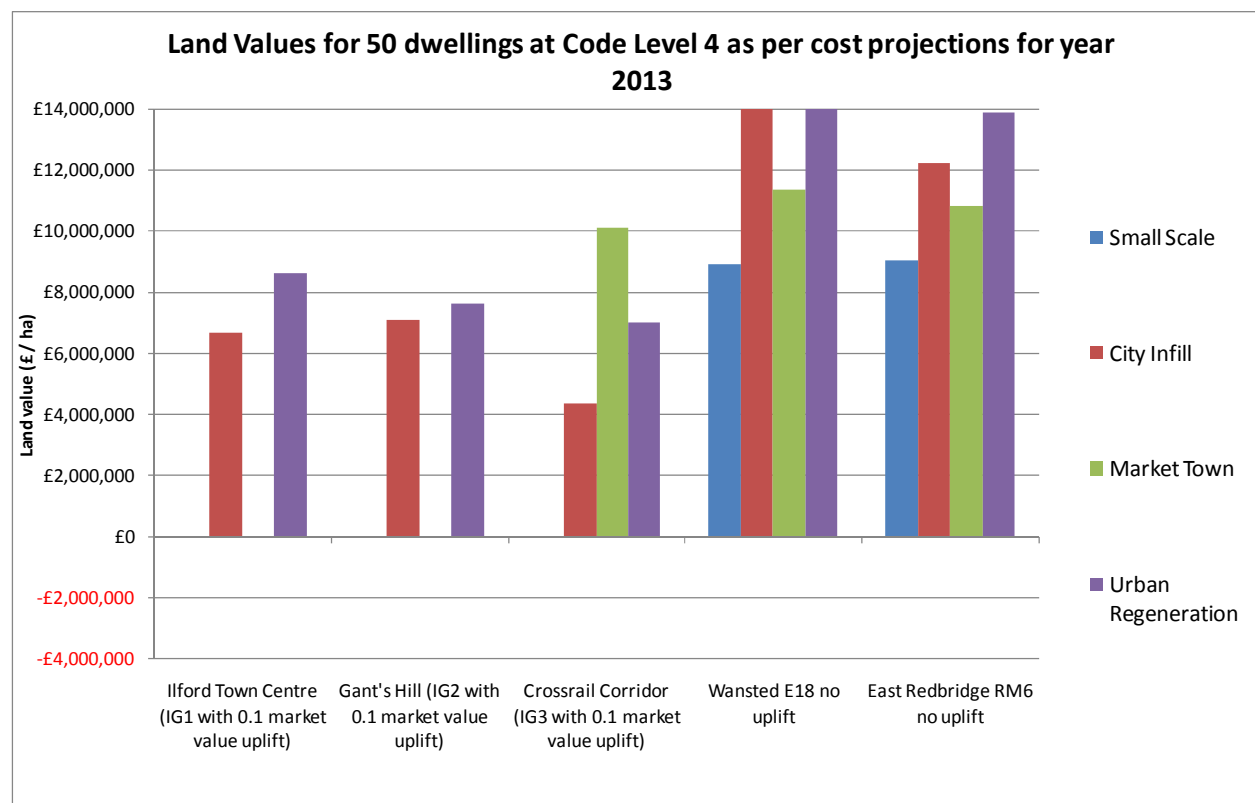


Figure 7-12: Land value as per cost projections for Code Level 4 in 2013 (Policy Option 1)⁸⁹

Although the market town scenario is not directly relevant to Redbridge it has been included to provide a comparison to the other development scenarios in Redbridge.

A constant land value has been assumed over time. Market prediction was not possible within the scope of this study. The only change over time would be in the cost of code compliance, e.g. how the market learns to achieve Code 6 at a lower cost.

This chart illustrates that when the CSH is applied (to Code 4 in 2013) as per the current timetable for its introduction, the land values resulting from the analysis methodology outlined above are all positive and considerably higher than zero. Whilst this modelling does not include all costs (as outlined in Section 7.5.1), the level of land values shown suggests that there would be sufficient margin / residual value to allow for an increase in sustainability standards beyond those tested here. Certain typologies are excluded from certain areas; for example small scale development (less than 10 units of different housing types, but no flats) is not included in Ilford and Gants Hill, as City Infill and urban regeneration are considered to constitute majority of the new development. Based on housing projections, the Crossrail Corridor, Wanstead and East Redbridge are expected to have market town type of development (an average of 100 units, of 75 per cent houses and 25 per cent flats, making up around 70 per cent of new build)

⁸⁹ market value uplift – 0.1 is the same as 10%

Implementation of Code 6 in 2016 (Policy Option 1 – Government Standards) – 50 dwellings.

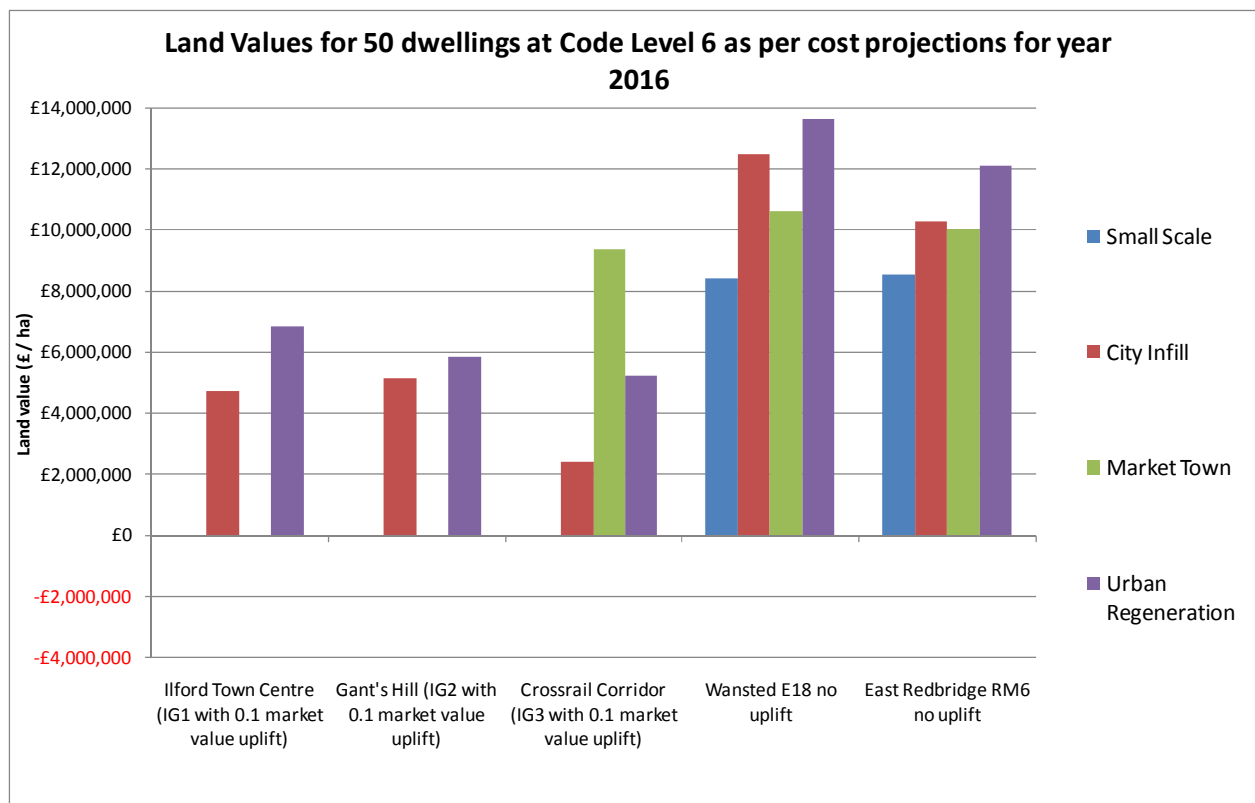


Figure 7-13: Land Values as per Government Standards (Policy Option 1) – Code 6 in 2016 - 50 dwellings

This chart also illustrates that under currently proposed Government standards, when the CSH is applied (to Code 6 in 2016), the resulting land values are all positive. Whilst this modelling does not include all costs (as outlined in Section 7.5.1), the level of land values shown suggests that there would be sufficient margin / residual value to allow the standards to be imposed.

7.5.3 Policy Option 2 (Accelerated Implementation) – 50 Dwellings

Acceleration of Standards to Code 4 in 2010 (Policy Option 2 – Accelerated Implementation) - 50 dwellings.

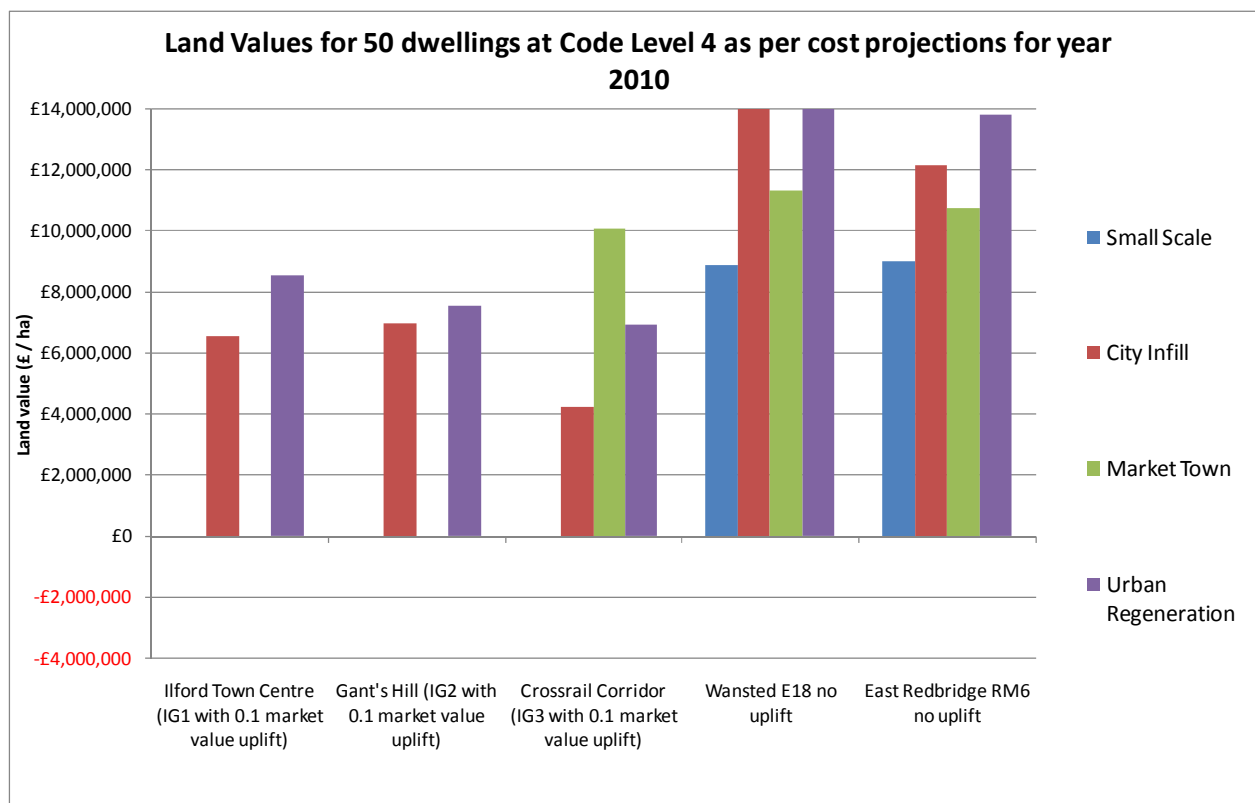


Figure 7-14: Land value as per cost projections for Code Level 4 in 2010 (Option 2) – 50 dwellings

This chart shows a somewhat accelerated timetable of Code standards, and illustrates that in all areas, there would appear to be sufficient margin to allow the sustainability measures to be imposed in this accelerated fashion.

Acceleration of Standards to Cost 6 in 2013 (Policy Option 2)

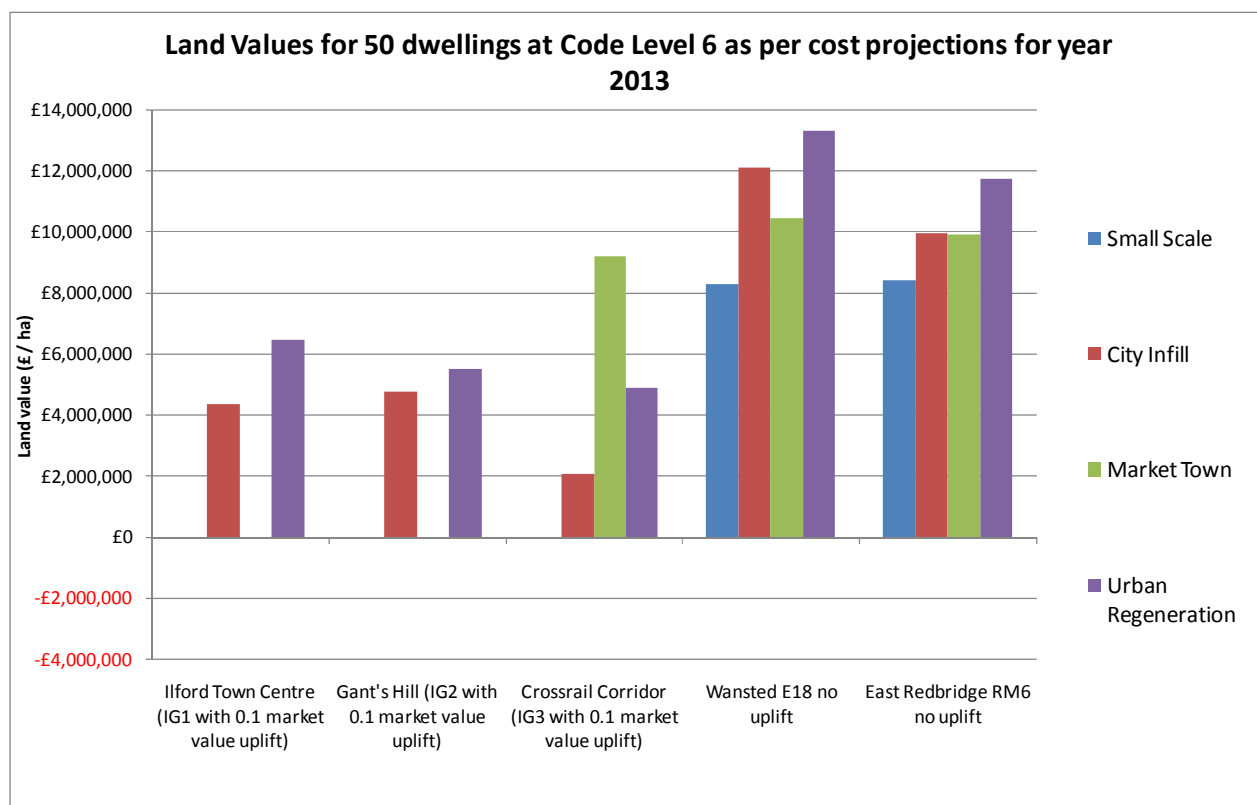


Figure 7-15: Land Values of Accelerated CSH Implementation (Code 6 in 2013) – 50 dwellings

Under the accelerated timetable of Code standards, Code 6 is modelled as being imposed in 2013. Under this timetable, it can be seen that there is a significant reduction in residual values, bringing the Crossrail Corridor area to a level of around half of the value calculated under the 'standard' timetable for CSH standards.

7.5.4 Policy Option 3 (Aspirational Standards) – 50 dwellings

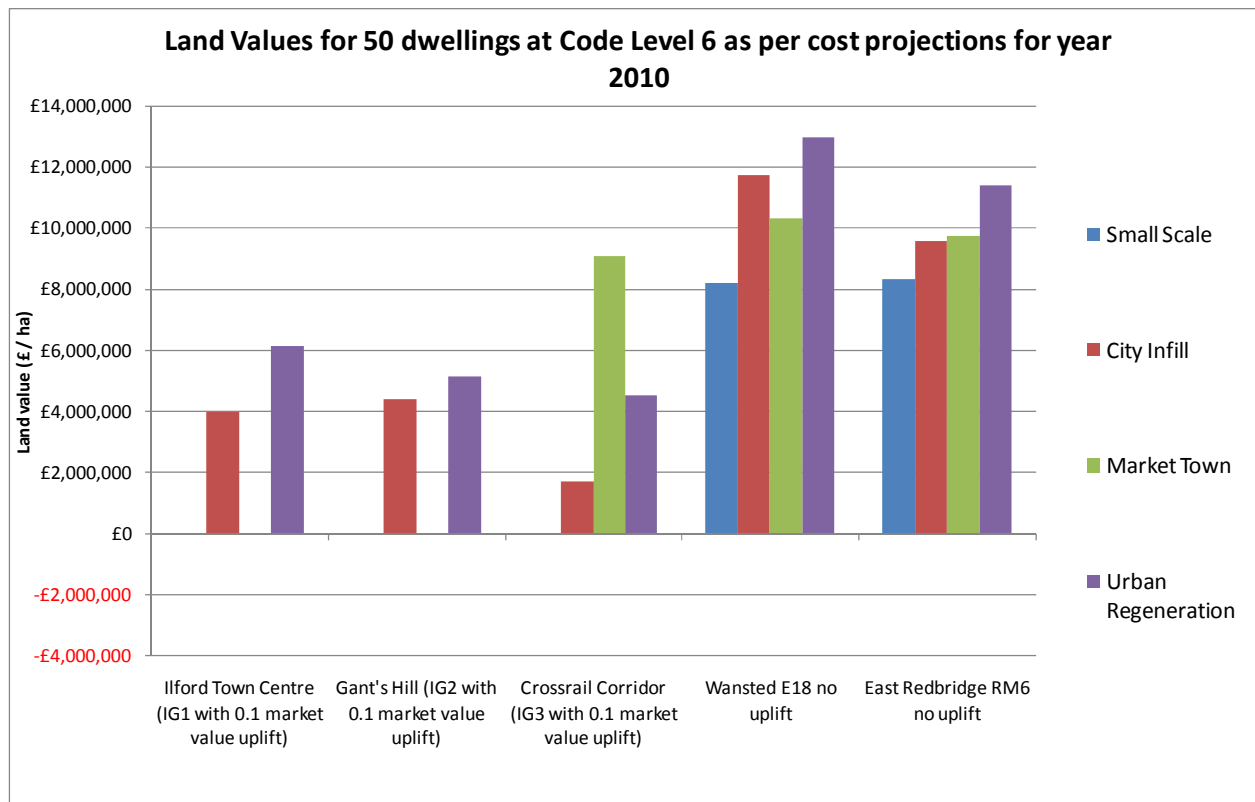


Figure 7-16: Land Values/Residual values of Aspirational CSH Implementation (Code 6 in 2010) - 50 dwellings

When Code 6 is imposed immediately it can be seen that whilst all areas appear to exhibit positive land values, there is a noticeable reduction against the other policy scenarios. Although the graph above indicates that Code Level 6 is achievable right now, it should be noted that this would need to be studied and in further detail through detailed site viability testing.

It should be noted that the residual values identified in the viability modelling have not been compared against the EUV and the development viability analysis has been developed to identify positive and negative trends and thus inform policy development. More detailed site specific viability analysis will be required at the time of application to support site specific verification.

Sensitivity Analysis

The following sensitivity analysis further illustrates that the major components of viability are market value (land value/residual value) and build costs, and that as might be expected under the model outlined above, the energy component only represents a relatively minor element of overall viability.

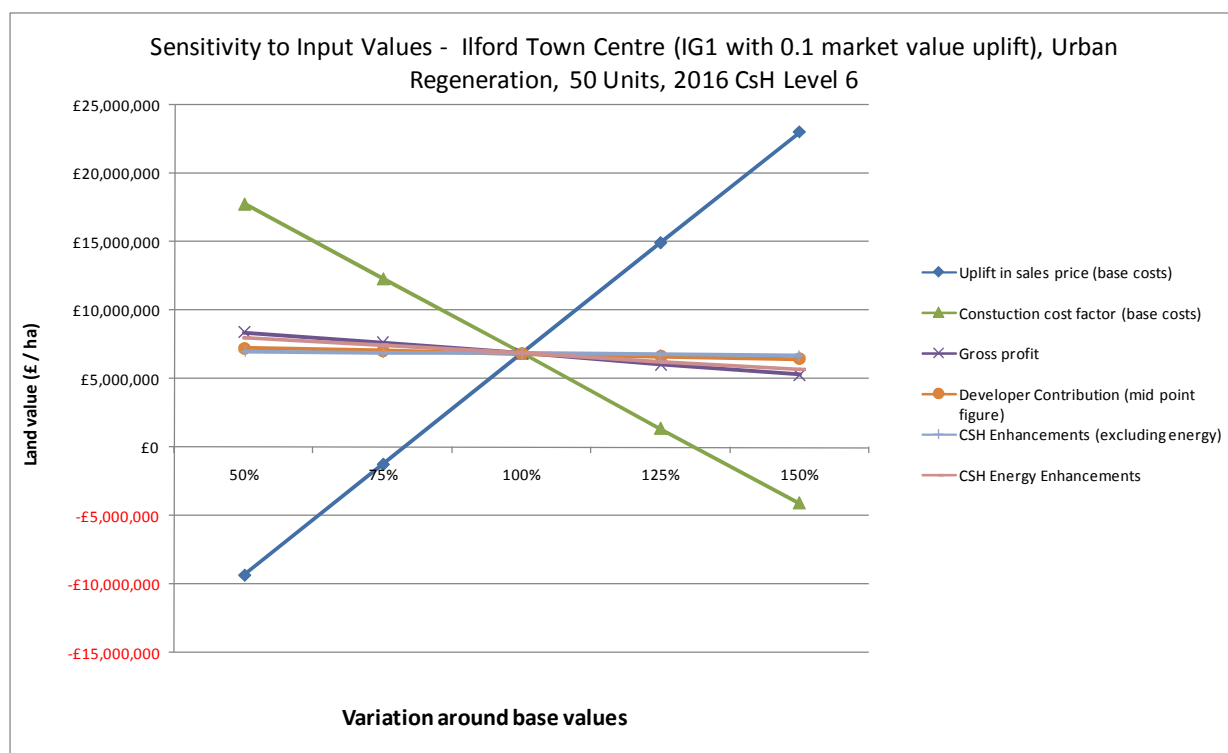


Figure 7-17: Sensitivity chart for viability testing

Figure 7-17 shows that as input values are multiplied by certain percentages (on the x-axis) (e.g. if assumptions made on build costs are multiplied by 110%, then obviously viability decreases and land value decreases). The figure illustrates the comparative impact that various factors have on land value and highlights which are the biggest numbers in the cost build-up.

Figure 7-17 is instructive in clarifying two issues surrounding viability testing. First, that development viability (and hence the viability of increased environmental standards) will much more significantly depend on market conditions rather than variations in the cost of Code enhancements, and second, that the site-specific elements of build-cost make up can also radically outweigh the element of Code enhancements that are under consideration throughout this analysis.

This analysis suggests that from a policy development perspective, it would be appropriate to impose higher standards on development in the knowledge that market conditions and site specific constraints can radically impact viability in directions that policy analysis of this nature cannot predict. The implementation and deliverability of higher levels of energy performance should then be assessed on a site-by-site basis as development comes forward, and the onus of evidence should be placed on the developers to demonstrate viability or non-viability. This must be done in a manner that can be verified by a third party.

7.6 Implication of Feed-in Tariff / Renewable Heat Incentive

There has been considerable discussion regarding the potential of the Feed-in Tariff and Renewable Heat Incentive to impact the viability of development. These discussions have generally focussed around the concept of a sales value premium resulting from the installation of a technology that will benefit from the proposed support mechanisms. E.g. would a prospective purchaser be willing to pay a premium for a given building in the knowledge that the energy systems installed are likely to reduce their running costs substantially for a given period of time?

Unfortunately it is not possible to give a robust, evidence-based answer to this question as this has not yet been tested in the market. The 'conservative' approach adopted here has been to assume that no market premium will be seen, and to conduct a general sensitivity analysis on sales prices.

A further potential mechanism through which the Feed-in Tariff and Renewable Heat Incentive could positively impact viability is through the involvement of a third party. It is anticipated that private companies will propose that they install, own and operate low carbon technology that benefits from the Government policy support mechanisms, and lease the installation back to the building owner. This mechanism would allow the site to meet its carbon emissions reductions commitments without the developer having to bear the capital cost of the low carbon installation. In this instance, however, the building owner / occupier would also not benefit from the reduced running costs that the installation would generate. Given that it is not certain exactly how these leasing schemes will operate nor the degree to which the capital cost of the installation may be supported by the third-party investor, again this potential mechanism has not been directly adopted in viability testing modelling at this stage.

7.7 Implication of ESCos & District Heating

There are also potential viability implications for higher environmental standards surrounding the use of district heating and the involvement of Energy Service Companies (ESCOs).

District heating (DH) enables technology thresholds to be crossed and economies of scale to be realised both in plant selection and fuel procurement. This allows high efficiency, low carbon and low cost heat to be provided to a wide customer base given appropriate system design and operation.

The policy demands for low carbon development in constrained sites often leads to a practical requirement for a district heating system. The site development density and heat demand density (as well as other factors) influence the cost-effectiveness of installation on a life-cycle basis, but the following general points can be made for typical sites:

- Viability depends on a large variety of factors some of which are beyond ESCo control and therefore represent a substantial level of risk – e.g. utility price fluctuations and
- Private sector discount factors (linked to risk levels) employed by the ESCos mean that only limited contributions to capital installation costs are generally offered by ESCos. In Scott Wilson's experience these are generally not sufficient to cover the whole of the DH network installation cost and the energy centre plant. Another party, e.g. the developer, therefore has to fund the remainder of the DH installation cost.

The regulatory context in which ESCOs are operating is changing with the introduction of the Renewable Heat Incentive, and for renewable fuelled installations this may change the balance of contribution that ESCOs are willing to make, but it is considered unlikely that this will substantially alter the overall level of viability of schemes of this nature. It is beyond the scope and resource of this project to identify the impact of the RHI in a DH / ESCo context, and the knock-on effects in terms of costs of more stringent environmental standards. The approach adopted here assumes a standard cost for district heating installations implicit within the higher policy target scenarios, that is then examined in sensitivity analysis.

7.8 Interpretation of Viability Results

The results illustrated here and in the Appendices F and G show that for all areas of the Borough investigated, development delivers Land Values in a range that suggests viability. In particular the higher market sales values of Wanstead and East Redbridge suggest that these areas could generate the assumed level of Developer profit and also high residual value.

Of the three strategic sites investigated (Ilford Town Centre, Gants Hill and the Crossrail Corridor), the Crossrail Corridor shows the lowest level of value. In this area, the results show that for 5 dwellings the delivery of Code Level 6 in line with the current Government timetable is not viable (e.g. delivers a negative land value) for urban infill development (See Appendix G). However, the costs of being 'zero carbon' in this modelling do not take account of 'allowable solutions', which could potentially reduce developer costs and push sites of this nature towards viability.

In essence, viability depends on the land value for the proposed scheme being higher than a) retaining the existing use, b) alternative uses to which the land might be put c) the present value of some future value that might be realised for the land. For development to take place the landowner needs to secure at least as much for the land than they can reasonably expect in the future. If a firm price is paid for the site then this should be sufficient, alternatively if the land value is contingent on other factors (eg sales prices) then the viability will depend on the likely risk of the desired land value not being achieved (and the extent to which this will impact on the developers profit or the land value).

The extent to which it would be better for a landowner to retain existing use or apply for a non residential use will vary with the location and planning context of the site. If LBR were to consider proposing higher performance standards for both residential and non-residential development then it is only a 'non development' use that is unaffected by the policy. It is likely a non development use would realise a higher land value than a development use (even if it were permissible under planning requirements).

When considering bringing forward requirements that will become regulatory in the future then the impact of option c), above, depends on the extent to which the costs of complying with the standard will fall over time (or at least the landowners view on this) and how this relates to the time cost of not selling the site now. Given that the uplift in cost of the land value (approximately £200,000 maximum) and assuming the developer would incur an opportunity cost of at least this much each year they delayed selling the site, it is unlikely that introducing policies in advance of national targets would have a major impact on the likelihood of sites coming to market.

The key question therefore is whether land values can be achieved that are higher than non development uses, these values will vary by location but are typically much lower (in the £100k's not £M's per Ha) depending on the nature of the site. Cyril Sweett have approximated that any land value above, £200K per Ha is likely to be viable on these grounds. It is important to remember that this conclusion does not mean that landowners will be bringing forward sites in the short term because of depressed market conditions. However, it does suggest that the policy in isolation should not be sufficient to make development unviable. The impact of renewable energy / code requirements will not influence the viability of sites unless it a) is has disproportionate costs on one type of development over another, b) pushes land values to a level where the alternative of not developing is more attractive (eg a negative land value).

8 Policy and Implementation Options

8.1 General Core Strategy Policies

8.1.1 Defining Criteria-Based Policies

Planning Policy Statement 22 (Renewable Energy) advises that planning applications for stand-alone renewable energy installations should be assessed against specific criteria that are set out in local development documents. Criteria-based policies should be drafted to reflect local circumstances, focusing on the key criteria that will be used to judge applications, with more detailed issues set out in Supplementary Planning Documents. In areas that are nationally designated, there is a presumption that small-scale developments should be permitted, provided that there is no significant environmental detriment to the area concerned.

The Companion Guide to PPS22 makes it clear that policies should be expressed positively, with the presumption being that stand-alone renewable energy developments will be permitted unless they fail to meet defined criteria. Typically, criteria may include impact on landscape (particularly in designated areas) including visual, cultural and historical character and attributes, as well as a range of other environmental impacts such as noise, dust, odour and traffic generation (see Paragraph 4.11 in the Companion Guide to PPS 22).

PPS1 includes the key principle that local planning authorities should ensure that development plans promote the development of renewable energy resources. It also sets out that development plan policies should seek to promote and encourage, rather than restrict, the use of renewable resources, and that local authorities should promote small scale renewable and low carbon energy schemes in developments. Please refer to Section 2.2.3 for further details

Clearly, the policy criteria by which a proposal is to be assessed must be demonstrably related to the specific circumstances (and in particular environmental sensitivities) that exist within a given area. Visual and landscape character sensitivity will be of concern in certain areas in Redbridge, such as Epping Forest. However, these should not necessarily preclude any opportunities for renewable energy, particularly where resource opportunities (such as wind speed and availability of wood fuel) may favour the location of renewable energy installations, either as stand-alone projects, or where proposed as part of another development proposal.

It is reasonable to assume that as the market for renewable energy grows with the introduction of new financial incentives, such as the proposed Renewable Heat Incentive, further proposals will come forward for renewable energy installations within Redbridge.

8.1.2 Consequential Improvements

In common with many other Local Planning Authorities, the majority of planning applications relate to proposals for small extensions to private dwellings ('Householder Applications'). In 2009, these accounted for around 80% of all applications determined by the Council⁹⁰. Whilst individually they have very limited impact in terms of increased energy demand and carbon emissions, the cumulative impact of these proposals is significant, even compared with many

⁹⁰ Redbridge Planning Application Statistics
http://www.redbridge.gov.uk/cms/planning_land_and_buildings/planning/about_us_and_feedback.aspx

major schemes proposing new development. As a result, a number of Councils have considered the introduction of planning policies that seek to address the impact of extensions to existing dwellings. This also provides the opportunity for Planning Authorities to bring about measures that will contribute to National Indicator 186 (per capita reduction in CO₂ emissions).

Uttlesford District Council in Essex has adopted an SPD⁹¹ and uses planning conditions in order to ensure household extensions are carbon neutral through 'consequential improvements' to the property as a whole. Consequential improvement comprises improving the energy efficiency of a building to negate (either in part or entirely) the effect of increased energy use arising from an extension to the building. Uttlesford DC's approach is designed to improve the energy performance of existing residential stock, an area often considered to be outside the remit of the planning process. There is a close relationship between this and Part L (Conservation of Fuel and Power) of the Building Regulations, with a similar requirement for 'consequential works' originally proposed to be implemented through the 2006 revision to Building Regulations. However, this was not included in the adopted version and is not proposed in the amended Regulations to be introduced in 2010.

Uttlesford DC's planning condition '*Improving energy efficiency in an extended dwelling*' states that for any extension or loft or garage conversion granted planning permission after 1st April 2006: "*The Council will require simple, cost effective energy efficiency measures to be carried out on the existing house if possible and practical*". This was originally introduced on the basis of the Supplementary Planning Document on home extensions adopted in November 2005 and has been reinforced through a more recent SPD on energy efficiency and renewable energy. When planning approval is granted for an extension or conversion of a dwelling, the applicant is asked to complete a home energy form. This becomes the basis of a report produced by the Council recommending measures that could be implemented to improve the energy efficiency of the existing building. These are drawn from a menu of eight different measures to improve insulation, the energy efficiency of heating systems or reduce electricity consumption.

Uttlesford Council's Building Control team is responsible for agreeing with the householder which measures are to be implemented to the rest of the building fabric as part of the condition. Householders are asked to implement as many of the eight measures as are practical and cost effective (defined by a payback period of less than 7 years), limited to no more than 10% of the total cost of the extension. In the first two years of implementation of these measures, Uttlesford believes it has achieved a reduction in energy consumption in the District's dwellings of nearly 2,000 MWh, equivalent to over 400 tonnes CO₂ emissions per annum.

The LBR may wish to implement a requirement to ensure its contribution to achieving the targets defined in respect of NI 186 is not undermined by the many small but incremental increases in energy consumption that arise through household extensions. The introduction of measures to secure consequential improvements would provide an effective and measureable strategy to help address this challenge.

⁹¹

http://www.uttlesford.gov.uk/documents/website/Climate%20Change/Energy%20Efficiency%20Condition/epbc_uttlesford_spd_cs.pdf

8.2 Defining which elements of building energy use should be included within policy

The term 'regulated' energy relates to all energy consumed within a building for purposes that are included in assessment of compliance with Part L of the Building Regulations. For example, within a house, regulated energy relates only to comfort heating and hot water (including heating system pumps and fans), and fixed lighting (i.e. ceiling and wall-mounted lights). All other energy uses such as cooking and electrical appliances are excluded, and together comprise 'unregulated' energy use. The proportion of total energy demand (i.e. the sum of regulated and unregulated energy) arising through unregulated energy uses can be significant, as shown below.

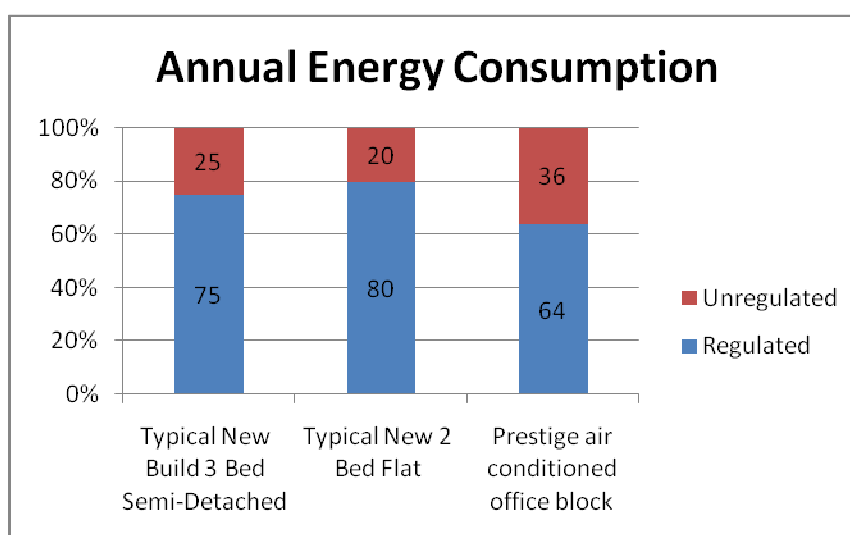


Figure 8-1: Energy Consumption of Dwellings against Offices

Some Local Planning Authorities have set out in their supporting information an expectation that planning applications shall be assessed in terms of their anticipated total energy consumption. This removes a distinction based on regulatory measures that fall outside the planning system and ensures the policy aligns more closely with the planning objective that the whole impacts of a development proposal be considered.

8.2.1 Policy Targets Based on Carbon Emissions

The relative levels of carbon savings arising from a particular LZC energy technology are partly dependent on the 'carbon intensity' of input energy. In wind, solar or hydro energy, the input energy has a carbon intensity of zero. Biomass wood fuel has much lower carbon intensity than natural coal, oil or gas. However, where grid electricity is used as the input energy the carbon intensity is much higher. The relative carbon intensity of a number of fuels (produced by Thamesway) is shown below:

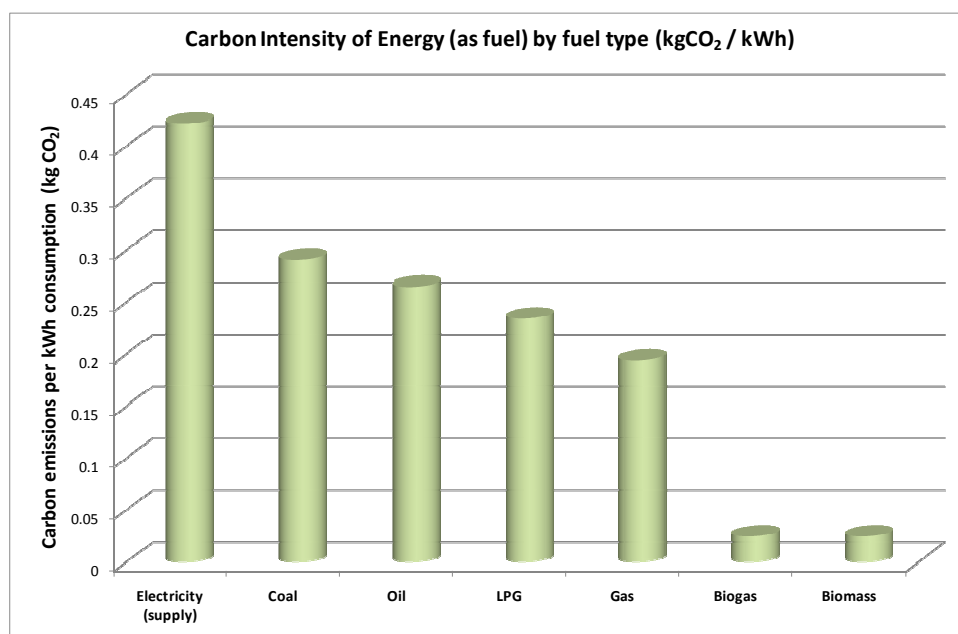


Figure 8-2: Carbon Intensity of Fuel Types

Due to the differing carbon intensity of fuel types, the reduction in carbon emissions arising from different types of LZC technology is dependent on the type of conventional energy that they are replacing. As a general rule, renewable electricity generation (for example from a photovoltaic panel) provides a greater saving in carbon emissions than an equivalent amount of energy generated by a renewable heat source (such as a solar hot water panel). Furthermore, heat-producing LZC technologies that require an input of electricity to operate (such as ground source heat pumps) make the smallest contribution to reducing carbon emissions. As a result, some proposals may meet targets expressed in terms of energy generation on site through LZC means, but achieve a significantly more modest reduction in carbon emissions. The figure below produced by Thameswey illustrates this.

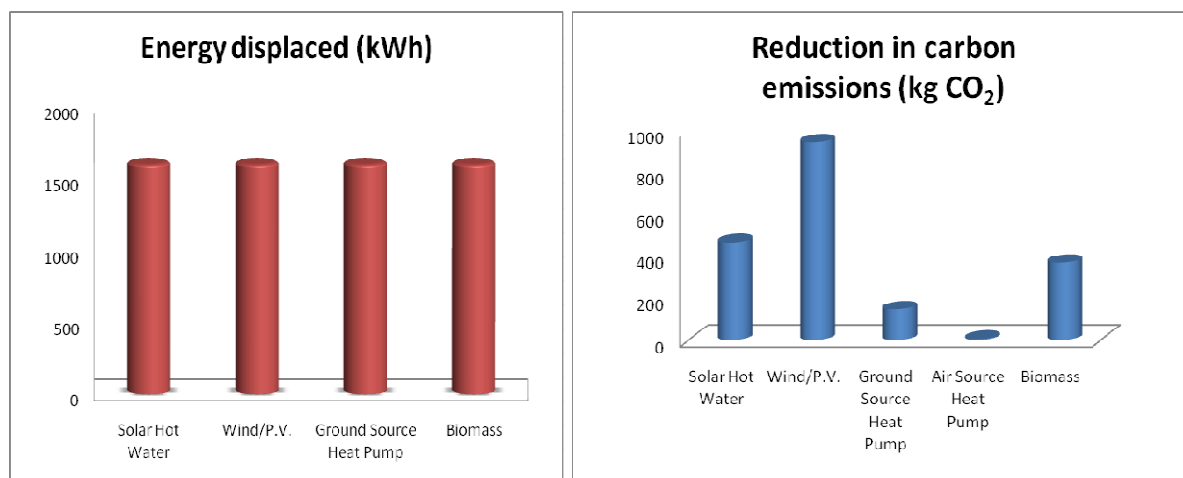


Figure 8-3: Energy Displaced and Reduction in Carbon Emissions

By defining a policy in terms of a target level of reduction in carbon emissions, the Council will be able to ensure it is focusing on the desired outcome of the policy.

8.2.2 Setting a Policy Based on Betterment over the Building Regulations

As described above there are clear linkages between Planning and Building Control. The Council should be clear about how it intends to define the relationship between the two regulatory environments in order to demonstrate it is not duplicating the Building Regulations within its Core Strategy. It should be noted that the Government has announced its proposals to revise the minimum statutory requirements for regulated energy consumption through revised Building Regulations in the latter half of 2010, with further changes proposed in 2013. The 2010 revisions will set a requirement for all residential and non-residential buildings to achieve a 25% improvement in energy efficiency compared with current standards set in 2006.

The Council may wish to consider setting its planning policies against a base defined by the prevailing Building Regulations. This will enable the Council to set targets for new development that require them to demonstrate they will achieve a lower energy demand and/or level of emissions than the 'base case' (i.e. the Building Regulations minimum). This could be achieved by the following individual measures, or a combination of both:

- Assessing development proposals on the basis of predicted total energy consumption (as above) and/or
- Setting a minimum performance improvement over and above the Building Regulations (i.e. developments should secure at least 10% LZC energy production or carbon emissions reduction compared with the minimum standards set out in the current Building Regulations).

8.2.3 Removing the Size Threshold

Policy 4A.7 of the London Plan requires that all development proposals considered by the Mayor should achieve a reduction in carbon dioxide emissions of 20% from onsite renewable energy generation, and seeks to encourage the adoption of the same requirement by London Boroughs when considering development proposals. The London Plan policy does not include minor planning applications for development proposals of 10 houses or less, or less than 1,000 m² non-residential floorspace. In Redbridge, 478 minor applications⁹² were determined in the year ending 2009. These schemes comprise a significant proportion of all development proposals within the Borough.

Adopting a policy that removes the size threshold currently set within the London Plan would enable the Council to secure significant reductions in energy consumption and carbon emissions in smaller developments.

A further option is to consider applying the targets set out in the London Plan on a phased basis, with an initial requirement for at least 20% of carbon reductions to be on-site generated through renewable technologies, to be replaced through the phased introduction of higher standards over time. This would enable the Council to bring development in line with the Government's planned introduction of milestones towards achievement of zero carbon homes by 2016 (and other

⁹² http://www.redbridge.gov.uk/cms/planning_land_and_buildings/planning/about_us_and_feedback.aspx

buildings by 2019) as set out in Chapter 2. However, it would appear that the next revision of the London Plan (currently in draft format) will relax the 20% rule, and hence a policy of this nature imposed through Borough documents could conflict with wider London Plan aspirations. Consultation with the GLA energy team would be required for development of policy of this nature.

8.2.4 Policies Seeking Contributions from Renewable Energy (the 'Merton Rule')

Merton was the first council in the UK to adopt a prescriptive planning policy requiring new commercial buildings to generate at least 10% of their energy needs from on-site renewable technology. It was adopted in 2003 and influential to the point where many other local authorities adopted it, or similar policies. The policy has been challenged, and successfully defended, albeit the national policy backdrop to its introduction has now considerably changed. It is important to note that the 'Merton Rule' was introduced requiring a percentage contribution in *energy* terms, whereas the policy has now been updated to require a percentage contribution to *carbon emissions*. As noted above, the use of carbon emissions targets is considered more appropriate in the wider context of both current legislation and given the use of technologies such as CHP (which increase on-site energy consumption, whilst decreasing overall site emissions).

On this basis, an outline indicative analysis has been taken on the impact of a Merton-style rule (based on carbon emissions) for Redbridge. This is shown graphically below for various policy targets on an illustrative basis:

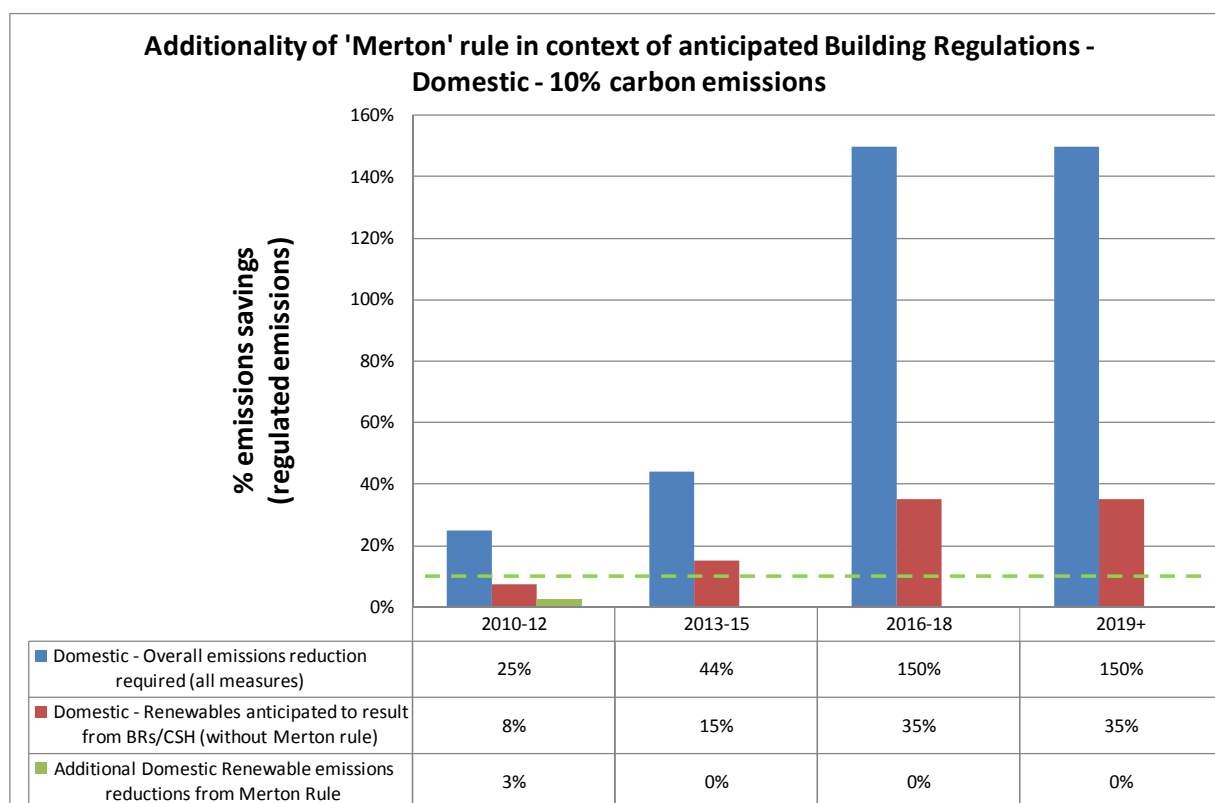


Figure 8-4 Additionality of Merton Rule at 10%

This graph shows three coloured bars – the blue columns are the total level of emissions reductions required by Building Regulations or the Code for Sustainable Homes; the red columns represent an estimated level of renewable technology emissions reductions that would be achieved through renewables as an indirect result of BR / CSH (e.g. irrespective of a 'Merton Rule'); the green bar shows the additional contribution to emissions savings that a Merton rule would achieve, in this case assuming the rule were imposed at 10% emissions savings level.

This example shows that it would only be in the period between up to 2013 that any additionality (in terms of carbon savings) would result from a policy of this design.

Further levels of Merton-style rule are shown below:

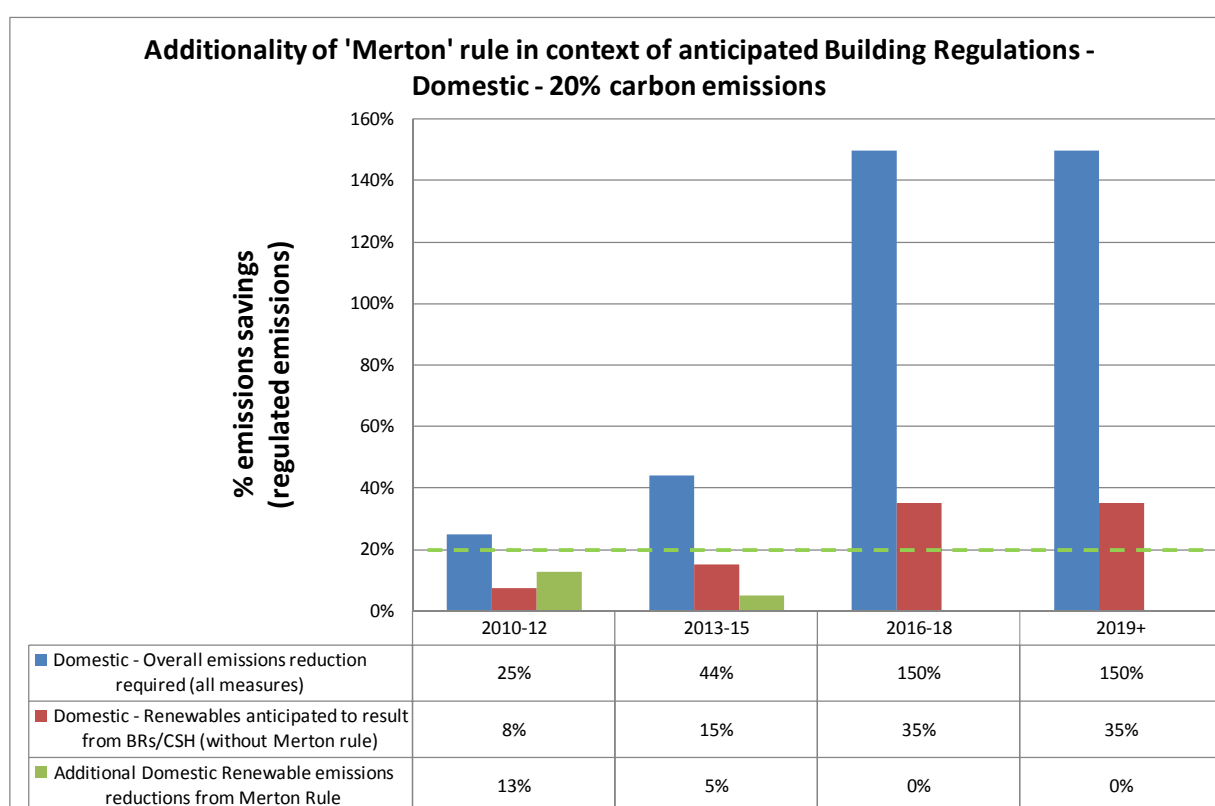


Figure 8-5 Additionality of Merton rule at 20%

This case assumes the rule was imposed at 20% emissions savings level.

This example shows that it would only be in the period between up to 2016 that any additionality (in terms of carbon savings) would result from a policy of this design.

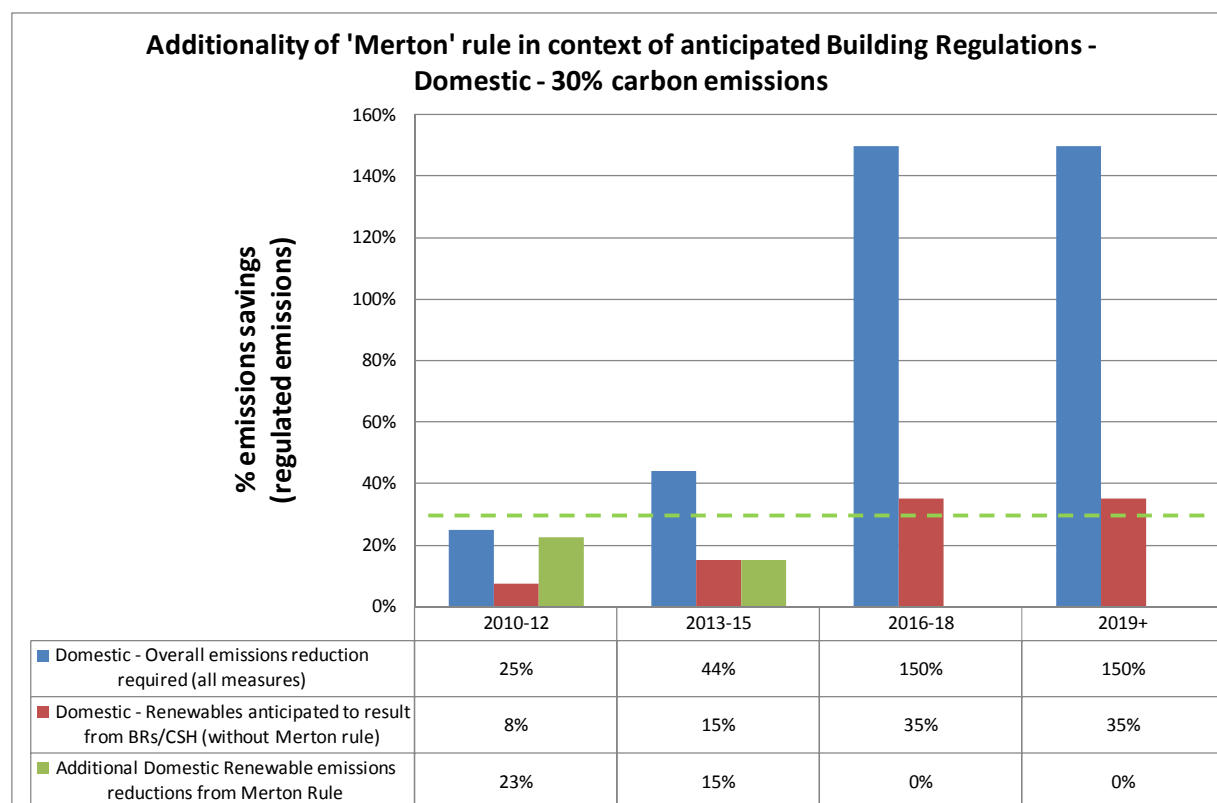


Figure 8-6 Additionality of 'Merton Rule' at 30%

This figure shows that even when the ambitious target of 30% is imposed, this is only estimated to have any impact on the pre-2016 domestic development.

When this rule is coupled with the volume of domestic development anticipated in the three Redbridge strategic sites evaluated in this report, the following figures are derived:

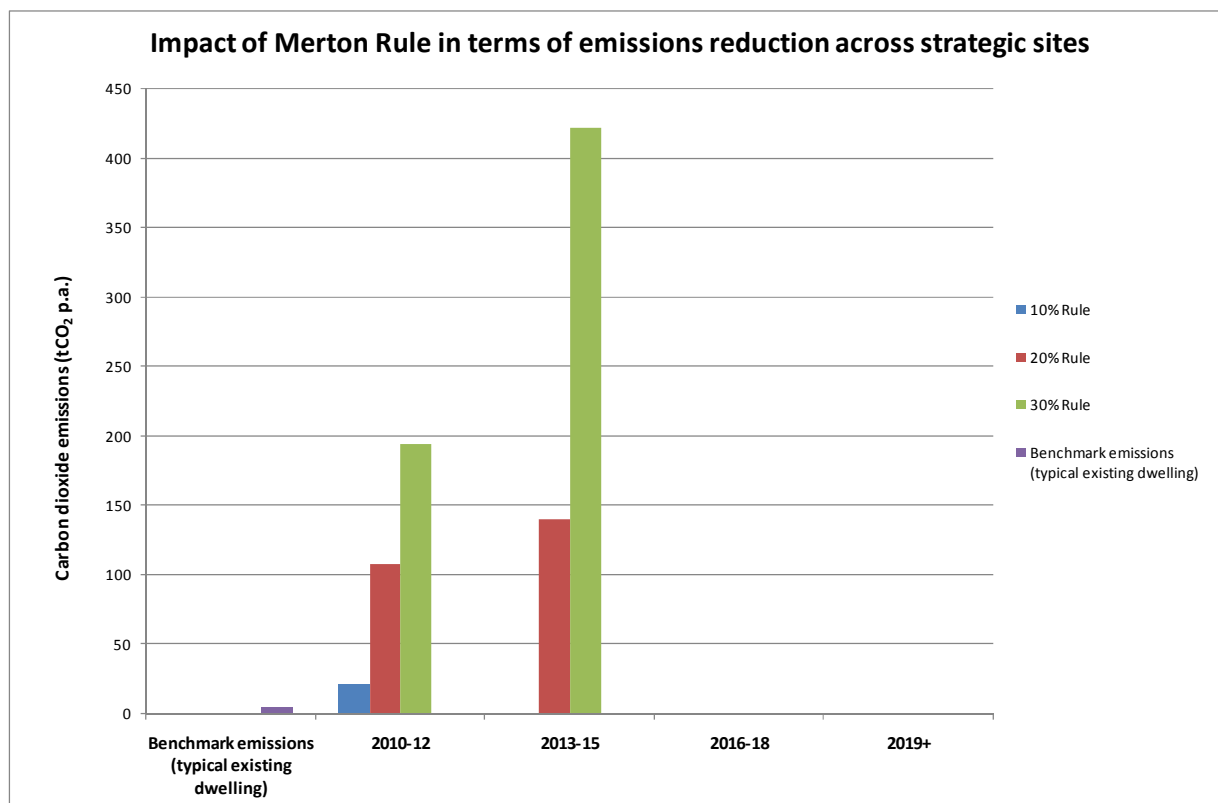


Figure 8-7 Carbon emissions impact of Merton rule at different levels across strategic sites

The vertical axis demonstrates the result of the data that was available on housing developments planned in those different periods (in the strategic sites only), multiplied through with the additional savings that would result from the imposed renewable energy targets.

This graph illustrates that a 10% Merton-style rule (e.g. blue column) would only have an impact equivalent to the emissions of approximately five typical dwellings.

On this basis, it would be suggested that if a Merton-style rule is approved, then the level should be set at 20% or greater in terms of emissions reductions required in order to have any level of significant additionality. However, the time-limited impact of this policy intervention must also be borne in mind – only limited or zero impact would be seen after 2016.

However, by strictly applying % renewable target rules, i.e. where cost effective energy efficient measures are not implemented, developers will be required to install a greater proportion of renewable energy which will incur greater cost to achieve the 20% target. Therefore, targets should specify a level of energy efficiency to be achieved to ensure this as practice as adopted first and foremost. i.e. 5% energy efficiency and 20% renewables = 25% CfSH Level 3.

8.2.5 Carbon Fund - Policies Seeking Aspirational Levels of Carbon Reduction

The draft replacement PPS Planning for a Low Carbon Future in a changing Climate (March 2010) comments that planned revisions to Building Regulations in 2013 and 2016 will be contributing to a shift in the focus of local planning policy and implementation towards community-scale low and zero carbon energy infrastructure. Current proposals for Zero Carbon Homes include a mechanism to secure investment through 'allowable solutions' for local community energy infrastructure and other measures to reduce community carbon emissions through payment into a fund. A number of local authorities have pioneered the establishment of carbon funds as a means of delivering carbon reduction measures in their local communities funded by payments by developers. This has proved in some cases to be an effective means of achieving carbon reductions associated with new developments that are deemed to be 'carbon neutral'.

There are examples of this being set out in the form of a policy requirement for a minimum level of renewable or carbon reduction within a development proposal, plus an aspirational target that seeks to secure further significant carbon reductions through funding and implementation of off-site measures.

This approach offers a number of benefits for Redbridge:

- Developers may pay into a carbon fund where circumstances would prevent high levels of on-site carbon reduction being economically viable, as the charge levied for mitigating carbon emissions through a fund may be significantly less than the costs that would otherwise have to be met by a developer to avoid an equivalent amount of emissions within a development.
- The use of a fund could provide a level of flexibility for the LBR in prioritising the delivery of community carbon reduction measures. For example, it may wish to target insulation within poorer performing stock, thereby also enabling it to deliver its objectives for reducing fuel poverty. Alternatively, the funding may be pooled towards investment in major new energy infrastructure programmes, such as a community heat network.
- The establishment of a local fund can be used to secure additional sources of funding or to focus delivery of carbon reduction measures through existing partnerships and programmes.

The mechanism for contributing to a carbon fund could take a number of forms. For example, Milton Keynes Borough Council in its Local Plan policy D4⁹³ (adopted 2005), has set a levy based on a single one-off payment set at £200 per tonne of carbon. The levy is calculated on the basis of an aspirational target for all residential developments of more than 5 units (or over 1000m² commercial floorspace) should be carbon neutral. This permits new developments to have net emissions as long as they pay into the fund to enable these emissions to be off-set elsewhere within the borough. The payment is based on estimated annual emissions from the new development and recognises the cost-effectiveness of offsetting carbon emissions through low-cost measures to reduce energy use within existing stock. Milton Keynes set the levy on the basis of an offset feasibility study it commissioned in 2004.

⁹³ <http://www.miltonkeynes.gov.uk/planning-policy/documents/Local%5FPlan%5FPart%5F5%2Epdf>

Milton Keynes Borough Council uses section 106 agreements to secure financial contributions. The policy has proved to be effective, raising over £800,000 towards a number of measures and initiatives aimed at reducing local carbon emissions.

Ashford Borough Council has adopted a similar policy approach aimed at achieving carbon neutrality. Policy CS10 of its Core Strategy (adopted 2008) states that new development should be carbon neutral “with any shortfall being met by financial contributions to enable residual carbon emissions to be offset elsewhere in the Borough.”

Ashford sets out how this policy is to be implemented through an SPD. In common with Milton Keynes, Ashford requires developments to pay a levy based on the predicted emissions arising from energy use in a development over the course of year. A one-off payment is made into the fund, the sum being based on the ‘Shadow Price of Carbon’, currently set at £27/tCO₂⁹⁴. This has the advantage of using a monetary value that is set by Defra, and avoids detailed justification of the cost per tonne of emissions by the Council. However, the cost of carbon emissions defined within the Shadow Price is considerably lower than the figure set by Milton Keynes and significantly lower than the assumed abatement cost of £95/tCO₂ by the Government under Scenario 2 – Balancing on-site and off-site. Significantly, Ashford states that it will use the sums paid into the carbon fund for reducing energy consumption within existing buildings and tree planting.

Dover District Council’s Core Strategy (adopted 2010) includes policy CP9 which sets out the Code for Sustainable Homes and BREEAM levels that it expects new development to achieve. However, there is provision for developers to offset some of the impacts of their proposal through contributions into a fund and where it can be demonstrated that a development is unable to meet these standards, the Council may grant permission if the “applicant makes provision for compensatory energy and water savings elsewhere in the District.” Dover’s Core Strategy further explains that developments that are unable to meet the standards of Policy CP5 on-site can make commensurate energy and water savings elsewhere in the District by making a financial contribution to the Council to enable it to help fund schemes that would make the savings. The mechanism by which these sums are to be calculated and appropriate schemes are to be identified will be set out in due course by the Council. This approach provides the potential for developers to either take action directly to achieve commensurate levels of energy and water savings elsewhere in the district, or to pay into a fund.

Dover’s focus on measures to energy and water measures within the district accords with emerging national policy. The draft replacement PPS proposes that, subject to justification, local planning authorities may set targets for compliance with high levels of the Code for Sustainable Homes, focusing exclusively on the energy and water standards within the Code.

By providing the opportunity to relax the requirement to meet the more demanding standards for water and energy on-site, the policies that have been adopted recognise the high costs that can be encountered in achieving these standards within new developments (especially as these developments are likely to achieve significant improvements in energy and water efficiency over existing stock), and the potential to achieve equivalent levels of energy and water efficiency at a

⁹⁴ The Social Cost Of Carbon And The Shadow Price Of Carbon: What They Are, And How To Use Them In Economic Appraisal In The UK, Economics Group, Defra, December 2007.

lower cost through measures to improve the performance of existing stock. Therefore, this can be an effective mechanism for stabilising the growth in emissions through new development where the additional costs of achieving high standards of energy efficiency and/or carbon reduction threaten to exceed the economic viability of a scheme.

However, some local authorities' proposals for seeking carbon fund contributions have not been supported by Inspectors. For example, Reigate and Banstead Borough Council's submission draft Core Strategy (2009) included in its policy CS 10 Sustainable Construction a requirement that development should be 'carbon neutral' through a combination of measures based on accelerated implementation of the Code for Sustainable Homes (or BREEAM 'Excellent'), the use of on-site renewable energy and payment into a 'Carbon Reduction Fund' in respect of residual emissions not mitigated through the other measures. Prior to examination, the inspector expressed some reservations regarding justification for the approach, the basis on which it would be implemented and overall clarity of the proposal. The Council responded by submitting a re-structured policy and further evidence that sought to address the Inspector's comments. However, following further concerns expressed during and following the examination in respect of a number of other substantive issues in the Core Strategy (in addition to the Sustainable Construction policy), the Council withdrew its Core Strategy.

The Inspector subsequently provided an informal advisory letter to Reigate and Banstead in which his concerns were expressed. This re-iterated his concern that there was inadequate justification for requiring compliance with Code standards in advance of national policy. In addition, the Inspector commented that the Core Strategy "did little to provide a framework that promotes and encourages renewable and low energy carbon generation or to facilitate projects to help achieve regional targets". In this regard, the Inspector was clearly not convinced that the Carbon Reduction Fund proposed by the Council would make a significant contribution to generating renewable energy. This reveals a tension between meeting the related but distinct objectives of securing reduced carbon emissions on one hand, whilst also securing increased generation renewable and low carbon generation.

Finally, on the question of economic viability of the proposal to include a carbon fund in the policy, the Inspector commented: "The fact that the policy may be affordable in some circumstances and that the cost of offsetting has a marginal effect on viability is not a justification for introducing the policy. " In other words, the justification for the purpose of the policy must be clearly demonstrated, in addition to demonstrating its economic viability.

If Redbridge concludes that it wishes to establish a carbon fund too, it will need to demonstrate it has a clear programme for implementation of off-site energy measures and an appropriate means of delivering this. In common with other authorities that have adopted policies that permit developments to mitigate a proportion of carbon emissions through off-site measures, Redbridge will need to set out the detail behind this policy in a supplementary document. This should include:

- A sound justification for the policy approach;
- A clear explanation of the circumstances in which a development proposal may mitigate its impact through off-site measures;
- The minimum standards that are to be achieved on-site;

- The funding levels to be applied to calculate the value of contributions to a carbon fund;
- The mechanism to be applied to enable developers to contribute to the fund;
- Whether such measures can be carried out directly by the developer; and
- An indication of the programme of off-site measures that will be targeted for implementation through a carbon fund.

8.3 Measures to Support Implementation of Policies

8.3.1 Pre-application Discussions

Pre-application discussions and encouraging developers to engage with the Council as early as possible will be essential in order for the LBR to respond to the need to apply energy policies and standards.

For strategic sites, such as Ilford Town Centre, where developers will be required to respond to higher standards of sustainable design and construction, Redbridge may be required to take a more flexible approach in order to ensure development proceeds; flexibility may be required in terms of accommodating the increased capital cost imposed by higher standards and policies. On these specific sites, for example, affordable housing contributions may need to be reduced and S106 contributions agreed accordingly.

8.3.2 Skills and Training

In order for the LBR to engage with developers and ensure the successful integration of their policies in development applications, they will require the necessary up-skilling and training on low carbon and renewable technologies, so that appropriate knowledge is available, which can be utilised during the application determination process.

A process for ensuring knowledge transfer and assimilation would be required both internally within the Council, and within the Local Strategic Partnership. This would likely involve a training program for selected planning officers and a simple process to ensure knowledge and skills were not lost if staff moved on. Therefore, it would be essential to ensure more than one officer was adequately trained at any one time, enabling the continual monitoring and measurement of applications, in accordance with energy policy and standards.

Skills and training are important both within the Council and also for owners/occupiers of existing stock. Leaflets providing information and training days run by the Council may be required to further educate and disseminate information within Redbridge. This may best be facilitated via cross-border initiatives, through reliance on the shared resources and knowledge of the Local Strategic Partnership.

8.3.3 Local Development Orders (LDOs)

The Planning and Climate Change Supplement to PPS1 encourages planning authorities to consider using LDOs as a means of helping secure low and zero carbon energy supplies. LDOs could form a suite of tools (including guidance and design codes) that can help stimulate investment in energy infrastructure. For example, by granting additional permitted development

rights relating to the installation of community heat plants, some of the cost and uncertainty associated with new low carbon energy infrastructure may be reduced, hence deeming developers less resistant to funding its provision. Other potential applications of an LDO include: broadening the range of 'permitted development rights', in some or all of a Local Authority area, to cover a wider range of householder micro-renewable energy installations; or providing a 'framework permission' for a decentralised energy network to serve a development and/ or existing buildings.

We are not aware of any LDOs having been adopted specifically to facilitate climate change and decentralised energy objectives and indeed their application has thus far been limited. However, an LDO is being piloted by the London Development Agency⁹⁵ in respect of the implementation of a cross-boundary approach to the provision of a new district heating network in east London. Elements that may be included in the LDO are, for example: below-ground works, such as trenching and laying of pipes and other apparatus; above-ground apparatus and street furniture; associated small buildings; and building extensions. The LDO will enable staged roll-out of the heat energy network and extensions to the scheme without the need for numerous individual planning applications.

The pilot is still at a relatively early stage with adoption planned for summer 2010. However, if the pilot is successful, the use of LDOs may become more widespread as a means of reducing costs and risk of delays associated with the delivery of community-scale decentralised energy networks.

8.3.4 Planning Performance Agreements (PPAs)

A PPA is a mechanism for dealing with complex development proposals. PPAs bring together a developer, the Local Planning Authority and key stakeholders from an early stage to cooperate throughout all stages of the planning process. They are, essentially, a collaborative project management tool that provides greater certainty and transparency to the assessment of a planning application and decision-making process. PPAs require 'front-loading' of the planning process, ensuring planning applications are of a high standard when they are submitted and, through close collaboration with stakeholders, have addressed many of the key issues prior to submission.

On 1 December 2009, the Government announced the first of six PPAs that are designed to support low carbon and/ or renewable energy developments. The first one refers to an urban extension at Sowerby Gateway in Yorkshire where proposed development comprises over 900 new dwellings to be built by 2026 (of which 40 percent will be affordable). The development will further include offices and commercial space and will use a centralised Combined Heat and Power/district heating scheme and domestic scale solar photovoltaics.

The use of PPAs is becoming more widespread since their introduction in 2008 and a number of Planning Authorities have found them to be a useful mechanism for agreeing with developers on a structured approach to addressing planning issues that may be of a complexity or scale that requires close collaboration with expert advisors, consultees and other stakeholders. The Council may, therefore, wish to consider the use of a PPA in order to secure the provision of low carbon energy infrastructure as part of the development of urban regeneration area such as Ilford Town Centre in particular.

⁹⁵ <http://www.pas.gov.uk/pas/core/page.do?pagelId=194954>

8.3.5 Supplementary Planning Documents (SPDs)

Whilst Planning Authorities are expected to set out their requirements relating to decentralised energy supply or the environmental performance of developments in their DPDs, the use of SPDs is an effective mechanism for guiding developers on the more detailed aspects of a proposal, including matters relating to implementation and phasing.

The Council may wish to consider preparing further SPD guidance relating to the delivery or funding of new energy infrastructure in the Borough. For example, Chelmsford Borough Council's Planning Contributions SPD (adopted April 2009)⁹⁶ defines a framework for commuted payments to be made in lieu of the provision of infrastructure on-site, and monetary contributions towards Strategic and Off-site Community Infrastructure. These contributions, based on a set of standard charges and/ or formulae, can be pooled to fund provision of large infrastructure. Chelmsford has defined Off-site Community Infrastructure as *"land/ development, works, or facilities necessitated by the combined and cumulative impact of a number of developments where, because of the nature, size and/ or scope of infrastructure, this cannot be provided as part of the development."*

A similar approach could be applied by the LBR to a number of small- or medium-sized developments (for example below 50 house units) where the scale of development is inadequate, or their location inappropriate, for the use of community-scale renewable energy. In such cases small- or medium-sized developments could pool their planning contributions to provide new renewable or low carbon energy infrastructure and hence meet a prescribed proportion of the developments' energy consumption or carbon emissions target.

8.3.6 Monitoring and Review of Policies

The Supplement to PPS1 emphasises the importance of effective monitoring of policies to ensure implementation is line with an Authority's strategy, and this should be incorporated into annual monitoring arrangements.⁹⁷ Monitoring should provide key data on outcomes to assess performance against a Council's policy objectives and Regional Spatial Strategy (RSS) targets.

The LBR must ensure it can demonstrate how its objectives and appropriate indicators of outcomes have been adequately identified and that measures have been put in place to adequately monitor their implementation. Targets relating to carbon reductions require consistent and transparent methodologies for assessing proposals, monitoring their implementation and reporting on outcomes. Tools such as the London Renewables Toolkit⁹⁸ have established a methodology for expressing the contribution of low and zero carbon decentralised energy towards the energy demand of new developments.

8.3.7 Implementation Plan: Heat Mapping

PPS1 Supplement also requires through Policy LCF 4 that a local planning approach for renewable and low-carbon energy and associated infrastructure is considered:

iv. set out how any opportunities for district heating (to supply existing buildings and/or new development) identified through heat mapping will be supported;

⁹⁶ http://www.chelmsford.gov.uk/media/pdf/b/t/Planning_Contributions_SPD_-_Final_Adopted_with_Addendum.pdf

⁹⁷ See Paragraph 34 of the Supplement to PPS1 for details.

⁹⁸ http://www.lep.org.uk/uploads/renewables_toolkit.pdf

v. set out the decentralised energy opportunities that can supply new development proposed for the area;

Through the heat mapping element of this study, opportunity areas have been identified and how these opportunities relate to new development. Phase 2 of this study will facilitate the development of local policy setting in accordance with the priority areas identified. Area Action Plans and Supplementary Planning Documents can guide applications in the right direction in terms of what is necessary. It is understood the Council has already made progressive steps towards this through the development of Area Action Plans. For example in the Crossrail Corridor, where policy is encouraging decentralised energy in the form of CHP, greater definition will need to be provided by the Council in terms of ensuring other low carbon and renewable technologies do not compete for heat that would otherwise have been used to ensure the viability of a CHP and district heating network. Ilford Town Centre and the Crossrail Corridor provides a good example and SPDs will need to be guided by the outcome of the Phase 2 Feasibility Study.

9 Conclusions and Next Steps

9.1 Conclusions and Recommendations

Global and national policy is undergoing radical transition, as it responds to the scientific certainty of our changing climate and the impact associated with development, which requires a response to mitigate the effects of climate change and global warming through a reduction in building-related carbon emissions.

The study sets out an evidence base which reviews a balance between policy drivers, local constraints and opportunities, including the implications of cost on development viability, with the key aim of developing sustainable communities within Redbridge. These legally binding national policies require Redbridge to take incremental steps to reducing carbon emissions by 80% by 2050 and ensure this be implemented in a way that reflects the local context and physical characteristics of the region.

The carbon footprint of Redbridge is 1,033, 000 tonnes CO₂ per year which can be compared to 432,727,000 tonnes CO₂ for the UK (Redbridge is 0.24% of the total). Based on an evaluation of this carbon footprint, the figures for domestic and commercial emissions projections identify there is only a limited level of impact on overall building stock emissions that new-build policy can make. If the overall goal of policy design and implementation is to reduce carbon emissions, then this analysis strongly points towards the need for policy measures that target the emissions of existing buildings as well as new construction.

This study involved a heat mapping analysis to identify 'cluster' sites for potential decentralised energy networks. Five 'cluster' sites (Ilford Town Centre and Crossrail Corridor, Gants Hill, Loxford School area, King George Hospital Site and Fullwell Cross) were identified with potential for synergies for the deployment of a heat network. Key barriers, opportunities, next steps and individuals responsible have been identified in order to facilitate Phase 2 of the Heat Mapping Study; a detailed feasibility study of key cluster sites. Two high priority cluster areas and one medium level priority area has been identified in this study.

Site One: Fullwell Cross (Medium Priority)

Site Two: King George Hospital (High Priority)

Site Three: Ilford Town Centre & Crossrail Corridor (High Priority)

Some difficulties were encountered in heat load data collection for private buildings for the Heat Mapping Study. This suggests that an alternative approach to data collection may be required, which could include site visits and contact with energy companies to obtain data directly. From the experience obtained while establishing stakeholder contact, it was felt that a minimum of 1-2 months are required between initial contact with stakeholders and obtaining the final data which would include time for site visits.

A borough wide and site specific renewable energy appraisal was undertaken to evaluate the suitability of low carbon and renewable energy across the borough and for different scales of development. An analysis for Gants Hill, Ilford Town Centre and the Crossrail Corridor was

undertaken and revealed that overall the three Strategic Sites are highly conducive to district heating solutions due to their high densities. Nevertheless, microgeneration can also contribute to overall targets, especially during the earlier phases of development, and given their increased viability with feed-in tariffs.

In terms of development viability, for all areas of the Borough investigated, development delivers Land Values in a range that suggests viability. In particular the higher market sales values of Wanstead and East Redbridge suggest that these areas could generate the assumed level of developer profit and also high residual value. Of the three strategic sites investigated (Ilford Town Centre, Gants Hill and the Crossrail Corridor), the Crossrail Corridor shows the lowest level of value.

Addendums to this document provide specific guidance to support the Council's objectives of ensuring both internal staff and developers have a clear understanding of the best strategy for achieving different levels under the Code for Sustainable Homes. **Appendix H** sets out the most cost effective credits which can be achieved by house builders. It also enables LBR planning officers to advise accordingly with respect to planning applications. For example if an application is narrowly missing a specific Code Level the planning officer can respond to the application in question and propose alternative low cost credits, should they have been excluded in the application.

Appendix A provides guidance for residents on applying the energy hierarchy, facilitating the adoption of energy efficiency measures within households, provides information on low carbon and renewable technology and provides an indication of cost savings from the measures proposed. It also provides advice on how residents can access grants and funding and the route they should take in order to access this funding.

9.2 Next Steps

Recommendations for the Council to follow up on the results of this Study include:

- Incorporation of recommendations made within this Study into LDF Policies;
- Further address emissions from existing housing stock, the need for which is highlighted by the emissions projections study carried out in Section 3;
- Follow up on the next stage of the Heat Mapping Study. For example, a detailed feasibility study of one or more sites should be commissioned.
- Establishing contact with local developers in priority areas to ensure awareness of renewable energy potential and to encourage them to ensure that developments are compatible with district heating; Installation of decentralised energy compatible infrastructure such as plate heat exchange and capped heat pipe connections could be encouraged through the planning framework or Section 106 Agreements
- Consider a program which will enable Council to obtain the necessary skills and training to review applications, enforce policies and engage with developers at a high level in pre application discussions;